Volume 2

# 2 Technical Submissions

CENTRAL 70
PROJECT

I-70
mile high partners

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Volume 2

# 2.1 Technical Proposal



Volume 2

# 2.1.1. Executive Summary

# Executive Summary

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *We are invested in the Central 70 project. We walked through the communities, held conversations with the Colorado Bridge Enterprise/High Performance Transportation Enterprise (the Enterprises), conducted outreach with businesses and residents and solicited input from our local staff and teaming partners. We understand this project is a catalyst for transformation. As the face of the project and the Enterprises, we take the responsibility seriously. We will be a good corporate citizen and will make investments in the community that deliver long-term benefits.*

## 1. PROJECT MANAGEMENT

Our team, I-70 Mile High Partners (MHP), will deliver a facility that serves travelers in a context that improves the community. We will serve as part of the Enterprises' team with complete transparency, fostering a culture of mutual trust with all project stakeholders.

**Approach.** Our three-part management philosophy of integrated personnel, effective communication and clear decision making is the foundation for avoiding and minimizing conflicts. Tools and strategies that support successful project implementation, differentiate our team and/or exceed requirements include:

- **Task Force Groups –** face-to-face coordination of disciplines, between suborganizations and with the Enterprises, utility companies, railroads and other third parties
- **Escalation Matrix –** structured issue-resolution with staff empowered to make decisions
- **Risk Management –** a formal approach for risk identification, mitigation and management
- **Communication and Coordination –** proactive, timely counterpart communications with the Enterprises, City and County of Denver (CCD), Swansea Elementary School, community groups, businesses, residents, railroad operators, adjacent property owners and other stakeholders
- **Effective Document Control –** enhanced with hand-held devices and used by our design, construction and operations and maintenance (O&M) teams and the Enterprises
- **Building Information Modeling (BIM) –** extends from design throughout the project's life cycle
- **Co-location –** our staff with the Enterprises' personnel near the alignment to facilitate face-to-face communication

*SEMA's local resources include an 800-piece equipment inventory.*

### Summary Organization Charts

Figure E-2 on the next page summarizes our team members and their ownership relationships. Our summary organization chart with key personnel and functional teams for both the construction and operating periods is in Figure E-3 on the next page. Our staffing mobilization strategy is shown in Figure E-5 on the next page.

### Schedule and Key Milestones

Figure E-4 on the next page provides a summary of our schedule including key construction and O&M milestones. Key milestones for the operating period include the start of full operations on November 5, 2022 (substantial completion), renewal work (Figure E-6), the beginning of handback operations 70 months prior to the end of the term and the end of handback in November 2052.

**Figure E-1:** *Requirements Exceeded and Quantifiable Benefits – Part 1 (ITP Evaluation Criteria, Part E.2)*

| Proposal Commitment | CRITERIA* a | b | c | d | e |
|---|---|---|---|---|---|
| Mobilization of project manager, public communications manager and public relations consultant within two weeks of commercial close | | ♦ | | ♦ | ♦ |
| Senior management decisions delegated to on-site team | ♦ | ♦ | | | ♦ |
| Additional task force groups to provide coordination/ technical solutions in every aspect of the project | ♦ | ♦ | | ♦ | ♦ |
| Project First commitment | ♦ | ♦ | ♦ | | |

**ITP Evaluation Criteria: a) Ensure quality; b) Project/schedule management for effective solutions/decision-making; c) Minimizing impacts; d) Addressing environmental/stakeholder/community impacts and disadvantaged business enterprise (DBE)/emerging small business (ESB)/workforce opportunities; e) Comply with contract requirements and schedule milestones*

**Figure E-2:** *Summary Core Proposer Team Member Organization Chart*

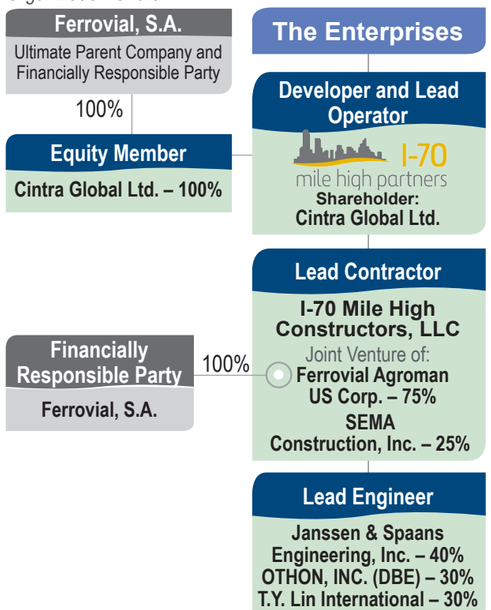



**Figure E-3:** *Summary Key Personnel and Management Structure Organization Chart*

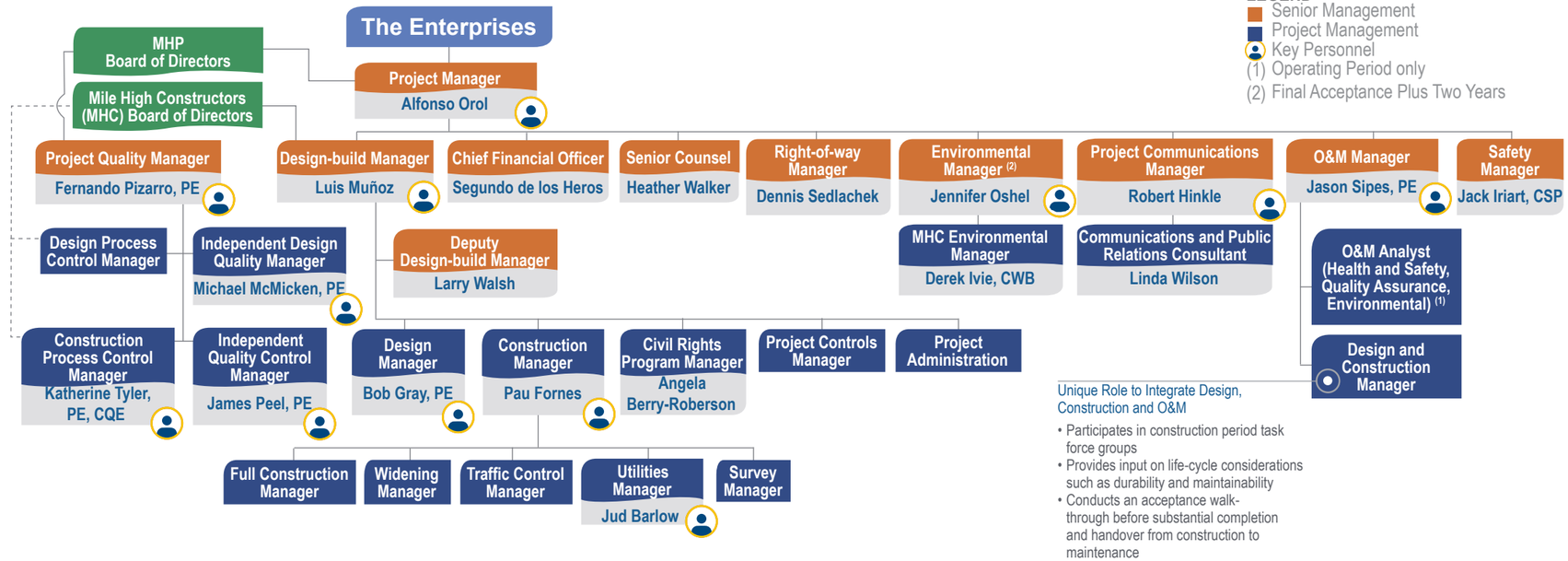



**Figure E-4:** *Summary Schedule*

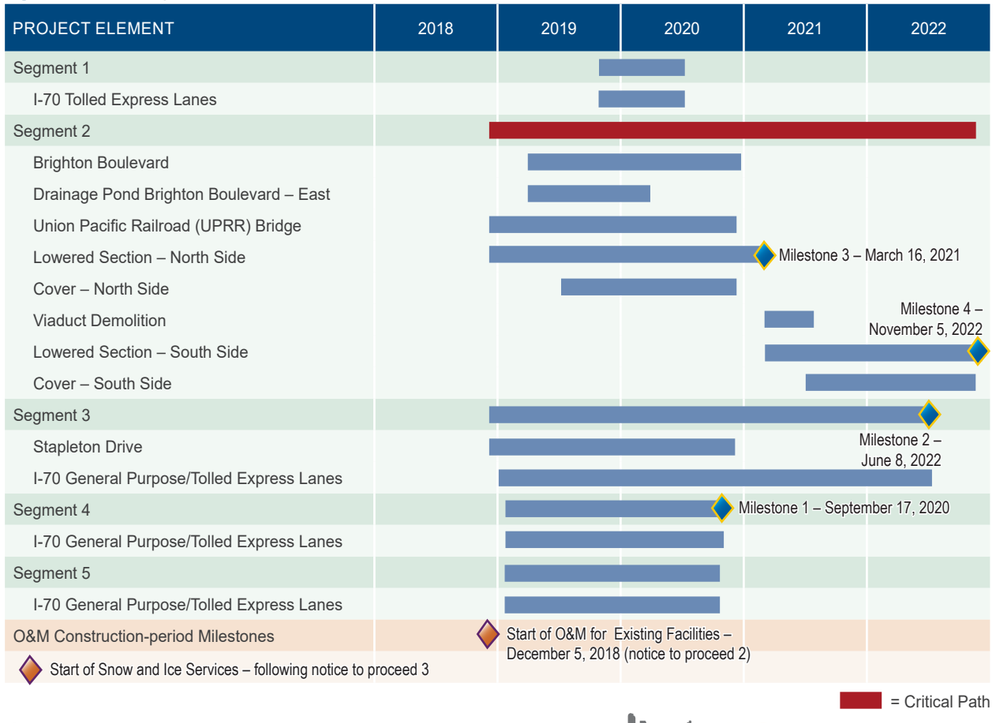



**Figure E-5:** *Phased Staffing Strategy*

**1 POST-AWARD/AND PRE-CONSTRUCTION**
- Assign and mobilize key leadership
- Hire critical administrative personnel from local hire area (human resources and workforce development staff)
- Hire additional critical project leadership from local hire area (project engineers, designers and managers)

**2 MOBILIZATION**
- Implement local hire and workforce development program (as described in *Part 4*, page 29)

**3 RAPID GROWTH THROUGH CONSTRUCTION**
- Implement rapid mobilization strategy used on similar projects
- Continue local hire and workforce development programs

**4 O&M**
- Implement strategy based on world-wide concessions staffing
- Continue local hire and workforce development programs

**Figure E-6:** *Preliminary Renewal Work Schedule*

CORA exempt materials redacted for the Public Disclosure Technical Proposal.



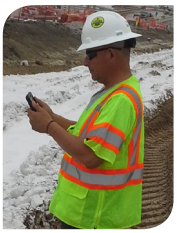
*Safety starts with the project manager and continues down to the foreman level. In the Monday morning safety meeting, we will distribute weekly safety meeting topics in English and Spanish and conduct daily job hazard analysis meetings to discuss pre-shift safety checklists.*

## 2. QUALITY MANAGEMENT

We are ready to deliver quality in all aspects of our service — final installed product, coordinated activities, good communication, safety-first priority, meeting commitments and serving as a partner to the community and the Enterprises.

**Independent Quality Management.** Our process control and independent quality control teams have functional independence established through reporting relationships. Every member of the team has authority to stop work.

**Non-Construction Quality Management.** Each functional area (such as design, project administration, strategic communications, procurement, environmental and right-of-way services) and each design subconsultant will implement procedures for their work, including a quality management process that is ISO-compliant. At least annually, we will audit each area, develop corrective actions (if needed) and establish continual improvement goals.



*Hand-held devices will be used by our process control team and the independent quality control firm.*

**Construction Quality Management.** "Doing it right the first time" is our objective. Testing and inspection by our process control team will be concurrent with the activities of the independent quality control firm, leading to final acceptance of each work element.

**Continuous Improvement and Corporate Quality.** Our policy requires ISO-compliant programs, including continuous improvement and annual corporate audits.

**Figure E-7:** *Requirements Exceeded and Quantifiable Benefits – Part 2 (ITP Evaluation Criteria, Part E, Section 2)*

| Proposal Commitment | CRITERIA* a | b | c | d | e |
|---|---|---|---|---|---|
| Expanded stop work authority for quality and safety | ♦ | ♦ | | | ♦ |
| Increased intensity of process control testing beyond minimum Guide Schedule frequencies | ♦ | ♦ | | | ♦ |
| Quick resolution of nonconformance reports | ♦ | | ♦ | | ♦ |
| Specific procedure for continuous improvement in Stage 2 Quality Management Plan | ♦ | | | ♦ | |
| Empowering all project team to be responsible for reporting nonconforming items | ♦ | | | | ♦ |
| Corporate quality management team oversight and internal audits, and internal standards more stringent than contract | ♦ | | ♦ | | ♦ |
| Independent corporate social and environmental governance evaluation | ♦ | | | ♦ | |

## 3. MAINTENANCE OF TRAFFIC

Requesting and listening to public input, our team will transform what can be a challenge for the local communities into a strength by incorporating their ideas for safe and efficient construction phasing, travel paths and signage solutions, especially around Swansea Elementary School. Our approach is based on our construction phasing sequence and aligns with our proposal schedule by considering right-of-way availability, utility relocations and other constraints.

### Establishing Collaboration and Coordination

We will invite the Enterprises, first responders, Regional Transportation District and local city and county personnel to actively participate in our task force meetings. These meetings facilitate coordination; tap into participant expertise; anticipate, avoid and resolve issues; and address mitigation for special events such as the National Western Complex.

**Extensive Planning to Minimize Impacts.** We developed detailed traffic control plans — including nearly 200 pages of detailed drawings — that describe construction phasing that minimizes traffic impacts, including:

- **Segment Approach –** five segments with segment-specific sequencing and traffic control
- **Local/Colorado Department of Transportation (CDOT) Roadway Impacts –** complying with cross street closure limitations, identify opportunities to keep roads open whenever possible and provide detours or runarounds.
- **Residential and Business Access –** maintaining access, including in the lowered section
- **Pedestrian Access –** maintaining existing routes, perhaps with temporary access

**Figure E-8:** *Requirements Exceeded and Quantifiable Benefits – Part 3 (ITP Evaluation Criteria, Part E, Section 2)*

| Proposal Commitment | CRITERIA* a | b | c | d | e |
|---|---|---|---|---|---|
| Eliminating closure of York, Josephine, Columbine, Clayton, Dahlia and Holly streets during construction | | | ♦ | | ♦ |
| Collaborating with CCD on constructing the planned permanent or a temporary York Street/UPRR pedestrian bridge | | | ♦ | ♦ | |
| Nearly 200 pages of detailed traffic control plan drawings that minimize traffic impacts for the community while maximizing construction efficiency | ♦ | | ♦ | ♦ | ♦ |

**ITP Evaluation Criteria: a) Ensure quality; b) Project/schedule management for effective solutions/decision-making; c) Minimizing impacts; d) Addressing environmental/stakeholder/community impacts and DBE/ESB/workforce opportunities; e) Comply with contract requirements and schedule milestones*

## 4. ENVIRONMENT AND COMMUNITY

Our commitment and investment in the project includes the environment, community, businesses, neighborhoods and workforce.

**Environmental Management.** Our environmental management approach is to integrate every environmental requirement, beginning with design and construction, and continuing through O&M. Our environmental team has stop-work authority.

**Hazardous Materials Strategy.** We engaged AMEC Foster Wheeler to assess the known soils and groundwater contamination. Our approach to managing hazardous substances is to avoid or minimize exposure through design, such as raising the profile elevation of I-70 to minimize exposure to the groundwater table and designing slurry or cut-off walls to reduce dewatering.

**Strategic Communications.** Our project communications manager and team (mobilized within two weeks of commercial close) will coordinate with the Enterprises and our construction and O&M teams to deliver timely, accurate communications using seven core rules shown in Figure E-10. Our strategies include:

- Engaging stakeholders and policy makers in dialogue
- Encouraging two-way conversation (in English and Spanish) with community members, Swansea Elementary School, businesses and governmental agencies
- Emphasizing cultural sensitivity for Globeville and Elyria-Swansea
- Providing 1,200 nearby businesses with construction information so they can plan customer access, delivery and shipments

**Community Development.** Our community development fund of $500,000 (construction period) and $1.6 million (operating period) will be allocated to programs such as street improvements, school programs, community parks, bicycle lanes, community center renovations and art programs. We will build a temporary or permanent pedestrian bridge at York Street/UPRR in collaboration with CCD.

*One idea we would like to pursue is preservation of murals with a poster program.*

**Disadvantaged Businesses Enterprises (DBE) and Emerging Small Business (ESB) Engagement.** We will facilitate participation by DBE/ESB firms and offer training programs, bonding assistance (Small Business Transportation Resource Center) and payment assistance. Our extensive outreach will build on the momentum established during the proposal phase that resulted in several hundred firms in attendance at our multiple events.

**Workforce Development.** Our objective is to create job opportunities that lead to career development and workforce stability throughout the greater Denver area. We will target individuals in communities in the corridor and those who have experienced significant barriers to employment, such as military veterans. Our approach provides job creation, skills development and social and economic growth opportunities.

**Figure E-9:** *Requirements Exceeded and Quantifiable Benefits – Part 4 (ITP Evaluation Criteria, Part E, Section 2)*

| Proposal Commitments | CRITERIA* a | b | c | d | e |
|---|---|---|---|---|---|
| Establish community development program fund of $2.1 million | | | | ♦ | |
| Exceed goals for DBE/ESB participation | | | | ♦ | ♦ |
| Exceed the on-the-job training and local hire goals for construction period | | | | ♦ | ♦ |
| Provide safety education program for teachers, parents and students | ♦ | | ♦ | ♦ | |
| Create stakeholders technical advisory group | | | | ♦ | ♦ |
| Establish recruitment office in target area for hiring (MHP and subcontractors) | | | | ♦ | ♦ |
| Provide bilingual job applications, portal, construction managers and foremen (English and Spanish) | | | | ♦ | ♦ |
| Place information kiosks in high-traffic areas | | | ♦ | ♦ | |
| Mitigate environmental impacts with design decisions (such as slurry/cut-off walls) | ♦ | | ♦ | | ♦ |
| Offer bonding assistance and accelerated payment programs | | ♦ | | ♦ | ♦ |
| Conducted significant engagement of DBE/ESB firms in January, February and March 2017 | | | | ♦ | |
| Use customized B2Gnow software for tracking compliance and payments | | ♦ | | ♦ | ♦ |
| Create tactical outreach plans, mini outreach plans for specific strategies/planned activities | | | ♦ | ♦ | |

**ITP Evaluation Criteria: a) Ensure quality; b) Project/schedule management for effective solutions/decision-making; c) Minimizing impacts; d) Addressing environmental/stakeholder/community impacts and DBE/ESB/workforce opportunities; e) Comply with contract requirements and schedule milestones*

**Figure E-10:** *Seven Rules for Public Involvement*

## 5. O&M MANAGEMENT

We strive to provide customers with the safest and most efficient highways in Colorado. We know how to plan and implement effective operations and maintenance (O&M) programs that are preventative, proactive and focused on the user experience.

**Global Best Practices.** With nine highway concessions in North America and 27 worldwide, we offer O&M technical experts who will provide quality services by integrating proven strategies and lessons learned.

*We have experience with severe snow and ice conditions as seen here in this 407 Express Toll Route snow removal brigade.*

**One O&M Team, All Phases.** Our O&M team (not our construction team or a separate construction-period subcontractor) will provide the O&M services for all phases — from notice to proceed 2 through handback. During construction, our O&M and construction teams are co-located for full integration of O&M services during the construction period.

**Life-cycle Considerations.** We assign a design/construction manager and a design/construction engineer reporting to the O&M manager throughout construction to consider life-cycle factors such as durability and maintainability.

**Unique Management Tools.** Our asset management system includes Toll Highway Operating and Reporting System (THORS), a proprietary cost management system that improves our budgeting accuracy; a GIS-based integrated asset management system for asset condition and work order management; and Maintenance Online Management System (MOMS), a proprietary software that automatically detects issues and generates work orders for intelligent transportation systems (ITS) elements.

**Cover and Lowered Section Event Response.** Based on our five years of experience maintaining a partially covered, lowered section on LBJ Express, our incidence response preparation will include training for closing traffic lanes and evacuating people from the cover and Swansea Elementary School. We will conduct a tabletop exercise that includes first responders and other local authorities to plan response protocols for different emergency scenarios (e.g., tank spill, fire under the cover area) including evacuation.

**Figure E-11:** *Requirements Exceeded and Quantifiable Benefits – Part 5 (ITP Evaluation Criteria, Part E, Section 2)*

| Proposal Commitment | CRITERIA* | | | | |
|---|---|---|---|---|---|
| | *a* | *b* | *c* | *d* | *e* |
| One O&M team from construction period through operating period | ♦ | ♦ | ♦ | ♦ | ♦ |
| O&M team design/construction manager and engineer to engage with lead contractor (life-cycle considerations) | ♦ | | | | |
| Redundant resources (more than one subcontract, spare parts, materials stockpiles), especially for on-call services such as hazardous materials clean-up and cover-related incidents | ♦ | | | ♦ | |
| Safety enhancements at accident hot spots (smart cushion attenuators, 6-inch-wide striping, rumble strips, wrong-way detection signs, additional wayfinding signage) | ♦ | | ♦ | ♦ | ♦ |
| In-house maintenance crews, especially for snow and ice removal on connecting ramps that are CDOT's responsibility | ♦ | | | | |
| Routine maintenance using single lane closure or mobile lane closure (when possible) and at off peak times | | ♦ | ♦ | | |
| Accident Investigation and Prevention Studies | | | ♦ | | ♦ |
| Wet Accident Reduction Program | | | ♦ | | ♦ |
| Inspection augmentation with drones for improved visibility and safety | ♦ | | ♦ | | |
| Cintra's O&M technical department to facilitate life-cycle best practices and shorten learning curve | ♦ | ♦ | ♦ | ♦ | ♦ |
| Proprietary THORS cost management software (improved budgeting/reporting) and MOMS (automatically detects issues/ creates work orders for ITS elements) | ♦ | | | | |
| Reduced environmental footprint with recycling program for debris (tires, metal) and our waste (concrete, asphalt, gravel, plastics) | | | | ♦ | |
| Best practices new facility for salt washdown and containment | ♦ | | | ♦ | |

**ITP Evaluation Criteria: a) Ensure quality; b) Project/schedule management for effective solutions/decision-making; c) Minimizing impacts; d) Addressing environmental/stakeholder/community impacts and DBE/ESB/workforce opportunities; e) Comply with contract requirements and schedule milestones*

*O&M Manager Jason Sipes brings directly relevant experience from the LBJ Express where he managed O&M for the 13-mile roadway (215 lane miles), including a lowered section that is 40 feet below grade with a partial cover. Incident response time, despite the more than 250,000 cars per day, is eight minutes.*

## 6. TECHNICAL APPROACH

Our design and construction solutions blend requirements with innovation to deliver infrastructure improvements to serve the local community and region. Our approach included developing a thorough understanding of Central 70 and creating design and construction solutions that provide added value for the Enterprises, the local community, the project's stakeholders and the traveling public. In addition to those identified in Figure E-12, examples include:

- Splitting the I-70 vertical profile and raising the I-70 profile (in the lowered section), reducing groundwater incursion, excavation and retaining wall heights
- Mitigating groundwater intrusion by encircling lowered section below groundwater with watertight walls and installing underdrain and filtration system
- Moving the sanitary sewer line underground, minimizing long-term maintenance for CCD
- Developing a 4-D building information modeling (BIM) Synchro model that provides more efficient management of the construction process and improves coordination with subcontractors and suppliers
- Providing a cover design that accommodates the tree soil capacity needs
- Realigning the I-270 connector to avoid impacts, and improve both constructability and maintenance of traffic
- Revising the profiles of 46th Avenue/Stapleton Drive to minimize required cut and fill

**Innovative Design Concepts.** Our design includes optimizations and alternative technical concepts (ATC) that result in a high-quality design and add value to the project for the Enterprises, the local community, the project's stakeholders and the traveling public. ATCs include:

- ATC 2 – Reroute of York Street 48-inch Sanitary Sewer
- ATC 4 – Reroute of Segment 2 On-site Drainage (see Figure E-13)
- ATC 14 – Optimized ITS
- ATC 18 – Lane Closure on Brighton Boulevard
- ATC 26 – Cover MEP Electrical Distribution Optimization
- ATC 28 – Swansea Elementary School Temporary Wall

**Figure E-12:** *Requirements Exceeded and Quantifiable Benefits – Part 6 (ITP Evaluation Criteria, Part E, Section 2)*

| Proposal Commitment | CRITERIA* a | b | c | d | e |
|---|---|---|---|---|---|
| Keeping York, Josephine, Columbine, Clayton, Dahlia and Holly streets open for duration of construction, allowing bridge construction to occur simultaneously | | | ♦ | ♦ | |
| Constructing a temporary or permanent pedestrian bridge at York Street/UPRR in collaboration with the CCD | | | ♦ | ♦ | |
| Optimizing the Holly Street bridge to provide the required stopping sight distance and eliminate the need for additional design exceptions | ♦ | | ♦ | | |
| Implementing numerous cover system optimizations (including adding one back-up jet fan per direction) for improved safety and quality | ♦ | | | | |
| Splitting I-70 profile under UPRR reducing excavation and groundwater incursion | ♦ | | | | ♦ |
| Conducting a thorough pavement design life-cycle analysis to develop the optimal pavement solution | ♦ | | ♦ | | |
| Developing early design packages, providing the Enterprises early notice of additional right-of-way needs | ♦ | | | | ♦ |
| Conducted additional geotechnical and environmental due diligence campaigns, resulting in optimized deigns, reduced groundwater incursion and accelerated construction start | ♦ | | | | ♦ |
| Using epoxy-coated rebar on all structures | ♦ | | | | |
| Using *ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data* to collect existing utility data | ♦ | | | ♦ | ♦ |

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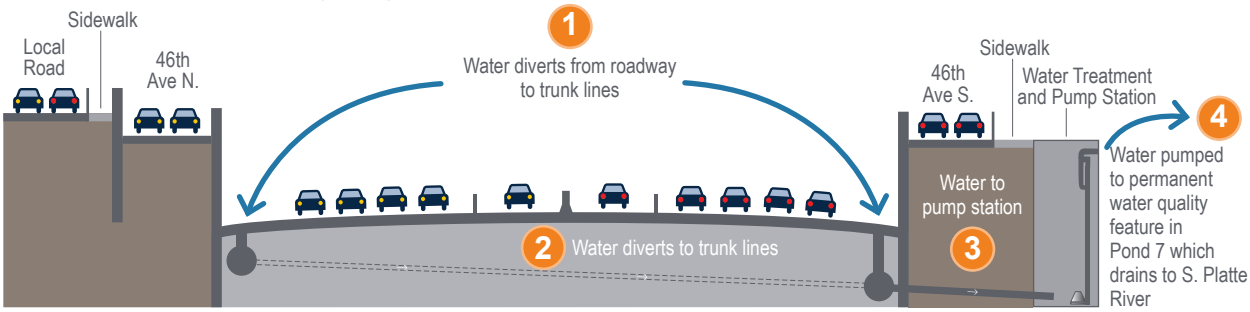
**Figure E-13:** *Drainage Solution (ATC 4)*




*By eliminating the on-site outfall to the north we significantly reduce construction in the Elyria-Swansea neighborhood.*

Volume 2

# 2.1.2. Part 1: Project Management



# 1 Project Management

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *We are invested in the Central 70 project. We walked through the communities, held conversations with the Colorado Bridge Enterprise/High Performance Transportation Enterprise (the Enterprises), conducted outreach with businesses and residents, and solicited input from our local staff and teaming partners. We understand this project is a catalyst for transformation.*

The overarching goal of our team, I-70 Mile High Partners (MHP), is to deliver a facility that serves travelers in a context that improves the community. We commit to operating as part of the Enterprises' team with complete transparency, fostering a culture of mutual trust with all project stakeholders. Every project has challenges — it's how we resolve those challenges that distinguishes our team. Using partnering strategies, we will collaborate to proactively identify issues and solutions. We embrace *Project First* because we know that alignment with the principles of this initiative will deliver a successful, safe and high-quality project. We know that if you are successful, we are too.

This section (*Part 1 – Project Management*) includes a summary of our management and organization, safety approach and scheduling approach. All of these topics are further detailed in *Appendix B – Project Management Plan*.

### *Project First* Commitment

We will collaborate with the Enterprises on implementing the three elements of the *Project First* initiative:

- Conducting training to build trust and a common mutual understanding, ensuring quality and safety
- Implementing executive, vertical and horizontal partnering to promote issue resolution at the lowest possible level and minimize impacts
- Using tools, such as a risk register, constructability reviews and an escalation matrix, to promote timely decision-making and advance the schedule

## A. MANAGEMENT AND ORGANIZATION

### i. MANAGEMENT PHILOSOPHY AND APPROACH

Our project management plan has been crafted under Project Manager Alfonso Orol's direction and will serve as the team's guiding document throughout the life of the project. It is based on our three-part management philosophy of integrated personnel, effective communication and clear decision-making while being uniquely tailored to the project and the requirements of the *Project Agreement*, specifically *Schedule 8 – Project Administration*. Our project management plan will be vital to the success of the project as it outlines management and organizational processes, clearly defines roles and responsibilities and informs team members on communications protocols and project controls. The plan also includes management systems for quality, environmental compliance, safety and overall project management that have been proven over decades of experience. Examples of tools and strategies that support successful project implementation, differentiate our team and/or exceed requirements include:

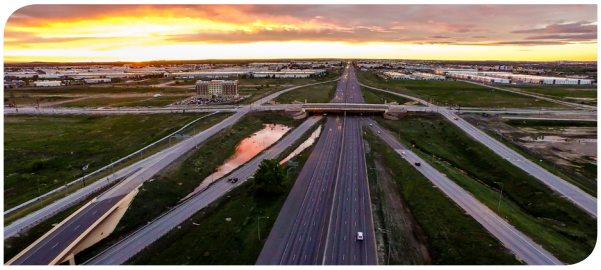
- **Task Force Groups.** Task force groups for key disciplines provide face-to-face coordination of our work internally (between suborganizations) and with the Enterprises, utility companies, railroads and other third parties. Figure a.5 in *Appendix B, a – Chart and Description of Overall Team Structure* provides a description of how we will collaborate with the Enterprises' representatives in the task forces.
- **Escalation Matrix.** Our structured issue-resolution approach occurs during regular meetings by staff empowered to make

### *Project First* Experience

The SH 56 Climbing Lane project provides our team first-hand experience with the Colorado Department of Transportation's (CDOT) *Project First* culture and philosophy. Empowered to make decisions at the project level, CDOT and SEMA staff collaborated to resolve several challenges — including a significant pavement reconstruction issue — always with a focus on the best outcome for the project. We understand how a *Project First* approach can produce small successes that have big impacts on the overall project.

decisions commensurate with their experience level. However, we will quickly convene additional task force meetings to address urgent issues, create a new task force for specific problems or escalate issues as needed. To further streamline the process and provide on-site decision-making, Project Manager Alfonso Orol will have the authority to resolve high-level issues on behalf of MHP.

- **Risk Management.** Our risk assessment and management includes a formal approach for risk identification combined with management, technical and maintenance experts, a structured process and checklists.
- **Communication and Coordination.** We will be proactive, timely in our communication with the Enterprises' representatives, the City and County of Denver (CCD), Swansea Elementary School, community groups, businesses, residents, railroad operators, adjacent property owners and other project stakeholders. We will establish counterpart relationships at each level of the organization and day-to-day interface will occur in our project meetings as shown in Figure a.4 in *Appendix B, a – Chart and Description of Overall Team Structure*.
- **Effective Document Control.** Used by our design, construction and operations and maintenance (O&M) teams and accessible by the Enterprises, the electronic document management system, enhanced with hand-held devices, facilitates timely document distribution, version control and work flow management. The system will notify team members (including subcontractors) about document updates, ensuring everyone is using current versions, and enables raw information to be entered in real time in the field.



*SEMA has led some of the most successful alternate delivery projects in Colorado, including CCD's I-70 Interchange/Central Park Boulevard Design-Build, recognized by* Engineering News-Record *with its 2013 Best Highways/Bridges Project Award.*

- **Building Information Modeling (BIM).** Our approach to BIM goes beyond the industry standard to consider the project's entire life cycle. O&M elements are considered at the earliest stages of design, promoting effective and efficient management at the programmatic level. In addition to creating visuals to support interaction with the public, it extends from design throughout the project's life cycle to support construction and maintenance work.
- **Co-location.** We will co-locate our staff with the Enterprises' personnel in a central building or office complex along the alignment to facilitate face-to-face communication.

## ii. PROJECT MANAGEMENT ORGANIZATION

### A. Core Proposer Team Members

Our core proposer team is presented in Figure 1-1 on the next page.

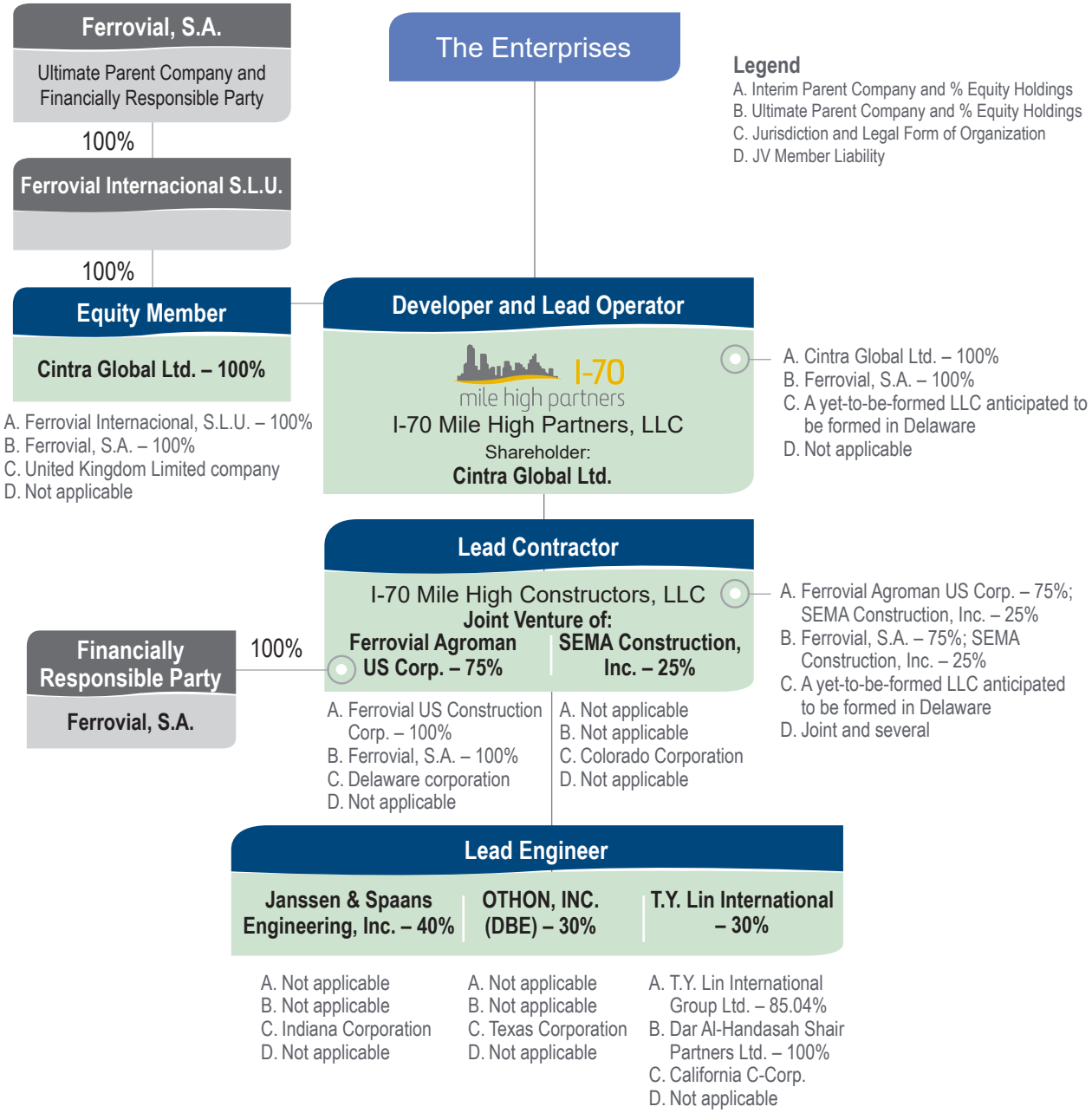
### B. Key Personnel and Management Structure

Figure 1-2 on page 4 outlines our team's structure during the construction and operating periods. It identifies our key personnel and reporting lines for design, construction, O&M and quality management activities. Organized into three groups — senior management, project management and task force specialists — our integrated structure is designed to maximize the value of each group's technical expertise, encourage collaboration between disciplines to deliver optimal technical solutions and facilitate prompt resolution of issues that impact multiple project functions.

### C. Resources and Experienced Personnel

We will provide highly skilled personnel, equipment and facilities, and will implement a mobilization plan by segment and work-front package that focuses on early actions (such as geotechnical investigations, hydrology studies, survey and utilities) and long-lead procurement items (such as railroad materials, precast beams and structural steel). We will draw staff from a global workforce of 96,000, recently completed U.S. design-build/public-private partnership (P3) projects (including the LBJ Express) and, locally, from our partner SEMA Construction and subcontractors. We will establish a project recruitment office that will recruit local staff using the employment portal on our website (i70milehighpartners.com), local job fairs, the

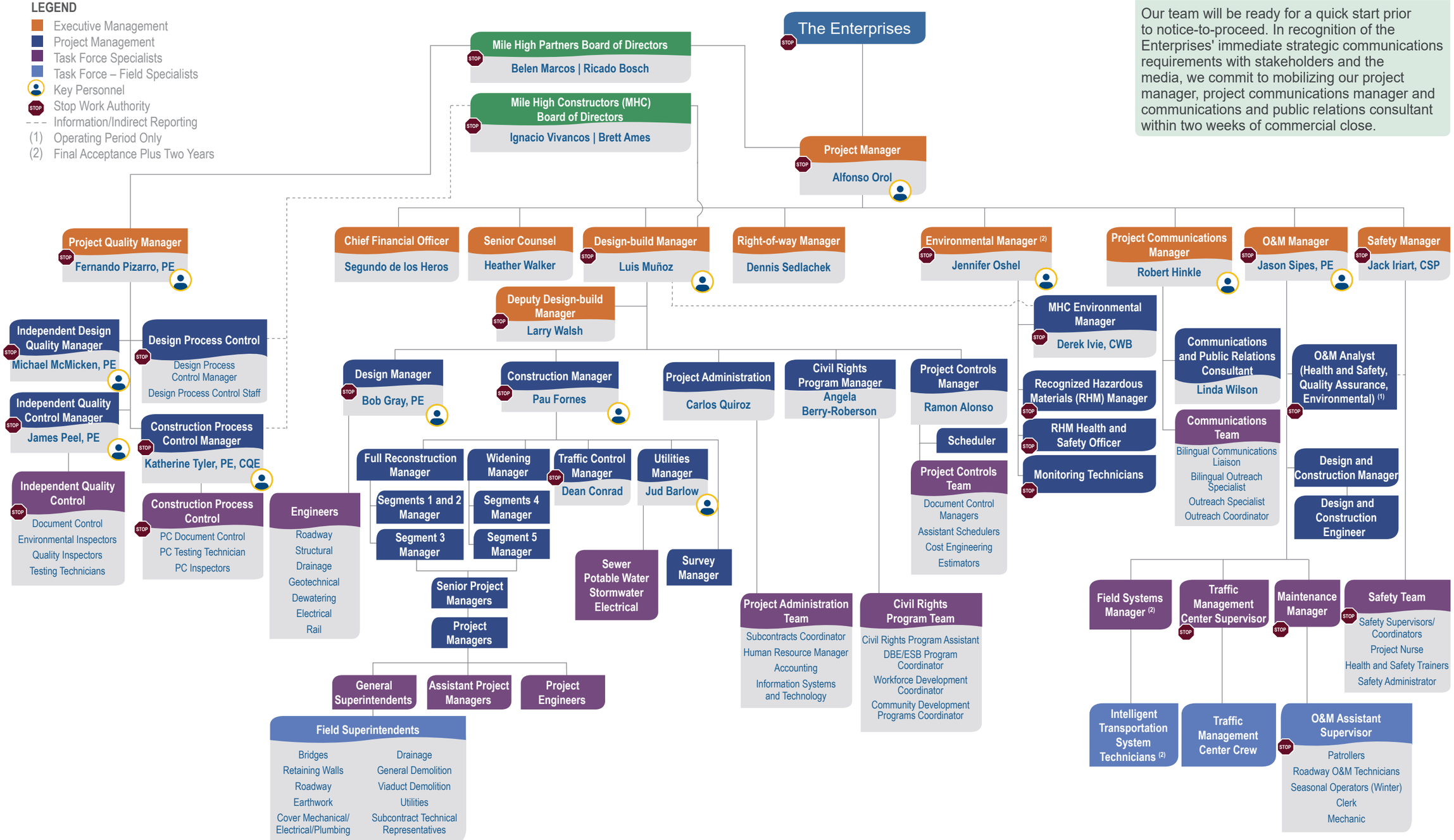
**Figure 1-1:** *Core Proposer Team Member Organization Chart*




**Changes Since Statement of Qualifications (all of these changes have been previously submitted to and approved by the Procuring Authorities):**

- Cintra Infraestructuras Internacional, S.L.U. is substituted by Cintra Global Ltd. as a member of the Equity Member/Developer and increases its participation from 80% to 100%
- Cintra Infraestructuras Internacional, S.L.U. is substituted by Cintra Global Ltd. as Lead Operator and increases its participation from 80% to 100%
- Bechtel Global Infrastructure and Minerals, Inc. is removed as Financially Responsible Party
- Bechtel Development Company, Inc. is removed from the Equity Member/Developer
- Bechtel Development Company, Inc. is removed from the Lead Operator
- Bechtel Infrastructure Corporation is substituted by SEMA Construction, Inc. as a member of the Lead Contractor with participation at 25%
- Ferrovial Agroman US Corp. increases its participation in the Lead Contractor from 51% to 75%
- Bechtel Infrastructure Corporation is substituted by T.Y. Lin International as member of the Lead Engineer

**Figure 1-2:** *Key Personnel and Management Structure Organization Chart*




## Rapid Mobilization

Our team will be ready for a quick start prior to notice-to-proceed. In recognition of the Enterprises' immediate strategic communications requirements with stakeholders and the media, we commit to mobilizing our project manager, project communications manager and communications and public relations consultant within two weeks of commercial close.

Associated General Contractors of Colorado Workforce Development Program, other recruiting outreach events and our workforce development program (described in *Appendix L*). For O&M, our mobilization plan includes local hiring, subcontracting and equipment and materials purchasing for most of the required resources.

### Local Resources

SEMA's local resources include:

- 800-piece equipment inventory
- State-of-the-art, 14,000-square-foot equipment maintenance/repair facility
- 3,300-square-foot welding shop

Expanding on position descriptions included in our plans, our staffing plan will detail qualifications and certification requirements, and our human resources team will conduct a thorough interview process to ensure qualified staff are assigned to each position.

We regularly evaluate progress against planned activities and adjust resources as required. For example, to achieve schedule recovery in construction, we will consider scheduling overtime, shifting crews to another location or adding staff or subcontractors.

## B. SAFETY

Safety and security is our highest priority. We support CDOT's Strategic Highway Safety Plan goals and are committed to construction and O&M processes that promote the safety and security of persons and property. We will comply with applicable safety and security laws, regulations, requirements and the Enterprises' safety guidance/regulations including *Schedule 8, Appendix A, Section 107 – Performance of Safety Critical Work*.

### Safety-driven Culture

Safety starts with the project manager and continues down to the craft level. All project managers, superintendents and foremen attend and participate in the Monday morning safety meeting. We distribute weekly safety meeting topics in English and Spanish, and conduct daily job hazard analysis meetings to discuss pre-shift safety checklists. All foremen and superintendents are required to conduct health safety observations of their work site daily for any and all safety-related items.

We will develop and implement a site-specific safety management plan (SMP) to ensure the safety of workers and the public and to increase the safety of maintenance activities. Safety, accident prevention and incident management procedures will be incorporated into the performance of every task.

### SAFETY AND SECURITY APPROACH

Through active participation, cooperation and compliance and effective coordination with the Enterprises' staff, project stakeholders and subcontractors, we will achieve all safety objectives. To achieve our goal of zero accidents, we will:

- Plan and execute all work to prevent personal injury, property damage or loss
- Comply with federal, state and local laws, ordinances, regulations, and industry consensus standards
- Immediately notify the Enterprises and investigate all incidents of injury, damage or near-miss incidents to determine causes and take necessary corrective action
- Establish and conduct an educational program including project safety meetings and training programs to stimulate and maintain the interest and cooperation of all employees and subcontractors

### Award-winning Safety Programs

LBJ Express

- Logged 16 million work-hours with a 1.2 safety incident rate and zero life-threatening injuries or fatalities
- Received the award for Best Project, Excellence in Safety: Award of Merit from *Engineering News-Record's* (ENR) Best of Best Awards in 2016 (Texas and Louisiana)
- Received ENR's 2016 Global Best Project (road/highway category) based on safety and other performance criteria

- Require proper use of personal protective equipment and all required safety equipment/devices
- Employ capable/competent personnel and develop processes providing safe and secure working environments for the construction work force, management facilities, the affected public and private businesses and their properties

We will be responsible for ensuring employees and subcontractors comply with the SMP. Project Quality Manager Fernando Pizzaro, PE, and Safety Manager Jack Iriart, CSP, will certify that all safety-critical work, in conformance with the SMP and per *Schedule 8, Appendix A*, has been reviewed and sealed by a professional engineer of responsible charge before construction begins.

## SAFETY ORGANIZATION

Our safety organization includes Safety Manager Jack Iriart, CSP, who will be responsible for development and implementation of the site-specific SMP for design, construction and O&M. Jack will serve as the on-site safety lead during construction and will be supported by a team of safety professionals during each phase including an on-site O&M analyst during the operating period. Jack and his team will develop, implement and execute our safety program, and will verify plan compliance and consistent safety practices throughout the project. They will perform safety evaluations, conduct daily, weekly and monthly safety meetings, develop and administer the project's safety incentive program and continuously monitor and review safety performance.

## SAFETY MANAGEMENT PLAN OUTLINE

The SMP will address field work-related hazards and mitigation processes and will be submitted for acceptance as a notice to proceed 1 condition. Our governing document for safety, the SMP will be updated when a process, method, chemical or other construction work criteria changes that affects the safety of a person or property. Our SMP will incorporate proven practices while conforming to all of the Enterprises' requirements. An outline of the content is provided in *Appendix B – Project Management Plan, Section N*.

### Qualified Safety Leadership

With 24 years of health and safety experience, Safety Manager Jack Iriart, CSP, has administered construction safety programs on bridge, highway, roadway, trench and rail projects constructed under live traffic. He has conducted rail safety training, and has managed multi-site safety organizations including up to nine safety professionals.

### Designing for Safety

We optimized the Holly Street bridge to provide the required stopping sight distance for improved safety for the traveling public.

Our plan to detour Brighton Boulevard traffic (ATC 18) improves safety for the public and workers by limiting vehicular and pedestrian traffic in the construction zone.

### Safety Critical Work

Applying our experience gained on numerous projects of this size and type, we will develop a detailed construction safety critical plan that includes an erection plan, bridge removal (full and partial) plan and other applicable *Schedule 8* requirements. We will perform task-specific hazard analyses to aid in the comprehensive development of the SMP and construction safety critical plan.

## C. PROPOSAL SCHEDULE SUMMARY

### i. KEY MILESTONES SUMMARY

Our construction plan completes the project on time. Figure 1-3 on the next page summarizes the schedule for each segment and includes major work elements within each segment as well as the planned key milestone completion target dates.

### ii. BASELINE SCHEDULE

**Baseline Schedule Development.** We used Primavera P6 v16.1 to develop a detailed critical path method proposal schedule (in *Appendix C – Proposal Schedule*) which will serve as the basis for the development of the Baseline Schedule in accordance with *Schedule 8*. With activity detail to work breakdown structure (WBS) level VI, the schedule incorporates all scheduled activities with accurate logic ties and activity durations to achieve on-time project delivery from notice to proceed 1 through final acceptance.

Our comprehensive schedule addresses the key project milestones as well as these major issues — right-of-way acquisition, utility relocations, railroad work, traffic control and construction logistics, earthwork balance requirements, environmental and weather limitations, environmental permitting and construction moratoriums for special events and to accommodate school schedules — and is organized by our five segments (see Figure 3-1 on page 19). To develop a solid baseline schedule, we:

- Compared what-if scenarios to optimize the requirements utility relocations, traffic control and construction logistics, earthwork balance requirements and bridge embankment settlement durations
- Used Schedule Analyzer Pro and Visualizer Pro to perform logic checks, develop histograms, and conduct other electronic reviews of the schedule
- Conducted a peer review on the schedule with project managers and schedulers from other projects and adjusted sequencing, logic ties and productivity rates based on their expertise

**Baseline Schedule Updates.** Our proposal schedule, submitted in *Appendix C – Proposal Schedule*, will serve as the basis for the development of the baseline schedule. We will perform three workshop sessions with CDOT that follow the requirements set forth in *Schedule 8, Section 3.3 – Project Schedules*. The baseline schedule will be submitted prior to notice to proceed 1, and will include seasonal and weather considerations; environmental limitations; right-of-way availability timing; lane and ramp closure limitations; maintenance activities; and involvement and coordination with utility owners, the railroads, governmental authorities, engineers architects, subcontractors and suppliers.

Further revisions to the baseline schedule will be developed in conjunction with CDOT during workshop sessions, and we will obtain approval prior to implementation in the field. Each version of the baseline schedule will be labeled with a sequential revision number and include greater detail of the current progress of work including the status of all activities, sequencing and logic. We will use a separate O&M schedule to coordinate and manage maintenance activities

**Figure 1-3:** *Summary Schedule*

and renewal work. A narrative describing changes, reasons, methods, resources, quantities, key objectives, critical milestones and time frames will accompany each update.

### Advanced Project Schedule Development

With approximately 10,000 activities, our proposal schedule is more comprehensive and accurate than typical proposal schedules, and it provides a head start and solid foundation for the development of the baseline schedule.

## D. SCHEDULE MANAGEMENT APPROACH

Our scheduler will be responsible for developing the baseline schedule, updating progress and collecting actual cost data. This individual will support the project managers and field engineers in planning, scheduling and implementing the work and in developing work-around schedules or recovery schedules.

**Daily Look-ahead and Four-week Rolling Schedules.** In addition to a daily look-ahead schedule, a four-week rolling schedule is prepared every week to show work completed last week and a three-week look-ahead. It is used in progress meetings to facilitate activity planning between managers, superintendents, subcontractors, traffic control, quality and public information teams and the Enterprises. During O&M we use similar tools including a scheduling component of our asset management system that helps manage the work order process by planning all preventive maintenance activities, including the labor and equipment resources needed. The tool also has functionality to automatically create work orders based on asset conditions or time-based triggers.

**Monthly Progress Schedules.** Monthly progress schedules and progress reports will be provided to CDOT within 10 working days following the prior month's end. These will outline the status of all work, provide updates on work associated with utilities and railroads and include planned-versus-actual comparisons key milestones. They will include problems and resolutions, timing changes, nonconforming work, communication efforts, estimated cost work performed and progress photos.

### i. RESOURCE MANAGEMENT

Our resource-loaded schedule was developed by seasoned designers and construction veterans, subcontractors and experienced schedulers. It considers the inter-relationship of design and construction and realistically schedules and tracks all activities, resource requirements and actual resource usage. The schedule includes appropriate durations for the 30-, 60- and 90-percent submittal reviews, identifies meetings with the Enterprises as well as task force meetings, and factors in testing and start-up for the cover systems as well as toll commissioning coordination activities.

To achieve substantial completion by notice to proceed 1 plus 1,768 days, our managers will collaborate at weekly coordination and scheduling meeting. They will determine overall project priorities and identify opportunities to more efficiently mobilize or shift resources to optimize or recover schedule, as needed. (See also Figure 2-6 on page 16.)

### Integrated Design and Construction Schedule Development

Working together, our designers, constructors and schedulers sequenced the work, developed productivity rates based on historical data and used what-if scenarios to identify opportunities for optimization. Design activities, such as submittals and reviews by the Enterprises, are linked to construction activities to fully consider both elements in the critical path.

### ii. MATERIALS DELIVERY MANAGEMENT

Each month, the production team will use a customized tracking system developed by our procurement team to monitor receipt of all materials to be delivered during the next month. It will also be used by field personnel to monitor and coordinate receipt of material. When used in conjunction with the four-week schedule that outlines fabrication times, potential material shortages can be identified and resolved before they impact the team's production goals. For materials with extremely long-lead times (such as structural steel, precast concrete beams, precast retaining wall panels and intelligent transportation system and cover systems components), we will identify and prioritize them

early, work with suppliers to establish delivery schedules and monitor them monthly until arrival.

### iii. MANAGING SCHEDULE INTERFACES

In collaboration with the Enterprises, we will create a partnering process, based on the *Project First* initiative, that fosters a relationship of a single team based on trust and open communication. We understand that resources invested in building a strong, cohesive team that trusts each other takes full ownership of all problems and collaboration to effectively implement win-win solutions.

We have a robust scheduling program and interface plan that will minimize:

- Displacement to local neighbors and businesses
- Access issues to local neighborhoods and Swansea Elementary School
- Construction air quality impacts by maximizing trucking efficiency
- Duration of right-of-way acquisition

Proven schedule tactics and applications to managing the scheduling interface, liaison and coordination among all critical team members include:

- Our schedule will include activities and sub-activities for coordinating the work with utilities, UPRR, BNSF Railway, Denver Rock Island Railroad, CCD, permitting authorities and other third parties such as local governmental agencies. Including these activities helps establish interdependencies and is a tool for managing each third-party requirement. Our schedule submittals will include a filtered list of these items.
- Weekly and monthly team meetings with the Enterprises and our key team members, in addition to subcontractors, agencies and stakeholders when necessary, to facilitate the flow of communication among all parties so that schedule status, problems and solutions are clearly communicated.

**MHP, Subcontractors and Supplier Schedule Integration.** Our project manager, design manager, design-build manager and construction manager will conduct a weekly construction coordination and scheduling meeting to evaluate performance against the schedule and develop the look-ahead schedule. Applicable subcontractors and suppliers will attend weekly and monthly progress meetings that include collaborating on the development of accurate schedules for effective forecasting of work. Additionally, they will have access to the electronic document management system providing all firms access to the latest design and schedule documents.

**Design, Quality Management, Construction, Operations and Maintenance.** To establish a common understanding of the deliverable content and the Enterprises' schedule expectations, we will kick off design with meetings between our design process control manager, designers, construction and O&M team members, and the Enterprises. Design managers and discipline leads will manage the development of design solutions and submittals. Design Manager Bob Gray, PE, and construction team members will work closely with the designers to verify coordination of all interfaces and incorporation of all requirements related to constructability and schedule. Additionally, discipline leads will attend weekly project management meetings, monthly progress review meetings, and permit coordination meetings (as required) to effectively coordinate design efforts with the schedule.

**Our Team and the Enterprises.** A two-day workshop held for the Enterprises and our team will establish communication in meeting key milestones for budget, critical submittal time frames and schedule parameters. We will use four-week rolling schedules to discuss the imminent work activities in our regular progress meetings. Monthly updates of the baseline schedule will formally communicate status against planned activities, activity re-sequencing (if any) and other impacts.

**Our Resources, Governmental Agencies and Stakeholders.** We will regularly communicate schedule issues with the Enterprises, CCD, utility owners, the railroads and stakeholders. Like our regular progress meetings, we will use four-week rolling schedules and monthly updates of the baseline schedule to communicate status. We will also provide informal communication (by telephone or in person) regarding major schedule concerns as we concurrently start our what-if analysis.

Volume 2

# 2.1.3. Part 2: Quality Management



# 2 Quality Management

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *The transformational outcomes anticipated for the Central 70 project require excellent execution. We are ready to deliver quality in all aspects of our service — final installed product, coordinated activities, good communication, safety-first priority, meeting commitments and serving as a partner to the community and the Colorado Bridge Enterprise/High Performance Transportation Enterprise (the Enterprises). We will deliver on the vision for a lasting investment.*

I-70 Mile High Partners (MHP) and our lead contractor, Mile High Constructors (MHC), bring quality policies based on the concept that quality work is everyone's responsibility, starting at the top of the organization with our boards, continuing through our leadership team to all workers, including subconsultants and subcontractors. Our quality management plan (QMP) and quality management system will comply with ISO 9001:2015 and ISO 14001:2015 for the mobilization, design, construction and operation and maintenance (O&M) phases.

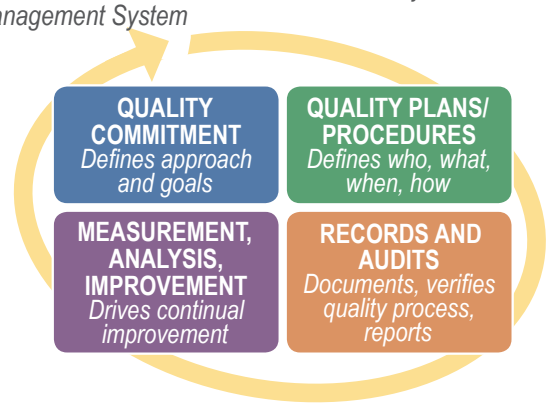
Our integrated quality management system, and the resulting ISO-compliant QMP, has proven effective on highway projects and is ready to implement. The four cornerstones of our quality management system (shown in Figure 2-1) summarize our delivery and continuous improvement process.

## A. QUALITY MANAGEMENT PLANS

Our approach is described in our draft plans — *Appendix D – Quality Management Plan, Stage 1, Non-construction (Stage 1 QMP); Appendix E – Quality Management Plan, Stage 2, Construction (Stage 2 QMP);* and *Appendix I, Exhibit I-1 – Operations and Maintenance Quality Management Plan (O&M QMP)*. Living documents updated to reflect opportunities and changed conditions, these plans are structured for decision-making and operations, yet flexible to foster continual improvement. The guidance is based on the following principles:

- Continual improvement
- Customer focus
- Leadership and involvement of the team
- Process approach (a system approach to management)
- Broad decision-making and stop work authority
- Mutually beneficial supplier and subcontractor relationships

**Figure 2-1:** *Four Cornerstones of Our Quality Management System*




### i. QUALITY ORGANIZATION

Our quality management organization is included in Figure 1-2 on page 4, showing the discipline leads and field superintendent responsible for ensuring the quality at the deliverable level. Stop work authority is also indicated.

### ii. APPROACH TO QUALITY MANAGEMENT

Our approach to quality management is presented throughout this *Part 2* and in the three quality management plans previously referenced.

#### Exceeding Requirements for Quality

**Stop Work Authority.** Our quality, safety and environmental teams all have authority to stop work. In addition, our construction manager, design manager, field superintendents and foremen have stop work authority. In fact, we encourage everyone at all levels to stop something that seems incorrect and discuss it with a supervisor. Similarly, we ask everyone to say something instead of walking by something that could be an accident waiting to happen.

**Enhanced Process Control Testing.** As shown in Figure 2-2 and *Appendix E – Stage 2 QMP*, we will increase the intensity of testing (performed by our process control laboratory) beyond the minimum *Guide Schedule* frequencies. For example, we will conduct additional compaction

and concrete cylinder testing by 100 percent. The result is increased confidence in the quality of the installed work and the ability to swiftly identify trends and make corrections.

**Urgency for Resolution of Quality Issues.** We commit to quick resolution of nonconformance reports (NCR) after an NCR is opened (see also *Part 2.A.xii – Nonconformances* on page 13).

## iii. INDEPENDENCE OF QUALITY TEAM

Independent Design Quality Manager Michael McMicken, PE, Independent Quality Control Manager James Peel, PE, Construction Process Control Manager Katherine Tyler, PE, and our design process control manager report to Project Quality Manager Fernando Pizarro, PE, who reports directly to the MHP board of directors. All quality teams function with full independence of the MHP project manager and MHC design and construction delivery teams. For O&M, the O&M analyst who will be responsible for quality reports to the O&M manager, independent of the maintenance and traffic control center management. None of the process control staff will be directly involved in the production of work products.

## iv. QUALITY COMMUNICATIONS

### Leadership and Clear Lines of Responsibility

As shown in Figure 1-2 on page 4, we assigned qualified managers to lead delivery of every work element. This structure provides the framework for communication within departments and forms the backbone of our information distribution and decision-making model. Our staff members are empowered at all levels to coordinate with their Enterprises counterparts, as part of our *Project First* implementation.

### Task Force Groups

As described in *Part 1* (page 1), task force groups for key technical disciplines will provide structured interface with the Enterprises, third parties and across all disciplines. The resulting collaboration and efficient decision-making will be essential to delivering the project requirements and maintaining the project schedule.

### Project Meetings

Daily, weekly and monthly meetings in all functional areas and between suborganizations will be the primary means to share information, control design, construction and O&M work, ensure efficient allocation of resources and provide overall coordination. The meeting schedule shown in A*ppendix B – Project Management Plan, Section a,* provides a sample meeting schedule.

## v. QUALITY KEY PERSONNEL ROLES

Project Quality Manager Fernando Pizarro, PE, is responsible for successful implementation of the quality plan in all phases of the work. The independent design quality manager, independent quality control manager and the design and construction process control teams report to him. All quality team members have authority to stop work. See *Appendix D, Exhibit D/E-1, Process Procedures Manual (PPM) 23,* for the stop work procedure.

**Design.** Our design process control manager will oversee the quality control process of the design consultants. Each firm will be responsible for implementation of an internal quality assurance/ quality control program that complies with the MHP quality program and contract requirements.

**Figure 2-2:** *Example Process Control Testing Frequencies That Exceed Contract Requirements*

| CDOT SPEC | DESCRIPTION | TYPE OF TEST | CDOT TEST PROCEDURE | TESTING FREQUENCY | | % INCREASE |
|---|---|---|---|---|---|---|
| | | | | CDOT | MHP | |
| 203 | Embankment | In-place Density | CP22, CP23, CVP25 & CP80 | 1 per 2,000 cubic yard (cy) | 1 per 1,000 cy | 100 |
| | | In-place Density | CP22, CP23, CVP25 & CP80 | 1 per 500 cy within 100 feet of bridge approach | 1 per 250 cy within 100 feet of bridge approach | 100 |
| | | Moisture Density Curve | T99 or T180 | 1 per soil type | 2 per soil type | 100 |
| | | Soil-survey Classification | CP20 or CP21 | 1 per 1,000 (two-lane roadway) | 2 per 1,000 (two-lane roadway) | 100 |
| 206 | Structure Backfill | In-place Density | CP22, CP80 | 1 per 200 cy | 1 per 100 cy | 100 |
| 304 | Aggregate Base Course | In-place Density | CP22, CP80 | 1 per 2,000 tons | 1 per 1,000 tons | 100 |
| 306 | Reconditioning | In-place Density | CP22, CP23 | 1 per 5,000 square yards | 1 per 2,500 square yards | 100 |

**Construction.** Katherine Tyler, PE, construction process control manager, will oversee the construction quality program and coordinate with our project quality manager and the independent quality control team. The construction teams will provide schedule information, including witness and hold points, to the quality teams (process control team, independent quality control firm, the Enterprises and project quality manager).

**O&M.** During the operating period, our O&M analyst will be responsible for quality assurance. Routine inspections will be performed daily, weekly, monthly and semi-annually. Special inspections will be conducted as required for each component to assess conditions and identify preventive and corrective measures. Issues identified will be incorporated into work plans or assigned a work ticket, tracked to completion and signed off by a supervisor.

## vi. QUALITY HIRING AND TRAINING

**Hiring.** Before a person is assigned to quality team (whether a direct-hire or subconsultant employee), we will verify they have the required qualifications, experience, credentials and personality required to perform the assigned functions. Copies of all certifications will be filed in our electronic document management system and tracked to ensure they remain current.

**Training.** Our training register will document participation and certification status of quality personnel (as applicable). See *Appendix E, Exhibit D/E-1, PPM 15 – Training*. Selected training programs include:

- **Mandatory safety and environmental training.** Required for all personnel (our own personnel and subcontractors) prior to accessing the site.
- **Quality training.** For construction and O&M personnel performing/overseeing activities (inspection and compliance monitoring) to ensure they have the job-specific proficiency required by our quality control procedures.
- **Contract documents Orientation.** For our design, construction and O&M teams on the provisions of the contract documents and strategies compliance of their work.

### Safety and Field Orientations
(provided by Ferrovial Agroman US Corp.)


## vii. STAFFING TO MEET REQUIREMENTS

We developed our proposed staffing levels based on our understanding of the work, deliverables, constraints and our experience providing similar services on other highway projects. Figure 2-3 provides our recruiting and staffing strategy by phase.

### Local Hiring and Workforce Development

We will consistently foster and implement strategies to mobilize local workforce within our organization and with our subcontractors. Our goal is help develop careers, providing long-term employment throughout the greater Denver area.

## viii. DOCUMENT CONTROL

**Design.** Senior engineers for each discipline develop check prints and project-specific checklists that become part of the permanent quality documentation. Only one set of check prints will exist for each milestone submission and will include the reviewer's name, identify deficiencies and track correction actions. The design process control manager will issue design NCRs, although design NCRs can be initiated by any design team member. All records will be archived in our electronic document management system.

**Figure 2-3:** *Phased Staffing Strategy*

**1 POST-AWARD/AND PRE-CONSTRUCTION**
- Assign and mobilize key leadership
- Hire critical administrative personnel from local hire area (human resources and workforce development staff)
- Hire additional critical project leadership from local hire area (project engineers, designers and managers)

**2 MOBILIZATION**
- Implement local hire and workforce development program (as described in *Part 4*, page 29)

**3 RAPID GROWTH THROUGH CONSTRUCTION**
- Implement rapid mobilization strategy used on similar projects
- Continue local hire and workforce development programs

**4 O&M**
- Implement strategy based on world-wide concessions staffing
- Continue local hire and workforce development programs

**Construction.** Both the process control and independent quality control firm will use hand-held devices while conducting their inspections and testing. The hand-held devices contain current versions of the approved drawings and checklists for each inspection program point (both witness and hold points). Making forms accessible on hand-held devices results in better consistency of inspections across staff, reduces information gaps and eliminates delays in transmitting information from the field to the office, quality team leadership, independent quality control manager and the Enterprises. The forms upload wirelessly to the document control system including photos with GPS data, date and time stamps. See *Appendix E, Exhibit D/E-1, PPM 3 – Documents and Data Control.*

**O&M.** Our quality control function is handled by our maintenance supervisors. They assign all work tickets, confirming they agree with the task, and they review the quality of the completed work prior to signing and closing the ticket. All relevant information will be managed through our electronic document management system.

*Hand-held devices with uploads to our electronic document management system (similar to those used here on North Tarrant Express Segment 3A) will be used by our process control team and the independent quality control firm.*

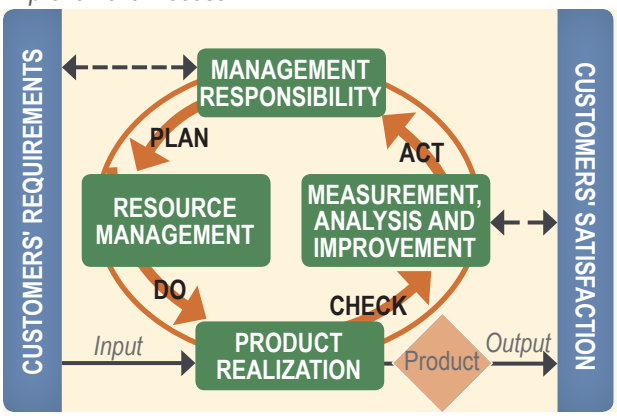
## ix. PROCESS CONTROL

Using our internal process control, we will manage the overall quality of design, construction, O&M, documents and decisions that we deliver under this project. Our goal is to ensure operational techniques and activities provide quality products that fully satisfy Colorado Department of Transportation (CDOT) standards and contractual requirements. Each functional manager will be responsible for delivering work that meets the quality standards and our quality teams will oversee and document compliance.

## x. QUALITY AUDITS

Periodic audits will be conducted by our quality teams based on the status and importance of each activity; each department will be audited at least annually. See *Appendix E, Exhibit D/E-1, PPM 11 – Internal Audits.*

**Figure 2-4:** *Quality Management System Continual Improvement Process*




## xi. CONTINUAL IMPROVEMENT

***Plan. Do. Check. Act.*** As shown in Figure 2-4, our corporate culture is based on continuous improvement. Required by ISO 9001, each year at the project-level quality management system review, we will analyze past year performance data including audits results, customer feedback, NCRs, status of preventive and corrective actions and follow-up actions from previous reviews. We will also consider changes that could affect the quality management system and develop recommendations for improvement. See *Appendix E, Exhibit D/E-1, PPM 26 – Continual Improvement.*

### Corporate Quality Team Oversight

Our corporate quality management teams will provide oversight and conduct annual audits in both the construction and operating periods to confirm that the project's quality control and quality assurance are properly implemented.

## xii. NONCONFORMANCES

The control and reporting of nonconforming items will follow *Appendix E, Exhibit D/E-1, PPM 9 – Control of Nonconforming Products,* based on the principle of empowering anyone associated with the project to be responsible for raising nonconforming items such as:

- Documentation that renders a permanent item to be nonconforming
- Procedure violations that render a permanent item to be nonconforming or indeterminate
- Material issues including traceability, material type, identification or quality
- Permanent items that are nonconforming or indeterminate and cannot be completed or reworked prior to final acceptance

### xiii. DEFECTS, DEFICIENCIES AND TRENDS

We proactively manage our work to avoid deficiencies and nonconformances by using proven project management techniques such as conducting pre-planning meetings, preparing extensive work plans and thoroughly training personnel. If any defect, deficiency or nonconformance occurs, we will immediately take steps to correct them following our quality procedure (*Appendix E, Exhibit D/E-1, PPM 10 – Corrective and Preventative Actions*).

When designer input is necessary to resolve a nonconformance, an NCR will be provided to the design manager and the design process control manager, and copied to our management, the independent quality control team and the project quality manager within 24 hours. All NCR resolutions will be expeditiously developed and, subject to approval by the independent quality control firm and the Enterprises, will be implemented as soon as practicable. We will distribute our NCR log, including resolutions, to the Enterprises and our management biweekly.

**Avoiding Repeat Mistakes.** Recurring nonconformances or quality short falls will be considered systemic deficiencies and trigger a root cause investigation. If necessary, a written corrective action request will be submitted to the work supervisor or elevated to management. Corrective actions may include new work procedures, existing procedure revisions, personnel training, personnel removal or other actions to restore or improve quality. We will also notify our production teams using a "Quality Alert" to avoid repeating the same quality issues in different locations after their discovery.

## B. STAGE 1 QUALITY MANAGEMENT

### i. APPROACH

*Appendix D – Stage 1 QMP* describes our approach to non-construction quality and full compliance with the quality requirements in *Schedules 8, 14, 15, 17 and 18*.

### ii. NON-CONSTRUCTION QUALITY MANAGEMENT

Each functional area (such as design, project administration, strategic communications, procurement, environmental and right-of-way services) will implement procedures for their work, including a quality management process that is ISO-compliant. At least annually, we will audit each area, develop corrective actions (if needed) and establish continual improvement goals.

#### Design

Our design deliverables go through a rigorous quality process to verify they consider contract requirements and design standards, constructability, environmental compliance, usability, reliability, availability, maintainability, operability, durability, safety, life-cycle costs and aesthetics (Figure 2-5). All plans, final submittals, specifications, calculations and reports for design changes will be stamped, signed and dated by an experienced registered professional engineer. In all cases, the design manager, the design process control manager and the independent design quality manager will verify and certify the design has been made in accordance with the requirements of the contract documents, applicable law and governmental approvals; checked in accordance with our approved quality management plan; and consistently prepared.

### iii. INTER-DISCIPLINARY REVIEWS

As previously discussed (in *Part 1)* our task force groups will provide the structure for the development, inter-disciplinary review and coordination of design, including integrating related issues such as right-of-way, survey, environmental permitting, third-party agreements, utilities, railroads, community relations, operations and maintenance. These teams will meet throughout the development of the design, and also during construction to anticipate and resolve issues before they significantly impact schedule, cost, quality, safety or the environment.

### iv. DESIGN PERSONNEL INTERFACE

Our team is organized in a matrix with direct lines of reporting by specialty personnel (design, construction, quality, safety, environmental

**Quality Award**

ENR GLOBAL BEST PROJECTS WINNER For outstanding efforts in maintaining environmental protection throughout construction, the LBJ Express project was honored by the American Road and Transportation Builders Association Transportation Development Foundation with a Globe Award in 2013. In 2016, *Engineering News-Record* awarded the project its Global Best Project in the Road/Highway category.

compliance, etc.). To coordinate our work, we establish task force groups for each key technical discipline that include members of the design, construction, quality, O&M and management teams, as well as the Enterprises and third parties. The task force groups will work together to develop the approach, value-added features, life-cycle evaluations, plans and quantities in the project.

## v. APPROACH TO DESIGN

### A. Delivering Design

Figure 2-5 summarizes our design quality management process. Design Manager Bob Gray, PE, will manage and deliver the design on behalf of MHC. An internal MHC design technical staff reporting to him will perform most of the day-to-day coordination with the developer and the design consultants. Each designer will designate a project manager to serve as the focal point between MHC and his own engineering team. Detailed roles, responsibilities and the organizational chart are provided in *Appendix D – Stage 1 QMP*.

### B. Managing Subconsultants/Off-site Design

To develop our proposal, we used a multi-office execution approach to develop the design. While we will continue this approach upon award, design leads for geotechnical, environmental, utilities, structures and earthwork will be dedicated to the project and co-located with our construction personnel at our project office located near the corridor.

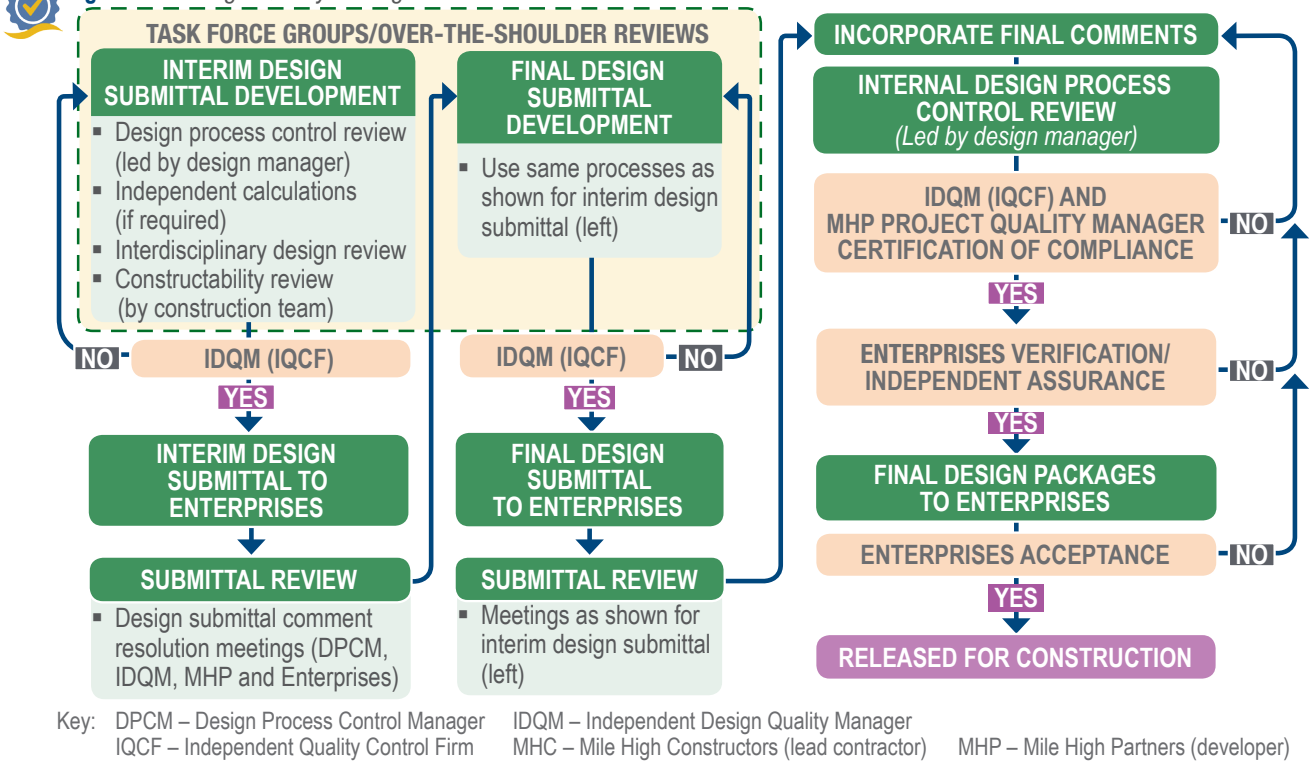
### C. Integrating Designs by Multiple Firms

Design Manager Bob Gray, PE, will establish the overall framework, protocols and conventions to be used by all designers. The scope of each design team will be clearly identified, in writing. To integrate and coordinate designs by different firms and office, task force groups will meet regularly, in person and using web-based meetings. Interface points will be identified in advance and coordinated throughout design development using checklists, meetings and design reviews.

## vi. DESIGN INTERFACE WITH AUTHORITIES

We anticipate that staff of the Enterprises will participate in the task force groups, along with our team. These meetings, focused on specific project elements, will bring together our subject matter experts with those of the Enterprises on a regular basis. We will also have formal and informal (over-the-shoulder) design review meetings.

**Figure 2-5:** *Design Quality Management Process*




Key: DPCM – Design Process Control Manager
IDQM – Independent Design Quality Manager
IQCF – Independent Quality Control Firm
MHC – Mile High Constructors (lead contractor)
MHP – Mile High Partners (developer)

### vii. DESIGN PACKAGES, STUDIES, REPORTS

Our approach to developing the design packages, studies and reports to support the demands of the construction sequencing is to first set the overall geometry for the local streets and all lanes of I-70. The reports and studies required in *Schedule 10* that support the design packages need to be developed and updated in advance and in coordination with the schedule of the design packages. Then, plan production will be segmented in logical packages that can be developed somewhat independently.

The plan sets are all developed from the common base drawings to assure continuity between the sets. We successfully implemented a similar strategy for the LBJ Express project, preparing plan packages for local streets in advance of the mainline packages. We will also develop packages by logical disciplines such as roadway, drainage, bridge, retaining walls, etc., resulting in plans that are easier to read and review.

## C. STAGE 2 QUALITY MANAGEMENT

### i. CONSTRUCTION QUALITY MANAGEMENT

"Doing it right the first time" is the mantra of our construction team. We know rework is expensive, negatively impacts productivity and schedule, and impacts worker morale. Our approach is to provide quality work and document conformance with the requirements. Figure 2-6 shows our construction process control work flow, including acceptance by the Enterprises. *Appendix E – Stage 2 QMP* describes our approach to construction quality management.

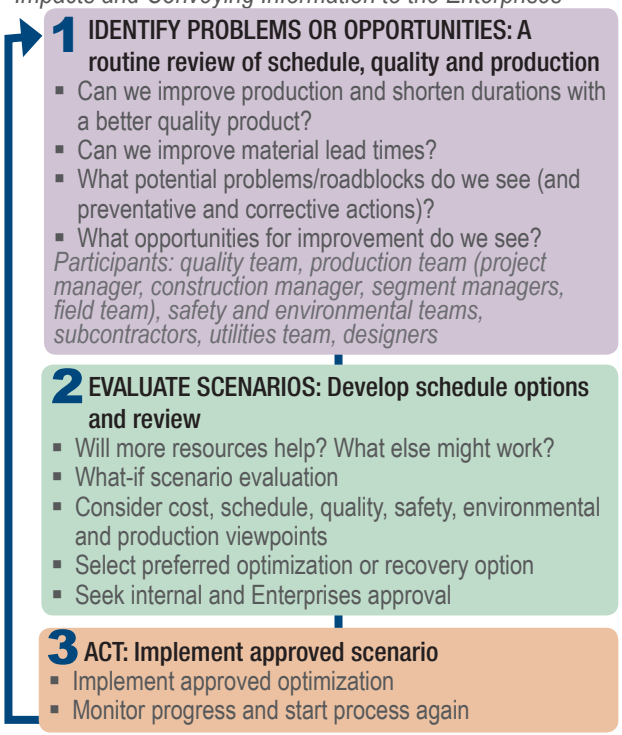
### ii. PLANNING AND CONTROLLING CONSTRUCTION

Our approach to planning and controlling the construction work to meet the key milestones identified in the baseline schedule is fully described in *Part 1.D* starting on page 8.

Long before any schedule or quality issues may occur, we strive to anticipate and prevent issues and have schedule recovery strategies ready to deploy that add and re-allocate resources, expedite materials, extend workdays and other reasonable means (see Figure 2-6). Strategies include:

- **Controlling Work.** We evaluate planned versus actual performance, witness and hold points coordination with schedule, discuss areas for improvement, conduct what-if analysis on options and adjust the schedule and resources as needed to maintain performance.
- **Rescheduling Work.** We develop recovery schedules to remedy slippage and achieve on-time completion for each element.

**Figure 2-6:** *Process for Analyzing Quality and Schedule Impacts and Conveying Information to the Enterprises*




### iii. INTEGRATING DESIGN AND MAINTENANCE

Design, construction and O&M activities will be coordinated to include a common approach for quality management system requirements such as lane closure requests, scheduling, document control, process auditing, corrective and preventive action and continuous improvement. Our O&M manager will start work during the construction period and will coordinate work using the construction schedules and lane closure requests.

### iv. MANAGING STAGED CONSTRUCTION

During construction, our project superintendents and their construction teams will begin work in multiple locations simultaneously. Regular meetings between our project manager, design-build project manager, deputy project manager, construction manager, project superintendents, O&M manager, environmental and communications teams,

and the Enterprises will be the primary means to share information, control construction work, ensure efficient allocation of resources and provide overall coordination between segments. Our project superintendents will have similar meetings for their segments.

### Inspection and Testing Program

We have learned from past experience that the quality benefits of an extensive testing program far outweigh its additional costs. Figure 2-2 on page 11 provides a sample of specific commitments to exceed the contract requirements for testing. A full list is in *Appendix E – Stage 2 QMP*.

*Process control teams perform survey control check (top) and stone matrix asphalt density test (bottom).*

### Integration with O&M Activities

During the construction period, all O&M activities will be coordinated with MHC, including traffic management requirements. O&M activities will be coordinated and scheduled using construction lane closures to minimize disruptions to the traveling public. After substantial completion, the O&M team will take the lead, and construction and third-party utility teams will coordinate their access requirements with the O&M traffic safety officer.

### Integrated Maintenance Team

The O&M team's design and construction manager and engineer will participate in construction period task force groups and provide input on life cycle considerations such as durability and maintainability. The O&M team will conduct an acceptance walk-through before substantial completion and handover from construction to maintenance.

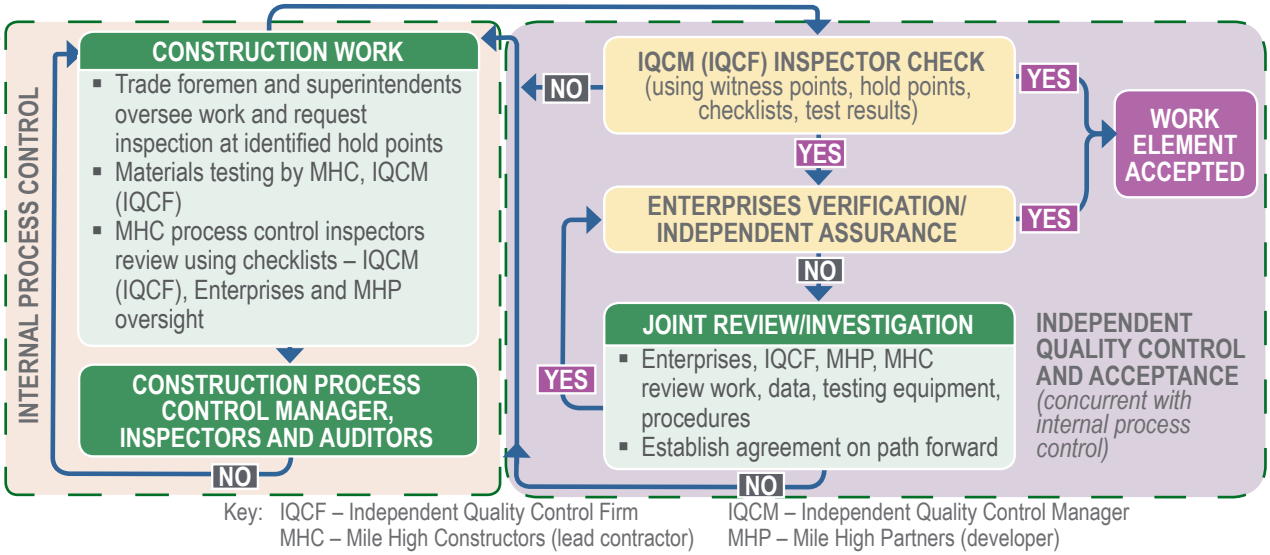
## v. INDEPENDENT QUALITY CONTROL

The independent quality control firm will perform oversight to verify the work is in compliance with the contract and the quality management plans. Through our project quality manager, our construction teams will provide advanced notice of items in the inspection points program (witness and hold points) so the independent quality control firm and the Enterprises teams can be on-site. We will also provide access for the team to take independent materials samples and/or preserve extra samples for their use.

## vi. CONSTRUCTABILITY, DURABILITY, MAINTAINABILITY, ENVIRONMENTAL COMPLIANCE

A design-build-maintain project allows the design, construction, environmental and O&M teams to collaborate and incorporate both constructability and life-cycle considerations into the design. Our task force format (introduced *Part 1*, page 1) enhances collaboration, integration of multiple perspectives and overall quality. Our approach to life-cycle considerations is discussed in *Part 5, Section B.v.a – Life-cycle Considerations* (page 38).

**Figure 2-7:** *Construction Quality Management Process*




Key: IQCF – Independent Quality Control Firm
MHC – Mile High Constructors (lead contractor)
IQCM – Independent Quality Control Manager
MHP – Mile High Partners (developer)

Volume 2

# 2.1.4. Part 3: Maintenance of Traffic

# 3 Maintenance of Traffic

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *Traffic management is one of the most visible ways we interact with the community during construction. We become the face for the project and Colorado the Bridge Enterprise/High Performance Transportation Enterprise (the Enterprises) and we take the responsibility seriously. Requesting and listening to public input, our team will transform what can be a challenge for the local communities into a strength by incorporating their ideas for safe and efficient construction phasing, travel paths and signage solutions, especially around Swansea Elementary School.*

## Maintenance of Traffic, Construction Staging and Construction Sequencing

We have developed detailed traffic control plans (included as an attachment to *Appendix F – Transportation Management Plan)* that far exceed the requirements. Including nearly 200 pages of detailed drawings, our plans describe construction phasing for the entire project. During the development of these plans, we analyzed numerous options, considering right-of-way availability, utility relocations and other constraints, and developed a comprehensive plan that minimizes traffic impacts for the community while maximizing construction efficiency.

Features that minimize impacts for the community include:

- Eliminating closure of Columbine and Clayton streets, significantly minimizing impacts to Swansea Elementary School and the adjacent community
- Eliminating closure of York, Josephine, Dahlia and Holly streets, significantly minimizing impacts to the adjacent communities
- Proposing to collaborate with the City and County of Denver (CCD) on constructing the planned permanent or a temporary York Street/Union Pacific Railroad (UPRR) pedestrian bridge as part of this project, significantly improving safety and mobility for the adjacent community

## A. OVERALL TRAFFIC MANAGEMENT

I-70 is bordered by dense industrial, commercial and residential developments. Our traffic management approach is based on our construction phasing sequence and meets all requirements of *Schedule 10, Section 2 – Maintenance of Traffic*. We commit to keeping existing lanes of I-70 operational, limiting ramp closures to allowed durations with proper sequencing, never closing adjacent cross streets

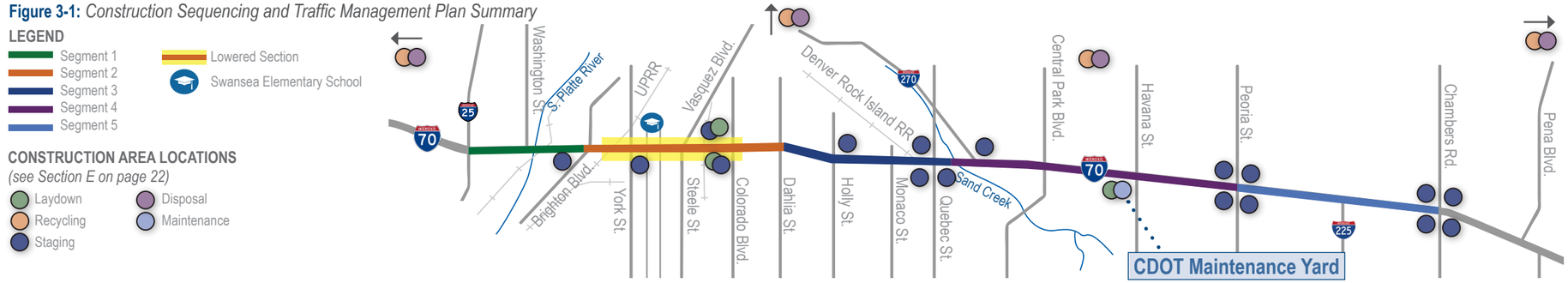

*Because construction is very close to Swansea Elementary School, our safety program will help educate students, teachers and parents about how to stay safe.*

simultaneously and keeping pedestrian detours to less than 1,000 feet. Signing and striping designs provide clear direction, and will be evaluated and adjusted as necessary throughout construction to maximize safety and minimize impacts. Figure 3-1 on the next page summarizes the sequencing approach to the major work activities and associated impacts by segment (segment description summaries begin on page 20).

Our general construction approach to I-70 (constructing in halves) requires only two major traffic shifts resulting in minimal impacts to the main lanes. The complex and challenging traffic control is on the local streets.

**I-70.** From I-25 to Brighton Boulevard, we reconfigure traffic to the south and build the north half of the Brighton Boulevard bridge. We then shift traffic to the north to reconstruct the remainder of the bridge. In the lowered section from Brighton Boulevard to Dahlia Street, we maintain the eastbound and westbound traffic on the existing viaduct to construct the north half of I-70. We then shift traffic to the new northern half and proceed with the removal of the existing viaduct and construction of the south half of the lowered section. From Dahlia to Quebec streets, we shift traffic to the inside of I-70 while we reconstruct the outside lanes, adjacent roadways and retaining walls and widen bridges. Traffic is then shifted to the outside while we construct the

**Figure 3-1:** *Construction Sequencing and Traffic Management Plan Summary*




*Constructing the I-25/Fillmore Diverging Diamond Interchange while maintaining traffic flow presented project phasing challenges. To deliver the project on time, SEMA proposed adjustments to the original 16-phased sequence plan, including implementing two fast-track weekend closures when traffic was lighter, that cut approximately two months from the schedule.*

| SEGMENT 1 | | | | |
|---|---|---|---|---|
| PH. | I-70 TRAFFIC CONFIGURATION | I-70 RAMP TRAFFIC CONFIGURATION | LOCAL ROAD TRAFFIC CONFIGURATION | WORK ZONE ACTIVITIES |
| 1 | ▪ Remain in existing configuration | ▪ Remain in existing configuration | ▪ Remain in existing configuration | ▪ Restriping of I-70<br>▪ Add drainage inlets along shoulders<br>▪ Commission tolling |

| SEGMENT 2 | | | | |
|---|---|---|---|---|
| PH. | I-70 TRAFFIC CONFIGURATION | I-70 RAMP TRAFFIC CONFIGURATION | LOCAL ROAD TRAFFIC CONFIGURATION | WORK ZONE ACTIVITIES |
| 1 | ▪ Alignment shifts to south side of Brighton bridge<br>▪ Three lanes per direction are maintained on existing viaduct<br>▪ Temporarily split WB traffic on I-70 onto temporary pavement at Colorado<br>▪ Temporary collector-distributor configuration for outside lanes (Colorado to Dahlia)<br>▪ Shift WB lanes to lowered section | ▪ Remain in existing configuration<br>▪ Full closure of York WB entrance ramp<br>▪ Colorado WB entrance loop ramp and EB entrance loop ramp and I-70 slip ramps to Stapleton<br>▪ Six-month closure of Steele/Vasquez exit ramp and Brighton WB exit ramp | ▪ 46th closed from Brighton to York<br>▪ Establish Brighton detour (ATC 18)<br>▪ Property impacts north and south side of I-70<br>▪ Josephine, Columbine and Clayton streets remain open<br>▪ Local access detours, temporary pavement, temporary short-term closures and construction impacts<br>▪ Shift traffic on Colorado Boulevard per phasing | ▪ Close 46th Avenue to build UPRR<br>▪ Construct UPRR bridge<br>▪ Construct north half of I-70 bridge over Brighton<br>▪ Construct temporary paving for Vasquez<br>▪ Construct Josephine, Columbine and Clayton bridges<br>▪ Construct the majority of York bridge<br>▪ Construct portion of Steele/Vasquez bridge not obstructed by viaduct<br>▪ Construct WB I-70 from Brighton to Dahlia<br>▪ Construct North 46th Avenue between Brighton and Colorado<br>▪ Construct new Colorado in two steps (west then east) |
| 2 | ▪ Three WB lanes on lowered segment, three EB lanes remain on viaduct | ▪ Remain in existing configuration | ▪ All ramps remain open from Brighton to Dahlia, minor changes at Steele Street/ Vasquez Boulevard | ▪ Construct I-70 north half transition portions at Brighton and Colorado<br>▪ Construct temporary exit ramp from lowered I-70 to Steele/Vasquez<br>▪ Construction remaining portion of Dahlia |
| 3 | ▪ Shift EB lanes to lowered section (six lanes now on north half of lowered segment) | ▪ Shift EB Steele/ Vasquez exit ramp and EB Brighton entrance ramp to temporary ramp under viaduct<br>▪ Shift EB Brighton traffic to final ramp configuration<br>▪ Traffic enters new I-70 near Fillmore bridge<br>▪ Shift EB ramp at Colorado to temporary ramp | ▪ Local access impacts, alternative connections open | ▪ Demolish as much of existing viaduct as possible without disrupting traffic<br>▪ Construct remaining portions of cross-street bridges<br>▪ Construct South 46th Avenue between Brighton and Colorado<br>▪ Complete Cook bridge construction<br>▪ Construct south half of I-70 bridge over Brighton |
| 4 | ▪ Shift I-70 onto ultimate alignment | ▪ Remain in existing configuration | ▪ Local access impacts, temporary lane closures to complete construction | ▪ Complete landscaping and finishing elements outside of I-70 traffic<br>▪ Commission tolling |

| SEGMENT 3 | | | | |
|---|---|---|---|---|
| PH. | I-70 TRAFFIC CONFIGURATION | I-70 RAMP TRAFFIC CONFIGURATION | LOCAL ROAD TRAFFIC CONFIGURATION | WORK ZONE ACTIVITIES |
| 1 | ▪ Existing alignment<br>▪ Minor changes, mostly to ramps<br>▪ Alignment shifts to center median area, three lanes per direction are maintained<br>▪ Temporary collector-distributor configuration for outside lane (Dahlia to Quebec) | ▪ Close EB exit ramp and WB entrance ramp at Quebec for allowed six months | ▪ Local access impacts and temporary closures<br>▪ No more access to Dahlia via I-70 | ▪ Construct temporary retaining walls and temporary pavement for Stapleton<br>▪ Construct local street intersections<br>▪ Construct outside portion of I-70<br>▪ Construction outside portions of I-70 overpass bridges<br>▪ Construct new ramp configurations at Quebec |
| 2 | ▪ Alignment shifts to outside lanes from Dahlia to Sand Creek, three lanes per direction are maintained | ▪ Remain in existing configuration<br>▪ Temporary overnight closures only | ▪ Local access impacts and temporary closures as cross-street bridges are constructed | ▪ Construct center portion of I-70<br>▪ Construct inside portions of I-70 overpass bridges<br>▪ Construct temporary pavement widening on west side of Monaco<br>▪ Construct temporary pavement on east side of Quebec using temporary lane closures<br>▪ Site preparation with temporary pavement for next phase of cross-street construction |
| 3 | ▪ Shift EB I-70 to outer pavement | ▪ Remain in existing configuration<br>▪ Temporary overnight closures only | ▪ Local access impacts due to construction and temporary lane closures | ▪ Finish half of construction of cross streets (Holly, Monaco and Quebec) |
| 4 | ▪ Ultimate alignment | ▪ Remain in existing configuration<br>▪ Temporary overnight closures only | ▪ Local access impacts due to construction and temporary lane closures | ▪ Finish other half of construction for Holly, Monaco and Quebec cross streets |
| 5 | ▪ Ultimate alignment | ▪ Remain in existing configuration<br>▪ Temporary overnight closures only | ▪ Move traffic onto finished pavement on cross streets | ▪ Remove temporary pavement and construct remainder of curb and cutter, medians and sidewalk during allowable closure periods<br>▪ Commission tolling |

| SEGMENT 4 | | | | |
|---|---|---|---|---|
| PH. | I-70 TRAFFIC CONFIGURATION | I-70 RAMP TRAFFIC CONFIGURATION | LOCAL ROAD TRAFFIC CONFIGURATION | WORK ZONE ACTIVITIES |
| 1 | ▪ Maintain traffic on existing lanes<br>▪ Maintain traffic on new outside pavement | ▪ I-270 to I-70 EB ramp traffic remains in existing configuration, minor lane shifts to place temporary pavement | ▪ Traffic shifts, temporary closures at Peoria | ▪ Construct new cross drainage structures<br>▪ Construct temporary pavement on both sides of Peoria<br>▪ Construct I-70 widening and Havana ponds<br>▪ Construct temporary widening along EB ramp from I-270 to EB I-70 to allow for construction of new I-270 ramp bridge and pavement<br>▪ Construct outside, then inside, portions of Peoria bridge and I-70 approaches<br>▪ Complete Peoria<br>▪ I-70 pavement mill and overlay during off-peak times<br>▪ Commission tolling |

| SEGMENT 5 | | | | |
|---|---|---|---|---|
| PH. | I-70 TRAFFIC CONFIGURATION | I-70 RAMP TRAFFIC CONFIGURATION | LOCAL ROAD TRAFFIC CONFIGURATION | WORK ZONE ACTIVITIES |
| 1 | ▪ Existing alignment<br>▪ Maintain 11-foot travel lanes while creating work areas<br>▪ Shift traffic per restriping | ▪ Remain in existing configuration | ▪ Traffic shifts at ramps, temporary closures | ▪ I-70 pavement mill and overlay from east of Peoria to east of I-225 (skip section at Havana)<br>▪ Restripe I-70 lanes<br>▪ Commission tolling |

inside portions. For the widened portion of the road from Quebec Street to Chambers Road, we shift traffic to the inside of the road to construct the full depth outside widening. Additional minor traffic shifts will be used to provide room for construction and maintain traffic. All shifts will be designed in accordance with Colorado Department of Transportation (CDOT) guidelines.

**Local Streets.** For the local street network to maintain connectivity throughout construction, the new 46th Avenue North must be built before the existing 46th Avenue is closed east of York Street. During construction of the north half of the lowered section, we construct as much of the cross-street bridges as possible while maintaining one lane in each direction on 46th Avenue. At the same time, we construct 46 Avenue North which will be the replacement for the existing 46th Avenue when we finally need to close that street to finish portions of the cross-street bridges and demolish the viaduct.

The major thoroughfares (Steele, Colorado, Quebec and Peoria streets) will be open for the duration of the project. We maintain the existing number of lanes by implementing phased construction. These streets will only be closed at allowed times to complete overhead work such as demolition and beam erection.

**Overall Coordination.** Our maintenance of traffic task force includes design and construction, maintenance, intelligent transportation system (ITS), communications and other representatives who have collaborated on the development of project-specific solutions to minimize traffic impacts and maximize safety for workers and the public. In addition to developing a plan for keeping York, Josephine, Columbine, Clayton, Dahlia and Holly streets open, they worked together to develop traffic configuration options for the lowered section and for working around the existing viaduct. The team examined the use of non-concurrent closures for the cross-street work compared to phasing of the work and found the non-concurrent closures extended the schedule for the cross streets by one construction season. By implementing strategic street closures and phasing, we were able to reduce the cross-street construction schedule by one season.

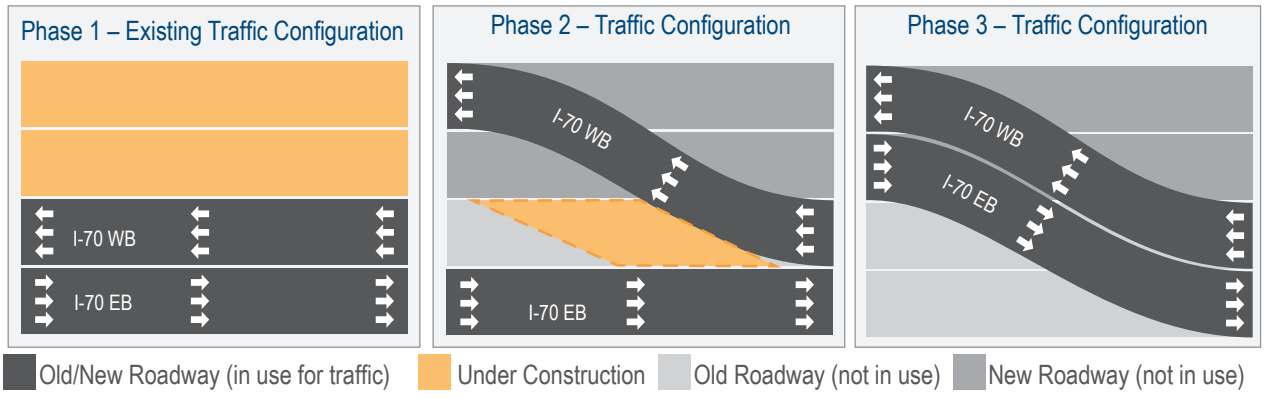
Upon award, the Enterprises, first responders, Regional Transportation District, Denver Police Department and local city and county agency representatives will be invited and encouraged to participate in our kick-off and weekly task force meetings. The goal of these meetings is to facilitate proper coordination with affected agencies, and tap into participant expertise to anticipate and avoid issues whenever possible and quickly resolve and mitigate issues that do occur. The task force will also develop mitigation measures for special events (for example, at the National Western Stock Show).

**Coordination Between Segments.** Coordinating the transitions between segments will be critical — particularly between segments 1 and 2 and segments 2 and 3 where the existing alignment overlaps with the shifted lanes. Our solution is to shift the traffic in three phases, constructing the critical overlapping pieces in phase 2 over a three-month period (see Figure 3-2).

## Sequencing Approach by Segment

We have divided the project into five distinct segments, each unique and requiring different construction sequencing and traffic control (see Figure 3-1 on the previous page).

**Figure 3-2:** *Traffic Phasing for Segment 2 to Segment 3 Transition*



**Segment 1 – I-25 to Brighton Boulevard.** Segment 1 begins east of I-25 and extends to west of Brighton Boulevard. This segment involves restriping the existing pavement and ITS preparation to provide the western termini of the managed lanes. As a result of the restriping, the outside shoulders will be narrowed. Drainage inlets will need to be added to the outside shoulders to prevent water spread on the pavement during rain events. The addition of these inlets and the restriping will occur during off-peak hours by closing one lane of traffic in each direction.

**Segment 2 – Brighton Boulevard to Dahlia Street.** Segment 2 extends west of Brighton Boulevard to east of Dahlia Street. This section contains the most difficult work of lowering I-70. The sequence in phase 1 begins with closing 46th Avenue from Brighton Boulevard, to York Street to begin UPRR track and bridge work, followed by construction of the north wall of the lowered section and bridge abutments for the cross-street bridges as well as excavation of the north half of the lowered section and reconstruction of Colorado Boulevard. Phase 2 shifts I-70 westbound traffic to the lowered portion to allow for reconstruction of the transition areas at Brighton Boulevard and Colorado Boulevard (see Figure 3-2 on the page previous page). Phase 3 begins by switching the eastbound traffic to the lowered portion, followed by the demolition of the existing viaduct and construction of the south half of the lowered section. Phase 4 is opening the final configuration.

**Segment 3 – Dahlia Street to Sand Creek Bridge.** Segment 3 begins east of Dahlia Street and extends to Sand Creek. This section of the project requires full reconstruction and widening of I-70 with reconstruction of Stapleton Drive and improvements to the cross streets. Construction will commence on both directions of Stapleton Drive and the outside portion of I-70, and proceed toward the middle.

**Segment 4 – Sand Creek Bridge to Peoria Street.** Segment 4 begins at Sand Creek and extends to Peoria Street. This section requires widening of I-70 and overlay of the existing pavement. The I-70/Havana Street interchange within this segment has been reconstructed by others and we have adjusted our design to accommodate this recent construction.

**Segment 5 – Peoria Street to Chambers Road.** The eastern most segment of the project, Segment 5 requires widening, all to the outside of I-70, as well as rehabilitation work on the existing pavement to remain and restriping.

## B. LOCAL AGENCY/CDOT ROADWAY IMPACTS

The lowered section of I-70 bisects the community creating an access barrier between north and south. Maintaining traffic on the cross streets is critical to the traffic in the area. We will keep cross streets open as prescribed by *Schedule 10, Section 2 – Maintenance of Traffic*. We will review opportunities to keep cross streets with allowed closures open during construction to maintain access and shorten the construction time. Because the allowed alternating street closures lengthen the construction time (by limiting the number of roads and structures that can concurrently be constructed), our plan keeps roads open during construction whenever possible to maximize the amount of concurrent work on adjacent roadways and accelerate the schedule. Figure 3-1 on page 19 summarizes the work and associated impacts for each segment.

### Closures, Detours and Mitigations

A key feature of our approach is never closing York, Josephine, Columbine, Clayton, Holly and Dahlia streets. Figure 3-3 on the next page identifies which of the allowable road closures our team will use and describes the detour route for each. Additional details are provided in *Appendix F, Section 5 – Detour Routes.*

## C. I-70 MAINLINE AND RAMP CLOSURES

Our plan includes no long-term closures for I-70 — only limited, rolling lane closures. Figure 3-1 on page 19 summarizes the work and associated impacts for each segment.

While temporary ramp closures are expected for construction of the new ramps, we only close ramps that are allowed to be closed per *Table 2-3* in *Schedule 10, Section 2 – Maintenance of Traffic.* Ramp closures will be supported by detour routing and we will obtain advance approval.

## D. RESIDENTIAL, BUSINESS AND PEDESTRIAN ACCESS

For the Central 70 project to be successful, local residents and daily users must be inconvenienced as little as possible.

**Residential and Business Access.** Access to residences and businesses along the corridor will be maintained throughout the alignment, including the lowered section where the potential for impacts are the greatest. We will work directly with property owners to coordinate access during each construction phase. For businesses, we will maintain a minimum of one driveway and one delivery access (as needed) at all times.

During road closures, if property owners do not have alternate access, temporary drives will be provided. Most properties along the lowered section have alternate access except one on the south side of I-70 between Columbine Street and Thompson Court. While the viaduct is demolished and 46th Avenue South is closed, we will coordinate access with this owner to make sure the business remains operational.

**Pedestrian Access.** We will maintain existing pedestrian routes, sometimes using temporary routes to do so. Our approach includes collaborating with CCD on the York Street/UPRR pedestrian bridge, and a comprehensive plan for pedestrian access in the Elyria-Swansea neighborhood — particularly around Swansea Elementary School — including added safety features such as certified crossing guards and flaggers during construction of the UPRR bridge. See *Part 6, Section I.iii – Safe Routes to School* and Figure 6-8 on page 50 for details.

**Access to Adjacent Roads.** The adjacent road access around the lowered section of I-70 will be maintained with detours or runarounds. We will implement traffic control in these sections to minimize closure durations. In the other sections of the project, there will be road approaches that require closure for construction. If a suitable detour is not available, the approaches will be built in sections to maintain access at all times.

**Mitigating Impacts to Adjacent Roads.** We minimize impacts to adjacent roads by:

- Keeping York, Josephine, Columbine, Clayton, Dahlia and Holly streets open
- Working within the existing right-of-way wherever possible
- Limiting cross-street closures
- Covering truck loads, requiring vehicle speed reductions and using watering, street sweeping and best management practices to control dust and debris
- Using designated haul routes with strict enforcement of load requirements
- Performing work that is sensitive to traffic conditions during off-peak hours
- Minimizing the number of lane closures that occur during peak hours

## E. CONSTRUCTION AREA LOCATIONS

Figure 3-1 on page 19 illustrates our construction area locations plan including anticipated laydown, recycling, staging, disposal and maintenance sites to be used during construction.

### Proven Pedestrian Traffic Management

Like Central 70, LBJ Express had several cross streets with heavy pedestrian traffic. Our traffic control plans detailed dedicated pedestrian routes, and where sidewalks were not available, portions of the pavement were blocked off by barrier for safe pedestrian passage or temporary sidewalks were used.

**Figure 3-3:** *Allowable and Actual Street Closures and Detour Routes*

| ROUTE | CLASSIFICATION | CLOSURE ALLOWED | NOT CLOSING | DETOUR ROUTE | DURATION |
|---|---|---|---|---|---|
| York Street | Minor Arterial | ♦ | ♦ | Not Needed | Zero days |
| Josephine Street | Minor Arterial | ♦ | ♦ | 48th Avenue, York Street, Steele Street or Columbine Street and 44th Avenue | Zero days |
| Columbine Street | Local Street | ♦ | ♦ | Not Needed | Zero days |
| Clayton Street | Collector | ♦ | ♦ | Not Needed | Zero days |
| Dahlia Street | Collector | ♦ | ♦ | 48th Avenue, Holly Street and 38th Avenue | Zero days |
| Holly Street | Arterial | ♦ | ♦ | 48th Avenue, Dahlia Street and 38th Avenue | Zero days |
| Monaco Street | Arterial | ♦ | | Stapleton Drive North, Holly Street and 38th Avenue | 30 days |

Volume 2

# 2.1.5. Part 4:

## Environmental Management, Strategic Communications, Community Development Programs, Small and Disadvantaged Business Participation and Workforce Development

# 4 Environmental Management, Strategic Communications, Community Development, Small/Disadvantaged Business Participation, Workforce Development

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *Our commitment and investment in the Central 70 project includes the environment, community, businesses, neighborhoods and the local workforce. Successful execution of these project elements is integral to the overall project outcome and drives our management and project implementation approach. We will be a good corporate citizen and will make investments in the community delivering long-term benefits.*

## A. ENVIRONMENTAL COMPLIANCE

Respect for the environment and communities are the foundations of our corporate culture. We recognize the long journey experienced by the Colorado Department of Transportation (CDOT) and the local community, started on August 19, 2003 when the Federal Highway Administration (FHWA) published its first Notice of Intent to prepare an environmental impact statement (EIS), to the issuance of the Record of Decision on January 19, 2017.

Our environmental management approach is to integrate every environmental requirement, beginning with design and construction, and continuing through the operation period. Key to implementation, we bring a thorough understanding of the extensive public involvement program leading up to the initial 2008 Draft EIS, 2014 Supplemental Draft EIS and the 2016 Final EIS.

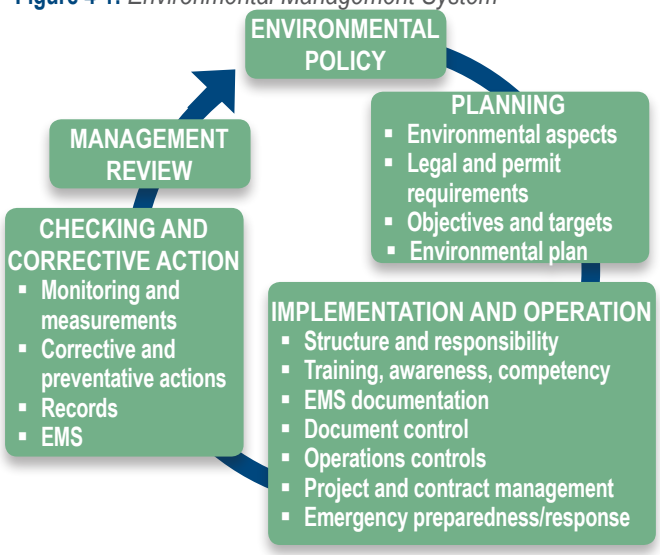
*Appendix M – Environmental Compliance Work Plan* (ECWP) describes our environmental management system (EMS) to assure we will exceed the environmental commitments in the Record of Decision and the requirements of *Schedule 17.* Our ISO 14001-compliant EMS is shown in Figure 4-1.

**Environmental Commitment.** Environmental awareness is a core value. Our management and environmental teams have the authority to stop any design, construction or operations and maintenance (O&M) process that fails to satisfy environmental compliance objectives and implement actions to ensure compliance.

### Our Environmental Philosophy

Environmental compliance is reflected in the design, delivered in the field and verified through inspection and documentation.

**Figure 4-1:** *Environmental Management System*




**Environmental Compliance Team.** Environmental Manager Jennifer Oshel will lead our environmental task force, provide day-to-day management and decision-making and be responsible for environmental program implementation and compliance. Her team includes the Mile High Constructors (MHC) environmental manager, recognized hazardous materials (RHM) manager, RHM health and safety officer and monitoring technicians.

Knowledge and individual ownership will ensure environmental compliance. All new employees and subcontractors will take environmental training discussing environmental regulations, mitigation and individual expectations.

### i. MANAGING HAZARDOUS SUBSTANCES

Our materials management plan, a component of the final ECWP, will provide complete procedures for proper personnel, requisite training, health and safety measures, sampling and analysis for the management of known and/or unknown and suspected contaminated conditions encountered during construction.

Based on the Limited Subsurface and Groundwater Investigation Report provided by CDOT and the Phase I Environmental Site Assessments (ESA), we engaged AMEC Foster Wheeler to assess and formulate an approach to the known soils and groundwater contamination on this site. Our primary approach to managing hazardous substances is to avoid or minimize the exposure through the design process such as raising the profile elevation of I-70 to minimize exposure to the groundwater table. When avoidance by design is not possible, our approach is a cost-effective design strategy for mitigation (such as our design of slurry or cut-off walls to reduce dewatering).

### Subsurface Soils Mitigation

**Appendix B Parcels.** Based on the information available, subsurface soils in Appendix B Parcels are anticipated to contain volatile organic compounds (VOC) and polycyclic aromatic hydrocarbons (PAH). Although we do not anticipate characterizing impacted subsurface soils as hazardous waste, the soil is contaminated and will be handled in accordance with Colorado Department of Health and Environment (CDPHE), CDOT and City and County of Denver (CCD) requirements.

**Non-Appendix B Parcels.** The Phase I ESAs indicate some parcels may be contaminated with VOCs, PAHs and lead; however, specific contamination locations were not provided. It is not anticipated the impacted subsurface soils will be characterized as hazardous waste, however we assume they are contaminated and shall be handled similar to Appendix B Parcels.

**Near Surface Soils.** Near surface soils are defined in the *Draft Beneficial Reuse and Material Management Plan* as those soils to a depth of one foot from Colorado Boulevard to the west for the entire length of the project. These soils are assumed to be contaminated with arsenic and lead and cannot be reused on site. They will be disposed of as contaminated, but non-hazardous soils at an appropriate landfill.

### Groundwater

Possible tetrachloroethene (PCE), related chlorinated VOCs, petroleum-related VOCs, total petroleum hydrocarbons (TPH) and metals may be encountered during construction dewatering operations (and through seepage of groundwater into the right-of-way during the operating period) that exceed surface water discharge criteria.

The organic compounds are present at low concentrations and are treatable using granular activated carbon (GAC) adsorption. The majority of the metals can be removed by cation exchange resin, however arsenic, selenium and uranium will require an anion exchange resin. Based on the combination of metals a mixed bed ion exchange system or chelating resin would be utilized to remove the metals. The design of an appropriate treatment system will require bench testing using actual site groundwater to evaluate the best metals removal approach.

### Unexpected Hazardous Substances

Regardless of the initial investigations, we will continue to diligently monitor on-site materials during excavation operations with qualified field representatives to ensure we are identifying and addressing the exposure of any unexpected hazardous substances. Field screening techniques will be used as potentially affected soil and groundwater media are exposed. If field screening indicates the presence of constituents of concern in the soil, grab samples will be collected for expedited analysis.

## ii. ENVIRONMENTAL COMPLIANCE WORK PLAN

The draft ECWP submitted in *Appendix M* and the supporting exhibits provide details for the information and approach summarized in this *Part 4.a*. The draft ECWP includes a description of the environmental compliance roles and responsibilities for the team. *Exhibit E-3, Ferrovial Environmental Core Processes* provides instruction on multiple topics such as risk prevention, energy management, hazardous waste management and demolition waste. *Exhibit E-4* provides the environmental permits matrix.

*Noise and dust control will be emphasized during construction. Left: team monitoring construction noise. Right: water application to control dust.*

## B. STRATEGIC COMMUNICATIONS

The Central 70 Corridor represents a diverse residential and business environment. Project Communications Manager Robert Hinkle will lead our communications team and work closely with Colorado Bridge Enterprise/ High Performance Transportation Enterprise's (the Enterprises) public information manager to implement a strategic communications approach, based on Schedule 14, that complies with the I-70 East Environmental Impact Statement. Our messaging will incorporate the overall framework provided by the Enterprises including the project vision, community benefits, express lane educational messages and how the project meets the transportation needs of Denver. Our communications team will coordinate with our construction and O&M teams to deliver timely, accurate communications to the communities, schools, traveling public, policy makers and businesses.

*Appendix J – Strategic Communications Plan* includes the construction period communications plan, the O&M communications plan and the crisis communications plan. The plan delineates the duties to be performed by the Enterprises, our communications team and all shared responsibilities.

### i. TWO-WAY COMMUNICATION

A successful project is often measured by the timeliness and transparency of communications about project status, and how quickly and thoroughly questions are addressed. We will work jointly with the Enterprises to develop critical messaging and outreach throughout the construction and operations phases. To ensure effective two-way communication is established and maintained, we will practice the seven core rules shown in Figure 4-2.

Our communications team will work with our construction and O&M teams on a daily basis, facilitating impromptu meetings to address real-time challenges. Robert will participate in weekly maintenance of traffic task force meetings. We will create a stakeholders technical advisory group to ensure timely information exchange.

### Commitment to Communications Readiness

We recognize the strategic significance of the project and will be ready to respond to stakeholders and the media immediately after award. MHP commits to making our project communication manager available within two weeks of commercial close.

**Coordination with Nearby Teams.** We will develop relationships with our counterparts working on other infrastructure projects planned for the area (e.g., National Western Center, RiNo development and projects along Brighton Boulevard). We will coordinate to ensure detours, closures and competing construction activities are well-planned and executed.

**Our Communication Commitments.** The overall message will inform and build support for the project, including the benefits of using a public-private partnership (P3). We are committed to:

- Engaging stakeholders in dialogue
- Creating an environment that encourages two-way conversation in English and Spanish
- Providing active and proactive communication with community members, Swansea Elementary School, businesses, and governmental agencies
- Placing an emphasis on cultural sensitivity for Globeville and Elyria-Swansea
- Providing the 1,200 businesses located within one-quarter mile with advanced construction information to plan customer access, deliveries and product shipments

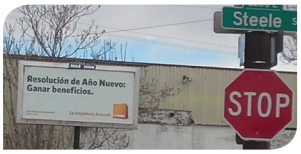
### Targeted Communications

We will undertake a planned and sustained approach to deliver outstanding service to the Enterprises and the many diverse groups along the corridor, including the Central 70 stakeholders on *Exhibit J-1*. We will select appropriate public information tools/methods for each group and situation (see Figure 4-3).

**Residents.** This environmental justice community includes bilingual, and in some cases, monolingual Spanish-speaking households in a tight-knit community, including the Elyria-Swansea neighborhood. The residents have

**Figure 4-2:** *Seven Core Rules for Public Involvement and Communication*

experienced the challenges of living in next to the interstate and demand accurate and timely project information in English and Spanish.




*Written and oral communication in both English and Spanish will be essential for an effective communications program.*

**Businesses.** This corridor is home to small businesses, and local and national industrial and warehouse companies that rely on a fully operational interstate to conduct commerce. They need reliable information they can count on, and contact information for quick resolution of any business concerns. Coordination with utility owners and railroads is discussed in *Part 6*.

**Institutions/Organizations.** Project stakeholders include the many state and local agencies, businesses and nonprofit entities that have a keen interest in a successful project outcome and the health and welfare of the local residents. Examples include local state patrol and police; emergency responders; local hospitals; chambers of commerce; schools; churches; neighborhood organizations; visitor/tourist destinations; railroads; special districts; Denver International Airport; and utility owners. Communication with this group will be targeted by organization.

**Schools.** Denver Public Schools and the parents, students, teachers and administrators of Swansea Elementary School, Garden Place Academy and Bruce Randolph School will require communications about safe travel (pedestrian and car) routes and drop-off zones, construction schedules and potential noise and dust impacts, for example.

**Traveling Public.** Our goal is to minimize impacts to residents, businesses and the traveling public. For example, we will reduce work zone impacts by providing advanced closure and delay information, allowing travelers to adjust plans to avoid delays and reduce traffic volume in the corridor. Social media, mobile apps and web alerts will be used for this group.

### Public Outreach Methods/Tools

Establishing and maintaining positive relationships with the community, media and stakeholders will be achieved by creating open lines of communication, and effectively distributing accurate information using tools such as those shown in Figure 4-3. All materials will adhere to the *Colorado Brand Guidelines* and will be submitted to the Enterprises prior to use. Our approach will be flexible and adapted to stakeholder requirements. All contact points will be tracked in our database.

## ii. NEW AND EFFECTIVE OUTREACH TOOLS

We identified new and effective public information outreach tools we will use to deliver timely and effective public information and outreach:

- Mobile apps
- Facebook Live
- Information kiosks
- Aerial drone photography
- YouTube videos

When the project reaches key milestones, we will capture the attention of the media and community with outreach and events to showcase the project's progress and reinforce the project vision. Potential milestones include:

- Ground-breaking ceremony
- Construction staging and deployment
- Viaduct demolition ceremony
- Major traffic shifts and opening of phases
- Excavation
- The halfway mark
- Completing the cover
- Ribbon-cutting ceremony

**Figure 4-3:** *Sample Communications Tools*

| PUBLIC/MEDIA RELATIONS | | PRINT COLLATERAL (BILINGUAL) | STAKEHOLDER MEETINGS |
|---|---|---|---|
| ▪ Project Website<br>▪ Web Alerts<br>▪ Social Media<br>▪ Email Subscription/Blasts<br>▪ Public Information Office<br>▪ 24/7 Bilingual Information Hotline<br>▪ Mass Media Outreach (radio, television, newspapers)<br>▪ Stakeholder Opinion Surveys<br>▪ Stakeholder/Community Interviews and Tours | ▪ Presentations<br>▪ Emergency Communications Plan<br>▪ Media Support<br>▪ Third-party Publication Articles<br>▪ Public Service Announcements<br>▪ Media Advertisements<br>▪ Highway Conditions Report System<br>▪ Dynamic Message Signs | ▪ Project Website<br>▪ Newsletters<br>▪ Fact Sheets<br>▪ Postcards<br>▪ Brochures/Mailers/Door-to-door fliers<br>▪ Public Opinion Polls/Surveys<br>▪ Travel Tips (for motorists heading to Denver Coliseum or the National Western Complex, for example, and the trucking industry)<br>▪ Media Kits<br>▪ Media Releases<br>▪ Lane Closure Reports | ▪ Open Houses<br>▪ Public/Community Meetings<br>▪ Elected Official Meetings and Tours<br>▪ Neighborhood Meetings<br>▪ Community Organization Meetings<br>▪ Area Business 1:1 Meetings<br>▪ Swansea Elementary School<br>▪ Denver Public Schools<br>▪ Denver Coliseum<br>▪ National Western Center<br>▪ Milestone Events |

## C. COMMUNITY DEVELOPMENT PROGRAMS

We enthusiastically support the infrastructure improvements, urban planning and social redevelopment goals in the Globeville and Elyria-Swansea neighborhoods. We will provide the programs required in *Schedule 15, Section 7*, and our commitment to *rebuilding, reconnecting and reuniting* goes further.

### APPROACH FOR PROGRAM IMPLEMENTATION

We will establish a community program fund of $500,000 during the construction period and $1.6 million during the operating period to invest in community programs. We will build a temporary or permanent pedestrian bridge at York Street/ UPRR in collaboration with CCD. *Appendix L, Exhibit L-1 – Community Development Program*, describes the approach to the requested programs and provides a menu of additional programs. Figure 4-4 summarizes additional program concepts. We will involve stakeholders in the selection of the community programs.

### Local Business Assistance

We will help local restaurants, food vendors, food carts and catering businesses position themselves to provide services to the construction teams. Described in *Part 4.D* on the next page, we will also provide opportunities for firms to participate in all phases of the work.

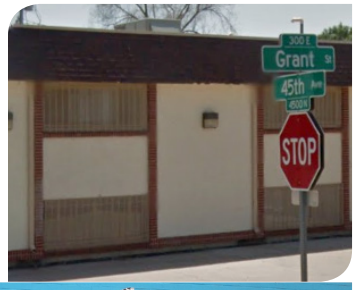
### Swansea Elementary School

- **College Scholarship Program.** We will establish a college scholarship program for students of Swansea Elementary School.
- **Construction Education.** We will fund a construction education curriculum modeled after the successful science, technology, engineering and math (STEM) programs implemented on the LBJ Express and North Tarrant Express Segments 1 and 2.

*One idea we would like to pursue is to preserve some of the art murals under the viaduct with a poster program, capturing the images before demolition.*

- **Safety Program.** We will implement a safety education program for teachers, parents and students to help them understand how they can stay safe near construction.

*Renovation of recreational centers is one idea for community investment, such as Globeville Community Center (top) or Swansea Park Recreational Center (bottom).*



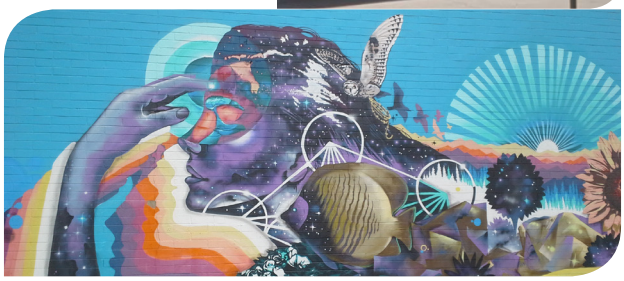



**Figure 4-4:** *Additional Community Development Concepts*

| | |
|---|---|
| 1 | **Community and Workforce Development**<br>*Historical Preservation*<br>History Museum of Globeville, Elyria and Swansea<br>History Colorado<br>*Affordable Housing*<br>Urban Land Conservancy<br>*Education*<br>Partnerships with scholarship organizations, colleges and trade schools (Community College of Aurora, Front Range Community College, Auraria Higher Education Center, Emily Griffith Technical College)<br>*Other Programs*<br>Focus Points Family Resource Center, the Growhaus, community/school gardens programs |
| 2 | **Street Improvement and Enhancement**<br>Improve 46th Avenue<br>Renewal of bus stops<br>Plant trees in neighborhoods<br>Improve street lighting |
| 3 | **Parks and Landmarks**<br>Swansea cover and surroundings – mural wall, gateway sculpture, benches, botanical gardens<br>Pocket park – 41st Street and Monroe |
| 4 | **Recreation Center Renovation**<br>Globeville Recreation Center<br>Colorado Miners Community Center<br>Swansea Recreation Center |
| 5 | **Bike Lane Construction**<br>Swansea Recreation Center/Swansea Park to Swansea Elementary School and to Colorado Miners Recreational Center<br>Globeville Recreation Center to Garden Place Elementary School |

## D. SMALL/DISADVANTAGED BUSINESSES

We will consistently foster and implement strategies to enhance diversity. We will support the CDOT disadvantaged business enterprise (DBE) program to ensure nondiscrimination in the execution of the project in compliance with *Schedule 15. Appendix K – Small and Disadvantaged Business Participation Plan* includes our initiatives and processes to facilitate participation by DBE and emerging small business (ESB) firms and help position them to compete on future infrastructure projects. We commit to exceeding the goals shown in Figure 4-5.

### ORGANIZATION, ROLES, RESPONSIBILITIES

As shown in Figure 1-2 on page 4, our civil rights program manager (CRPM) is responsible for implementing, managing and reporting on our civil rights program delivery. Angela Berry-Roberson is a nationally recognized expert with more than 20 years of experience in civil rights program management and has managed similar programs for the LBJ Express and North Tarrant Express Segments 1 and 2 (NTE 1&2). Angela and her team will work with our procurement, construction, design/technical, O&M teams to help them identify and subcontract with DBE/ESB firms. Other civil rights team roles include:

- Working closely with CDOT's Office of Civil Rights and its supportive services consultants
- Being visible in the project community, attending meetings and events involving small and diverse firms to encourage participation

### APPROACH FOR ACHIEVING GOALS

Based on the results and best practices learned on previous design-build and P3 projects (Figure 4-6), we will exceed the DBE/ESB goals (Figure 4-5) by project completion.

**Figure 4-5:** *DBE/ESB Goals*

| SERVICES | ESB | DBE |
|---|---|---|
| Design | 3% | 11.6% |
| Other Construction Work | 3% | 12.5% |
| Routine Maintenance | 3% | — |

**DBE/ESB Capacity and Participation Areas.** Through our outreach and research, we identified a sufficient number of ready, willing and able firms to confidently forecast DBE/ESB participation that meets or exceeds the goals. Our team currently includes two DBE members: Othon (member of lead engineer joint venture) and Linda Wilson Group (communications and public relations consultant). Maxx Impact Group assisted with diversity outreach during the proposal process. *Appendix K, Section 2* and our website identify potential areas for DBE/ESB subcontracting.

### Approach to Engaging DBE/ESB Firms

In January, February and March 2017 we conducted outreach events (a project overview, one for design/professional services and another for construction/O&M). We talked with more than 190 local firms and conducted one-on-one sessions — especially with DBE and ESB firms — about opportunities. Our web-based vendor registry at i70milehighpartners.com has been operational and collecting information from interested firms for more than a year.

*During 2017, more than 300 attended our DBE/ESB outreach events representing more than 100 firms. Local resources for certification and project bonding also attended.*

**Databases.** We will solicit DBE/ESB firms and other potential DBE/ESB firms using information available from our website registrants, CDOT, CCD, Colorado Unified Certification Program and other local vendor databases such as www.coloradodbe.org and www.coloradoesb.org.

**Advertising and Events.** We will advertise project opportunities and information in local and statewide media. We will participate in local DBE/ESB/diversity events including CDOT professional services and construction forums, and events hosted by Connect2DOT, local contractors and transportation and minority

**Figure 4-6:** *Examples of DBE Performance*

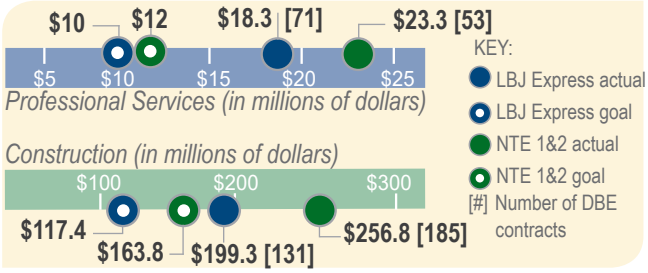


**Figure 4-7:** *Approach to Engaging DBE/ESB Firms*


associations (e.g., Black Construction Group, Hispanic Contractors of Colorado, Mountain Plains Minority Supplier Development Council and others in *Appendix K)*.

**Tools.** Figure 4-7 summarizes our three-step approach for achieving DBE/ESB participation.

### Solicitation Approach

We will integrate DBE/ESB participation into the project as the design, construction, and O&M packages develop. We will expect our major subcontractors to meet the goals. We will also:

- Assist firms in obtaining DBE/ESB certification and CDOT prequalification
- Develop selected packages for DBE/ESB firms
- Provide interested firms with adequate information in a timely manner and follow up
- Negotiate in good faith with DBE/ESB firms
- Conduct pre-start orientations to familiarize subcontractors with the site, contract requirements and our expectations

## COMPLIANCE, MONITORING AND REPORTING

Stringent monitoring and record-keeping will substantiate success. We will track our progress toward exceeding the contract goal in the monthly DBE progress report and other required annual, semi-annual and five-year reports. We will maintain effective documentation and consistent compliance monitoring including: good faith efforts, commitments, commercially useful function reviews and small business commitment modifications, if necessary.

## DEVELOPMENT AND ASSISTANCE

**Prompt Payment and Invoicing.** Payment and cash flow can be a challenge for many small businesses. As needed, we will use proactive payment initiatives such as accelerated payment schedules and providing payments before we get paid. We will use our customized B2Gnow vendor and diversity compliance software for consistent tracking of DBE/ESB commitments and payment data for accurate reporting.

**Assistance with Bonding and Insurance.** We will work with the U.S. Department of Transportation's Surety & Fidelity Association of America Bonding Education Program managed by the local Small Business Transportation Resource Center (SBTRC), as we have on several other projects. This program helps with subcontractor preparedness, especially bonding. The local SBTRC attended our Denver outreach events and agreed to work with us as a strategic partner on this project. We will also offer initiatives such as our flexible bonding for small businesses (requiring bonding for portions of the work, instead of the whole scope) to increase participation of DBE/ESB firms with our team.

**Small Business Training and Development.** We will implement training and effective mentor-protégé initiatives that facilitate increased capacity for DBE/ESB firms. Our small business capacity building mentoring program will help DBE/ESB firms develop a good understanding of their work, including schedule, performance and administrative requirements. Our practice is to establish mentoring relationships for DBE/ESB subcontractors with our team members and major subcontractors to educate, provide opportunities and build capacity of their firms.

*"SEMA gave us our first big opportunity as a minority-owned, small business on the C-470 at Alameda Parkway project. Their staff helped instruct us how to prepare invoices and how to manage our insurance requirements."*

*—Carmen Villalobos*
*Villalobos Concrete (DBE, ESB, SBE)*

## E. WORKFORCE DEVELOPMENT

Our objective is to create job opportunities that become a pipeline for career development and workforce stability on our project and throughout the greater Denver area. *Appendix L – Workforce Development Plan* outlines our approach that complies with *Schedule 15*. We will develop workforce programs and collaborate with local organizations and educational institutions to turn

unskilled or semi-skilled people who may also lack work experience into productive workers.

We are committed to exceeding the on-the-job training (OJT) and local hire goals for the construction period. We will target individuals in communities along the Central 70 alignment, as well as those who have experienced significant barriers to employment, such as military veterans. Our approach provides job creation, skills development, and social and economic growth opportunities.

### Key Initiatives

Our program key initiatives include:

- Create local skills training and technology transfer programs that maximize post-project employment opportunities
- Develop local workforce skills, craft skills and life skills (such as language, literacy, financial management)
- Provide educational programs and internships for local students that expose them to the industry, give hands on experience and demonstrate the practical application of STEM
- Leverage programs that transition non-traditional persons such as veterans through the Helmets to Hardhats program

## i. and ii. ACHIEVING THE GOALS

We will achieve the OJT and local hiring goals shown in Figure 4-8. Our recruitment and training strategy will be regularly assessed and refined as the packages, schedule and final scope develop. All subcontractors will be required to make best efforts to meet or exceed the goals.

### Recruiting Plan

Our commitment to providing meaningful, career-oriented work opportunities will be reflected in our aggressive recruiting plan. We will conduct a series of project-specific events, collaborate with approved workforce development organizations,

**Figure 4-8:** *OJT and Hiring Goals (in employment hours)*

| | SERVICES | OJT | LOCAL HIRING |
|---|---|---|---|
| Construction Period | Design Services | — | 760,000 total with 380,000 performed by new hires |
| | Other Construction Work | 200,000 | |
| | Routine Maintenance | — | |
| Operating Period | Routine Maintenance | — | — |
| | Renewal Work | To be established for each contract year | — |

### Multi-lingual Recruiting and Supervision

We estimate approximately 80 percent of our workforce will be Hispanic. Our website and employment applications will be in both English and Spanish. We will assign construction managers and foreman who are also proficient in Spanish (and other languages as required) to facilitate communication and clear direction.

contact local community groups such as churches and neighborhood/home associations, and participate in local job fairs. Candidates in our database of potential workers will be matched to specific training and employment opportunities.

**Online Resources.** The customized job portal at i70milehighpartners.com will include an easy to use, online application (in Spanish and English). The job portal is a one-stop shop for local residents seeking project employment — it will offer job postings from MHP and subcontractors.

**Outreach Events.** We will host and participate in job fairs (e.g., Associated General Contractors [AGC] Construction Career Now), volunteer to instruct trainings held by our team or local programs and initiate contact with potential craft persons through a myriad of options including secondary and vocational schools. Our goal is to heighten awareness of employment opportunities and entry requirements to attract workers.

**Advertising.** We will post job openings with our employment partners (CDOT-approved workforce development organizations) at least seven calendar days before advertising through other sources such as local media, construction periodicals, social media and our own website.

**Subcontractors.** Achieving the workforce goals is a project-wide initiative and all subcontractors will be required to participate. We will provide training to all firms about the expectations and strategies for meeting the project workforce goals.

**Local Agencies and Workforce Development Centers.** Our robust outreach will include local agencies, community partners and educational institutions to leverage notification of events, training and job opportunities. *Appendix L* includes an extensive list such as Center for Women's Employment and Education, Denver Works!, the AGC, Colorado Contractors Association

(CCA) Build Colorado program and Veterans Administration Community Workforce Training.

### 400 Scholarships Commitment

We will provide 400 scholarships to the AGC/CCA Build Colorado program for Globeville, Elyria-Swansea and surrounding area residents during the construction period.

**Local High School Programs and Internships.** We will integrate construction- and STEM-focused secondary and post-secondary schools, including all four Denver School of Science and Technology locations and the Colorado Construction Institute, into our recruiting plan. We will coordinate and participate in programs such as the Denver Public Schools' Career Connect and Arrupe Jesuit's Corporate Workforce Program, and provide project internships.

### On-the-Job Training

We will provide employment training, assessment placement and ongoing outreach to offer job seekers the tools to build better lives and more sustainable communities. We strive to reach beyond just the entry of low-income individuals, minorities and women in construction to creating career opportunities and long-term employment.

**Training Programs.** We anticipate training in more than a dozen categories and using the local training programs for iron workers, equipment operators, cement masons and skilled laborers, among others. The minimum length and training descriptions will be based on local apprenticeship programs as established prior to notice to proceed 1. Project-specific curriculum will be developed by our subject matter experts. We will also engage other agencies and their established training programs such as CCA apprenticeship and AGC's Construction Career Now initiative.

**Monitoring, Records and Reporting.** We will maintain records for the workforce goals, including the local hiring residency requirements. We will review performance and projections to stay on course. Anytime we need additional efforts, we will meet with hiring managers (including subcontractors) and help them identify positions and candidates. We will meet regularly with the Enterprises and provide the required monthly, semi-annual and annual reporting and forecasts.

**OJT Helper Training.** As an enhancement to the required OJT program, we will establish an OJT Helper program for the project (described in our plan). The helper training starts with remedial trade and life skills training (reading, listening, teamwork, etc.) and a basic training curriculum including a safety class. This OJT program would provide continuing skill development for incumbent craft workers.

### Local Hiring Plan

We will focus our recruiting and outreach efforts to attract workers from the impact target area identified by the Enterprises in the local hiring goals and document eligibility for current, former or displaced residents. We will establish a project recruitment office in the target area for project hiring activities of MHP and our subcontractors.

**Compliance – Residency Requirements.** We will submit the required documentation to the Enterprises for each local hire including a completed enrollment form and self-certifying residency disclosure and additional documentation required on a case-by-case basis.

**Barriers.** We will identify barriers or gaps in workforce entry readiness and address them. For example, we will partner with an organization to provide English as a second language to feed into our program.

- **Employment Barriers.** We anticipate we will need to address barriers such as literacy deficiencies, child care needs, transportation or financial constraints.
- **Graduation Barriers.** We will continue to support the underrepresented, low-income and displaced workers throughout their training to address barriers that may impact their ability to complete the program.
- **Permanent Placement.** We will provide incentives for subcontractors who place program graduates and will assist graduates with other placement opportunities.

### Affirmative Statement

No existing employees on our team or any subcontractor will be displaced or have their employment terminated as a result of the local hiring goal.

Our intention is to provide opportunities for careers, not just jobs!

Volume 2

# 2.1.6. Part 5: Operations and Maintenance

# 5 Operations and Maintenance Management

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *We strive to provide customers with the safest and most efficient highway in Colorado. We know how to plan and implement effective operations and maintenance (O&M) programs that are preventative, proactive and focused on the user experience. Our long-term strategies will provide lasting benefits for the community.*

## A. OPERATIONS MANAGEMENT PLAN

### i. MEETING OPERATIONS OBLIGATIONS

Our approach to operations management is to leverage our experience and ISO-compliant best practices (used for operating concessions in the U.S. and our global portfolio) to self-perform the work. This strategy eliminates the risk of default by third-party contractors, and provides better quality control and competitive pricing. *Appendix H – Operations Management Plan* provides the procedures that will deliver results that comply with *Schedule 11*.

Starting at notice to proceed 2 (construction period), O&M Manager Jason Sipes, PE, will build and lead a local team of supervisors, technicians and subcontractors to satisfy the performance requirements. The on-site team will be supported by Cintra's 15-person technical department — the highly specialized corporate O&M experts located in Austin. The corporate knowledge-sharing program includes weekly and monthly communications and a continuing education program that brings together all concessions to share best practices and discuss O&M innovations. The O&M team will have access to Cintra's worldwide concessions performance data to apply lessons learned from years of successful, global O&M experience.

#### O&M Quality Management

Quality for our O&M will be established, monitored and maintained through an ISO-compliant quality management system.

**Figure 5-1:** *Right First Time Delivery*


*Appendix I, Exhibit I-4 – O&M Quality Management Plan* establishes our self-monitoring process and focus on "Right First Time Delivery" (Figure 5-1).

#### Unique Features that Exceed the Requirements

- Cintra's O&M technical department – facilitates O&M and life-cycle best practices
- Global benchmarking – shortens the learning curve for Central 70 decisions
- One O&M team for both construction and operating periods – delivers synergies and lowers transition risk
- Design and construction manager and engineer – O&M team staff working with the design-build team to consider life cycle factors (e.g., durability and maintainability)

Reporting to our O&M manager, our O&M analyst is functionally independent from the maintenance, traffic management and field systems and will provide quality assurance for the O&M work (both in-house and subcontracted). Our corporate quality team from Madrid will audit annually to further refine and improve our performance.

#### a. Operations Organization and Management

Our O&M organization is shown in Figure 1-2 on page 4. O&M Manager Jason Sipes, who has significant experience managing maintenance on the lowered section on the LBJ Express, will lead the O&M organization in all phases.

#### b. Operations by Phase

Our O&M team (not our construction team or a separate construction-period subcontractor) will provide the O&M services for all phases — from notice to proceed 2 through handback. We will provide the skilled O&M team, with the right equipment, training and oversight to provide year-round roadway operations consistent with standard highway management practices and the contract requirements. We are long-term O&M partners from day one.

#### O&M Quality Recognition

In 2009, 407 Express Toll Route received the President's Award for Excellence, granted by International Bridge, Tunnel and Turnpike Association, considered the highest accolade in the concession industry.

**Construction Period.** Sixty days prior to notice to proceed 2, O&M Manager Jason Sipes will meet with the Colorado Department of Transportation (CDOT) to coordinate the hand-off of the existing roadway maintenance. We will discuss the baseline asset condition, time line and independent inspections. We will inform the cities and emergency responders along the corridor of the maintenance transition and provide our 24-hour response number.

Our O&M team includes a design/construction manager and a design/construction engineer who will actively engage with the design, environmental, construction and quality teams during the construction period to ensure integration of life-cycle and other O&M priorities. The O&M team will actively participate in the design review process and conduct thorough inspections before substantial completion and identify any deficiencies in a punch list.

**Operating Period.** We offer a seamless transition between phases — our construction-period O&M manager and team will accept the facilities and be responsible for them during the operating period. Our solution avoids potential loss of knowledge that occurs when a new contractor takes over the facilities. Our construction period O&M records, audits and asset assessments will be in our electronic document management system. We will have established relationships with CDOT and the adjacent facility teams and will continue to use our approved protocols, as applicable. During the operating period, the O&M team will be responsible for corridor management, including access control.

### c. Maintenance Facilities

We will use the CDOT maintenance facility yard near Havana Street for the contract term as permitted under the *Project Agreement*. We will place a modular office building (in a location that does not impact the ultimate configuration of the new interchange) to provide offices for the maintenance manager, maintenance technicians and patrollers.

*Left: potential administrative office at 425 Havana Street. Right: Havana Street maintenance yard (modular office in yellow).*

The existing maintenance building will be used as a repair shop and for parts storage. Consistent with winter maintenance best practices, we will provide an environmentally contained area to wash down salt trucks. The picture below shows the yard layout, which is generally unchanged.

### d. Maintenance Resources

As shown in *Appendix I, Section 1t – Transition of Maintenance to Developer*, we will perform certain activities in-house such as debris removal, pothole repair, joint seal repair, culvert silt removal, graffiti management and mowing. We will subcontract for all renewal specialty work and some maintenance tasks. When practical, we will hire firms used by CDOT to maintain corridor consistency.

## ii. ROBUST OPERATIONS AND RISK MITIGATION

We based our staffing levels on a careful review of the requirements, adjusted to reflect benchmarks data available from similar concessions. Our plan is to assign two shifts to the traffic management center and 24/7 field operations teams. When needed, our supervisory personnel can assist in the traffic management center. We will subcontract to supplement the field operations.

**Redundant Resources**

We will subcontract with more than one firm (possibly DBE/ESB) for on-call services such as hazardous materials clean-up to ensure we have expedient resolutions for every incident.

**Risk Assessment.** Figure 5-2 on the next page summarizes risks and our mitigation strategies.

## iii. PERFORMING OPERATIONS

### a. Safety

Our company-wide zero accidents goal is evidence of our "safety first" culture. Our policies focus on protecting the public, employees and subcontractors from harm. We will implement our *O&M Safety Plan* (*Appendix I, Exhibit I-3*) that describes how to perform our work safely, efficiently, and in compliance with the Occupational Safety and Health Administration standards. We will train supervisors and employees and reinforce safe practices with safety incentives, safety inspections and regular meetings such as toolbox safety meetings, job hazard analysis and daily safety pictures.

**Figure 5-2:** *Challenges, Solutions and Mitigation Techniques*

| CHALLENGE | SOLUTIONS AND MITIGATION TECHNIQUES |
|---|---|
| **Operations of the Corridor and Meeting Performance Criteria** | ▪ *Comprehensive O&M Program* – establishing protocols, procedures and guidelines to provide quick incident response times, maximize lane availability at all times and high O&M performance standards<br>▪ *Minimal Third-party Risk* – MHP retains full responsibility of O&M works, eliminating third-party default risk<br>▪ *Vast Historic Experience* – effective application of technical expertise and experience, based on successfully operating highway projects across North America and around the globe<br>▪ *Interfacing with Adjacent Operators* – lessons learned from other Cintra-operated concessions will enable MHP to proactively meet with CDOT, adjacent operators, counties to establish communications protocols |
| **O&M of Covered and Lowered Section** | ▪ *Specialist Support* – experience operating lowered highway sections (e.g., LBJ Express) and global experience in tunnel operations will bring value to the successful O&M of the lowered section |
| **Snow and Ice Control Services** | ▪ *Robust Strategy* – providing the right type and fleet of equipment, with sufficient spare parts and materials for winter operations; additional trained winter operators will be hired during each winter season to support snow and ice control and traffic control operations<br>▪ *Severe Weather Conditions O&M Experience* – best practices and know-how readily available from Cintra's 17 years experience in snow and ice operations in severe winter conditions comparable to Colorado |

**Accident Investigation and Prevention Studies.** During design, we will use historical data from CDOT and our concessions to identify potential accident "hot spots." We will integrate potential solutions into our design (shown on Figure 6-1 on page 41) and operations protocols.

**Vehicular Accident Pattern Analysis.** Throughout the operating period, we will perform traffic data collection and vehicular accident patterns analysis to develop and implement solutions that continuously enhance the safe operation of the corridor and help save lives. For example, we will implement a wet accident reduction program in areas with a high occurrence of wet accidents that includes friction testing and solutions such as patching mill and fill, and texturing.

**Swansea Elementary School and Community Safety.** We are committed to maintaining safe paths for the families, businesses and public in the corridor. Because Swansea Elementary School is very close, we will implement strong safety messaging, working with the school, teachers and students to impress upon them the need to always "Stay Alert, Stay Safe."

### Safety Design Elements Exceed Requirements

Our design and construction teams will include additional safety features that will be maintained by our O&M team:

- Smart cushion attenuators at complicated intersections
- Additional wayfinding signage for landmarks such as fire stations, hospitals, schools, the National Western Complex and the Denver Coliseum
- Six-inch pavement striping at exit ramps
- Rumble strips on ramps with limited breaking distances
- Wrong way detection signs at some ramps

## b. and c. Emergency/Incident Management

Our O&M teams consider, plan, address and train for all likely natural and man-made events or situations. We will staff the traffic management center 24/7 and have courtesy patrol on the highway for earlier detection and quick incident response. We will work with the Colorado Bridge Enterprise/High Performance Transportation Enterprise (the Enterprises) and Denver Regional Council of Government to meet the national unified goals eighteen strategy points. Management and workers will take the web-based National Traffic Incident Management Responder Training Course delivered by the Federal Highway Administration (FHWA). Hazardous weather conditions, traffic incidents and other road safety alerts will be displayed on dynamic message signs and information disseminated via websites and social media networks.

*We have experience with severe snow and ice conditions as seen here in this 407 Express Toll Route snow removal brigade.*

**Snow and Ice Control Plan.** Our objective is to maintain a safe and reliable highway system and a high level of service. *Exhibit H-1: Snow and Ice Control Plan* describes our approach including:

- Pre-winter season kick-off meeting with CDOT
- Dawn and storm patrols
- Weather monitoring and roadway weather information system (RWIS)
- Reduced environmental impact by using precise product application protocols
- Off-season preparation for fleet and team readiness by late September

### Incident Response Experience and Times

CORA exempt materials redacted for the Public Disclosure Technical Proposal.

**Incident and Emergency Response.** *Appendix H, Exhibit H-2 – Incident Response Plan* identifies the personnel and procedures for managing roadway incidents, governor-declared emergencies, natural hazards, severe weather or other major situations. We will provision rapid-deployment emergency equipment with arrow boards, emergency signs, traffic control devices for detours, absorbent materials for minor spills, first-aid kits and safety flares. Our enhanced closed circuit television camera placement in complex interchanges will help with incident identification, dispatching and monitoring. Figure 5-3 summarizes our response process.

**Cover and Lowered Section Event Response.** Preparation will include training our team and emergency responders for closing traffic lanes and evacuating people from the cover and Swansea Elementary School. We will model a tabletop exercise after the one we conducted for the depressed section of the LBJ Express that includes the cover maintainer, first responders and other local authorities. Conducted prior to facility opening, the team runs different emergency scenarios (e.g., tank spill, fire under the cover area) to plan response protocols including evacuation.

## d. Interfacing with Authorities

**Toll System Operator and Colorado Transportation Management Center (CTMC).** We will work with CDOT and the tolled express lanes operator to achieve full system functionality and user satisfaction. We will communicate issues and solutions through project meetings, monthly reports, written updates and priority issue alerts. Co-location in our administrative offices and the CTMC will facilitate communication.

**Neighboring Facilities.** We will coordinate with teams on neighboring facilities — I-25, I-76, I-270, I-225, Business Loop 70, Denver International Airport, I-70 segments connecting to the Central 70 project and local roads — to establish inter-operator plans.

**Utilities.** We will coordinate with utility companies who wish to work in the corridor, verify they have the proper approvals and monitor their traffic control implementation. Where practicable, we will provide access during scheduled lane closures to minimize impact on the public.

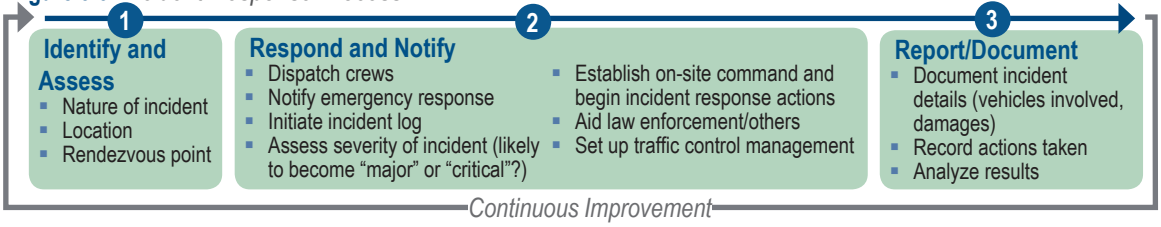
## e. Traffic Management and Lane Availability

Routine maintenance activities will be combined and undertaken within a single lane closure or rolling lane closure when possible, and considered at off-peak times. A traffic management plan will be implemented to mitigate O&M-related impacts. All work will be planned in advance to minimize traffic obstructions, public inconvenience and lost work time. We will keep the public informed with traffic advisories issued through online, dynamic message signs and traditional media outlets (see *Appendix J – Strategic Communications Plan, Section 6*). Access to public and private properties will be maintained.

**Personnel Safety and Flaggers.** All crews working around traffic will wear personal protective equipment including hard hats, safety glasses, gloves and reflective vests. Flaggers will be trained to slow or stop traffic where required for the protection of workers and the public.

**Traffic Control Inspection and Documentation.** We will conduct inspections of all traffic control operations and document findings in written and photographic records. Any required corrections will be documented, communicated and tracked through implementation.

**Figure 5-3:** *Incident Response Process*



### f. Courtesy Patrol Services

As described in *Appendix H, Exhibit H-3 – Courtesy Patrol Service Plan,* we will patrol to quickly detect incidents, minimize incident duration, rapidly restore freeway capacity, reduce secondary crashes and responder safety risks. The fleet of two dedicated tow trucks and two motorist assistance trucks will provide motorist assistance and move disabled vehicles to the shoulder or an appropriate drop site. We will subcontract with local firms for additional capacity and oversized vehicle towing.

### g. Performance Monitoring

We will maintain a high standard of service and customer satisfaction while meeting the performance requirements.

**Monitoring Performance and Availability through Inspections.** We will conduct routine and specialist inspections to determine asset conditions, document findings and use the information to inform our O&M activities (see Figure 5-3).

**Using Asset Management Tools.** Our asset management tools provide an efficient, integrated approach to performance monitoring, reporting and O&M planning. Software elements include:

- ***Toll Highway Operating and Reporting System (THORS)*** **–** cost management tracking by asset element, allowing benchmarking and more-informed budgets and work plans
- ***GIS-based Integrated Asset Management System*** **–** includes asset condition and work order management processes
- ***Maintenance Online Management System (MOMS)*** **–** automatically detects issues and generates work orders for intelligent transportation systems elements

**Internal Audits and Management Reviews.** We will perform audits to control and monitor quality and environmental compliance for O&M activities. Our corporate audit team will also conduct audits and inspections, providing another layer of oversight. In addition, we propose to engage an independent party to conduct corporate social and environmental governance audits and identify areas for improvement.

### h. Groundwater Dewatering

**i Methodology.** Because a portion of I-70 will be lower than the water table, it is expected that a small amount of groundwater incursion is anticipated during the operating period. We will monitor the collection point, secure all environmental approvals, sample and treat water from the collection system as necessary, and pump it into the stormwater system.

**ii Environmental Approvals Required.** We will obtain and comply with discharge approvals including:

- Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) Colorado Discharge Permit System and Stormwater Permit program, including preparation of a specific stormwater discharge permit (if required)
- CDOT's existing stormwater discharge permit (Permit No. COS000005)

We will also prepare and implement a substitute water supply plan if required by Colorado Division of Water Resources.

**iii Minimizing Dewatering Quantities.** We optimized the design to reduce the depth of the lowered portion, minimizing penetration below the water table. In addition, the permanent retaining walls of the lowered section will be embedded in bedrock as described in *Part 6, Section P.iii – Minimizing Dewatering Quantity*. These design features will reduce the amount of groundwater seepage during the operation period.

## B. MAINTENANCE MANAGEMENT PLAN

We will self-perform the management of the routine maintenance and renewal of required assets. Our approach to successful maintenance services includes a robust asset management system, an effective maintenance organization with access to an extensive equipment fleet, and a structured long-term rehabilitation program supported by a comprehensive inspection and condition monitoring program. Our approach is detailed in *Appendix I – Maintenance Management Plan.*

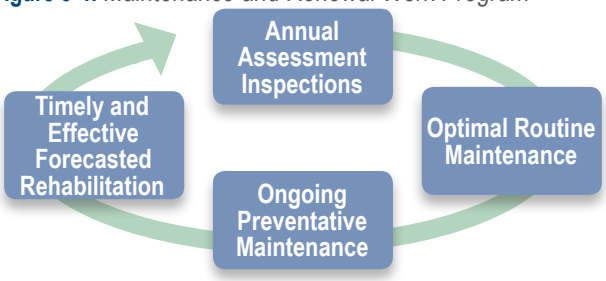
### i. MAINTENANCE ORGANIZATION

The organization chart shown in Figure 1-2 on page 4 provides the full O&M organization for both the construction and operating periods.

### ii. APPROACH TO MAINTENANCE

Our maintenance manager and supervisors will identify preventive and/or reactive maintenance

**Figure 5-4:** *Maintenance and Renewal Work Program*




activities to plan and schedule the work. All records will be maintained in the electronic document management system. If desired by CDOT, we are available to provide auxiliary maintenance support such as snow and ice removal on frontage roads and connecting ramps.

## iii. ROBUST STRATEGY AND KEY RISKS

Our strategy is to staff for expected requirements (based on similar operations) plus redundant resources in place and on call, and the ability to pull workers from one shift to another. For example, we will issue several subcontracts for on-call hazardous material clean-up. Figure 5-2 summarizes key risks and mitigation strategies.

## iv. ROUTINE MAINTENANCE/RENEWAL WORK

Best practices indicate proper road preventive maintenance contributes to fewer accidents and a better user experience. Remedial and routine maintenance of the maintained elements will meet or exceed requirements of the contract; renewal work will prolong asset life.

### a. Assumptions

Our overall goal is proper maintenance of each component, cost-efficiently extending useful life, and ensuring all assets meet performance and handback requirements. A transfer of asset information from the construction building information model (BIM) to the maintenance management information system (MMIS) will facilitate a well-coordinated routine maintenance and renewal work plans (shown in Figure 5-4).

### b. Sweeping, Cleaning and Debris Removal

Our routine maintenance includes:

- ***Drainage Systems*** **–** monitor inlets, outfalls, culverts and pipes to remove blockages; trim grass and vegetation
- ***Litter Removal*** **–** conduct regular roadside cleanup and special "black spot" cleanups in areas known for heavy litter accumulation
- ***Graffiti Removal*** **–** remove graffiti as soon as practical (considering safety and traffic management factors); expedite removal of offensive graffiti
- ***Recycling Program*** **–** recycle tires, metal and other debris picked up, along with waste generated by maintenance activities (concrete, asphalt, gravel, plastics)

### c. Inspection and Testing

Maintenance inspections are conducted on a frequency shown in Figure 5-5. These inspections can be subcontracted or performed in-house. We will augment our inspections with unmanned aerial vehicles (drones) to provide better quality and depth of information, extra inspections and improved inspector safety.

### d. Identification and Rectification of Defects

*Appendix I, Section 1i – O&M Defects* includes a detailed process for routine and audit inspections used for identifying, classifying (Category 1 or Category 2) and rectifying defects in the infrastructure assets within the time limits required in the contract (see Figure 5-5).

**Figure 5-5:** *Steps for Inspection, Identification and Failure Correction*

**1 - ASSESSING INSPECTIONS**

- Daily – visual inspections from daily roadway inspection routes to identify obvious hazards or category 1 defects
- Monthly and Semi-annual – assigned teams inspect roadway elements such as selected auditable sections and drainage inspections; MSE walls inspected every 6 months
- Detailed – monthly O&M manager inspections of pavement, structures and road assets to identify defects
- Quarterly Audit – O&M manager inspections of selected auditable sections, all elements within each auditable section are inspected (with specialist inspector at least annually)
- Specialist – performed on structures and bridges, electrical (signals, communications) and roadway pavement condition (using automated survey equipment)

**2 - PERFORMING COMPLETE INSPECTION FORMS**

- Complete inspection forms including photos, date and GPS location of any defects
- Attain supervisor observations and concurrence
- Initiate repair log and work order

**DISPATCH MAINTENANCE TEAM**

- Conduct repair, debris removal from culverts, etc.
- If temporary fix, schedule permanent repair

**3 - DOCUMENTING CLOSE-OUT**

- Submit completed work order
- Attain supervisor observation and concurrence
- Analyze results, close out work order, update repair log, document actions in MMIS
- Perform quality review

*Continuous Improvement*

### e. MMIS

The MMIS will ensure efficient data collection and meaningful reporting. Key components include inventory management, maintenance tracking, work scheduling/work load balancing and budgeting. The system will generate work orders, reports and a maintenance budget based on historic costs. Hand-held devices will be used in the field for conducting inspections, creating and completing work orders, and more. We will integrate data for existing assets using Element ID or spatially based asset location software.

## v. RENEWAL WORK

A clearly delineated renewal work program is fundamental to project success. As a result, our expectations for the long-term performance of the infrastructure are high, and we will use performance specifications with warranty requirements to help ensure these expectations are met. Figure 5-6 shows our preliminary renewal work schedule.

### a. Life-cycle Considerations

Our O&M experts have been engaged in the proposal. The ongoing involvement of the O&M team during construction (including the design/construction manager and engineer) results in a renewal work plan based on a thorough knowledge the installed facilities. Our O&M will continue to review the design and equipment/material selection to achieve a design that reflects constructability, energy efficiency, durability, serviceability and long-term reliability.

### b. Rolling Maintenance Program

Work that includes maintenance, repair, reconstruction and replacement of each applicable element will be identified and scheduled in an annual renewal work schedule and a rolling five year renewal work schedule to be updated annually. The plans will include budgets and a schedule of the associated road closures expected.

### c. Critical Structures

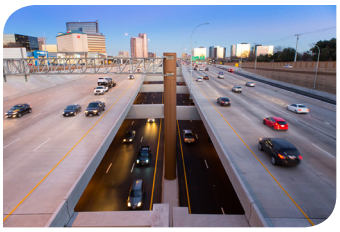
The *Baseline Asset Condition Report* documents the initial inspection of the existing corridor structures including bridges, walls and drainage structures. The predicted useful life of new structures and residual life of existing ones will be estimated during the design phase using data from the *Baseline Asset Condition* report, expected traffic and weather factors. During the operating phase, the inspection, testing and monitoring requirements will be addressed with the inspection program and frequency identified in *Appendix I, Section 1.i.4, Inspection Frequency.*

### d. Meeting Handback Requirements

We developed our maintenance and renewal work strategies to ensure the overall conditions of all infrastructure assets will be in good and operable condition for handback. These maintenance conditions are summarized in *Appendix I, Section 1v – Breakdown of Elements and Maintenance Tasks*. The MMIS, in conjunction with independent inspections, verifies compliance of maintenance and renewal work at handback, Our approach is to exceed the requirements if practicable.

**Figure 5-6:** *Preliminary Renewal Work Schedule*

CORA exempt materials redacted for the Public Disclosure Technical Proposal.



*The depressed section on LBJ Express requires similar O&M strategies required for the Central 70 cover — we will bring best practices.*

## C. COVER TOP O&M

We will provide a cover top maintenance manual, establish regular coordination with the cover maintainer, provide oversight and inspections and address any concerns that could cause damage or maintenance issues for the cover systems.

### i. VIDEO RECORDING INSTALLATION

To help the cover maintainer properly carry out maintenance and replacement activities, in addition to providing as-built drawings and the cover top maintenance manual, we will video record the installation of key components including:

- Key structural elements
- Waterproof membrane
- Drainage system and garden roof assembly

### ii. LOAD RESTRICTIONS

The cover dead load reserve capacity is 25 pounds per square foot as required in *Schedule 10, Section 13.6.4.v.* Fire truck loading is restricted to areas identified in *Sections 13.6.4.iii and iv*. Our cover top maintenance manual will include prescriptive information about loads by locations, and will include recommendations on load restrictions for special events (permits capacity) for use by the fire department, school and other permitting authorities.

### iii. WATERPROOFING LAYER

The cover top maintenance manual will include detailed instructions for waterproofing layer damage preventative measures. It will include the depth of the final waterproofing layer, instructions for maintenance against potential leaks in the vulnerable areas such as tree wells and corners, and protocols to locate and protect the waterproofing layer when digging.

### iv. SNOW REMOVAL AND STORAGE

Snow storage areas will be confirmed during the design development and included in the cover top maintenance manual. Snow and ice removal activities on the cover top shall be conducted only using appropriate equipment identified in the cover top maintenance manual.

### v. INSPECTION AND MAINTENANCE

The cover maintainer will be responsible for the membrane up. Our maintenance manual will be issued sixty days prior to substantial completion and will identify the recommended regular inspection and maintenance program, including:

- ***Structural elements*** **–** monthly visual inspection by the maintainer team and annual inspection by a certified structural specialist
- ***Drainage system*** **–** monthly visual inspection by the maintainer team and annual inspection by a certified specialist
- ***Landscaping*** **–** quarterly visual inspections

### vi. RECORD-KEEPING

Maintenance activities conducted by the cover maintainer shall be reported to the Enterprises monthly. Any unexpected damages to the cover top elements shall be reported to the Enterprises immediately, and emergency repairs of such damages shall be performed in coordination with our MHP O&M team.

### vii. COVER MODIFICATION

If any major modification is to be made to any cover top elements, the cover maintainer shall submit detailed plans (including drawings and work schedule) to the Enterprises and MHP for review, to ensure such modification has no negative impact on the functionality of the cover mechanical, electrical and plumbing systems and operations of the I-70 roadway.

### viii. OTHER COORDINATION REQUIREMENTS

An initial coordination meeting between MHP and the cover maintainer will be held upon on-boarding of the cover maintainer with subsequent meetings held at a frequency mutually agreed on by the Enterprises, MHP and the cover maintainer. A single point of contact will be established for each entity in regards to coordination of the cover O&M work.

*We will self-perform work including joint seal repair.*

Volume 2

# 2.1.7. Part 6: Technical Approach and Solutions



# 6 Technical Approach and Solutions

***Reimagine Community. Reconstruct Neighborhoods. Reunite North Denver.*** *The Central 70 project is transformational. Our design and construction solutions blend requirements with innovation to deliver infrastructure improvements to serve the local community and region. We will partner with the Colorado Bridge Enterprise/High Performance Transportation Enterprise (the Enterprises) and all stakeholders to bring the vision to reality.*

Our team developed a thorough understanding of Central 70 and created alternative technical concepts (ATC) and other design solutions that provide added value to the project for the Enterprises, the local community, the project's stakeholders and the traveling public. Examples include:

- Eliminating the need to close Columbine and Clayton streets by using temporary detours, significantly minimizing impacts to Swansea Elementary School and the adjacent community
- Eliminating the need to close York, Josephine, Dahlia and Holly streets reduces impacts to the adjacent community
- Collaborating with the City and County of Denver (CCD) on constructing the planned permanent or a temporary York Street/ Union Pacific Railroad (UPRR) pedestrian bridge as part of the Central 70 project
- Eliminating the on-site outfall toward the north (ATC 4) significantly reducing impacts to Elyria-Swansea community, right-of-way acquisition needs and cost
- Conducting advanced geotechnical investigations and environmental studies that enabled us to reduce environmental impacts and maximize mobility across the alignment (both during and after construction)
- Minimizing impacts to adjacent facilities by working exclusively within the right-of-way throughout the project
- Moving the sanitary sewer line underground, minimizing long-term maintenance for CCD
- Providing an optimized cover design that accommodates the soil capacity needs for tree plantings
- Providing a dewatering design both during construction and in the permanent condition that minimizes environmental impacts and improves constructability
- Developing a 4-D building information modeling (BIM) Synchro model that provides more efficient management of the construction process and improves coordination with subcontractors and suppliers (see Figure 6-2 on the next page)
- Minimizing environmental impacts by reducing excavation of contaminated soil and groundwater by implementing strategies such as raising the I-70 profile
- A utility data collection approach that exceeds requirements, results in a high-quality design and accelerates construction

**Community-focused Solutions**

Our plan includes keeping the Elyria-Swansea neighborhood streets open, minimizing impacts to the community and Swansea Elementary School in particular.

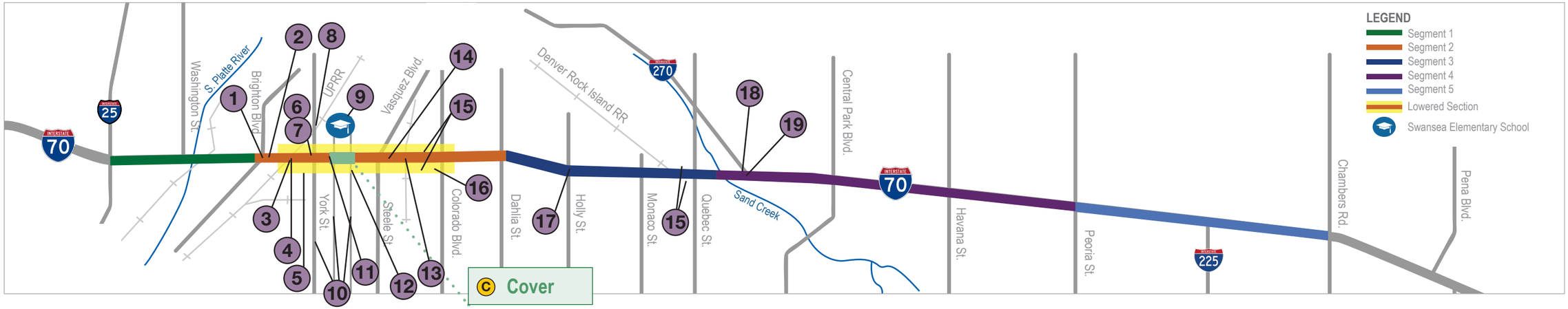
These and other enhancements are shown in Figure 6-1 on the next page and throughout this section, including identifying characteristics of our technical approach and design and construction solutions that exceed requirements with this icon: ⬆. ATCs and other optimizations we have incorporated in our design are detailed in *Section O – Design Changes*.

## A. DESIGN APPROACH

Our design approach begins with strict adherence to *Schedule 10 – Design and Construction Requirements*, all applicable standards and specifications listed in *Schedule 10A – Applicable Standards and Specifications*, *Schedule 10B – Contract Drawings*, the *Project Agreement* and all other federal and local standards and specifications. Additional standards the design follows include *ASCE 38 – Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data*, and for the cover we are following *PIARC 2012 – Road Tunnels: Vehicle Emissions and Air Demand for Ventilation* and *NFPA 170 – Standard for Fire Safety and Emergency Symbols (2015)*.

During the proposal development phase, as in final design, we perform value engineering for most aspects of the design to provide the

**Figure 6-1:** *Project Map — Design and Construction Features*




| ALIGNMENT VALUE-ADDED FEATURES | Exceeds Requirements | Safety | Community Benefit | DBE/Workforce Development | Ensure Quality | Achieve Schedule |
|---|---|---|---|---|---|---|
| 1 Detouring Brighton Boulevard traffic, greatly improving safety for the public and workers and accelerating construction (ATC 18) | | ♦ | ♦ | | ♦ |
| 2 Constructing noise walls near Brighton Boulevard as early as possible | | ♦ | ♦ | | |
| 3 Minimized depth of Union Pacific Railroad (UPRR) structure to reduce excavation in groundwater | | | ♦ | ♦ | |
| 4 Splitting I-70 profile under UPRR, reducing excavation and groundwater incursion | ♦ | ♦ | | ♦ | ♦ |
| 5 Eliminating the north outfall by rerouting the on-site flow to Pond 7, significantly reducing impacts by eliminating extensive construction through the Elyria-Swansea neighborhood (ATC 4) | ♦ | | ♦ | | ♦ |
| 6 Rerouted sanitary sewer line, enabling I-70 profile to be raised which reduces groundwater intrusion and excavation (ATC 2) | | | ♦ | ♦ | ♦ |
| 7 Using a more shallow post-tensioned, precast box beam structure for storm sewer utility bridge east of York Street enables I-70 profile to be raised, reducing groundwater incursion | | | | ♦ | |
| 8 Collaborating with CCD on constructing the planned permanent or a temporary York Street/UPRR pedestrian bridge as part of this project | ♦ | ♦ | ♦ | | |
| 9 Relocate Swansea Elementary School temporary wall (ATC 28) | | ♦ | | ♦ | ♦ |
| 10 Keeping York, Josephine, Columbine, Clayton, Dahlia and Holly streets open for duration of construction, allowing bridge construction to occur simultaneously | ♦ | | ♦ | | |
| 11 Designing the Steele Street exit sign so it is not under the cover for improved visibility and consistent driver expectation | ♦ | | | ♦ | |
| 12 Optimized ADA ramps to minimize footprint and bridge width flare | | | | ♦ | |
| 13 Mitigating groundwater intrusion by encircling lowered section below groundwater with watertight walls and installing underdrain and filtration system | | ♦ | ♦ | ♦ | |
| 14 Revising 46th Street profile and using CDOTM-203-1 at intersections to minimize earthwork | | | | ♦ | |
| 15 Revising 46th Avenue North and South and Stapleton Drive North and South profiles to minimize cut and fill | | | | ♦ | ♦ |
| 16 Analyzed 14 alternatives to optimize retaining walls | ♦ | | | ♦ | ♦ |
| 17 Optimizing the Holly Street bridge to provide the required stopping sight distance and eliminate the need for additional design exceptions | ♦ | ♦ | | ♦ | |
| 18 Analyzed four alternatives for I-270 connector superstructure design | ♦ | | | ♦ | |
| 19 Realigning I-270 over I-70 to reduce impacts to the existing I-70 as well as encroachment on the surrounding floodplain and overflow | | ♦ | ♦ | ♦ | |

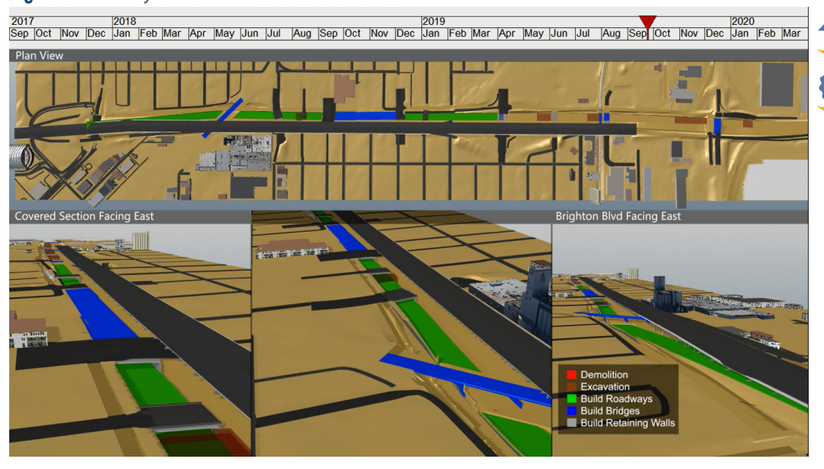
| ALIGNMENT VALUE-ADDED FEATURES | | Exceeds Requirements | Safety | Community Benefit | DBE/Workforce Development | Ensure Quality | Achieve Schedule |
|---|---|---|---|---|---|---|---|
| Project-wide | Pavement design life-cycle analysis to reduce risk and develop the optimal pavement solution | ♦ | | ♦ | ♦ | |
| | Epoxy-coated rebar used on all structures | ♦ | ♦ | | ♦ | |
| | Precast concrete beams for all non-rail bridges | | | | ♦ | ♦ |
| | Conducted thorough geotechnical investigation due diligence campaign resulting in optimized pavement, foundation and structure design, and reduced groundwater incursion | ♦ | | | ♦ | |
| | Conducted additional environmental due diligence campaign, enabling us to reduce risk and accelerate construction start | ♦ | | | ♦ | |
| | Expanding 4-inch-wide pavement striping to 6 inches wide at select locations for improved safety | ♦ | ♦ | | | |
| | Installing smart cushion attenuators at various locations throughout the project to improve safety and reduce maintenance | ♦ | ♦ | | | |
| | Installing rumble strips on exit ramps before traffic light intersections | ♦ | ♦ | | | |
| | Co-locating intelligent transportation system (ITS) equipment for improved safety and maintenance access (ATC 14) | ♦ | ♦ | | ♦ | |
| | Increasing the number of closed-circuit television (CCTV) cameras in complex interchanges to ensure full coverage of I-70, approach roadways and ramps | ♦ | ♦ | | ♦ | |
| | Using *ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data* to collect existing utility data | ♦ | | | ♦ | |
| | Coordinated construction schedule with parcel availability | | | | | ♦ |
| | Developing early design packages to optimize design development and approval processes and accelerate construction start | ♦ | | | ♦ | ♦ |

*During the proposal stage we have developed an initial 4-D Synchro model and will continue to advance this model through the design and construction phases. Going beyond the industry standard for BIM, our model is a result of collaboration among our designers, constructors, operators and maintainers that considers Central 70's full life-cycle management.*

| C COVER VALUE-ADDED FEATURES | Exceeds Requirements | Safety | Ensure Quality |
|---|---|---|---|
| Added one back-up jet fan per direction | ♦ | ♦ | ♦ |
| Upgraded ultrasonic anemometers | ♦ | ♦ | ♦ |
| Provided $CO_2$ fire extinguishers in all plant/ equipment rooms | ♦ | ♦ | ♦ |
| Provided fire alarm buttons at cover walls | ♦ | ♦ | ♦ |
| Provided LED evacuation lighting along walls | ♦ | ♦ | ♦ |
| Provided emergency equipment lighting for signage | ♦ | ♦ | ♦ |
| Optimized electrical power supply system configuration (ATC 26) | | ♦ | ♦ |
| Provided linear fire detection system | | | ♦ |
| Grounding system for all electrical components | | ♦ | ♦ |
| Analyzed five alternatives for cover superstructure design | ♦ | | ♦ |

*The temporary wall in ATC 28 will protect students from construction work, particularly during demolition of the viaduct.*

**Figure 6-2:** *4-D Synchro BIM Model Screen Shot*



best value for the project. For example, our team implemented a scientific approach to pavement design that involved a thorough life-cycle cost analysis. Geotechnical experts from Fugro developed a variety of pavement sections and collaborated with our construction and O&M teams to evaluate the future renewal work for each option. The team balanced up-front costs with future maintenance costs to identify the optimal pavement solution. Value engineering was also performed to identify the best solution for the design of the cover structure and the I-270 connector superstructure.

We also performed high levels of due diligence to identify and reduce risk and to optimize the design. Our geotechnical campaign is a good example. Fugro's advanced geotechnical investigations, as well as the environmental studies, enabled us to develop optimizations to enhance the design. In addition to an optimized pavement structure, we provide more efficient drainage, wall system and bridge structure designs. We were also able to accelerate the schedule (reducing impacts for the surrounding community and the traveling public) while improving safety and quality and reducing operating and maintenance costs. We will perform additional geotechnical, environmental and survey campaigns at the beginning of final design.

Our approach includes efficient design management focused on developing early design packages to respond to right-of-way availability or to accelerate critical-path elements. Examples include foundation elements related to the UPRR bridge and the cover structure, and major drainage elements, such as the on-site drainage system outfall.

Additional information on our design approach are detailed in *Appendix B, Section F – Design Approach* and *Part 2 – Quality Management*. Features include regular informal and formal interface with the Enterprises; collaboration across disciplines and with the construction and O&M teams; and a thorough quality management program involving a structured design review process.

## B. DESIGN FEATURES THAT IMPROVE FUTURE MAINTENANCE

Throughout the proposal development phase, we have implemented design features that increase efficiency and safety and reduce cost of future maintenance activities. We will continue this during the final design. Examples include:

CORA exempt materials redacted for the Public Disclosure Technical Proposal.

Additional durability features related to structures are provided in *Section K – Structures*.

## C. PAVEMENT DESIGN APPROACH

Figure 6-3 details our pavement design approach which is based on the requirements and the experience of our pavement specialists at Fugro. We analyzed both rigid and flexible

**Figure** *6-3: Pavement Design Details*

| FACILITY | METHODOLOGY | MATERIAL TYPES | ROADWAY CLASSIFICATION | TRAFFIC LOADING | DESIGN LIFE |
|---|---|---|---|---|---|
| I-70 | ▪ Colorado Department of Transportation's (CDOT) *M-E Pavement Design Manual*<br>▪ AASHTO's M-E design procedure (using AASHTOWare Pavement M-E Design software) | ▪ Mainline: flexible (SMA + HMA + granular base)<br>▪ Widening: flexible or rigid (jointed concrete slab + cement-stabilized granular base) | ▪ Per *Schedule 10, Section 9, Appendix A – Roadway Design Criteria* | ▪ Per CDOT's Online Transportation Information System data | 30 years (exceeds requirements by 10 years) |
| Local Agency Roadways | ▪ Metropolitan Government Pavement Engineers Council, *Pavement Design Standards and Construction Specifications* (2009) | ▪ Flexible (HMA + granular base) | ▪ Per *Schedule 10, Section 9, Appendix A – Roadway Design Criteria* | ▪ Per Atkins' *Local Roadway ESAL Calculations* memorandum (January 6, 2016) | 20 years |

pavement, complied with all requirements and performed a detailed life-cycle cost analysis to determine the overall optimal pavement design, construction and maintenance strategy for each segment of the mainline pavement. The analysis included pavement for all roadway types, various maintenance strategies during the 30-year maintenance period and adherence to the performance and handback requirements. The study resulted in the choice of a flexible pavement with base course (see Figures 6-4 and 6-5).

### Life-cycle Cost Analysis Benefits

Our comprehensive life-cycle cost analysis enabled us to thoroughly evaluate the performance and hand-back requirements, providing the Enterprises with the greatest cost benefit. Our history and experience with roadway asset management using our proprietary software, provides us a depth of experience and resources for evaluating life-cycle costs.

## D. SIGNING, STRIPING, SIGNALIZATION AND LIGHTING

Our signing, striping, signalization and lighting design approach is centered on improving safety and efficiency for the traveling public.

**Signing and Striping.** Our pavement striping design exceeds requirements by expanding four-inch-wide markings to six inches wide in select locations to improve visibility and safety. Efficiently integrating freeway lanes, ITS systems and tolled express lanes, our signing and striping design provides drivers with safe and efficient travel, and follows the *Interstate Access Request* approved by the Federal Highway Administration (FHWA). During construction, thorough signage and pavement markings provide drivers with safe guidance as lanes are shifted, particularly on I-70.

**Traffic Signals.** We will seamlessly integrate traffic signal infrastructure into the overall highway, bridge, wall and utility design. Given the close spacing of adjacent intersections to the I-70 mainline, we have established the location of signal pole caissons and the routing of signal conduits through bridge structures early in the design process and have carefully

**Figure** *6-4: I-70 Pavement Structure*

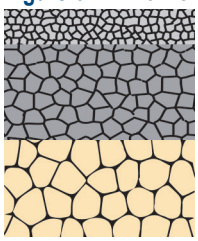
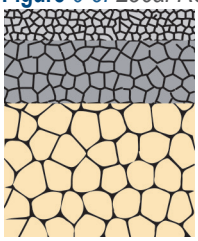



**Figure** *6-5: Local Roads Pavement Structure*




coordinated the incorporation of signal conduit infrastructure within bridge and wall structures. Based on our extensive experience in the Denver area, our design addresses critical traffic signal elements including:

- Interconnecting traffic signals for closely spaced intersections to ensure they can communicate and provide coordinated traffic operations
- Coordinating with CCD and Xcel Energy regarding ownership and installation practices of signal poles and lighting, and establishing power source locations and connections to each of the traffic signal meters early in design
- Coordinating traffic signal preemption and pre-signal operation with the railroads
- Using the “Key Notes” from CCD's Traffic Signal Standards to properly annotate each signal design component

### Improved Equipment Accessibility

By mounting field equipment cabinets on poles/structures, we improve accessibility and reduce construction and future maintenance costs.

### CCD Experience Adds Value

Our team’s strong relationship with CCD — based on 20 years of local experience — adds significant value in implementing the signal design within CCD’s extensive network. We will coordinate closely with CCD to determine the appropriate means for providing communication to each of the proposed traffic signals and interconnecting them with the existing system.

**Lighting.** Key features of our lighting design approach include:

- Complying with the criteria, ownership and maintenance agreements with the individual cities along the alignment and Xcel Energy
- Reducing operating and life-cycle maintenance costs and providing improved visibility by using LED luminaires
- Improving safety for the traveling public, by locating poles 10 feet behind the travelway

## E. EARTHWORK

### i. GEOTECHNICAL

Our approach to geotechnical uncertainty is to develop a thorough understanding of the existing subsurface conditions as early in the design process as possible. Led by our renowned geotechnical consultant, Fugro, we reviewed regional geologic information, reference documents provided by the Enterprises as well as previous studies performed by Fugro in the vicinity of the project to develop a detailed subsurface model along the corridor. We also conducted supplemental exploration, as shown in Figure 6-6, to develop a subsurface model that helped us anticipate stratigraphy, engineering parameters and associated variability.

The developed detailed subsurface model helped us:

- Quantitatively and qualitatively evaluate the subsurface materials to determine necessary geotechnical parameters required for analysis and design of project elements and determine suitability of the materials along the project
- Identify locations where removal and replacement of existing soil may be required (such as in the depressed section with predominantly clayey subgrade or where soil susceptible to frost heave is exposed in the pavement subgrade)
- Estimate the volume of material removal as well as excavation means and methods
- Optimize reuse of existing materials and minimize grading operations and off-haul
- Identify exposed subgrade that could be treated in place to improve R-values, reduce expansion potential and increase strength
- Identify alternate mitigation strategies to optimize earthwork quantities and reduce the project's environmental footprint
- Identify the percentage of excavated material that meets specifications for use as embankment fill or Class 1 structure backfill for mechanically stabilized earth (MSE) walls
- Identify bridge abutment embankment locations where existing material will need to be removed and improved or replaced with engineered fill to provide adequate capacity to support surcharge pressures

Upon award, we will conduct additional field and laboratory investigations to develop a complete database of the existing subsurface conditions required for completion of the project. These include:

- Conducting field and laboratory testing in accordance with pertinent CDOT, AASHTO, FHWA or ASTM procedures and protocol
- Conducting static and dynamic load tests for drilled shafts and driven piles as additional quality assurance measures
- Performing additional continuous cone penetration testing including pore water dissipation tests
- Conducting field instrumentation monitoring (such as vertical and horizontal inclinometers, piezometers and load plates) to ensure proper settlement and stability in the overburden and fill soils and to mitigate potential short- and long-term concerns for key stability areas (these measures

**Figure 6-6:** *Supplemental Geotechnical Investigation During Procurement Phase*

| ACTIVITY | PURPOSE | HOW DATA WAS USED |
|---|---|---|
| Numerous additional borings (including bulk samples) targeted at specific areas of concern | ▪ To provide additional detail in locations where historical data lacked sufficient coverage or additional detail was needed | ▪ To determine depth of foundation, subgrade design requirements, construction means and methods, depth and thickness of retaining walls |
| Additional cone penetration tests | ▪ To further confirm stratigraphy and provide additional information for settlement analyses | ▪ To determine settlement durations as well as the amount of settlement that will occur |
| Pressuremeter tests, packer tests and permeability tests within the lowered section | ▪ To further detail lateral earth pressures/ capacities, groundwater cut-off depths and hydraulic conductivity of subsurface layers | ▪ To determine wall structure type and thickness, bridge foundation drilled shaft sizes, and depth of walls and foundations to avoid permeating water |

can also benefit the corridor long after construction of the project is complete)

**High-quality Geotechnical and Pavement Engineering**

Through our comprehensive due diligence including supplemental field and laboratory investigations (see Figure 6-6), we significantly reduced environmental, geotechnical and pavement design risk, optimized foundations and accelerated construction start.

## ii. EXCAVATION

**Excavation Methods.** Our primary excavation approach will be to use trucks and excavators to excavate and transport material to its final location, whether on site or off site, while minimizing double handling the material. For earthwork remaining on site, our goal is to stay within the right-of-way when hauling material to minimize traffic impacts. For export material, we will carefully designate routes that minimize impacts to the community and, when necessary, schedule night or off-peak hour operations to minimize impacts to local communities and roadways.

**Earthwork Construction Techniques.** Prior to beginning earthwork operations, we will have a detailed supplemental soil survey and excavation/embankment plan in place, and refine the mass-haul plan created during the proposal phase to assist our crews in knowing where excavated material can be placed, whether on site or off site, based on the technical requirements. In the deeper cut areas where we encounter groundwater, we will use slurry walls to cut off the groundwater from our excavation area and implement a dewatering system prior to the excavation operations. To further reduce the water/moisture content of this material, we may supplement the operation when necessary with disking the material or moving the material into piles to remove excess water prior to loading into trucks.

**Mass-Haul.** During the proposal phase, we have examined the earthwork with respect to the construction sequencing and developed a mass-haul logistics plan for the entire project. Early phases of work on the northern portions including 46th Avenue North and westbound I-70 have been analyzed independent of the work to the south. We anticipate the first phases to result in a waste balance. The excavated material from the northern portion of the lowered section will be used as fill for the widened portions and major crossings east of Colorado Boulevard.

**Borrow Sources and Uses for Waste Material.** While borrow will not be required, waste areas we are considering include the ultimate construction areas west of I-225. The ramps and mainline in this area will be built on a fill section. The waste material will be placed where drainage will not be affected so the embankment will be ready for the future construction.

The southeast quadrant of the Quebec Street interchange provides an ideal location for stockpiling excavation waste. The space is large enough for approximately 70,000 cubic yards built with 3:1 slopes to a height of approximately 30 feet. The mound will be built with natural looking undulations and landscaped with appropriate vegetative cover to enhance its appearance. We checked the surrounding properties and the existing buildings, generally, do not have windows facing this location, reducing visual impacts and will, likely, add a natural look to the area.

## iii. EARTHWORK ENVIRONMENTAL

**Screening and Soil Sampling.** Field screening will include visual inspections for staining, presence of non-soil materials, presence of odors or layers in soil cross section that appear out of place. If potentially contaminated soils are encountered or are identified through field screening or location-specific data from previous investigations, we will collect conformation samples. The samples will be collected in accordance with the final *Beneficial Reuse and Materials Management Plan* (BRMMP). The final BRMMP sampling requirements will be consistent with Section 3.2.1 of the Draft BRMMP prepared by CDOT. The sampling frequency will be dependent on the nature of the excavation and the intended reuse of the soil. In each case, 10-point composite samples will be collected and analyzed for polynuclear aromatic hydrocarbons, RCRA 8 metals and volatile organic compounds (VOC) using EPA SW-846 methods.

### Future Environmental Investigations

Future environmental investigations will further identify the limits and extent of contaminated soil, enabling us to target areas of known contamination with more frequent screening and sampling. This additional effort will also help us identify suitable soil at the time it is needed for embankment, maximizing overall construction efficiency and accelerating the schedule.

**Material Reuse.** To maximize the use of excavation material as embankment, excavation on the north half of the lowered section will be performed concurrently with the embankment portions east of Colorado Boulevard. No soil with concentrations of chemical constituents above standards for unrestricted reuse will be used west of Colorado Boulevard. Our plan also maximizes the amount of excavation material that can be used for CCD projects, specifically at the National Western Center.

**Minimizing Material Disposal.** In addition to performing excavation and embankment activities concurrently, our design includes an optimized profile for the lowered portion that minimizes excess material. A soil screening and sampling program will be implemented to identify clean soils that have no reuse restrictions and contaminated soils that have reuse restrictions. We have identified several waste areas west of I-225 that can be used for stockpiling or final disposal in lieu of disposing of materials off site.

**Material Tracking and Documenting.** We will track and document ground-disturbing activities. We will provide documentation of how materials met specific use criteria and the final disposition of the materials. The BRMMP will provide tracking and documentation procedures. Reporting will include summary of field screening/observation and analytical results (including copies of analytical reports), description (including GIS maps that meet Colorado Department of Health and Environment (CDPHE) Environmental Covenant requirements and GPS coordinates) of the final disposition of materials with concentrations above the regional screening level – residential (RSL-R) (including, as applicable, specific on-site location and associated cover material or off-site disposal location) and copies of all waste manifests.

## F. RAILROAD COORDINATION

**Coordination.** Work around the rail lines requires a high level of coordination. We will assign a single point of contact for the railroads (one for UPRR and another for BNSF Railway and Denver Rock Island Railroad) through design and construction. These individuals will be responsible for managing all railroad permits which will be executed prior to any work occurring in a railroad's right-of-way. We incorporate each railroad's unique review, approval and schedule requirements and durations into our proposal schedule.

Railroad owners will be included in our task forces or special coordination workshops so they can stay informed on our progress and provide input during the design development. Constant communication will prevent unwanted surprises that could lead to schedule risk. We will provide timely submissions of our design drawings and work plans, including interim and final submittals.

During construction, we will meet weekly to anticipate and resolve concerns, and provide updated schedule forecasts. We will secure the contractor's right-of-entry agreement and coordinate with each operating railroad for establishing the work footprint and clearances, track allocation schedules, flaggers and stand-down notices.

**Design and Construction Solutions.** Having completed more than $245 million of work directly for UPRR and BNSF Railway, team member SEMA understands the importance of coordination and construction sequencing when constructing rail facilities. The primary rail element, construction of the UPRR bridge over I-70, is on the critical path as it requires multiple phases to ensure rail operations are never impacted. To accelerate the schedule, we will construct the entire bridge in the first phase of the project (when the north lowered section is constructed). This will require specialized caisson drilling equipment capable of drilling caissons with low vertical headroom (see Figure 6-7 on the next page) as we construct the foundations and superstructure of the bridge underneath the existing I-70 viaduct. Our design and construction teams will work closely

to ensure constructability and accommodate limitations caused by the existing viaduct.

**Figure 6-7:** *Example of Specialized Caisson Drilling Equipment for Areas with Low Vertical Clearance*

In Phase 2, when all traffic is on the new westbound I-70 alignment, we will implement an engineered demolition approach to remove the existing I-70 viaduct over the newly constructed UPRR bridge. We will analyze the existing structure and dismantle it through cutting and lifting of individual elements, working within UPRR's right-of-way to ensure safety and eliminate interference with rail operations. Demolition will be coordinated with UPRR and performed only during scheduled windows when trains are not running. We will also protect the tracks during demolition by either covering or flooding the tracks with ballast.

## G. COVER DESIGN APPROACH

Our design provides mechanical, electrical, control, communication and fire/life safety systems that are fully integrated to deliver safe and efficient operation and maintenance of the I-70 cover. Our design and O&M teams collaborated to ensure maintenance aspects were considered. For example, duct banks are placed in locations that will be easier for maintenance crews to access. Our approach also included the development of preliminary models to confirm the effectiveness of the equipment. To be refined during final design, the models developed to date (and the section of *Appendix G – Cover Design Baseline Report* where they are detailed) include:

- Ventilation simulations: *Section C.ii – IDA-Tunnel Analysis (Simulations)*
- Fire simulation model using a 3-D model and a 2-D computational fluid dynamics simulation: *Section K.ii – Fire Simulations*
- Evacuation simulations: *Section K.iii – Evacuation Simulations*

We have maintained strict adherence to all relevant U.S. Environmental Protection Agency, National Fire Protection Association, FHWA, Illuminating Engineering Society and Denver Fire Department requests, codes, limits and requirements. All required deliverables will be developed in coordination with the appropriate jurisdictional authorities and submitted to the Enterprises for acceptance. Deliverables include a comprehensive, project-specific tunnel operation, maintenance, inspection and evaluation manual (TOMIE) that will be developed and refined throughout the design in collaboration with the O&M team. Our *Appendix G – Cover Baseline Report* describes the design basis, criteria, functional requirements, scope, major equipment requirements and block diagrams for the cover's 10 major systems. Figure 6-1 on the page 41 highlights design features.

**Systems Integration.** We will develop a comprehensive systems integration management plan that will result in a seamless interface of the cover's complex systems. We plan to use Ethernet as the communications platform for all inter- and intra-communications among peer sub-systems. Where the native means of communication is not directly compatible with Ethernet, we will arrange for suitable protocol conversions. We will begin by identifying and confirming the interface requirements among individual systems, such as electrical power and ventilation, communication and lighting systems or firefighting and drainage and pumping systems, as well as with the Enterprises and third parties such as CCD, Denver Fire, Denver Police and the Colorado State Patrol. During detailed design, we will establish a cover systems task force which will meet once a month (at a minimum) to coordinate interface points and identify and resolve challenges before work begins in the field. Management of the systems interfaces will continue into construction and will culminate in the systems integration testing phase to verify compliance with the interface

requirements. We will develop uniform criteria and procedures for testing the operational system and its major components, allowing us to ensure the quality and compatibility of the entire system prior to operation.

**Systems Integration Success**

Our systems integration specialists have completed similar tasks for several tunnels in the past and are familiar with the technical challenges. We are confident in the systems integration process we have developed and refined, and plan to apply the same when executing this project. Through this process, we will achieve a seamless interface that results in high-quality, safe cover operation.

## H. COVER AND SWANSEA ELEMENTARY SCHOOL LANDSCAPE AND AESTHETICS

Our cover and Swansea Elementary School landscape design is consistent with the design established and vetted with the community by the Enterprises. The design and aesthetic will create a space that unifies both sides of the interstate, integrates the neighborhood, expands the open space of the school property and provides a critical recreation and gathering space for the community.

We have made slight adjustments to the design plans to meet the criteria established in the request for proposal documents.

### i. INTEGRATION

Our cover task force, including mechanical/electrical/plumbing (MEP), structures, drainage, utilities, ITS, landscape and aesthetics representatives, have been collaborating on the cover design throughout the proposal development phase. They reviewed multiple options for the structural design of the cover structure and selected a design (precast, prestressed bulb-T girders) that provides ample growing space between the girders for the trees and landscape (600 cubic feet of soil volume for shade trees and 350 cubic feet for ornamental trees) without compromising the design. The drainage system design keeps water away from sensitive ITS, fire protection and detection systems, utility and communication systems. Drainage is provided by surface drainage directed either to the streets or to area drains that connect to the storm system below the cover. Weep holes are provided in the raised planters and a drainage layer and concrete v-pan located at the bottom of the trenches will connect to the storm system. Utilities are separated from the trenches where planting is located and are placed either in landscape areas where enough coverage is provided or hung below the deck to connect to the storm system. Our team will continue to collaborate throughout final design and construction to ensure the seamless integration of the cover's systems with the landscape and aesthetic features of the park.

### ii. LONG-TERM OPERATION AND MAINTENANCE

Our cover task force team also includes O&M representatives who have supported the development of the design from the start and will continue to provide their expertise throughout design and construction. Their role includes developing maintenance plans for the cover maintainer (who will maintain the cover top) and for our team (who will maintain the bottom portion of the cover). The plans will include detailed processes for routine and audit inspections to identify and classify issues with a focus on preventative maintenance that minimizes the possibility of defects.

The cover top maintenance plan will detail inspection and maintenance requirements for the landscape and aesthetic features as well as the supporting irrigation, drainage and utilities systems in accordance with the *Cover Top O&M Manual* as described in *Schedule 11, Section 3.2.3.e*. We will coordinate with the cover maintainer and provide advance drafts of this plan upon substantial completion to ensure a smooth transition.

The maintenance manual for the bottom of the cover will identify inspection and maintenance requirements for all systems as well as other structural and roadway elements. Our team will self-perform the maintenance of standard roadway elements, and will engage specialty subcontractors to maintain the cover MEP elements such as the oil/water separators, storm drainage pump, fire detection and alarm, firefighting and ventilation

systems, and radio rebroadcast systems. Specialized inspection firms will perform:

- Laser surveys to establish baseline ceiling elevations
- Airflow test measurements for mechanical ventilation
- Laser pointing temperature measurements for shaft bearings and electrical starter contacts to identify loose contacts and bearing condition trends
- Power meter analyses for fan motor power measurements
- Portable measurements for motor winding insulation testing

## I. CONSTRUCTION ADJACENT TO SWANSEA ELEMENTARY SCHOOL

### i. TRAFFIC PHASING

Driven by maintaining safety and minimizing impacts to Swansea Elementary School, our approach in this area minimizes construction during school hours and eliminates road closures around the school. We complete both 46th Avenue North from York Street to Colorado Street and the temporary 46th Avenue connection between Clayton Street and Columbine Street early in the project, providing local connectivity and facilitating student drop-off and pick-up as the project progresses to the south.

A key feature of our plan includes construction of temporary roads adjacent to the existing ones to reroute traffic on Clayton and Columbine streets, enabling us to complete road and bridge construction for those two street crossings without long-term or full closures of those roads. This greatly reduces impacts to Swansea Elementary School and the surrounding area, and allows these streets to be open for school traffic when the school year begins.

**Keeping Streets Open**

Never closing Clayton and Columbine streets exceeds requirements, eliminates significant construction impacts to the school and improves safety by maintaining existing traffic patterns and providing connectivity during construction.

### ii. CONSTRUCTION DURATION

Construction of the northern half of the cover will be completed between July 2019 and December 2020. Construction of the southern half of the cover will be completed between June 2021 and October 2022. Construction of the Brighton Boulevard drainage pond will occur between May 2019 to May 2020 with the off-site outfall system from the Brighton Boulevard drainage pond to York Street occurring from April 2020 to September 2020.

**Cover Design and Construction Experts**

In addition to lessons learned and proven strategies, our staff from the LBJ Express bring special expertise related to the cover, having designed and constructed a similar system on that project.

### iii. SAFE ROUTES TO SCHOOL

Our construction sequence will provide pedestrian detours to support Colorado's Safe Routes to School initiative. The existing 46th Avenue east of York Street will remain open for as long as possible and will not be closed before the temporary connection for 46th Avenue North is built, providing east-to-west school routes during the remainder of the construction. No adjoining roads will be simultaneously closed to pedestrians throughout construction, allowing for north to south travel at all times. Temporary sidewalks will be provided as needed.

We will coordinate with CCD, Denver Public School District and each school (Garden Place Elementary, Bruce Randolph Junior High and Swansea Elementary) to further understand current bicycle/pedestrian activity at each location. Additional strategies we will explore to maximize safety and mobility near the school include:

- Providing walk/bike route maps for construction stages impacting the schools
- Coordinating safety staff during pick-up and drop-off times to guide parents and school buses
- Considering handicap access and special education transportation needs
- Identifying potential safety upgrades such as street lighting, signing and striping

- Considering traffic control improvements, including pedestrian signals
- Installing fencing around construction zones
- Maintaining a no-equipment buffer between our work and students, parents and school staff
- Installing construction entrances/ exits away from the school
- Conducting loud construction activities and scheduling deliveries outside of school hours
- Designing truck routes to avoid streets around the school
- Scheduling major construction operations around drop-off and pick-up times
- Coordinating with public transportation provided for students
- Providing construction updates to the school's Parent Teacher Association and to parents and students at assemblies and/or via flyers, school newsletters and/or the project website
- Providing monthly construction updates

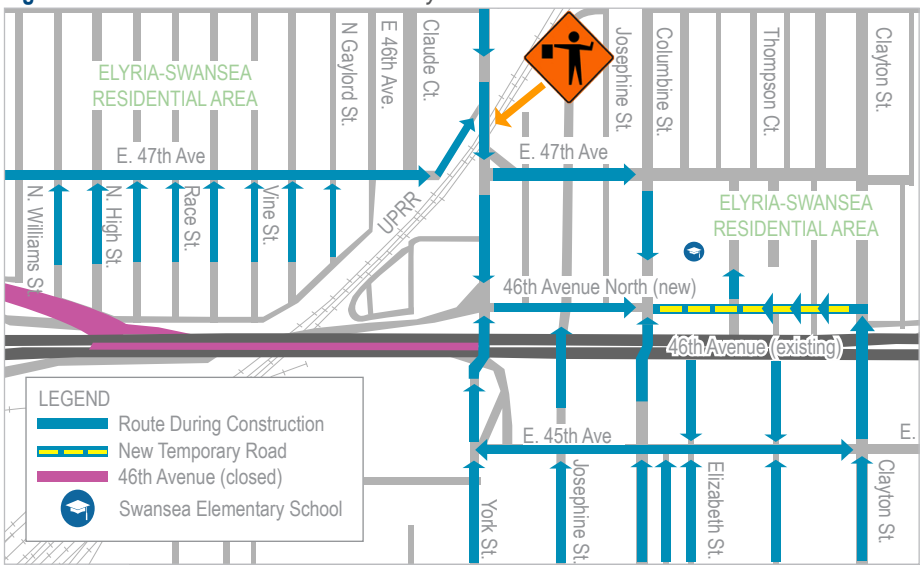
### York Street/UPRR Pedestrian Crossing

Working in collaboration with CCD, our proposal includes constructing the planned permanent or a temporary York Street/UPRR pedestrian bridge as part of this project — creating a win-win-win for the community, CCD and the Central 70 project.

**46th Avenue Closure.** Once 46th Avenue is closed between Brighton Boulevard and York Street, we anticipate increased vehicular and pedestrian traffic on the roads adjacent to Swansea Elementary School including at the at-grade UPRR/York Street crossing. We will maintain a safe pedestrian railroad crossing including Americans with Disabilities Act-compliant detour sidewalks, temporary railroad pedestrian crossings and proper signalization. Flaggers will be present during rail construction to safely guide vehicles through the construction zone. Our approach around the school includes providing certified crossing guards during construction of the crossing, especially during school commute times, to safely guide parents and students through the area. We will also coordinate with the Swansea Public Schools' bus service.

Figure 6-8 identifies detour routes for accessing Swansea Elementary School.

**Figure 6-8:** *Routes to Swansea Elementary School*




## J. FOUNDATIONS

As discussed in *Section E.i – Geotechnical*, to create a detailed subsurface model our team performed additional field and laboratory investigations during the proposal phase to complement the existing data released by the Enterprises. That model's geotechnical parameters were then used, in conjunction with *AASHTO LRFD Bridge Design Specifications*, CDOT's *Bridge Design Manual* and the *Geotechnical Design Methodology for Drilled Shafts Socketed in Weak Rocks* report, to design the major foundation elements. Our geotechnical consultant, Fugro, has a vast database of foundation load tests data within the Denver area, including full-scale static axial tests using O-Cell, that were analyzed during design of foundation elements for I-70. Our due diligence resulted in optimized wall and foundation design, lowered risk, accelerated construction and reduced contingencies.

The foundation design selected results in the design of the most economical bridge, taking into account constructability issues or constraints. Factors considered in the

design of foundations include foundation soils, bedrock and groundwater conditions, structure loads, construction access, traffic staging requirements, shoring and other potential construction constraints. The structural design provides adequate strength to resist the applied loads within the parameters obtained from geotechnical recommendations.

**Bridge Foundations.** Due to the anticipated alluvium layers above and below the groundwater elevation during drilled pier construction, casing and/or drilling slurry will be used during construction of drilled piers to maintain the sides of the excavations stable. Upon completion, more than 90 drilled piers will be inspected with either cross-sonic log or thermal integrity profiler to check their structural integrity.

From review of existing and additionally acquired geotechnical information, the strength of the underlying bedrock was determined to be variable. During the proposal phase, bedrock cores were logged and examined for characterization; unconfined compressive strength was evaluated in conjunction with additional laboratory testing; and additionally acquired pressuremeter testing was analyzed and incorporated into the design of bridge foundations. For final design, we will perform additional field and laboratory tests as well as pile load tests to confirm design capacities.

Refusal depth of driven piles into bedrock is expected to be variable. As part of our proposed thorough testing and monitoring program or final design, indicator pile, load testing and dynamic testing programs are used to reduce uncertainty in the estimated depth to refusal and confirm design capacity.

**Retaining Walls.** Sections of the trench excavation will extend below the anticipated groundwater elevation. Groundwater pump tests performed near Race Court and York Street indicate the existing alluvium (sand and gravel layers) has very high permeability. The results of our field exploration program indicates the bedrock underlying the existing alluvium has low permeability. To reduce the potential for groundwater seepage into the lowered roadway section and groundwater drawdown outside of the lowered roadway section, we provide secant pile walls extending into the underlying bedrock that serve as cut-off walls. Our team completed a series of packer tests and permeability tests within the bedrock to confirm minimum depths of embedment into the rock to effectively construct the groundwater cut-off walls.

### Foundation Experts

With more than 25 years of specialized experience performing thousands of full-scale load tests in more than 60 countries, Fugro is the leading expert in full-scale static axial using O-Cell and other methods.

## K. STRUCTURES

Our structure designs balance optimization, quality and user satisfaction with the overall goal of meeting and exceeding expectations. Our design and construction teams collaborated on conducted value engineering studies to improve construction efficiency, reducing material and earthwork and accelerating schedule to provide the Enterprises with a high-quality, economical design. All bridge and wall designs comply with the design criteria listed in *Schedule 10, Section 13 – Structures* and *Schedule 10, Section 14 – Landscaping and Aesthetics.*

**Loading and Design Life.** All bridges are designed per loading requirements (wind, seismic, etc.) in *AASHTO LFRD Bridge Design Specifications*. The cover structure design accommodates eight loading cases in the 11 zone locations needed to address the unique conditions created by the integration of MEP systems, landscaping and park features. Retaining walls are designed to accommodate lateral earth pressure and groundwater effects. All structures meet or exceed a 75-year design life.

**Figure 6-9:** *Foundations Design Approach*

## Bridges

Our design methodology focuses on reducing quantities, optimizing superstructure design, reducing superstructure depth to raise the profile of I-70, and increasing overall structure durability. Figure 6-10 provides a summary of structural design elements including key features of each. Other highlights include:

- Realigning I-270 over I-70 to reduce impacts to the existing I-70 as well as encroachment on the surrounding floodplain and overflow
- Developing a construction approach for below-grade columns that provides the most visually pleasing aesthetic finish possible
- A superstructure design that allows for accelerated beam production, lighter lifting loads and reduced loads to the substructure

**Figure 6-10:** *Structure Summary*

| | TYPE/MATERIAL | LOCATION | FEATURES/NOTES |
|---|---|---|---|
| Superstructure | Structural steel beams and deck | ▪ UPRR structure | ▪ Reduced depth of plate girder (by 4 feet), reduces groundwater pumping and excavation requirements |
| | | ▪ BNSF Railway structure | ▪ Optimized steel through-plate girders eliminates multiple piers and spans<br>▪ Using steel through-plate girders with bolted bottom flanges minimizes excavation |
| | Post-tensioned precast tub girders | ▪ I-270 eastbound connector ramp structure | ▪ Eliminates a beamline by reducing three-girder configuration to two-girder layout<br>▪ Precast – improved quality control, concrete quality and curing conditions for improved corrosion protection<br>▪ Precast – reduces traffic impacts to I-70<br>▪ Post-tensioning – reduced cracking/crack widths, improved corrosion protection provided by concrete |
| | Prestressed concrete beams | ▪ All other roadway bridge structures | ▪ Results in improved quality and accelerated construction<br>▪ Reduces future maintenance |
| | Post-tensioned, precast box beam | ▪ Storm sewer utility bridge east of York Street | ▪ Provides a more shallow structure that enables I-70 profile to be raised<br>▪ Reduces groundwater impacts<br>▪ Reduces rock excavation and associated truck trips |
| Substructure | Drilled caissons | ▪ All piers in areas with relatively shallow bedrock<br>▪ Abutments in lowered section where relatively small foundation footprint is required | ▪ Reduces noise impacts during construction<br>▪ Provides extremely high axial resistance<br>▪ Small footprint for single-shaft foundation without need for a pile cap |
| | Driven piles | ▪ Earthwork fill<br>▪ Deep bedrock | ▪ Environmentally preferable as it reduces excavation of contaminated soil and groundwater |
| Permanent Retaining Walls | Secant or tangent pile | ▪ Lowered section: tangent pile walls where finished grade is above water table; secant piles walls where finished grade is below water table (to control groundwater inflow into excavation)<br>▪ Constrained areas where tie-backs are not an option | ▪ Provides relatively high stiffness compared to other types of walls<br>▪ Minimal ground disturbance to adjacent properties<br>▪ Low noise and vibration<br>▪ Will also be used to support bridge structures<br>▪ Allows for top-down construction<br>▪ Secant walls allow for minimal groundwater flow |
| | Solider pile | ▪ Cut locations where finished grade is above the water table<br>▪ Where excavation is not able to stand unsupported in a 3- to 6-foot-high layer<br>▪ Where maintenance of traffic or right-of-way does not allow for MSE or soil nail wall construction | ▪ Cost efficient alternate to a tangent pile wall<br>▪ Improved constructability Widely used locally |
| | MSE | ▪ Cut locations where finished grade is above water table<br>▪ Preferred option where sufficient space behind wall for soil reinforcement is available | ▪ Simple and quick construction procedure<br>▪ Cost effective |
| | Soil nail | ▪ Cut locations where finished grade is above water table<br>▪ Where excavation is able to stand unsupported in a 3- to 6-foot-high layer<br>▪ Where right-of-way allows for soil nail use<br>▪ Where maintenance of traffic does not allow for MSE construction | ▪ Less disruptive to traffic compared to other construction methods<br>▪ Requires smaller right-of-way than other construction methods with tie-backs |
| Other | Noise walls (precast concrete) | ▪ North of I-70 near Brighton Boulevard | ▪ Simple and quick construction procedure |
| | Cover | ▪ West of Columbine Street to east of Clayton Street | ▪ Analyzed eight loading zones to provide a thorough and optimized design<br>▪ Provides for efficient tree well placement that provides ample space for tree roots |

- Providing aesthetic features, including street names and columns, that comply with the aesthetic requirements

**Cover Structure.** We conducted a value engineering study that analyzed five different superstructure types for the cover comparing materials, constructability, construction schedule duration and integration with the landscaping and park features and the MEP system. The selected option (BT-63 beams) provides ample space for the tree roots, allows for architectural flexibility and maintains structural integrity while maximizing constructability.

**Durability.** Because using precast elements is the best way to ensure durability, we do so throughout the project. We have used precast deck panels and girders for all concrete bridges. In addition, all designs follow *AASHTO LRFD Bridge Design Specifications* and CDOT's *Bridge Design Manual* guidelines as well as requirements regarding corrosion. To meet or exceed the durability requirements, the structures will provide initial bridge deck overlays, incorporate epoxy-coated (or equivalent) reinforcing, meet the concrete cover requirements for CDOT's "High" design category and use corrosion protection on any post-tensioning strands. To monitor and maintain the structural components, inspection access will be provided in accordance with *Schedule 10, Section 13.5.5 – Inspection Access*. We anticipate with periodic inspection and maintenance of these structures, the 40-year residual life at handback will be available. Additional details are provided in *Appendix B – Project Management Plan*, *Section K* which addresses the durability plan we will submit within 60 days of notice to proceed 1.

## Retaining Walls

Our team conducted an extensive value engineering effort that evaluated 14 alternatives to optimize retaining walls. The selected designs are primarily driven by location (i.e., cut or fill), retained soil height and groundwater intrusion. Our methodology focuses on reducing quantities while maintaining overall structure durability. Figure 6-10 on the previous page details the options for retaining walls.

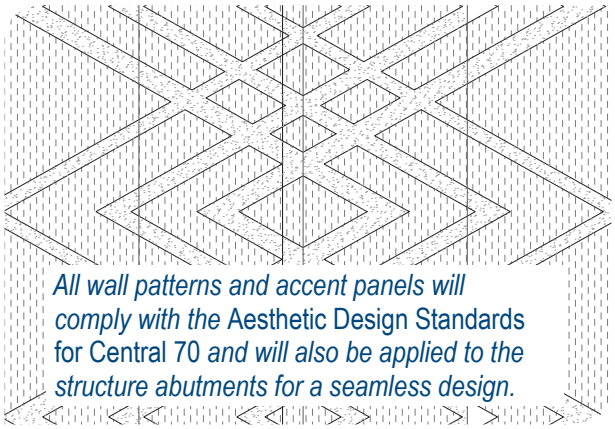
Where soil tie-backs and anchors were determined necessary, our cut retaining wall designs incorporated the conventional geotechnical testing results released as well as additional pressuremeter testing. The additional information from the pressuremeter testing allowed for design optimizations as well as reductions in the overall risk. The anchor tie-backs incorporated into the design of the cut walls also helps eliminate potential right-of-way constraints and utility conflicts.

**Challenges and Solutions.** Due to the relatively high exposed heights for most of the walls in the lowered section, the biggest challenges are limited room for tie-backs (due to right-of-way or utility constraints) and groundwater mitigation. For walls in the lowered section that are below the groundwater level, secant pile walls were found to be the most suitable solution, as they act as both a retaining wall and a cut-off wall and provide the necessary stiffness without requiring tie-backs.

Additional features of our design include providing precast fascia panels with architectural treatments for all exposed portions (regardless of wall type) and locating walls appropriately to enable construction to occur solely within the right-of-way.

**Durability.** We selected materials and incorporated design details, such as rebar cover and protective coating, to resist environmental factors. Our strategies that enhance durability include:

- Increasing galvanized coating thickness on MSE wall straps
- Using epoxy-coated rebar
- Using galvanized rebar



*All wall patterns and accent panels will comply with the* Aesthetic Design Standards for Central 70 *and will also be applied to the structure abutments for a seamless design.*

**Temporary Retaining Walls.** The construction staging along I-70 and the cross streets requires temporary retaining walls to support the work during various stages. While several

types of walls will be used, the most common is sheet piling which will be used to support earth embankments less than 8 feet high. Taller walls will be required to support temporary ramps or the UPRR shooflies. These walls will be constructed of wire-faced MSE wall which is easy to construct and economical. The wall between the viaduct and the lowered westbound lanes is the largest temporary wall. This wall is being constructed to keep the groundwater from the existing ground from reaching the new lowered lanes.

## L. DRAINAGE

Our drainage approach focuses on designing an efficient surface water collection and conveyance system that is well coordinated with and does not negatively impact the existing drainage system in the region. In strict compliance with *Schedule 10, Section 8 – Drainage*, our design meets or exceeds the specified targets and design criteria and satisfies the environmental commitments while achieving a cost-effective design. Our approach guarantees no adverse impacts downstream or outside the right-of-way, provides detention as necessary and accommodates the ultimate configuration while maintaining existing drainage patterns wherever possible.

**Optimizations.** We removed the pipe and on-site pond north of I-70 by draining it to Pond 7 using a pump station (ATC 4, see Figure 6-11). Benefits of this concept include:

- Significantly reducing impacts to the neighborhood to the north along the northern outfall alignment
- Eliminating right-of-way acquisition for the detention facility adjacent to the Riverside Cemetery
- Replacing risky and costly micro-tunneling with routine jack-and-bore and cut-and-cover construction of the stormwater culvert, reducing impacts to the traveling public, businesses and nearby communities and improving safety for workers and the public
- Reducing depth of excavation which reduces incursion into the groundwater by approximately 1.5 feet on the westbound lanes and 3.8 feet on the eastbound lanes

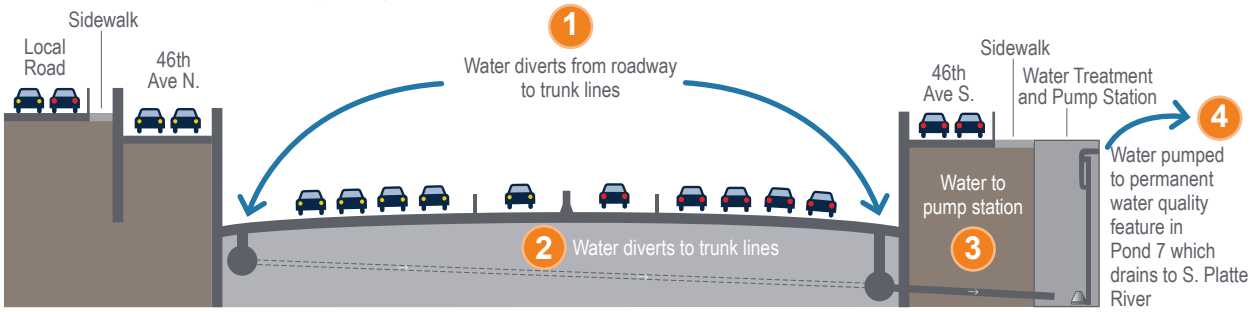
Additional features of our design include optimizing the spacing of inlets, pond sizes and geometry to maximize drainage efficiency. We also raised the storm sewer bridge by approximately one foot by replacing the 72-inch pipe with a 7-foot-by-6-foot post-tensioned reinforced concrete box which enable us to raise the I-70 profile, reducing groundwater intrusion.

### i. SURFACE WATER COLLECTION SYSTEM

**Highway Drainage.** Features of our highway drainage design include placing slotted drains at superelevation transitions and at driveways with large drainage from off site, and using GIS to verify existing pipe size and upsizing whenever necessary. We will also spaced inlets to meet the allowable spread and size pipes to accommodate the flow entering each inlet.

**Stormwater Management.** We will develop a comprehensive stormwater management plan to confirm drainage areas and pond and swale sizes, and to document any changes or additions to approach proposed in the reference documents. Stormwater management facilities will be designed for water quality control per CDOT and CCD requirements. Best management practices will be implemented upstream of outlets when right-of-way is not available for water quality ponds.

**Figure 6-11:** *Drainage Solution (ATC 4)*




*By eliminating the on-site outfall to the north we significantly reduce construction in the Elyria-Swansea neighborhood.*

**Water Crossings.** Our design for the I-270 ramp bridge over Sand Creek analyzed the upstream and downstream effects to ensure no negative impacts will occur. We confirmed the alignment would not increase the water surface elevation but it does raise the overflow channel which will require coordination with and approval from the Federal Emergency Management Agency. A thorough erosion and sediment control plan will be prepared and implemented to mitigate environmental impacts.

**Temporary Drainage.** We will use the existing systems initially and construct major outfalls as early as possible to minimize the need for temporary drainage. We identified several temporary connections will be installed as needed.

### ii. ON-SITE AND OFF-SITE DRAINAGE

**On-site Drainage.** Our innovative drainage design eliminates the on-site outfall to the north, channeling flow from the lowered section to the off-site drainage via a pump station adjacent to Pond 7 (ATC 4). The water passes through permanent water quality features before being released to combine with the off-site water (see Figure 6-11 on the previous page). We use inline detention along I-70 and will coordinate with CCD in all locations where our storm sewers drain to the existing system. On-site drainage design meets CDOT's MS4 Permit and New Development and Redevelopment Program requirements.

**Off-site Drainage.** Close coordination with CCD and the other adjacent agencies and cities is a critical element of our drainage approach — particularly with respect to the off-site outfall (Pond 7 and 7A and related systems). The outlet pipe from Pond 7A was designed to account for CCD flows and on-site flow from the lowered section (per ATC 4). It accommodates the Globeville Landing Outfall maximum design flow at the downstream junction structure. We will coordinate timed releases to avoid large peaks.

### iii. DETENTION AND DRAINAGE FACILITIES

All detention ponds were designed using EPA SWMM5. Key features include designing detention ponds for off-site stormwater to ensure I-70 does not flood during a 100-year storm and providing inline or underground detention (in lieu of ponds) for outfalls with limited available right-of-way. New drainage facilities include the pump station adjacent to Pond 7 (part of ATC 4); no existing drainage facilities are incorporated into the project.

Construction of the ponds will begin as soon as access to these parcels is available. We will then proceed upstream for work on the storm drain system. The pump station adjacent to Pond 7 (part of ATC 4) will be built early with the ponds to support efficient drainage between Brighton Boulevard and Colorado Boulevard (Segment 2) throughout construction.

### iv. REDUCING MAINTENANCE REQUIREMENTS

By eliminating the on-site outfall to the north (ATC 4), we eliminate the need to maintain a mile-long micro tunnel. Other concepts that reduce maintenance include simplifying drainage and collection equipment in one location (at the east end of Pond 7) with improved access (including an access road) for maintenance; strategically locating manholes for easier access; and steepening pipe profiles, wherever possible, to avoid the collection of material in the pipe.

**Designs that Consider Maintenance**

We increased the size of drainage culverts to improve access for maintenance crews and located culverts under the shoulders (rather than the highway lanes) to avoid impacting traffic should issues arise.

## M. UTILITIES

We will implement a comprehensive utility coordination and management plan that exceeds requirements and includes a data collection approach that goes beyond standard practice in Colorado. We will provide experienced personnel who will serve as a single point of contact for improved accountability to oversee all work. And we've already started. We have:

- Compiled the utility data provided by the Enterprises and analyzed it against our design
- Held discussions with all utility owners to gain an understanding of their needs and concerns so we can develop mutually agreeable solutions to resolving conflicts
- Developed full utility relocation drawings based on collaboration among our roadway,

structures, drainage and utility teams that accelerate schedule and reduce cost

This work has resulted in reducing the initial 330 conflicts by one third to 220 (and potentially fewer) relocations.

### Innovative Utility Solutions

Our design and utility teams collaborated on several utility solutions — the most significant being the elimination of the 48-inch sanitary sewer utility bridge near York Street (ATC 2). Relocating this utility underground provides CCD with long-term benefits including significantly reduced maintenance and reduced risk of damage to the line in the future.

## i. LOCATING UTILITIES

We exceed the requirements by using *ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data* for all underground mapping of existing utilities. ASCE 38 is a risk-based approach to classifying the certainty of existing utility data that results in a high-quality design. This approach protects all parties from the uncertainties related to the existence, location and character of existing underground utilities and fosters better engineering judgments in how to best use that data. The steps we will follow are based on ASCE 38 and summarized in Figure 6-12.

## ii. UTILITY RELOCATION COORDINATION

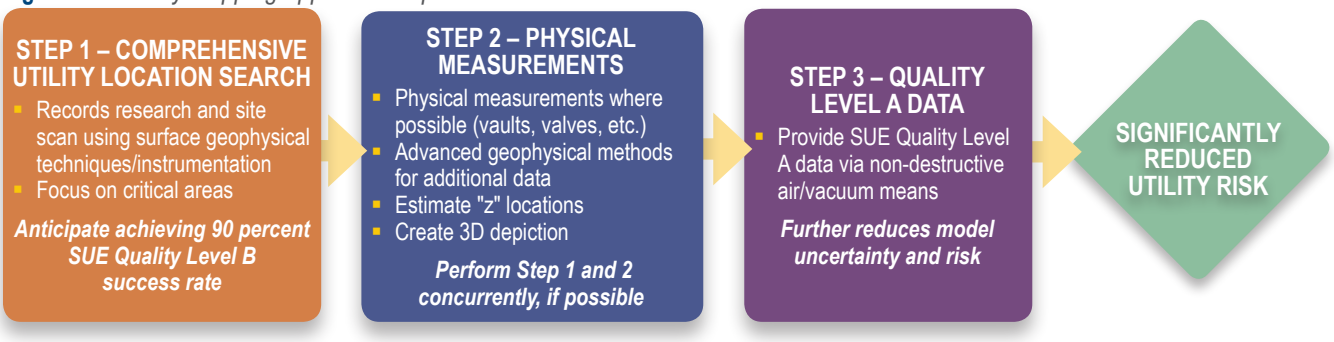
Utility coordination begins during design by using the achieved subsurface utility engineering (SUE) Quality Level B to identify potential conflicts and assess the most efficient resolution. We will use professional judgment to analyze the data and adjust the design where feasible in an attempt to eliminate as many relocations as possible to minimize cost, relocation time required, and impact to the public. In locations where design adjustments are not feasible, we will make recommendations to the utility companies on suggested relocation plans that will mitigate the conflicts while limiting schedule impacts. We will use the new *FHWA SHRP2 R15B Utility Conflict Matrix System* for tracking conflicts and their resolutions.

Utility coordination during construction includes assigning utility coordinators on site daily while relocations are occurring to ensure utilities are relocated to areas not in conflict with the new alignment. Our utility coordinators will photograph relocations, document progress and complete inspection logs.

We will hold biweekly coordination meetings to facilitate cooperation between the utility companies, construction team and stake holders. These meetings will provide a platform for resolution of conflicts that arise due to multiple utilities relocating in close proximity to each other or the construction of the new I-70 alignment and structures. The relocation and construction schedules will be discussed and schedule conflicts between the utility companies and our team will be resolved through communication and collaboration.

Existing utilities within the construction limits that have not yet relocated will be staked in the field and monitored to maintain their integrity while construction occurs. Utilities that have been relocated within the construction limits will be documented and staked in the field and construction personnel will be notified of their new location to prevent damage to the relocated utilities. Utility coordinators will brief the construction crews at the daily tailgate safety meetings regarding any utility relocation efforts in the vicinity of the crew's activities for

**Figure 6-12:** *Utility Mapping Approach Steps*



the day and notify the crew of existing utilities in the area that must be maintained during the day's operations. By serving as the point of contact between the construction crews and utility companies, utility coordinators maintain an open line of communication between all entities involved in operations on site.

## N. CONSTRUCTION PLAN

Figure 6-13 provides a summary schedule for the segments and major work elements and Figure 6-14 on the next page summarizes our phasing plan for each segments. Additional details are provided in *Part 3 – Maintenance of Traffic*. Our plan includes a strategy for coordinating the critical transitions between segments 1 and 2 and segments 2 and 3 where the existing alignment overlaps with shifted lanes. As described in *Part 3*, our solution involves shifting the traffic in three phases to construct the overlapping piece (see Figure 3-2 on page 20).

## O. DESIGN CHANGES

Our design includes optimizations and ATCs that result in a high-quality design and add value to the project for the Enterprises, the local community, the project's stakeholders and the traveling public. This section includes additional details and the benefits of changes we have made to the *Reference Design*. These are also summarized in Figure 6-1 on page 41.

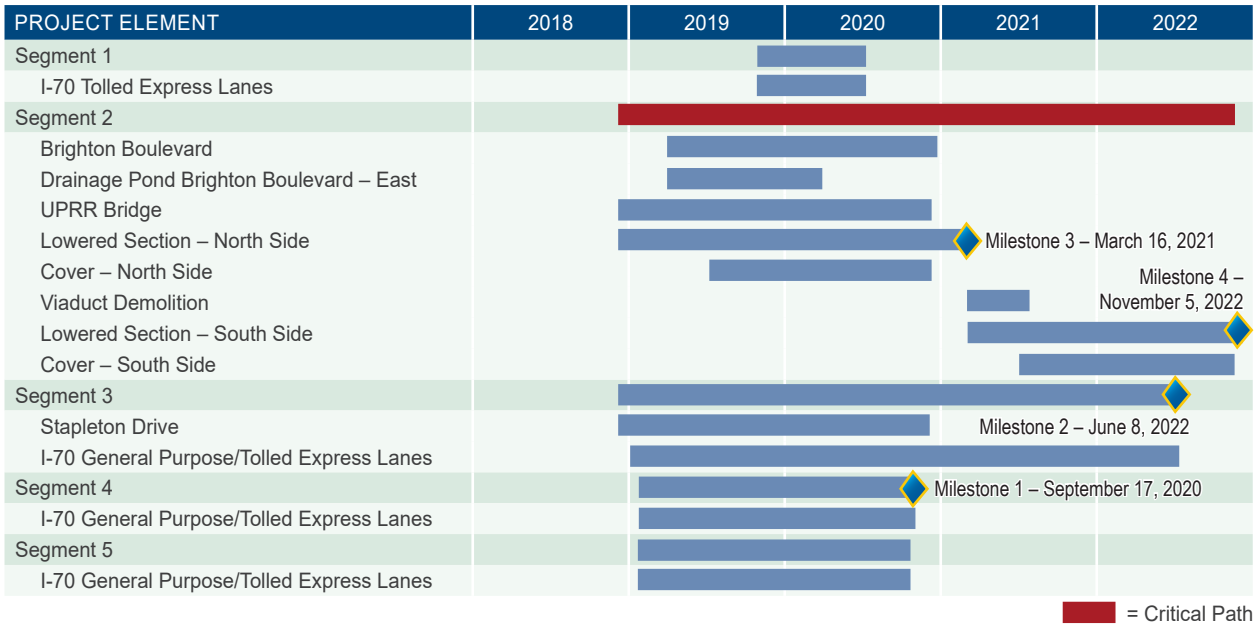
## ALTERNATIVE TECHNICAL CONCEPTS

Following are ATCs we have incorporated into our design including the benefits of each. No negative aspects are anticipated related to the implementation of these ATCs.

**ATC 2 – Reroute of York Street 48-inch Sanitary Sewer.** This ATC eliminates the 48-inch sanitary sewer utility bridge in the vicinity of York Street and relocates it further west to a location where the I-70 profile is at-grade or in a fill condition. By eliminating the sanitary sewer bridge and the associated roadway vertical clearance constraints, I-70 can be raised which reduces costs related to excavation and groundwater incursion. Additional benefits include reduced cost associated with shortened retaining walls; elimination of construction and maintenance costs associated with the sanitary sewer structure; accelerated construction; and reduced traffic impacts at York Street. Burying the pipe also results in a smaller environmental footprint, reducing air emissions, noise, vibration, dust and dirt production.

**ATC 4 – Reroute of Segment 2 On-site Drainage.** This ATC eliminates the on-site outfall to the north, channelizing the flow to the off-site drainage system via a pump station adjacent to and east of Pond 7. The water passes through permanent water quality features before combining with the off-site flows in Pond 7. Benefits of this ATC include reduced neighborhood impacts

**Figure 6-13:** *Construction Phasing by Element*



and right-of-way acquisitions, elimination of risk involving micro-tunneling and accelerated construction. (See Figure 6-11 on page 54.)

**ATC 14 – Optimized ITS.** This ATC incorporates dual-mounted closed-circuit television (CCTV) cameras to provide full, overlapping coverage, and mounts field equipment cabinets on poles/structures (rather than on the ground) wherever site conditions allow. Benefits of this ATC include reduced construction and maintenance costs, improved accessibility to equipment and potentially reduced right-of-way needs. Mounting equipment cabinets on poles reduces roadside obstructions, creating a safer roadway for both motorists and maintenance personnel.

**ATC 18 – Lane Closure on Brighton Boulevard.** This ATC allows continuous lane closures on Brighton Boulevard for all lanes in both directions between the north and south I-70 intersections while detouring traffic to 46th Avenue and 44th Avenue. Benefits include reduced construction costs by accelerating construction due to the ability to construct all of the new Brighton Boulevard roadway at once. Additional cost

**Figure 6-14:** *Construction Phasing by Segment*

| SEGMENT | DESCRIPTION OF WORK | PHASE | KEY ACTIVITIES |
|---|---|---|---|
| **Segment 1 – I-25 to Brighton Boulevard** | ▪ Restriping of I-70 | 1 | ▪ Add drainage inlets along shoulders<br>▪ Re-striping, shift traffic to final configuration, commission tolling |
| **Segment 2 – Brighton Boulevard to Dahlia Street** | ▪ Construct lowered section of I-70, cover structure and cross-street bridges<br>▪ Demolish viaduct | 1 | ▪ Construct UPRR bridge<br>▪ Construct north half of I-70 bridge over Brighton<br>▪ Construct northern portions of cross-street bridges<br>▪ Construct the majority of York bridge<br>▪ Construct portion of Steele/Vasquez bridge<br>▪ Construct north half of the cover<br>▪ Construct westbound I-70 from Brighton to Dahlia<br>▪ Construct North 46th Avenue between Brighton and Colorado<br>▪ Construct new Colorado |
| | | 2 | ▪ Construct transitions near Brighton and Colorado<br>▪ Construction remaining portion of Dahlia |
| | | 3 | ▪ Demolish existing viaduct<br>▪ Construct southern portions of cross-street bridges<br>▪ Construct south half of I-70 bridge over Brighton<br>▪ Construct south half of the cover |
| | | 4 | ▪ Complete landscaping and finishing elements outside of I-70 traffic<br>▪ Shift traffic to final configuration, commission tolling |
| **Segment 3 – Dahlia Street to Sand Creek Bridge** | ▪ Full reconstruction of I-70<br>▪ Construction of adjacent roadways and retaining walls<br>▪ Bridge reconstructions | 1 | ▪ Construct local street intersections<br>▪ Construct outside portion of I-70<br>▪ Construction outside portions of I-70 overpass bridges<br>▪ Construct new ramp configurations at Quebec |
| | | 2 | ▪ Construct center portion of I-70<br>▪ Construction inside portions of I-70 overpass bridges<br>▪ Site preparation with temporary pavement for next phase of cross-street construction |
| | | 3 | ▪ Finish half of construction of cross streets (Holly, Monaco and Quebec) |
| | | 4 | ▪ Finish other half of Holly, Monaco and Quebec cross streets |
| | | 5 | ▪ Shift traffic to final configuration<br>▪ Commission tolling |
| **Segment 4 – Sand Creek Bridge to Peoria Street** | ▪ Construct the full depth outside widening of I-70 | 1 | ▪ Construct new cross drainage structures<br>▪ Construct temporary pavement on both sides of Peoria<br>▪ Construct I-70 widening and Havana ponds<br>▪ Construct temporary widening along eastbound ramp from I-270 to eastbound I-70 to allow construction of new I-270 ramp bridge and pavement<br>▪ Construct Peoria bridge and I-70 approaches<br>▪ I-70 pavement mill and overlay during off-peak times<br>▪ Shift traffic to final configuration, commission tolling |
| **Segment 5 – Peoria Street to Chambers Road** | ▪ Construct the full depth outside widening of I-70 | 1 | ▪ I-70 pavement mill and overlay from east of Peoria to east of I-225 (skip section at Havana)<br>▪ Restripe I-70 lanes<br>▪ Shift traffic to final configuration, commission tolling |

savings result from a reduction in temporary pavement needed and safety is improved as co-mingling of vehicular and pedestrian traffic with construction activities is greatly reduced.

**ATC 26 – Cover MEP Electrical Distribution Optimization.** This ATC provides a simpler configuration of the power supply system to ensure the cover remains operational in the event of a single power supply transformer failure. Benefits of this system include reduced construction and O&M costs, and improved safety as critical systems will remain operational during an emergency event.

**ATC 28 – Swansea Elementary School Temporary Wall.** This ATC places the temporary wall designed to protect students from the work and reduce noise impacts against the right-of-way line (rather than away from it) to allow room to construct the cover structure while the temporary 46th Avenue connector is in place. Without this ATC, construction of the cover, including Columbine and Clayton streets cannot occur until the viaduct is demolished and 46th Avenue South is completed which is not possible since all crossings must be completed before excavation of I-70 can occur. Benefits of this ATC include accelerated construction and improved constructability without impacting safety and the environment while reducing impacts to traffic and the community.

### OPTIMIZATIONS

Figure 6-1 on page 41 highlights numerous optimizations included in our design. Following are details on key features.

**Split Vertical Profile for I-70 Mainline.** Splitting the I-70 vertical profile benefits the project by allowing the overall profile to be raised, minimizing groundwater incursion, reducing excavation and reducing retaining wall heights. There is also less elevation variation across I-70 at areas of superelevation which allows for better interconnection with adjacent roadways.

**Raising the I-70 Profile in the Lowered Section.** We have implemented design optimizations to raise the I-70 profile in the lowered section from approximately east of Brighton Boulevard to Colorado Boulevard. Benefits include reduced construction costs by reducing excavation, groundwater incursion and retaining wall height. Optimizations that contributed to raising the I-70 profile include:

- Splitting the vertical profile for I-70
- Lowering Brighton Boulevard by approximately 1 foot
- Relocating the Vasquez Boulevard exit sign to west of the cover, reducing the required clearance under the cover
- Reducing the depth of the UPRR bridge so that required clearance is less
- Eliminating the sanitary sewer bridge near York Street (ATC 2), reducing the required vertical clearance

**Holly Street Stopping Sight Distance.** The I-70 shoulders at the Holly Street bridge were revised and the bridge was widened by three feet to provide the required sight stopping distance, improving safety and eliminating the need for a design exception.

**I-270 Connector Realignment.** The I-270 connector was realigned to avoid impacting the existing I-270 abutment, and improve both constructability and maintenance of traffic.

**46th Avenue/Stapleton Drive Profile Revisions.** The profiles of 46th Avenue North and South and Stapleton Drive North and South were revised to minimize required cut and fill.

## P. CONSTRUCTION DEWATERING

### i. FINAL DISPOSITION OF WATER

Water from construction dewatering will be treated using temporary treatment system designed to meet anticipated MS4 discharge criteria for the South Platte River (segments 14 and/or 15). The system will be modular and able to include components as necessary based on the influent water quality. The system will be able to address, as necessary, total suspended solids (including total and potentially dissolved metals), dissolved metals (particularly manganese), inorganic parameters (particularly chloride, nitrate, phosphorus and sulfate) and organic contamination. The actual treatment components will depend on actual influent concentrations found prior to dewatering.

## II. ENVIRONMENTAL APPROVALS

We will comply with dewatering approvals including:

- Construction Activities Stormwater Discharge Permit
- Colorado Discharge Permit System Stormwater Construction Permit
- Municipal Separate Storm Sewer System (MS4) Discharge Permit (CDOT MS4 discharge requirements)
- MS4 Discharge Permit (outside CDOT right-of-way)
- Subterranean Groundwater Permit
- Construction Dewatering Permit
- Remediation Activities Discharging to Surface Waters Permit
- Remediation Activities Discharging to Groundwater
- Substitute Water Supply Plan
- Notice of Intent to Construct Dewatering Wells
- Stormwater Quality Discharge Permit for Construction Activities

## iii. MINIMIZING DEWATERING QUANTITY

Our dewatering plan includes installation of east-to-west and north-to-south cut-off walls to create "bathtubs" where groundwater and saturated soil can be sampled and the volume of water to be extracted is limited (Figure 6-15). In the northern portion of the lowered section where excavation will extend below the water table, we install an east-to-west cut-off wall at the southern limit of the construction zone (south of the proposed center line of I-70) from just east of Race Street to approximately Thompson Court. North-to-south cut-off walls will be installed on either end of the section and at intermediate locations as necessary. The north permanent wall will serve as the cut-off wall. This will be the permanent system to handle groundwater, which will be used during construction as the different elements are constructed. Temporary cut-off walls will be installed as needed to create the bathtub areas. An underdrain system will be installed to collect any seepage of groundwater which will then be treated for contaminants prior to discharge into the stormwater system.

### Environmentally focused Solutions

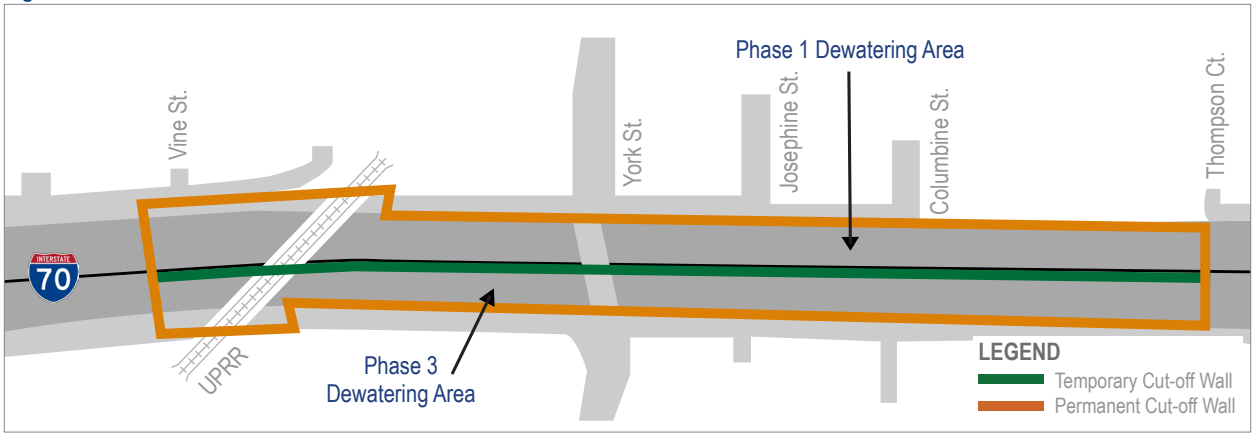
Our design, construction and O&M teams collaborated on a design that collects groundwater seepage and channels it to a collection facility where it is treated to meet/exceed surface discharge requirements before it is pumped into the storm sewer system. This proactive solution will reduce long-term maintenance.

Pumping wells and temporary dewatering/filtration systems will be used to extract the groundwater, store and test for contaminants, remove contaminants and proper disposal.

A similar approach will be used at the southern portion of the lowered section where the south permanent wall will serve as the cut-off wall and intermediate north-to-south cut-off walls will be installed to create bathtubs.

For a discussion about dewatering during the O&M period, see *Part 5, Section A.III.h – Groundwater Dewatering* on page 36.

**Figure 6-15:** *Cut-off Wall Locations to Create Bathtubs*



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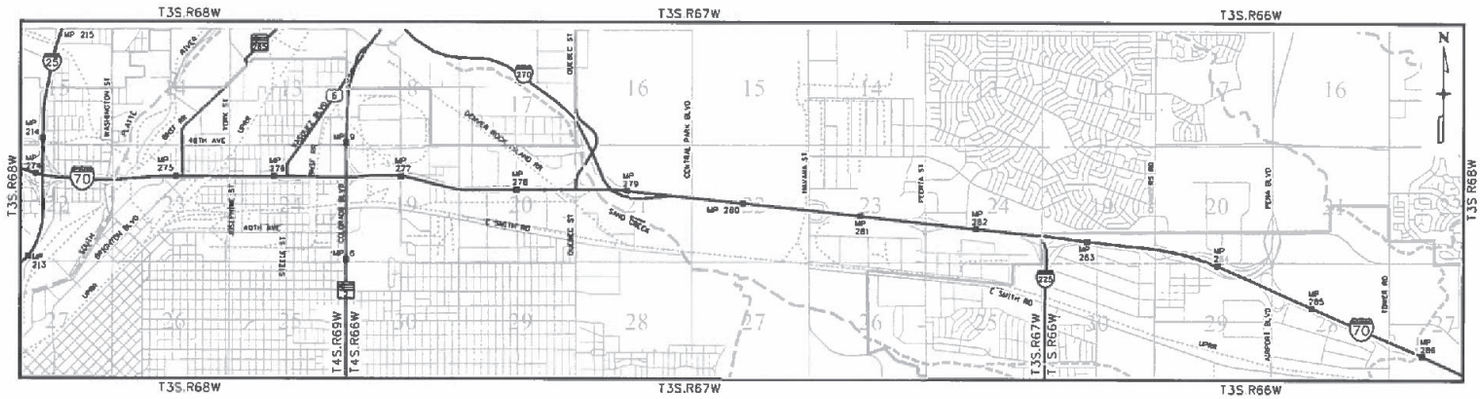
# 2.1.8. Appendix A: Draft Design Drawings

Click on underlined text above and Appendix A will open in a new window.




PROJECT LOCATION MAP

0 1/2 MILE 1 MILE 2 MILE

| | | | | | | |
|---|---|---|---|---|---|---|
| 7/2015 | | Sheet Revisions | | | Colorado Department of Transportation | PRELIMINARY | Contract Information | Project N |
| DES_Maint-Responsibilities_Operations_CoverSh | 01.dgn | Date: | Comments | Init. | 2000 South Holly Street<br>Denver, CO 80222<br>Phone: 303-757-9934 FAX: 303-757-9907 | No Revisions: | Contractor: | FBR 07 |
| 280 | Vert. Scale: As Noted | | | | | Revised: | Resident Engineer: | 196 |
| | Unit Leader Initials | | | | | | Project Engineer: | |
| | 7604 Technology Way, Suite 400 | | | | | | PROJECT STARTED: / / ACCEPTED: / / | |

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# 2.1.9. Appendix B: Draft Project Management Plan

CORA Exempt Materials redacted for the Public Disclosure Technical Proposal.

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# 2.1.10. Appendix C: Proposal Schedule

Click on underlined text above and Appendix C will open in a new window.

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# 2.1.11. Appendix D: Draft Stage 1 Quality Management Plan

CORA Exempt Materials redacted for the Public Disclosure Technical Proposal.

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# 2.1.12. Appendix E: Draft Stage 2 Quality Management Plan



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# 2.1.13. Appendix F: Draft Transportation Management Plan



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# 2.1.14. Appendix G: Draft Cover Design Baseline Report

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# 2.1.15. Appendix H: Draft Operations Management Plan

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# 2.1.16. Appendix I: Draft Maintenance Management Plan

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# 2.1.17. Appendix J: Draft Strategic Communications Plan



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# 2.1.18. Appendix K: Draft Small and Disadvantaged Business Participation Plan



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# 2.1.19. Appendix L: Draft Workforce Development Plan

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# 2.1.20.

# Appendix M: Draft Environmental Compliance Work Plan

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# 2.2 ATCs

CORA Exempt Materials redacted for the Public Disclosure Technical Proposal.