DC WATER NORTHEAST BOUNDARY TUNNEL
for
DC Water

Dr. AJ McGinn, President, Brierley Associates
&
Jacob Mitchell, Associate, Brierley Associates

DBIA-HOUSTON CHAPTER
PUBLIC AGENCY DESIGN-BUILD FORUM
OCTOBER 17, 2018
AGENDA

• Technical Components of NEBT
  • Jacob Mitchell

• Design-Build for Subsurface Projects
  • AJ McGinn
THE NEBT DESIGN-BUILD PROJECT TEAM
THE NORTHEAST BOUNDARY TUNNEL PROJECT

DC Clean Rivers Background
Magnitude of the Challenge

- Combined Sewer Overflows
  - Flooding on Mt. Olivet Rd NE
  - Flooding on Rhode Island Ave NE
  - Flooding on Rhode Island Ave NW
  - Flooding at 1st and V Streets NW
  - Flooding at Shaw metro
  - Flooding at 1st and P Streets NW

CSO Discharge to Anacostia River
Trash in Anacostia River
TECHNICAL COMPONENTS OF THE PROJECT

- NORTHEAST BOUNDARY TUNNEL
- CSO-019 SITE
- MT. OLIVET ROAD SITE
- W STREET SITE
- RHODE ISLAND AVE. SITE
- 4TH ST. SITE
- PUMPING STATION
- 1ST ST. CONNECTOR TUNNEL
- T ST. SITE
- FLORIDA AVE SITE
- R ST. SITE
The Northeast Boundary Tunnel Project is part of the Anacostia River Tunnel System.

- Included in the Consent Decree Modification for Potomac River and Rock Creek
- 27,000 LF, 23-foot ID, ~ 100-ft deep, EPBM
TUNNEL SEGMENT DESIGN
ACHIEVES STRENGTH, SERVICEABILITY AND DURABILITY

<table>
<thead>
<tr>
<th>Tunnel Ring main features</th>
<th>Values</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring Type</td>
<td>Universal ring, 6 + 1</td>
<td></td>
</tr>
<tr>
<td>Inner diameter</td>
<td>23’</td>
<td>feet</td>
</tr>
<tr>
<td>External diameter</td>
<td>25’4”</td>
<td>feet/ inch</td>
</tr>
<tr>
<td>Thickness</td>
<td>14”</td>
<td>inch</td>
</tr>
<tr>
<td>Average Length</td>
<td>6’</td>
<td>feet</td>
</tr>
<tr>
<td>Ring Taper</td>
<td>+/- 1 1/4”</td>
<td>inch</td>
</tr>
<tr>
<td>Available erecting positions</td>
<td>19</td>
<td>%</td>
</tr>
</tbody>
</table>

- Brierley is the EOR
- Tunnel Consult to support the EOR
- Preliminary design has been completed
- Similar to ART design and enhanced to meet NEBT design requirements

Datwyler Portland Anchored Gasket (26mm)
Slurry walls selected to address:

- Subsurface conditions
- Groundwater control
- Geometry
- Satisfy mandatory requirements
- Cost and schedule impacts

<table>
<thead>
<tr>
<th>Site</th>
<th>Slurry Wall</th>
<th>Secant Pile</th>
<th>Tremie</th>
<th>Jet Grout</th>
<th>Dewatering</th>
<th>Rock Mass Grouting</th>
<th>Socket The Soe Into Rock</th>
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<tbody>
<tr>
<td>Mt Olivet Rd</td>
<td>P</td>
<td></td>
<td>C</td>
<td>A</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W Street</td>
<td>P</td>
<td></td>
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<td></td>
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<tr>
<td>Rhode Island Ave</td>
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<td>A</td>
<td>C</td>
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<td>P</td>
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<tr>
<td>4Th Street</td>
<td>P</td>
<td>A</td>
<td>C</td>
<td></td>
<td>P</td>
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<tr>
<td>T Street</td>
<td>P</td>
<td>A</td>
<td>C</td>
<td></td>
<td>P</td>
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<td>A</td>
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<td>P</td>
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<tr>
<td>R Street</td>
<td>P</td>
<td></td>
<td>P</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Note: P – Preferred option    A – Alternate    C – Contingency
Support of excavation type selected to address:

- Meet mandatory requirements
- Subsurface conditions
- Groundwater control
- Mitigate third party impacts
- Site constraints
- Cost and schedule impacts

### NEAR SURFACE STRUCTURE TEMPORARY SUPPORT OF EXCAVATION PROVIDES A UNIQUE ROBUST SOLUTION AT EACH SITE

<table>
<thead>
<tr>
<th>Site</th>
<th>Support Of Excavation</th>
<th>Base Seal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Secant Piles</td>
<td>Cement/Bentonite Wall With Embedded Soldier Piles</td>
</tr>
<tr>
<td>MT OLIVET RD</td>
<td>A</td>
<td>P</td>
</tr>
<tr>
<td>W STREET</td>
<td>A</td>
<td>P</td>
</tr>
<tr>
<td>RHODE ISLAND AVE</td>
<td>A</td>
<td>P</td>
</tr>
<tr>
<td>4TH STREET</td>
<td>A</td>
<td>P</td>
</tr>
<tr>
<td>T STREET</td>
<td>P</td>
<td>A</td>
</tr>
<tr>
<td>FLORIDA AVE</td>
<td>A</td>
<td>P</td>
</tr>
<tr>
<td>R STREET</td>
<td>-</td>
<td>P</td>
</tr>
</tbody>
</table>

Note: P = Preferred option, A = Alternate, C = Contingency, NA = Not Applicable

**Diagram:** NEAR SURFACE STRUCTURE TEMPORARY SUPPORT OF EXCAVATION PROVIDES A UNIQUE ROBUST SOLUTION AT EACH SITE
Ground improvement selection criteria:

- Subsurface conditions
- Groundwater Control
- Meet mandatory requirements
- CSA occupancy restrictions
- Maintenance of traffic
- Project schedule
W STREET SITE

NORTHEAST BOUNDARY TUNNEL

RETAINING WALL

CONSTRUCTION STAGING AREA 1

CONSTRUCTION STAGING AREA 2

WS-J5

WS-VC

WS-VCF

WS-VCV

WS-IP
RHODE ISLAND AVENUE SITE

CONSTRUCTION STAGING AREA 1

CONSTRUCTION STAGING AREA 2

CONSTRUCTION STAGING AREA 3

CONSTRUCTION STAGING AREA 4

CONSTRUCTION STAGING AREA 5

RI-A-W

RI-A-DS

RI-A-IN1

RI-A-AC

NORTH EAST BOUNDARY TUNNEL

BRIERLEY ASSOCIATES
Creating Space Underground

LANE

salini
impregilo

dc
clean
RIVERS

water is life®

dc
clean
PROJECT
• Provides Robust Design with Redundancy for Ground Support
• FSCT on critical path for construction
• Design 18-in C.I.P. liner for temporary and permanent conditions
• Temporary shotcrete liner with lattice girders adjacent to NEBT
• Perform 3D finite element modeling

• Ground improvement via jet grouting
• Proof testing
  • Verify grouting parameters and column size
  • Evaluate potential for “shadow” below FST during proof testing
• Including potential contingency in the schedule
DESIGN-BUILD FOR SUBSURFACE PROJECTS

Design-Build
SUBSURFACE PROJECTS

Second Edition

Edited by
Gary S. Brierley
David H. Corkum
David J. Hatem

SME
A successful DB subsurface project must satisfy certain requirements:

- Defined in detail at CD stage to solicit proposals; clear design criteria, performance requirements, so that all proposers have the same understanding of the final completed project.

- Risks of unforeseen conditions, especially in the subsurface, must be dealt with fairly and realistically. DSC claims are common on subsurface projects, even with extensive geotech exploration; With DB, much less is known at proposal phase, and so DSC are greater.

- Owner must be flexible on performance requirements, and must relinquish control over design and construction process. If the Owner can't do this, then DBB may be better.

- Clear acceptance criteria must be established, so that completion of the project is unambiguous.
A successful DB subsurface project must satisfy certain requirements:

- Regulatory requirements must be clear. Don’t oversimplify intent during permitting process – this will limit flexibility and innovation otherwise associated with DB.

- A fair and equitable payment method, recognizing up-front costs, and providing clear mechanisms for measuring payment.

- 3rd party constraints must be defined and controllable.

- Funding must be available to support the projects project cash flow.

A subsurface project meeting these requirements is a candidate from Design-Build.
Risk Allocation for Subsurface Conditions, Defective Design

- Guiding principles should be fairness and clarity, with recognition that the hallmark DB single-point responsibility does not necessarily mean or require complete and absolute risk transfer under all circumstances to the Design-Builder.

- The project participants in the optimum position to control a particular risk should be clearly allocated the responsibility for that risk.

- The greater the risk the Owners control, decision-making and dominance in the design development and finalization process, the less likely the Owner will be able to transfer all, or even most, defective design risk to the Design-Builder.

- Owner decision-making regarding defective design risk allocation should be undertaken understanding the consequences of those decisions in relation to the insurability of that risk.
Team Structures and Relationships

**Recommendation 4-1:** The Owner must clearly define the project and develop a detailed scope of services that it desires. Not having a clearly defined scope can lead to misunderstandings, disputes, and mistrust among the parties. In addition, an unclear scope will inevitably lead to scope creep, additional costs, and a disappointed Owner and Design-Build team.

**Recommendation 4-2:** There must be communication between the Design-Build Team and the Owner during all phases of the project. The expectations of each party must be clearly communicated to the other.

**Recommendation 4-3:** Formal partnering should be adopted by the Owner and the Design-Build team as a way to handle the inevitable conflicts that will develop during the life of the Design-Build project.

**Recommendation 4-4:** The Design-Build team must have a teaming arrangement that clearly spells out the roles and responsibilities of each party, the deliverables and schedule for these, the relative financial participation and risks or rewards of each party, and how internal disputes will be resolved.
Recommendation 4-5: Each party to the Design-Build procedure needs to have a voice at the negotiation table so there is clear understanding of what is being asked and agreed upon and are no surprises.

Recommendation 4-6: A joint Contractor/Designer risk assessment is an effective way to get both parties on the same side to avoid the "us versus them" trap.

Recommendation 4-7: A review by an outside insurance expert of the insurance products, project requirements, risk matrix, and teaming agreement is advised.

Recommendation 4-8: The Design-Build contract provisions should clearly delineate each party’s risk responsibilities and include risk-sharing clauses (e.g., risk-sharing pools, provisional sums, and/or Contractor incentives for managing risk effectively). The party best able to manage or mitigate risks should be contractually responsible for them. In areas where risks are unknown or poorly defined at the time of bidding (such as unknown or poorly defined geotechnical conditions), provisions for price adjustment should be built into fixed-price-type contracts to help share cost-risk and provide equitable adjustment once such conditions or risks are better defined. This will minimize the need for unnecessarily large cost contingency in the bid price.
Procuring the Design-Build Team

**Recommendation 5-1:** The Owner's team and its consultants need to clearly define all key project technical and management issues, thus reducing all uncertainties to as low a level as possible. At a minimum, the design should be carried to at least the 30% level, with adequate drawings, design criteria, and special specifications to define the finished product, while leaving means and methods largely to the Design-Build team. The geotechnical aspects should be nearly complete to save time and to reduce uncertainty.

**Recommendation 5-2:** The Owner must be familiar with formal procurement methods and the public and legal policies on which they are based before undertaking a large, complex procurement such as a Design-Build subsurface project. Careful selection procedures must include planning and a detailed and thorough documentation of the selection process, which must be effective and defensive to demonstrate the technical basis and objectivity in selecting the Design-Build team.

**Recommendation 5-3:** The Owner needs to understand the balance of control, time, cost, and technical approach that is required for a Design-Build procurement. Trust in the Design-Build team is essential to get the desired result.

**Recommendation 5-4:** The Owner should limit the number of qualified proposers because of the potential risk and financial expense involved.

**Recommendation 5-5:** The Owner needs to evaluate and decide, and make clear in the RFP, what will be the selection methodology: best-value, lowest-price-technically-qualified, or low bid with basic qualifications.
Procuring the Design-Build Team (continued)

Recommendation 5-6: The Owner must create a clear and concise but comprehensive RFP that defines all elements to be submitted. The Owner should be clear about what it needs, what risk it will retain, how the selection process will unfold, and how the project will be managed and controlled. A pre-qualification step that focuses on getting bidders that have experience both with Design-Build and working effectively together in the past on similar projects is essential.

Recommendation 5-7: The Owner's team must communicate clearly to the proposers the evaluation criteria and how each is valued. Past performance on similar projects; design and construction expertise; legal, bonding, and insurance standards; and history of work-zone safety are all important and must be valued and weighed in a fair and reasonable manner. It cannot be understated how important it is to make these issues clear in the RFP.

Recommendation 5-8: As a general rule, a single contract package is preferable. Multiple contracts will create interfaces that are notoriously difficult to manage and that will increase management costs significantly.

Recommendation 5-9: To bring out the best teams and proposals, the Owner needs to evaluate the benefits and equity of a stipend for unsuccessful proposers. An honorarium will encourage more proposers after the pre-qualification stage and encourage a more detailed knowledge base for evaluation of the final proposals. An Owner should state whether or not all nonselected proposers will receive a stipend, or just the top two or three.
Recommendation 5-10: A prudent Owner will create a specific set of Design-Build contract documents rather than modify ones used in Design-Bid-Build work. The Owner will have to supplement its in-house team with legal, technical, political, and economic specialists (experienced in Design-Build projects) to adequately cover all aspects of risk definition and allocation, warranties, limits of liability, QA/QC enforcement, and so forth.

Recommendation 5-11: The Owner must plan how to do the procurement early in the process. Objectives and constraints, especially in public projects, must be identified early and considered when planning an RFP for a subsurface Design-Build project. Legislation to allow the process may be necessary to go forward. Effective outreach to both the public and design and construction communities is also necessary.
Agreements: Owner-Design-Builder and Design-Builder-Engineer

**Recommendation 6-1:** Members of the Design-Build team should exchange concerns about proposed terms and conditions prior to finalization of a contract with an Owner and understand the risks posed by the contract, including, but not limited to, schedule and delay risks, onerous terms, and financial penalties, before final pricing occurs and commitments are made.

**Recommendation 6-2:** Once the project commences, it is critical that the subconsultants and subcontractors to the Design-Builder identify project issues as they occur and provide timely notice to the Design-Builder. In turn, the Design-Builder must take guidance from its team members (when appropriate) and notify the Owner when such issues and concerns are identified.

**Recommendation 6-3:** The agreements should contain an obvious and unambiguous memorialization of the allocation of risks, which should be clearly assigned through one of the project's contracts. The Owner should understand how the Design-Builder is transferring and mitigating contractual risks through the services to be provided by other members of the Design-Build team.

**Recommendation 6-4:** Sureties and appropriate insurance should be used to backstop otherwise unacceptable risks. The Owner should also consider establishing contingency accounts to address risks that are beyond the control of project participants. In addition, the members of the Design-Build team offering professional services (i.e., the design engineers) should provide certificates of insurance providing evidence of sufficient coverage for the amount of reasonably foreseeable risk associated with a project.
Recommendation 6-5: Careful early planning of the entire project should be factored into developing the contracting architecture. Of particular importance, in the early phase of the project, is identifying and characterizing the interfaces between contracts. The Design-Builder must translate the entire scope of work negotiated with the Owner into clearly defined segments so that appropriate scope risk is assigned to the proper party and each party clearly understands its role in the entire process.

Recommendation 6-6: The generally accepted farm agreements will likely require some modification to fit a subsurface project, and editing and modification should be accomplished by practitioners familiar with the underground construction industry.

Recommendation 6-7: The Owner and the Design-Builder should address (in the contract) an appropriate transfer of risk and responsibility for unique challenges associated with a specific project. To a certain extent, reasonable contingencies can be developed for issues such as material shortages, permitting delays, seasonal interruptions, and accommodations due to public needs.

Recommendation 6-8: For the resolution of disputes, an effective agreement should also include a fair and reasonable process that allows the parties to raise and attempt to resolve their issues and disputes without affecting ongoing project performance and completion.
Design Development

**Recommendation 7-1:** In order to minimize bidding contingencies resulting from uncertain scope and to avoid potential liability, the Owner should establish in as detailed a manner as possible the project scope in the tender documents, while still leaving the Contractor with the flexibility to develop innovative design solutions. In particular, the Owner should identify specific details needed to comply with existing third-party agreements and perform sufficient pre-tender geotechnical investigations to enable bidders to evaluate feasible means and methods of construction.

**Recommendation 7-2:** The Owner should recognize that the Design-Builder’s level of effort required to complete the final design is not significantly different from that on a Design-Bid-Build project and should allow sufficient time in the project schedule to complete the design process.

**Recommendation 7-3:** In order to facilitate communication and identify conflicts at an early stage, the entire Design-Build team should go through a formal partnering program in which the goals and objectives of each party are set forth and recognized by the other participants.
Recommendation 7-4: The Owner is advised to take contract packaging considerations into account when determining delivery methods.

Recommendation 7-5: The Contractor and Designer that form the Design-Build entity must define the risk allocation between themselves and clearly identify when one is solely responsible for specific outcomes.

Recommendation 7-6: To increase the efficiency of the design process, the Owner should refrain from specifying detailed quality assurance processes in the RFP document but should consider allowing the Design-Build team to establish its own quality assurance plan and include it as a part of the technical proposal.
Subsurface Explorations

**Recommendation 8-1:** The Owner's geotechnical consultant should perform a phased subsurface investigation program during design. This program should address the needs of both the Owner's Engineer and the Design-Build team.

**Recommendation 8-2:** All geotechnical data obtained should be made available to shortlisted Design-Build teams prior to tender development. Refer to Chapter 9 for detailed recommendations regarding format of reports.

**Recommendation 8-3:** Design-Build teams should retain their own geotechnical consultants during the procurement phase to assess the adequacy of the existing geotechnical database provided by the Owner, given the Design-Builder's planned means and methods. Design-Build teams should be allowed to request additional geotechnical investigations during the procurement phase as necessary to finalize their pricing/or the work.

**Recommendation 8-4:** The Owner's geotechnical consultant should implement supplemental subsurface investigations during the procurement phase and should provide that information to all tenderers before finalization of their proposals.

**Recommendation 8-5:** It is expected that the selected Design-Build team will need to perform its own geotechnical investigation after NTP. This program should be subject to the oversight and acceptance of the Owner's geotechnical consultant, and the results of this program should be incorporated into the contract documents.
Geotechnical Reports

**Recommendation 9-1:** A thorough investigation of the subsurface ground and groundwater conditions should be carried out in advance of the selection of a Design-Build team.

**Recommendation 9-2:** Existing underground and overhead utilities should be addressed, including efforts by the Design-Build team to identify and relocate utilities in advance of construction.

**Recommendation 9-3:** All information learned and obtained in the procurement documents should be properly disclosed.

**Recommendation 9-4:** Design-Build teams should be engaged in a bilateral process during the bid phase that achieves a jointly prepared and agreed-upon GBR-C.
Construction Phase Issues

**Recommendation 10-1:** For a typical Design-Build contract, the usual principle that the Contractor takes responsibility only for those risks over which it has some control still applies. Specifically for subsurface work, “The Owner owns the ground” and differing site conditions clauses apply. The Geotechnical Baseline Report will set out the conditions to be expected and the less likely but still possible conditions that the Contractor may have to deal with and for which it is compensated according to the contract.

**Recommendation 10-2:** During the construction phase, the risk register should be maintained as an active document, regularly updated to identify new risks and re-assess existing ones, and to actively manage risks through the construction and commissioning phases and successful project completion.

**Recommendation 10-3:** When disputes occur, effective formal and facilitated partnering can lead the parties to resolve the dispute in a constructive manner and minimize the impact on progress of the work. The Design-Build contract should include an alternative dispute resolution provision for disputes that cannot be resolved between the parties, with the aim of speedy resolution through a fair and transparent process that all parties respect and are likely to accept.
Recommendation 10-4: To avoid lengthy design submittal reviews, rework by the Design-Builder's Designer, and disputes and delay claims, design workshops should be conducted in which the Owner's Consultants explain the development of the reference design and share their knowledge of the ground conditions, while responding to the Designer's proposed approach to the design and design innovations. Initial design workshops should cover the main areas of design, and additional workshops should be instigated by the Owner's Engineering Consultant when review of design submittals shows differences in approach or apparent misunderstandings of requirements.

Recommendation 10-5: The Design-Builder's responsibility for quality control should be accompanied by responsibility for quality control-overseen by appropriate quality assurance audits. For underground construction, it is in the Owner's best interests to have its own forces or consultants perform some level of direct inspection and an independent laboratory perform verification testing. The quality assurance audits should include direct observation of the inspection process and independent review of the data collected.
Insurance Coverage Issues

Recommendation 11-1: To determine the true extent of coverage, it is important to review the standard policy exclusions and limitations.

Recommendation 11-2: Coverage for pollution exposure is typically provided through an endorsement to the standard professional liability policy that buys back the pollution coverage by eliminating or modifying the pollution exclusion.

Recommendation 11-3: Contractor wording will name the Design-Builder and provide coverage via the insuring agreement for damages arising from the named insureds architects and engineers as well as the named insureds legal liability for design professionals under contract to them.

Recommendation 11-4: Before deciding which method of risk management is best for the project, consider all the advantages of a CIP.
Insurance Coverage Issues  (continued)

**Recommendation 11-5:** When working with the surety underwriting community, several key issues, such as contract terms, qualifications of team members, and financial conditions, should be emphasized in order to enhance underwriters' comfort level with the Design-Build project.

**Recommendation 11-6:** One of the most important builder's risk insurance policy endorsements to review is the Tunnel and Subsurface Construction Endorsement.

**Recommendation 11-7:** For subsurface projects, several important builder's risk insurance exclusion wordings should be reviewed. Several of these exclusions can and should be deleted; for example, for loss or damage due to subsidence if caused by insufficient compacting or grouting and for expenses incurred for the repair of eroded slopes or other graded areas if the insured has failed to take preventative measures.

**Recommendation 11-8:** The pollution policies can be extended to cover off-site waste disposal locations, transportation exposures, or even contingent risks such as business interruption or economic loss associated with contamination.
THANK YOU!