Falls Bridge Advisory Committee

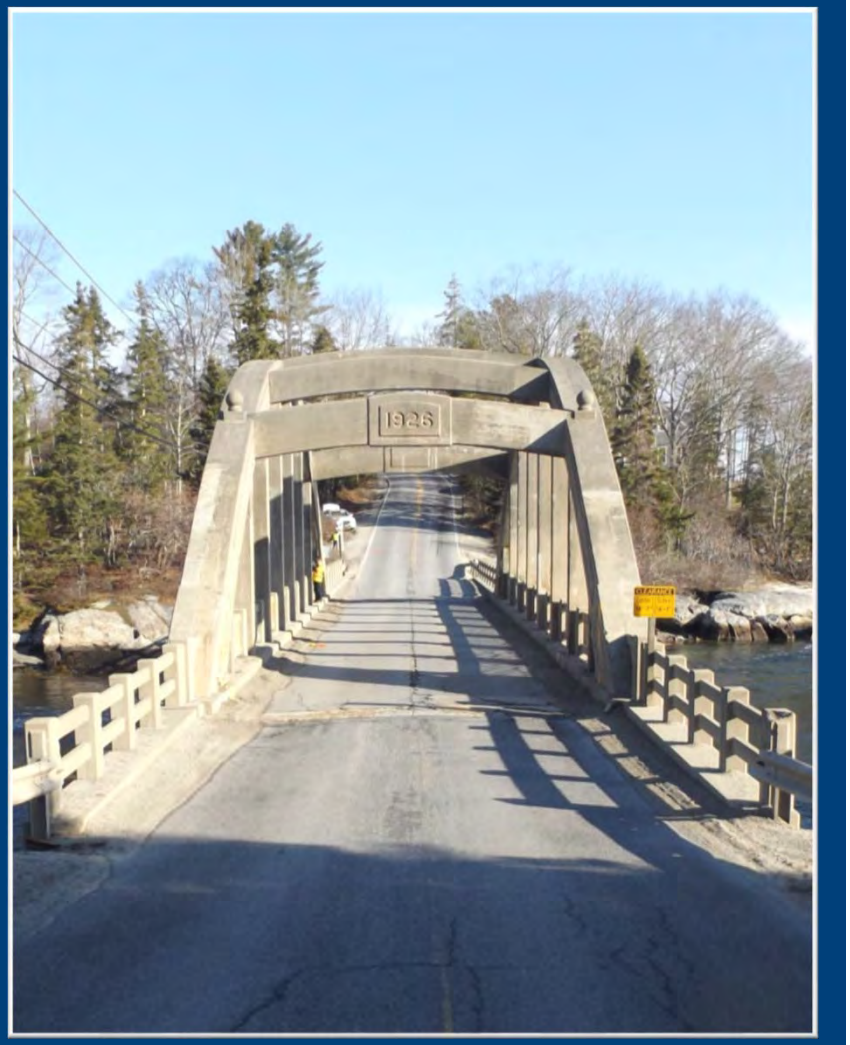
Meeting #9

Rehabilitation of Existing Bridge – Constructability

November 16th, 2017

Meeting Agenda

- Refined Rehabilitation Strategy
- Construction Approach
  - Assumed Construction Methods
  - Assumed Constr. Sequence
- Construction Schedule
- Construction Cost
- Alternatives Matrix
- Next Steps
- Discussion



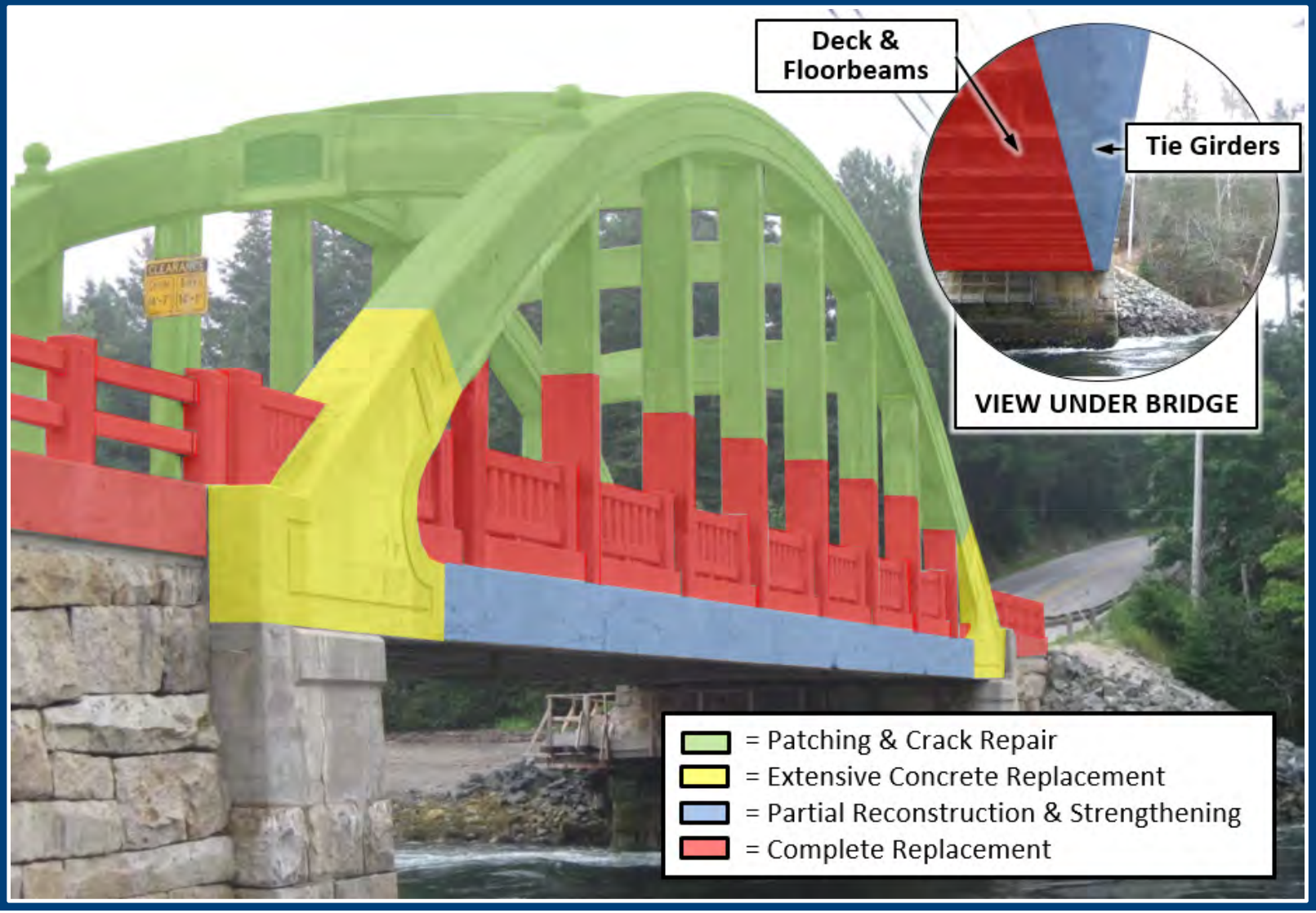
Refined Rehabilitation Strategy

Approach to Evaluating Rehabilitation

- Steps 1 & 2: Identify, assess & short list initial options ✓ Presented Last Meeting
  - Superstructure
    - Replace deck, floorbeams and railings
    - Extensive concrete rehabilitation at tie girders, knuckles and hangers
    - Strengthen tie girders
  - Abutments & Retaining Walls
    - Strengthen / Reinforce abutments
    - Remove eroded fill within approaches, replace with concrete fill
- Step 3: Assess constructability, schedule, impacts, longevity & cost
- Step 4: Identify most suitable rehabilitation strategy

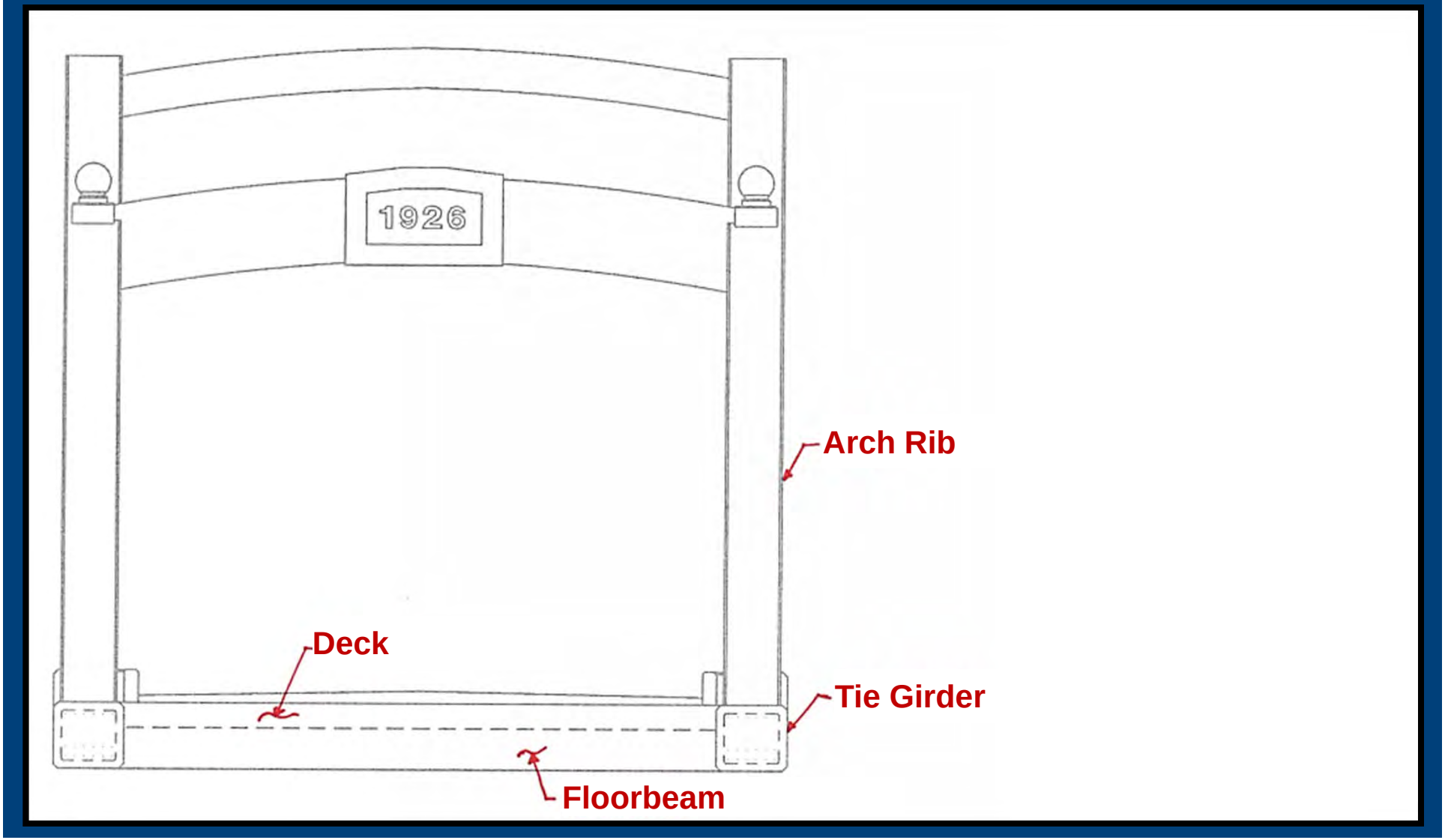
Refined Rehabilitation Strategy

Superstructure Rehabilitation



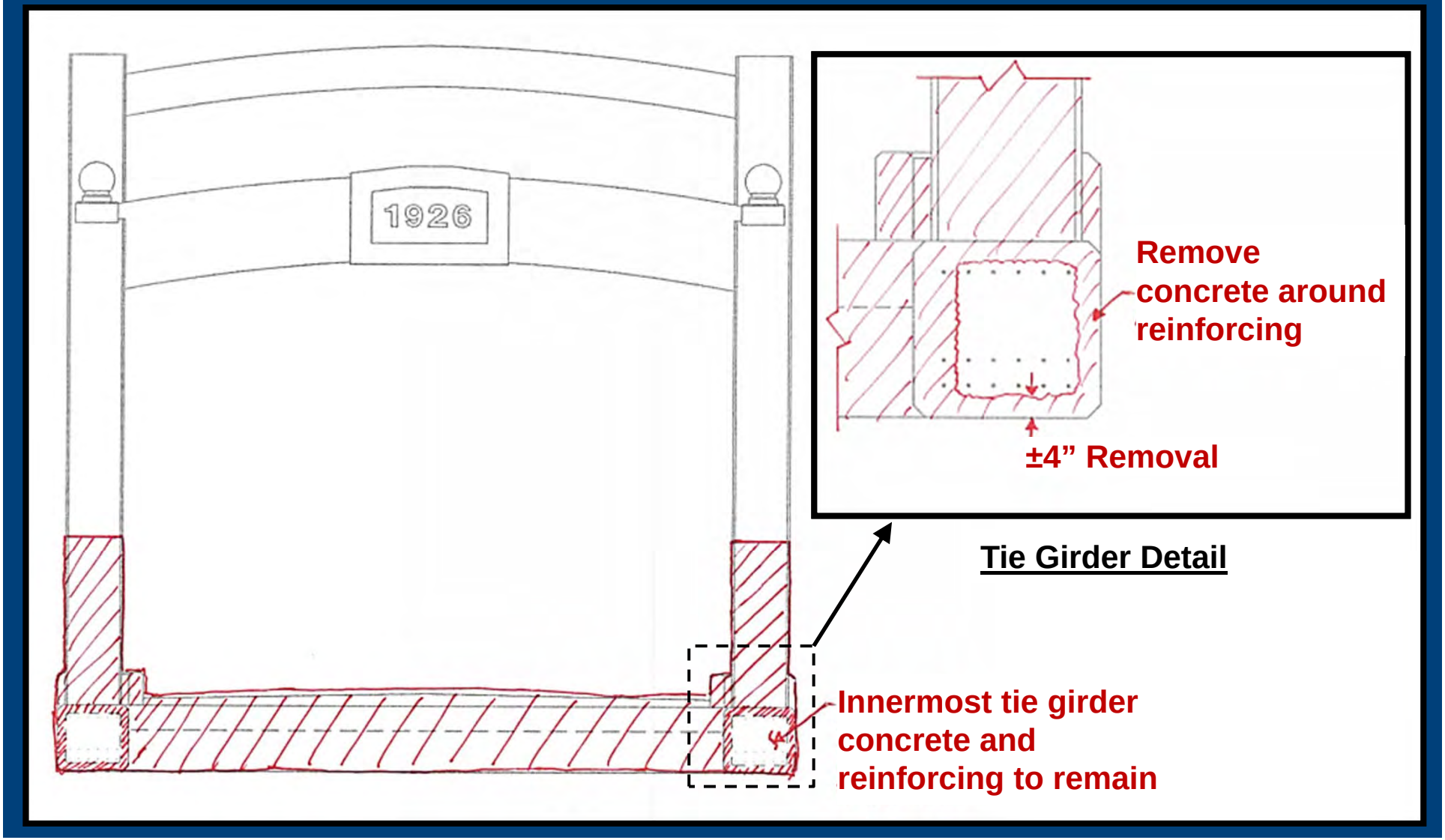
Refined Rehabilitation Strategy

Superstructure Rehabilitation - Existing



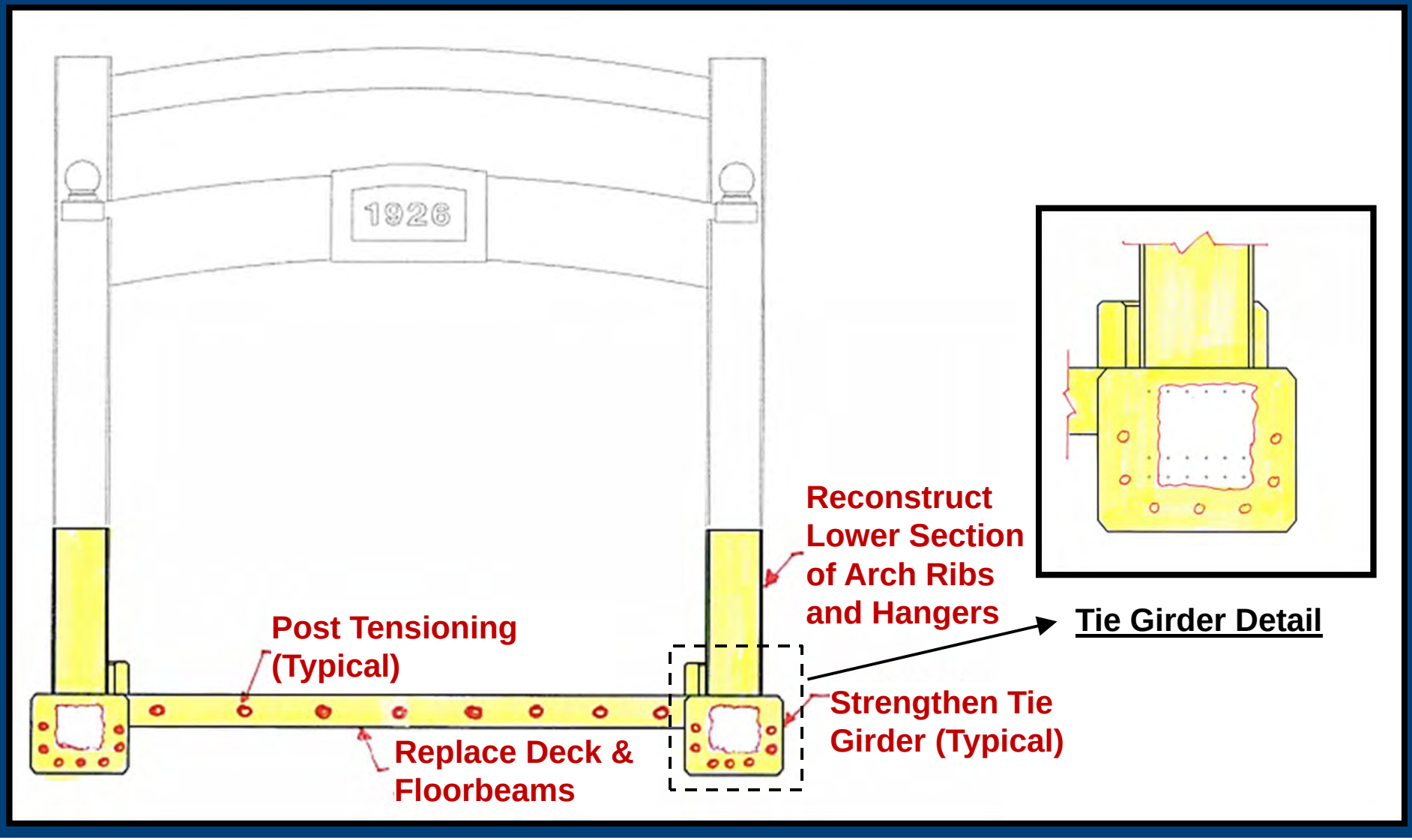
Refined Rehabilitation Strategy

Superstructure Rehabilitation - Demolition



Refined Rehabilitation Strategy

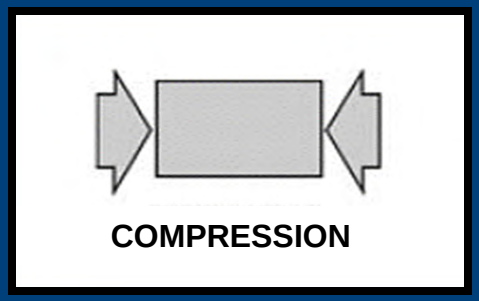
Superstructure Rehabilitation - Strengthening

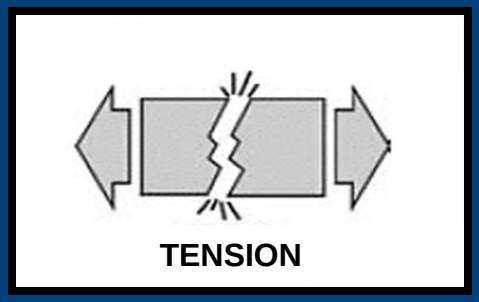


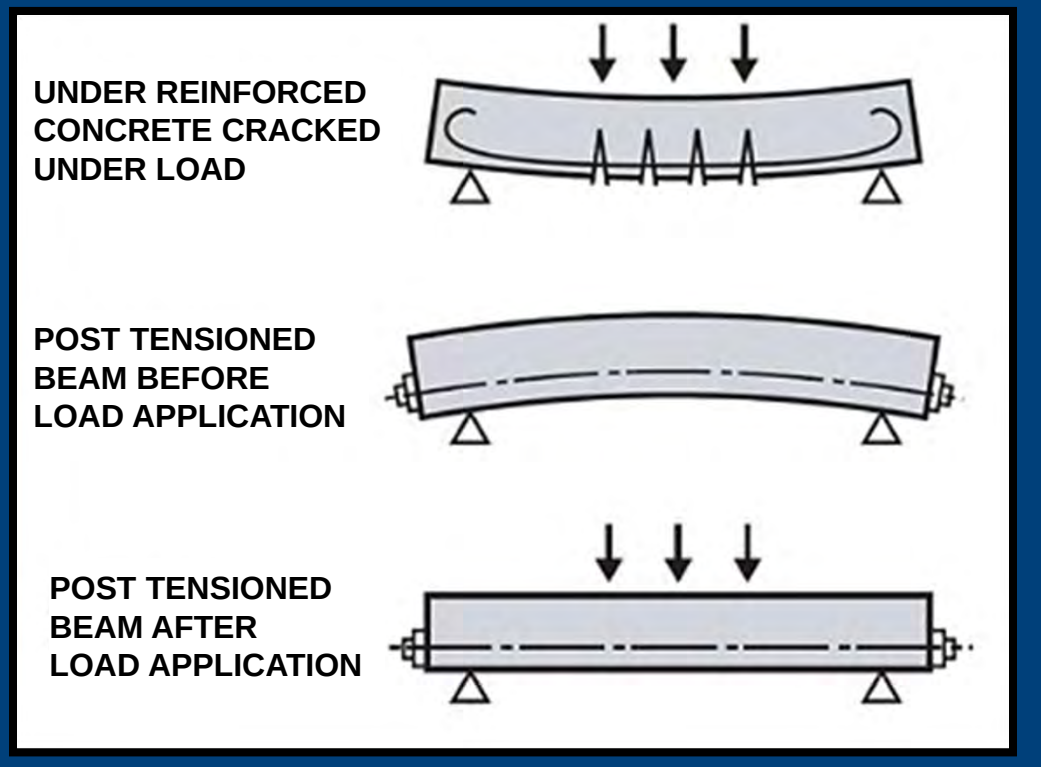
Refined Rehabilitation Strategy

Superstructure Rehabilitation

- Why Post Tension?
  - Concrete is GOOD in compression, POOR in tension
  - Significantly improves capacity



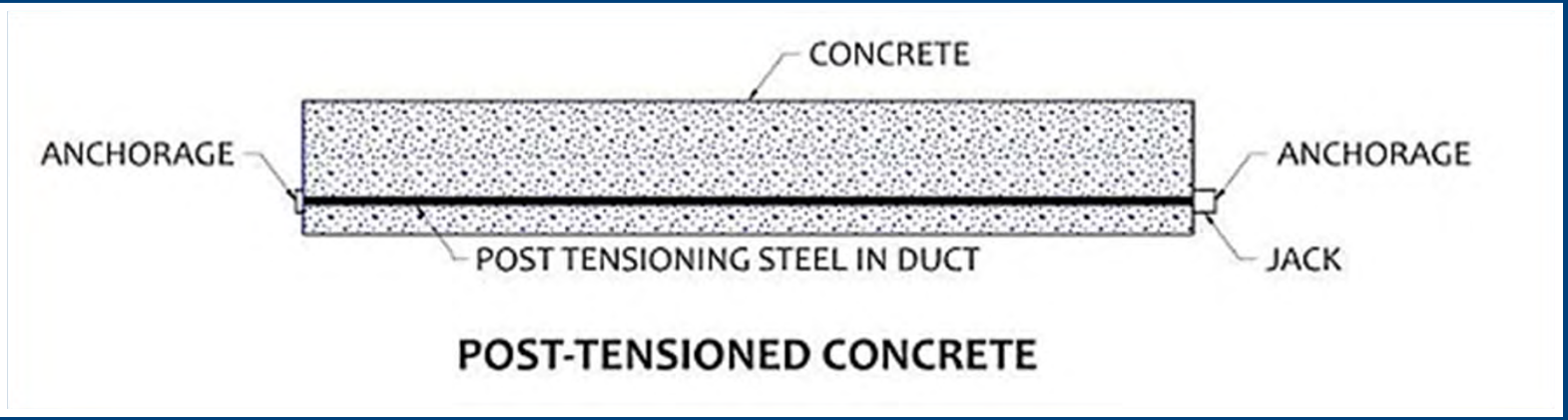


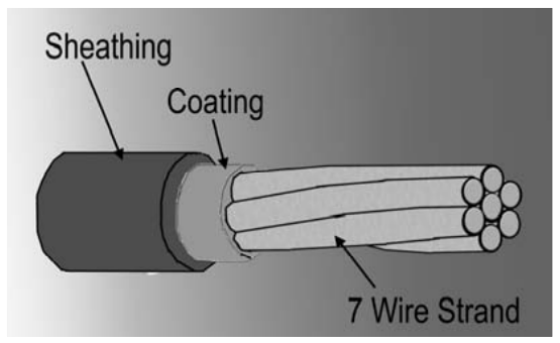


Refined Rehabilitation Strategy

Superstructure Rehabilitation

- How is Post Tensioning Achieved?





POST TENSIONING STRAND

STRAND DUCTS INSTALLED

STRAND TENSIONING

Refined Rehabilitation Strategy

Substructure Rehabilitation

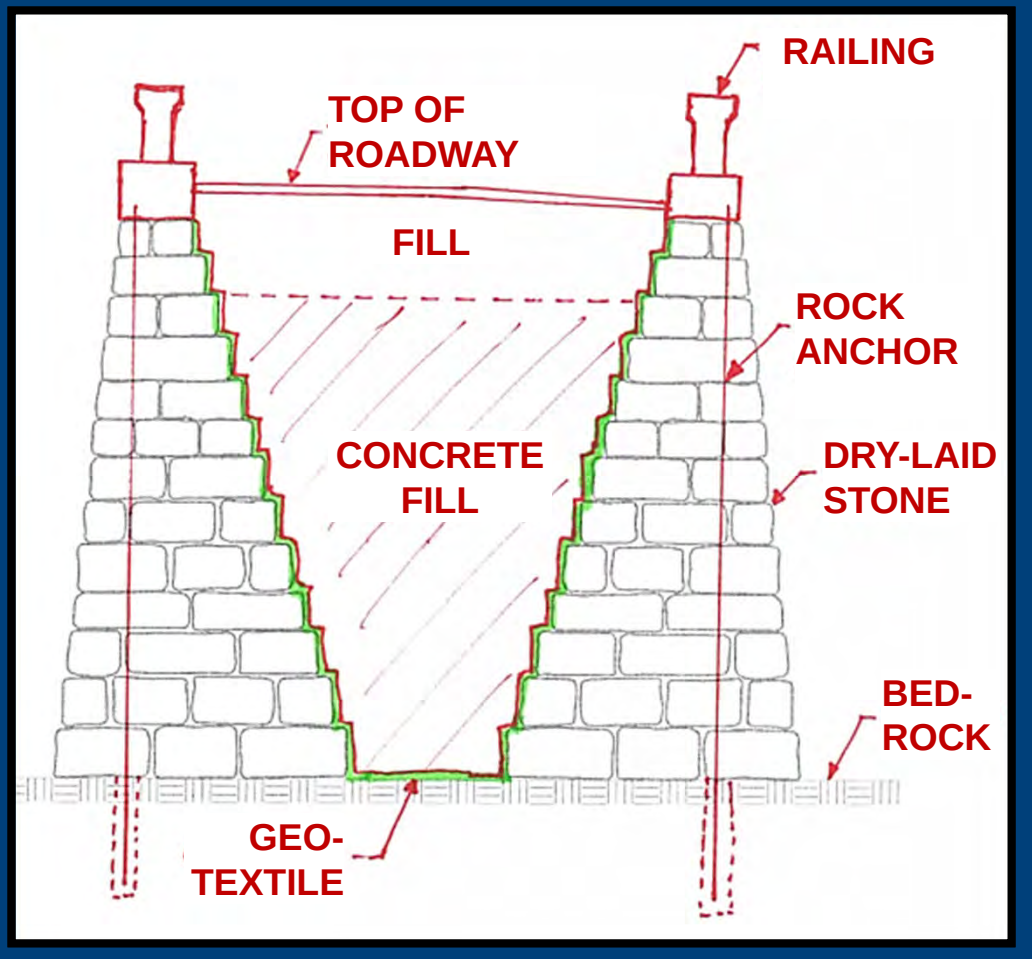
Refined Rehabilitation Strategy

Substructure Rehabilitation

Approach Walls: Address wall stability and water infiltration through the installation of rock anchors and placement of concrete fill.

Construction Sequence:

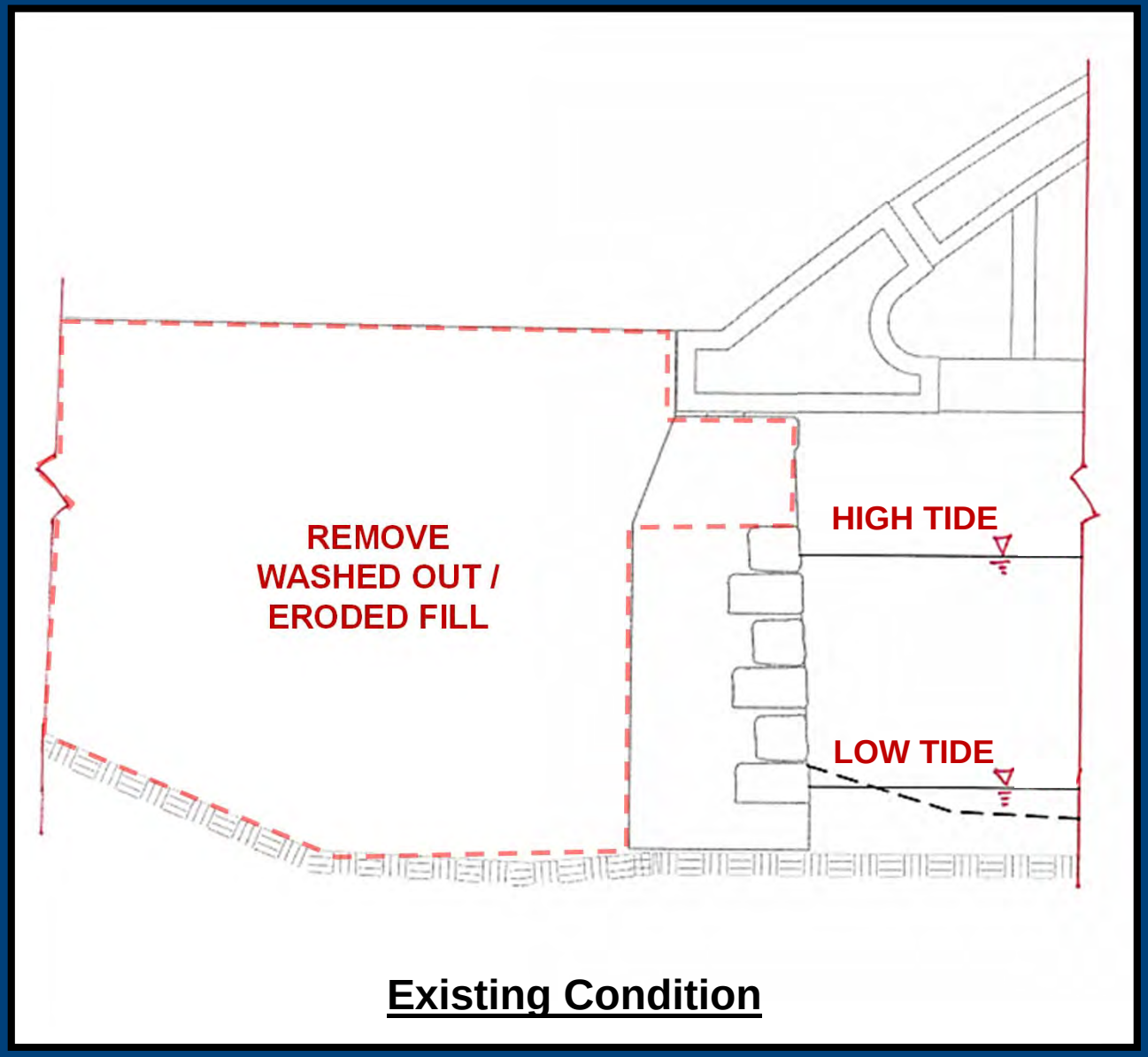
1. Install rock anchors
2. Excavate existing fill at low tide
3. Place geotextile layer
4. Place concrete in layers
   - Approx. 1,000 CY of concrete
5. Perform superstructure rehab.
6. Place fill, pavement, and barrier



Refined Rehabilitation Strategy

Substructure Rehabilitation

Abutments: Address masonry shifting, concrete condition and potential stability by replacing the existing concrete abutment cap.



Existing Condition

Refined Rehabilitation Strategy

Substructure Rehabilitation

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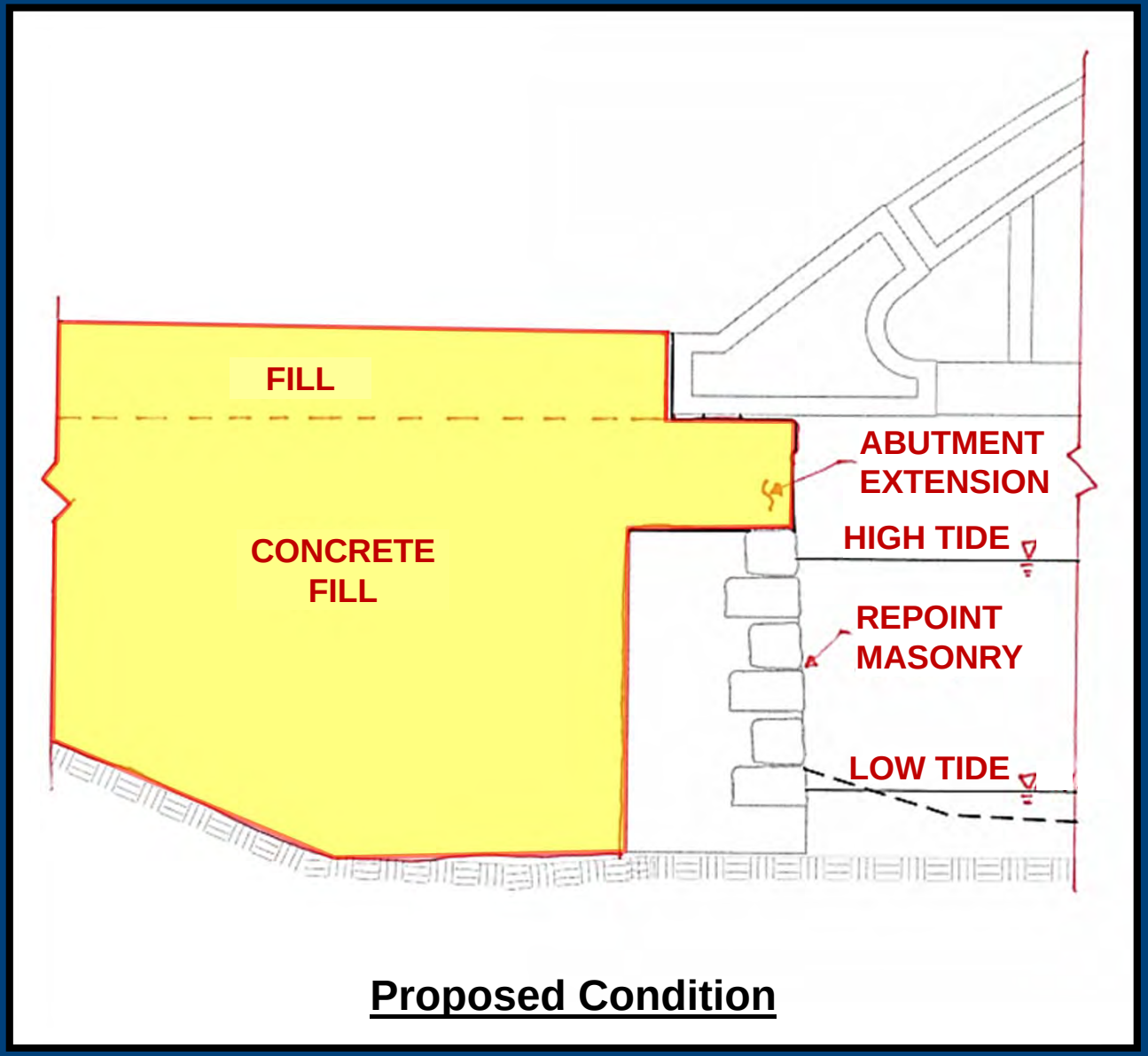
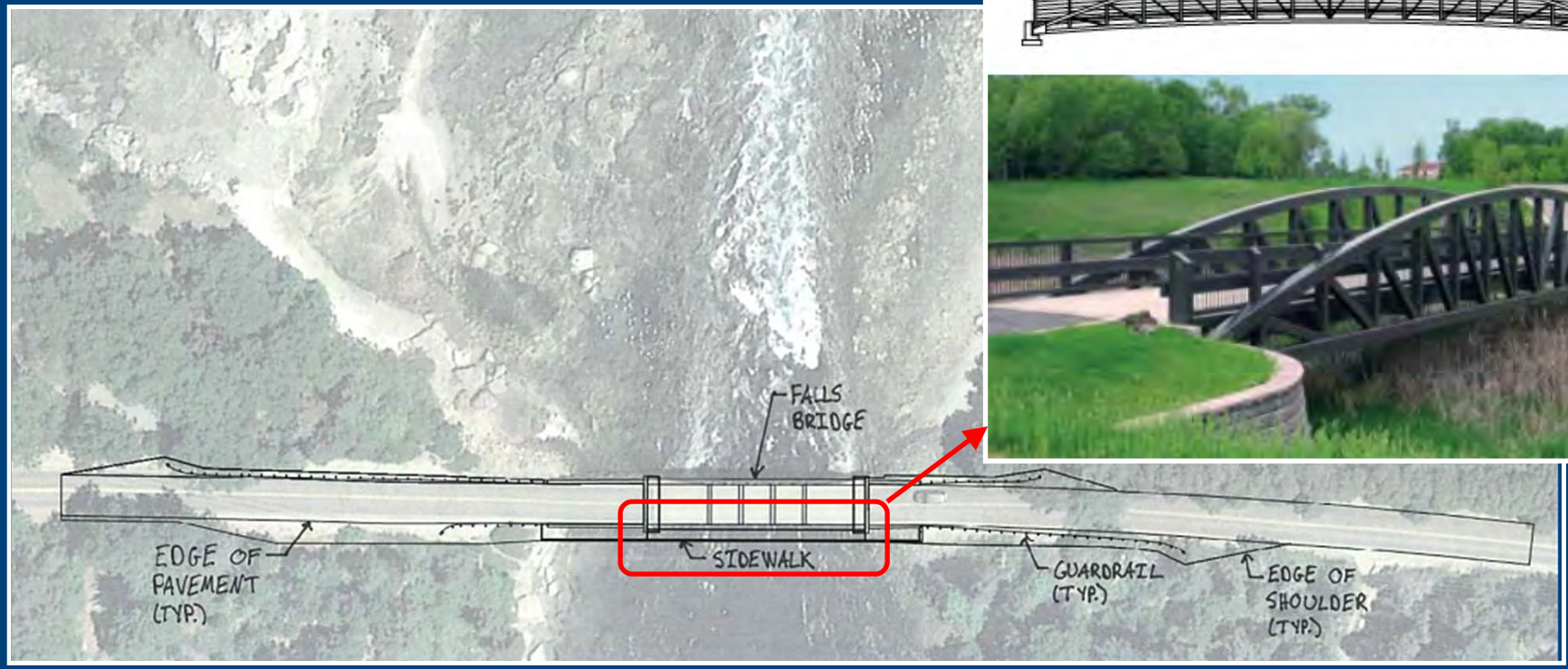


Proposed Condition

Refined Rehabilitation Strategy

Sidewalk Addition

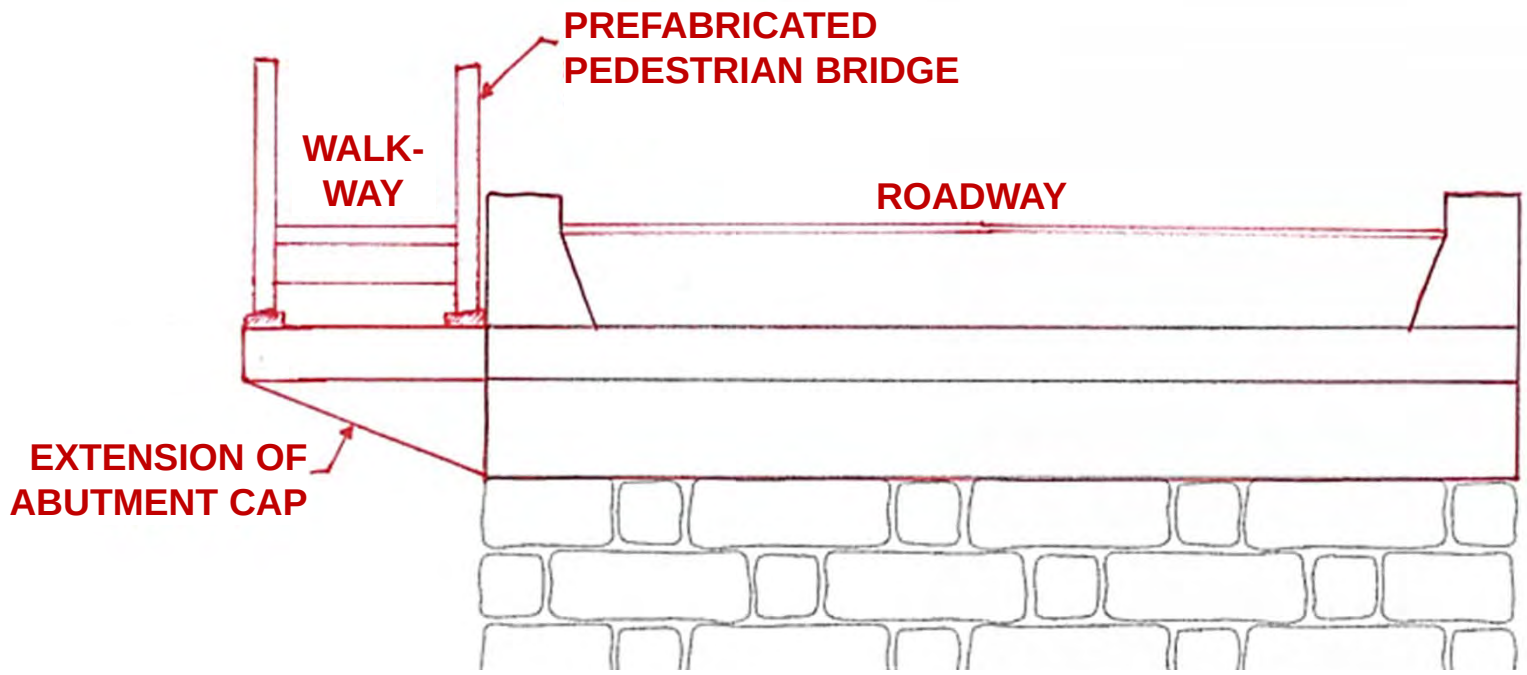
- Alongside Bridge: Independent pedestrian bridge, prefabricated steel.



Refined Rehabilitation Strategy

Sidewalk Addition

- At Abutment: Support for pedestrian bridge extended from abutment.

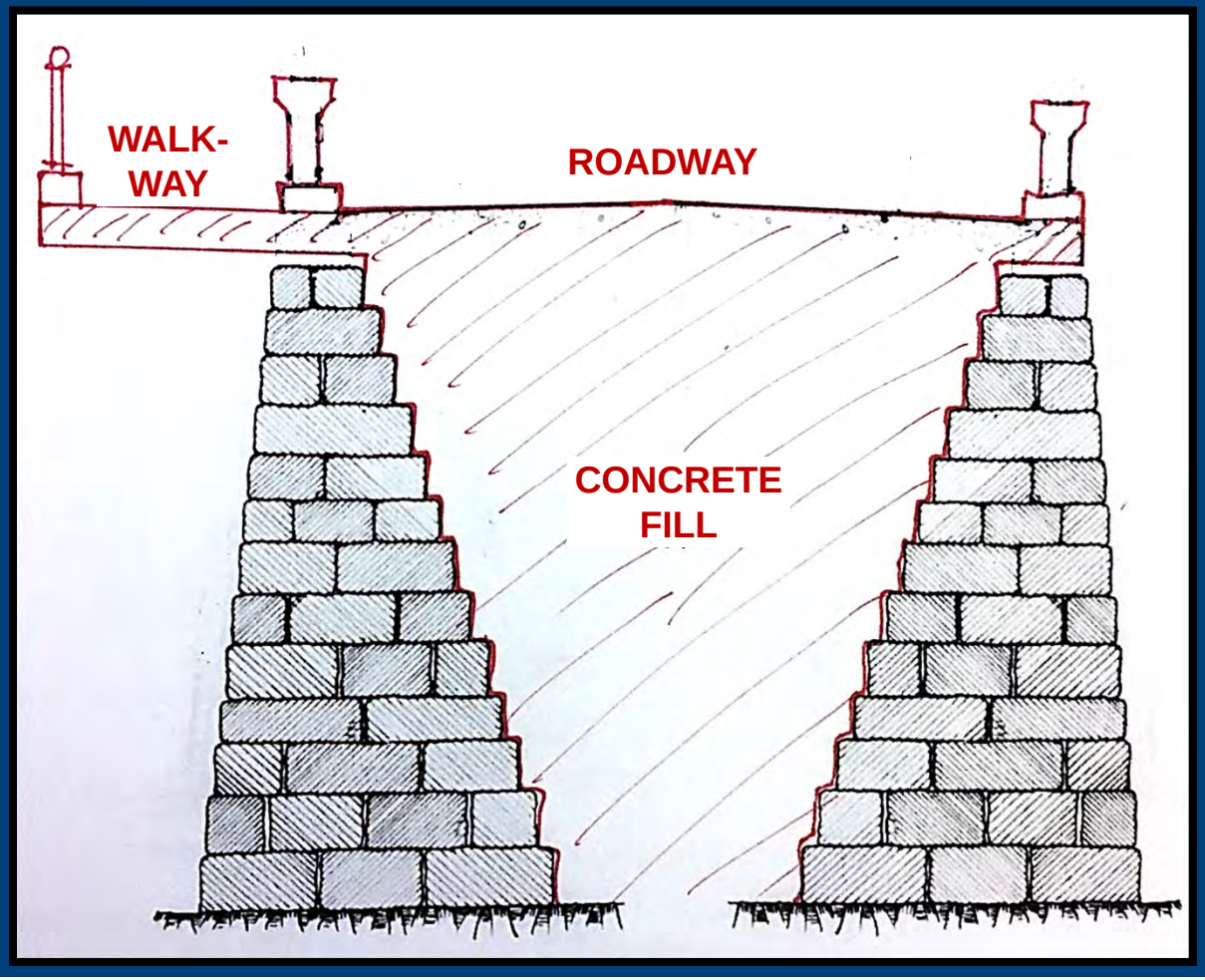


Proposed Condition – Front of Abutment

Refined Rehabilitation Strategy

Sidewalk Addition

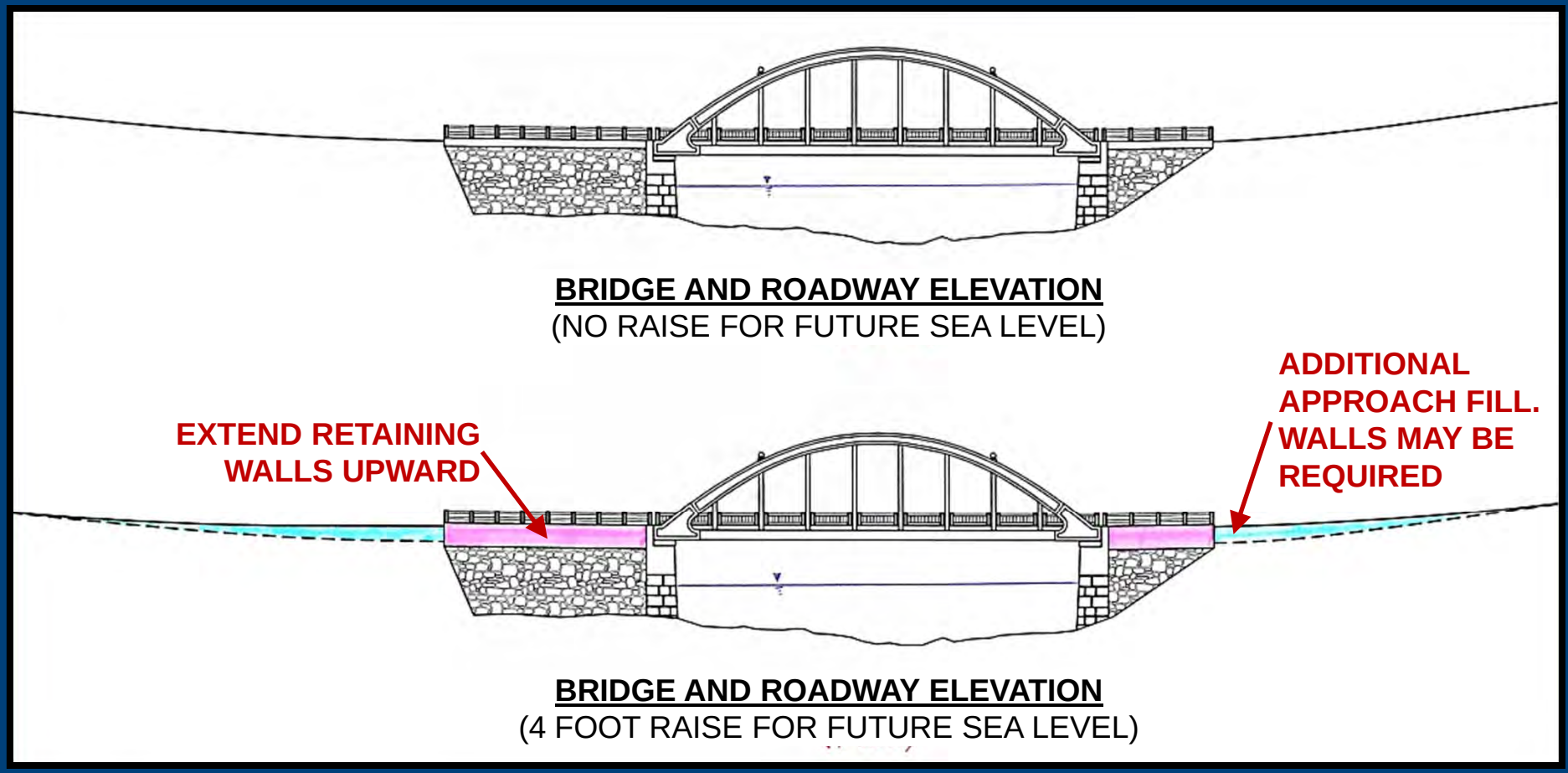
- Along Retaining Walls: Sidewalk cantilevered from concrete fill.



Refined Rehabilitation Strategy

Lift for Sea Level Rise

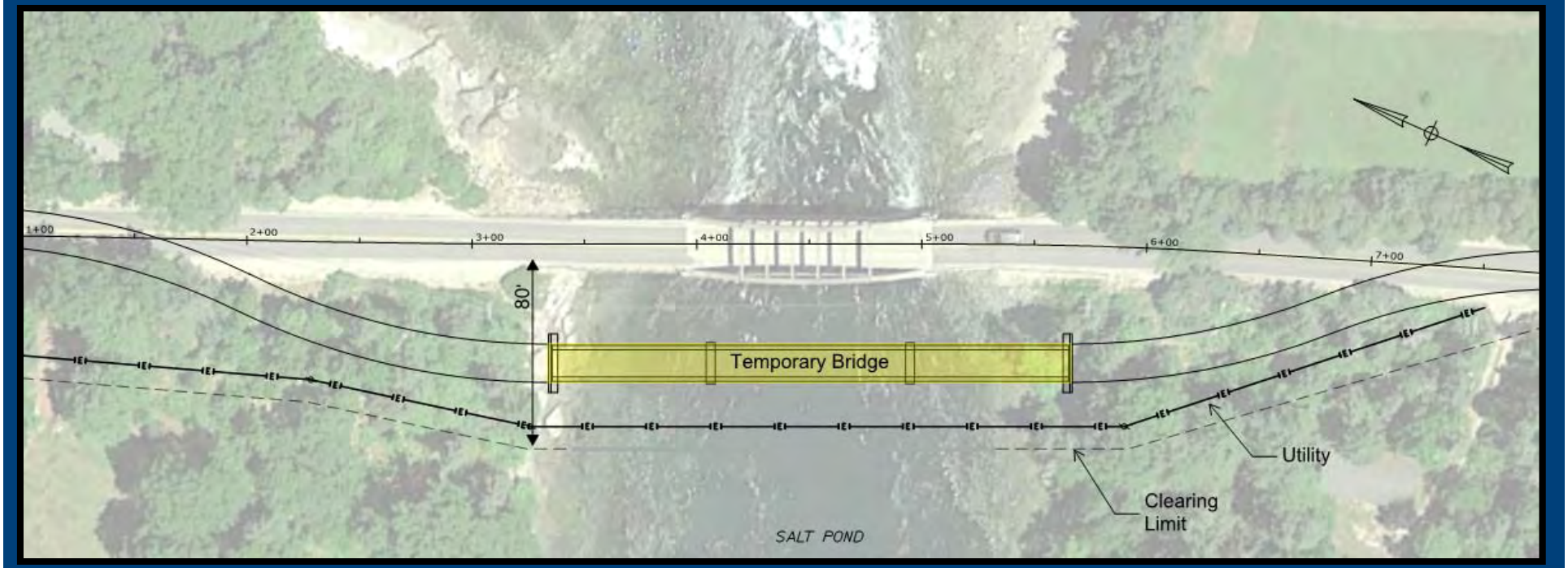
- Consider 2’ and 4’ of sea level rise in the next 100 years. Raise bridge and roadway. Total length of roadway reconstruction similar for all cases.



Refined Rehabilitation Strategy

Temporary Bridge

- Additional evaluations are ongoing
- Constructability assumes a 220’ long temp. bridge. Two piers required.
- Requires clearing up to 80’ from west edge of pavement.



Construction Approach

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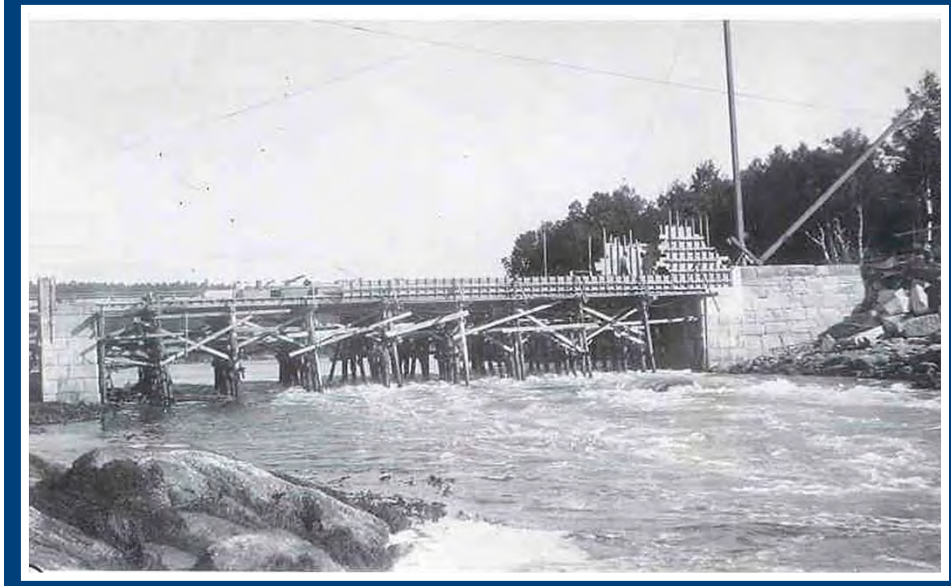
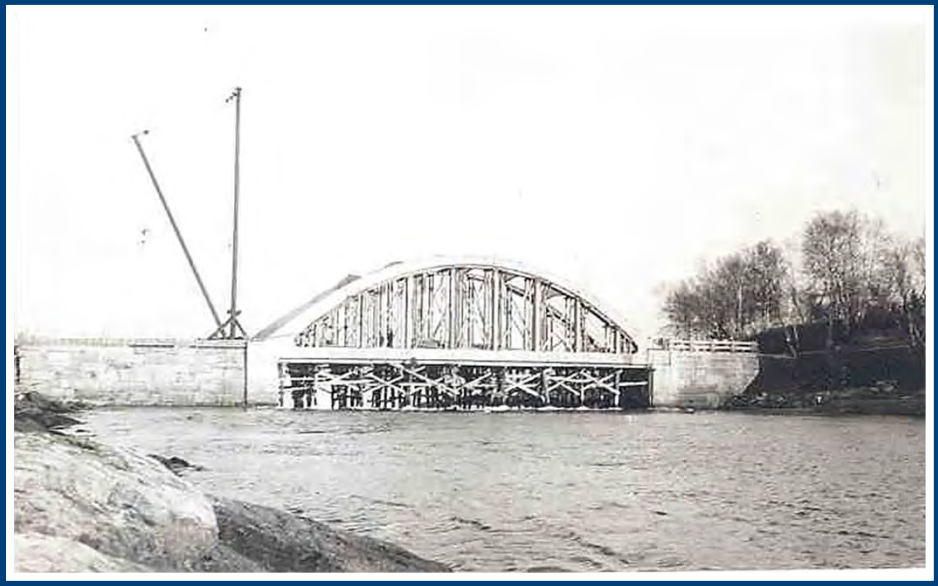
Construction Approach

Assumed Construction Methods

- Temporary Support: Bridge was built using supports from below.
  - Continuously supported during construction.
  - Ensured stability during construction, minimized stresses in bridge.
  - Rehabilitation ideally would replicate this condition during construction.
  - The bridge is HEAVY! *(600 Tons = 12 Tractor Trailer Trucks)*

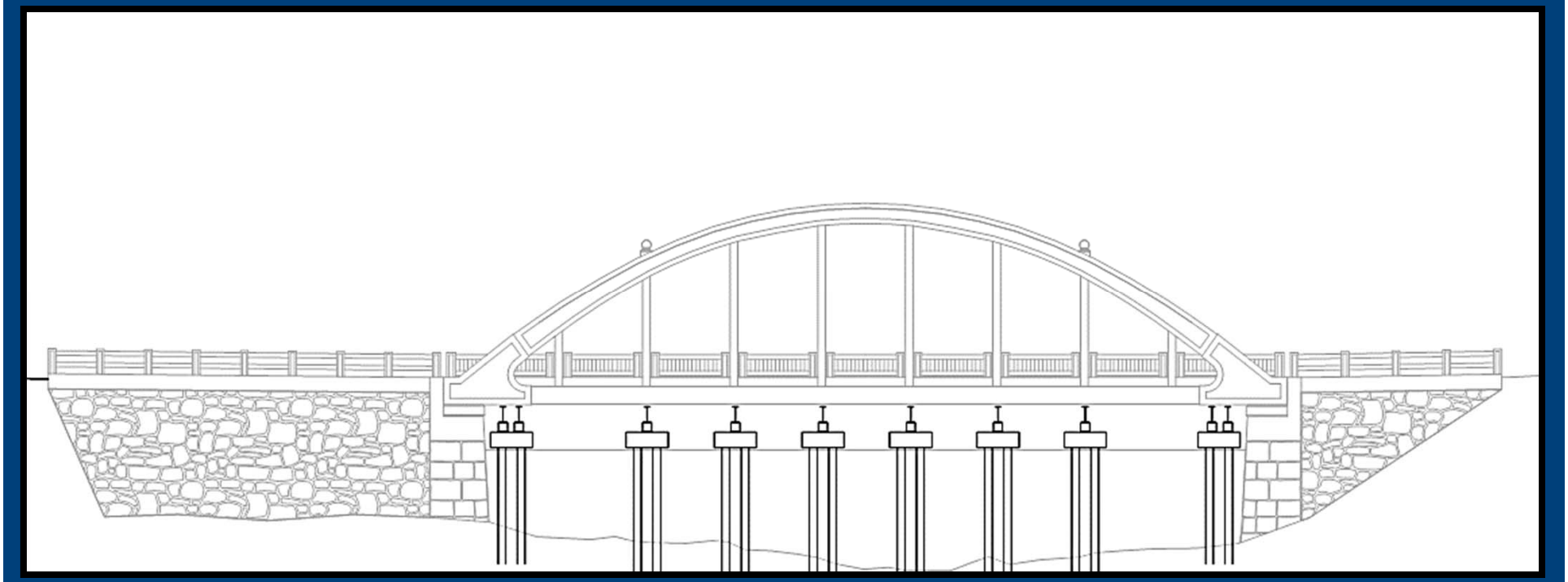




Construction Approach

Assumed Construction Methods

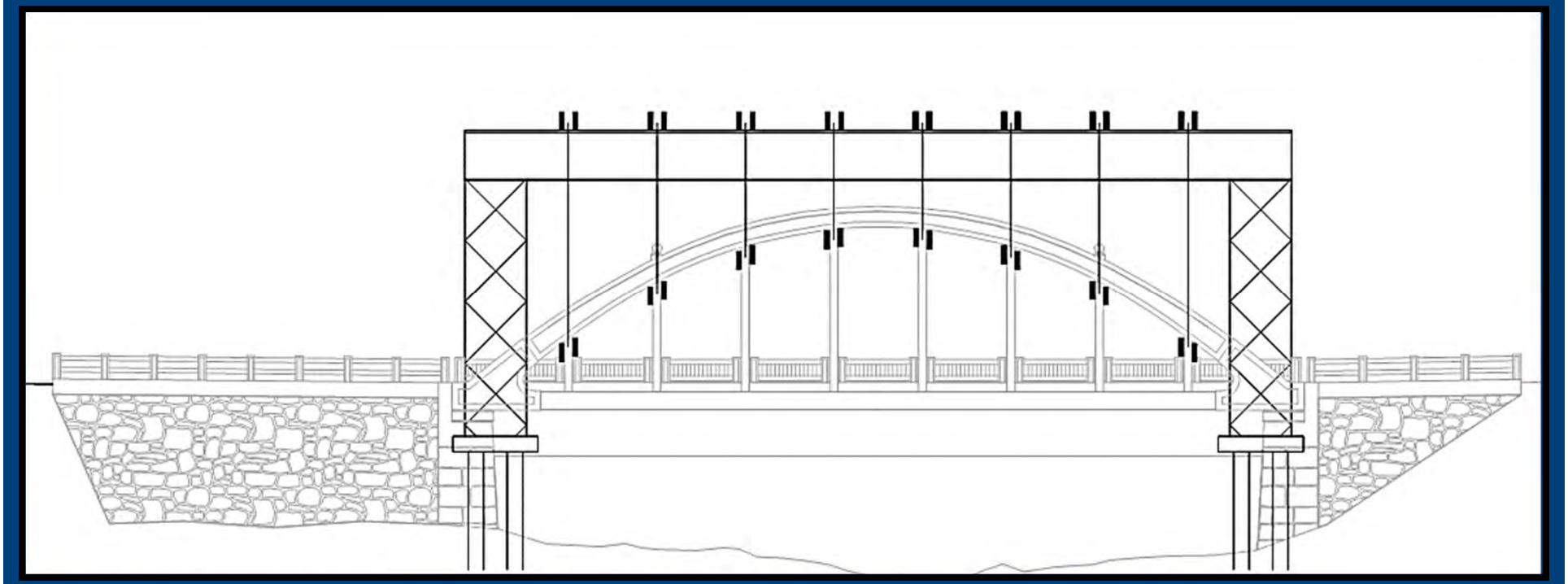
- Temporary Support Approach #1: Support from below
  - Pros: Similar to as-built construction.
  - Cons: Significant in-water work, limited clearances, higher risk, high cost.
  - Assessment determined contractors are less likely to use this approach.



Construction Approach

Assumed Construction Methods

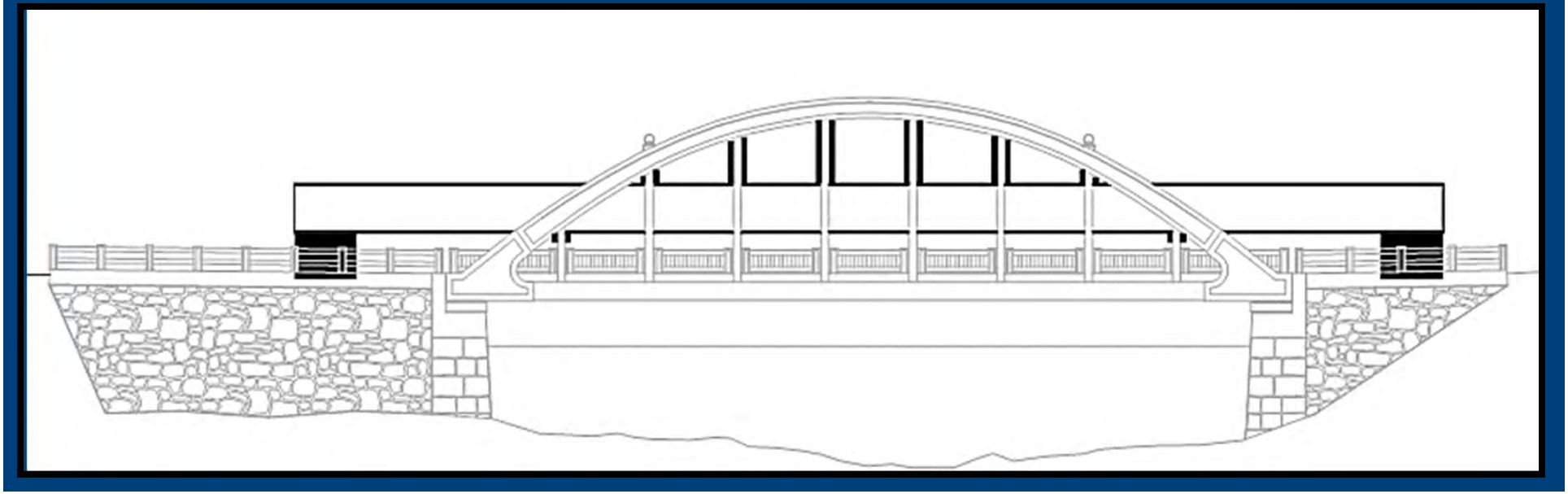
- Temporary Support Approach #2: Support with overhead structure
  - Pros: Provides nearly unobstructed work space for contractor.
  - Cons: In water work, large foot print, complex, higher risk, high cost.
  - Assessment determined contractors are less likely to use this approach.



Construction Approach

Assumed Construction Methods

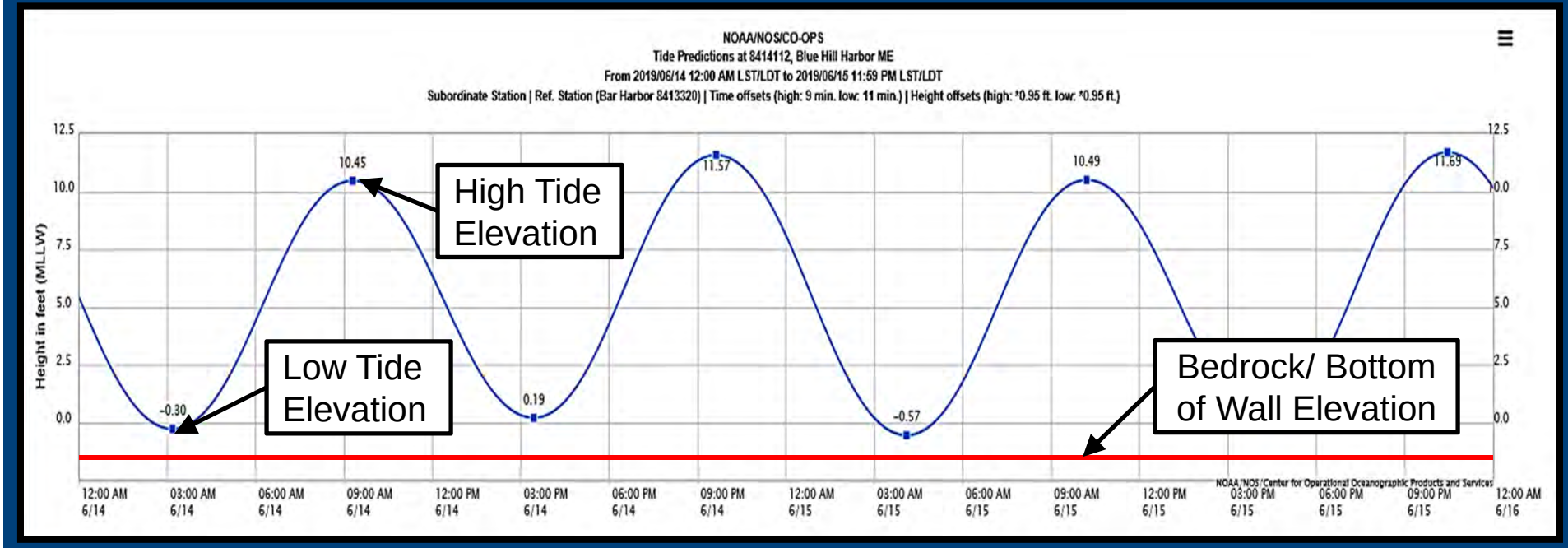
- Temporary Support Approach #3: Plate Girder Insertion
  - Pros: Avoids in-water work, simple details, less risk, lower cost to construct.
  - Cons: Limited working space within bridge. Requires completing approach and tied arch work sequentially rather than concurrently.
  - Assessment determined contractors are more likely to use this approach.
- This approach used as the basis for conceptual cost estimates.



Construction Approach

Assumed Construction Methods

- Stabilization of Approach Retaining Walls:
  - Constructability assessment determined installing cofferdams is not practical.
  - Concrete fill to be placed without an enclosure, chasing tides. Minimizes the need for cofferdams.



Construction Approach

Assumed Construction Sequence

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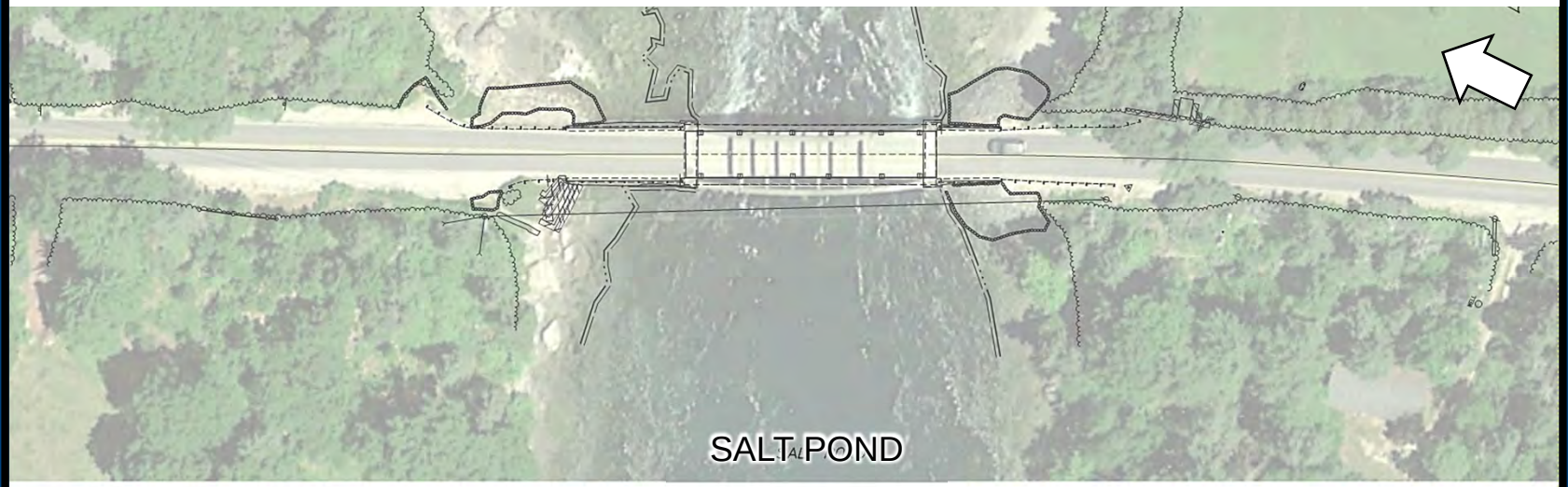
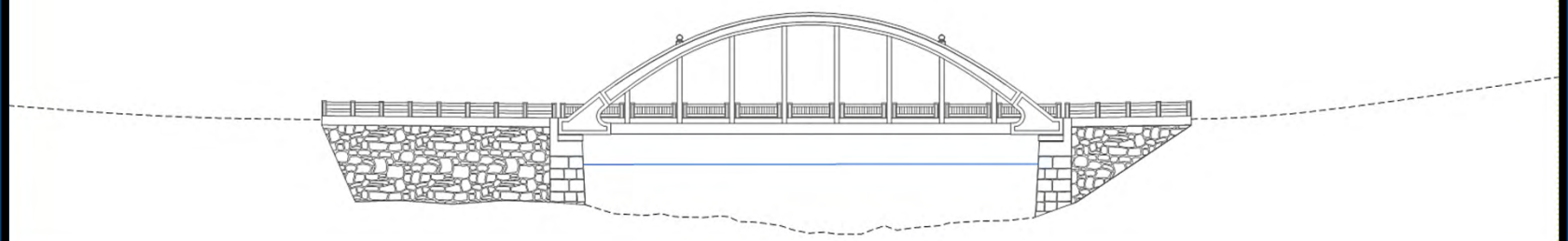


EXISTING CONDITIONS



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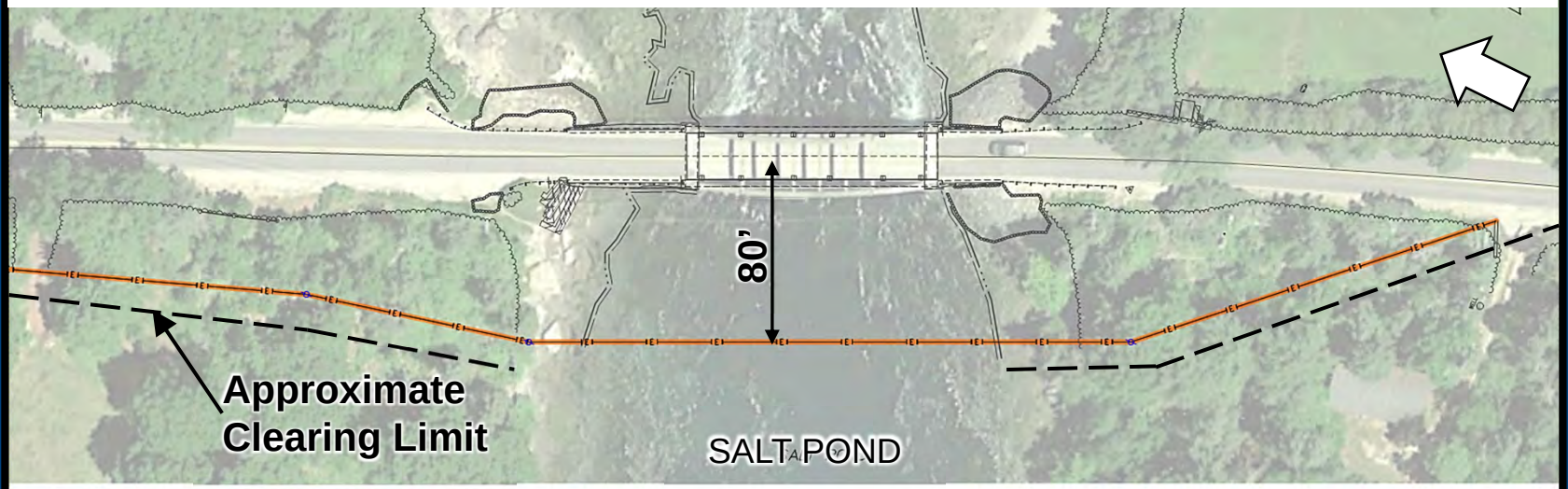
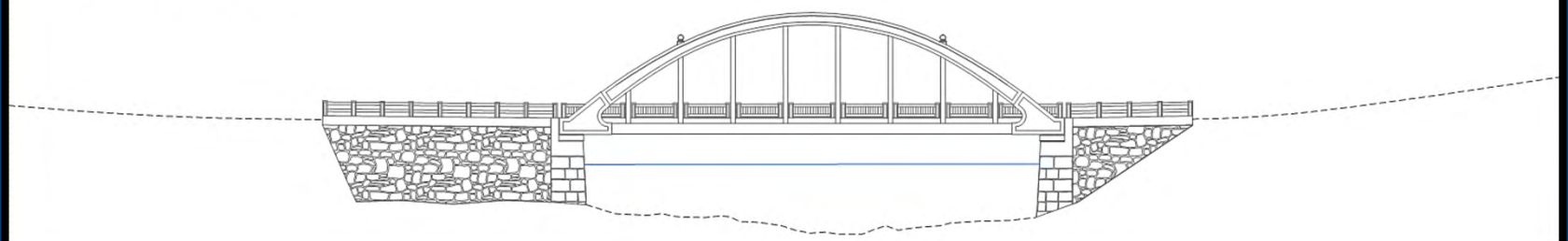


PHASE I - UTILITY RELOCATION

1. CLEAR TREES

2. INSTALL TEMPORARY POLES AND SHIFT OVERHEAD LINES WEST



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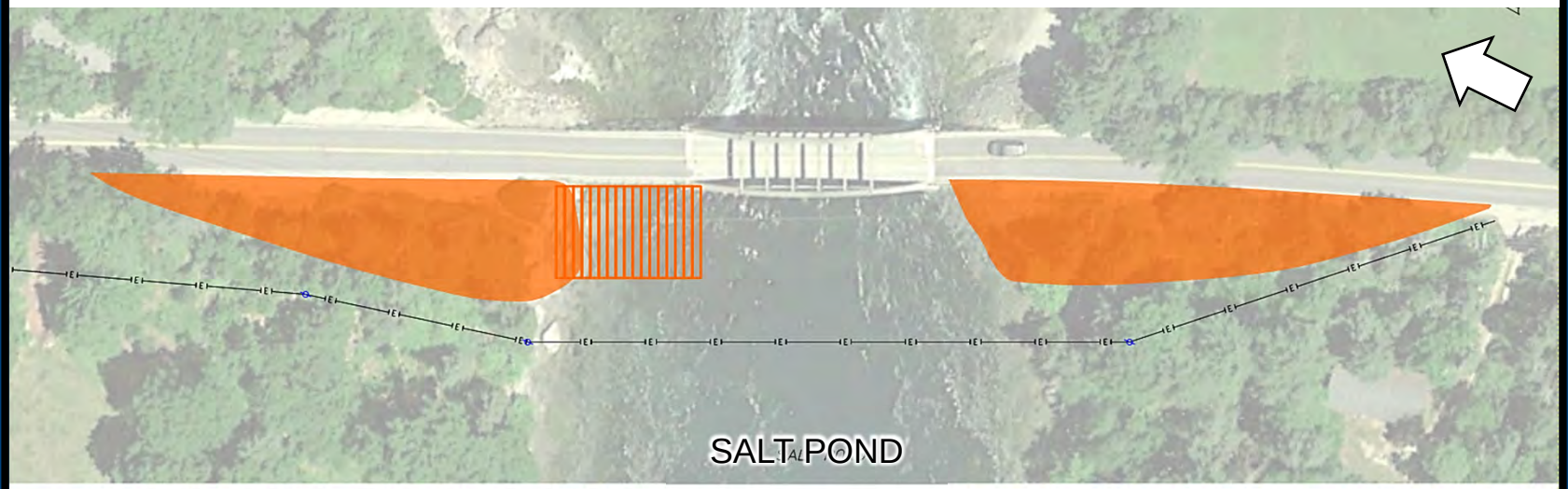
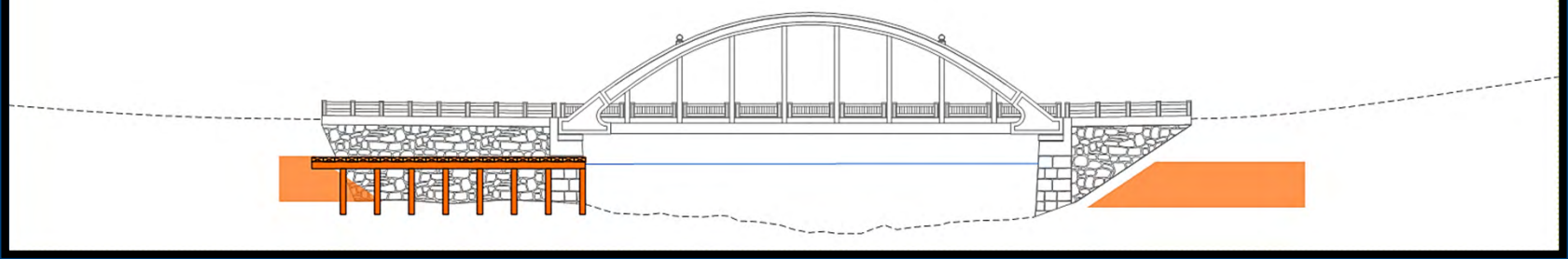


PHASE 2 - TEMPORARY EMBANKMENTS & TRESTLE

1. PLACE TEMPORARY FILL AND TRSETLE FOR CRANE PAD AND STAGING



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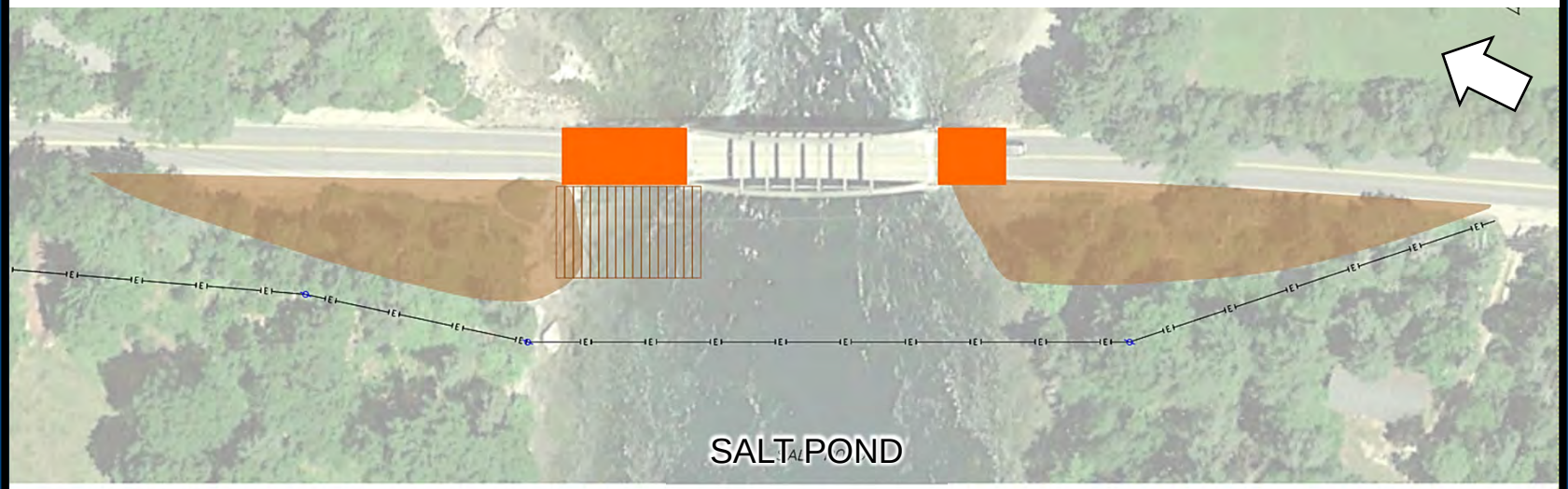
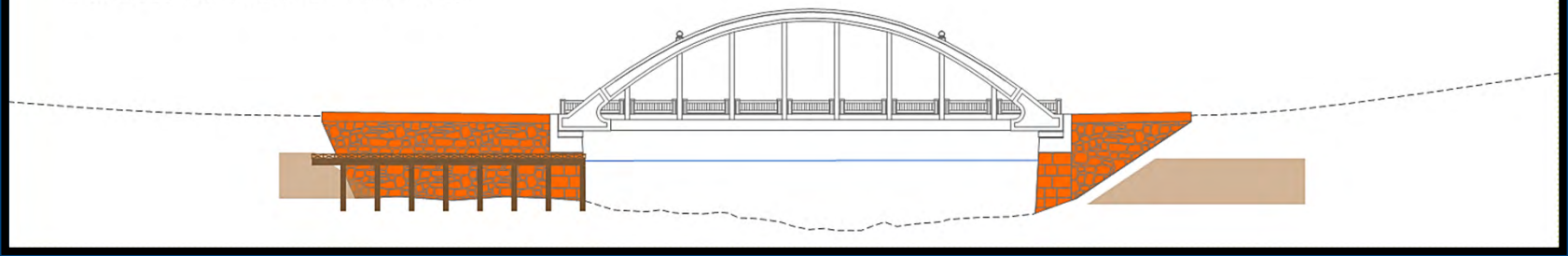


PHASE 3 - SUBSTRUCTURE REHABILITATION:
RETAINING WALLS AND APPROACHES

1. REMOVE RAILINGS IN TOP OF WALLS

2. STABILIZE AND STRENGTHEN MASONRY WALLS



Construction Approach

Assumed Construction Sequence

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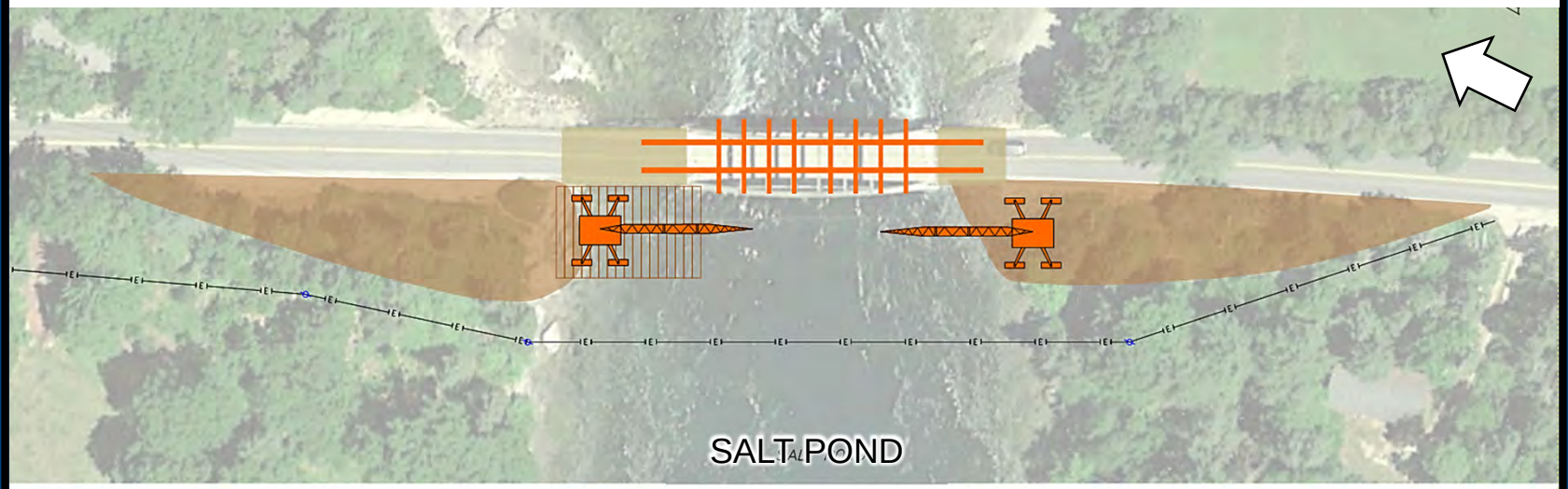
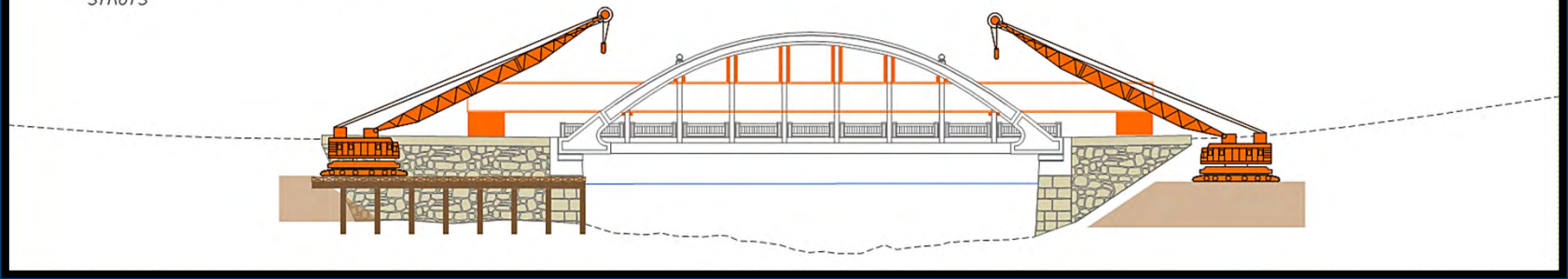


PHASE 4 - CONSTRUCT TEMPORARY ARCH SUPPORTS

1. MOBILIZE CRANES
2. INSTALL TEMPORARY SUPPORT BEAMS AND STRUTS



Construction Approach

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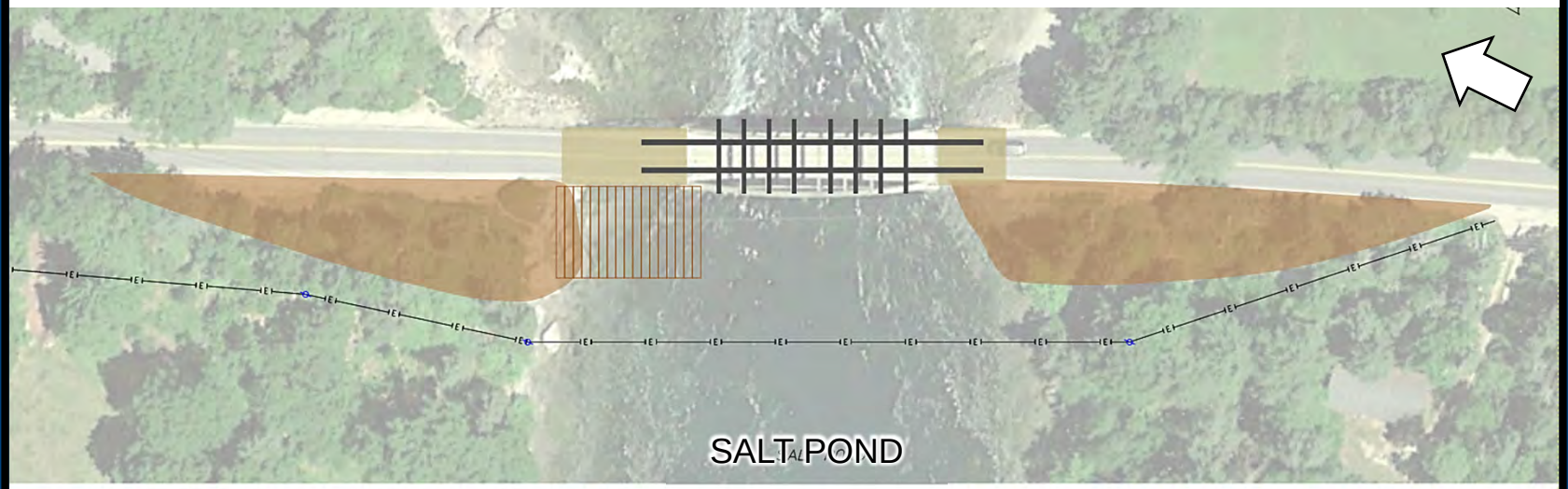

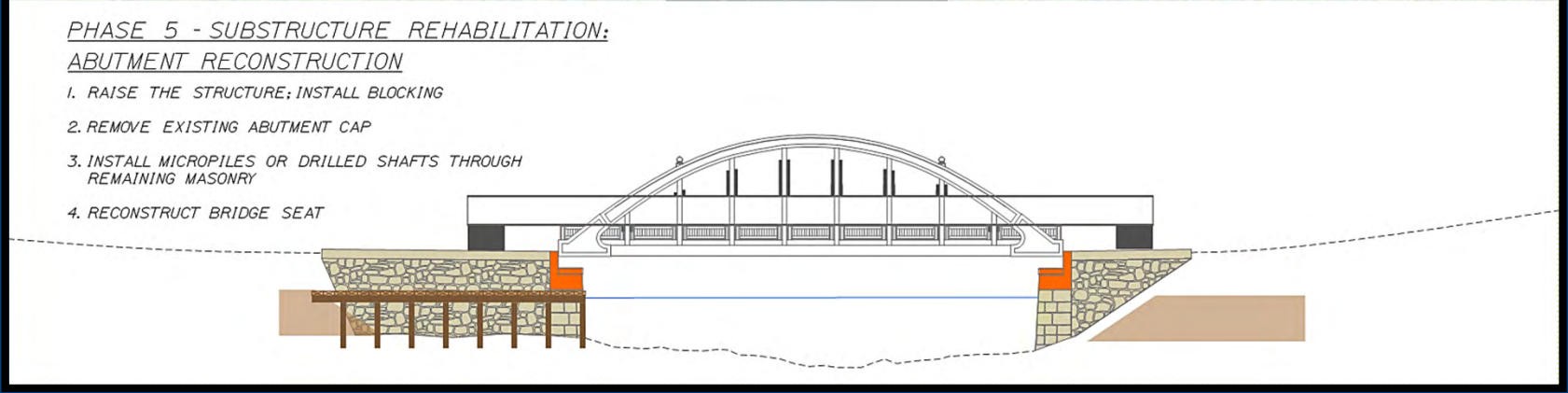

Construction Approach

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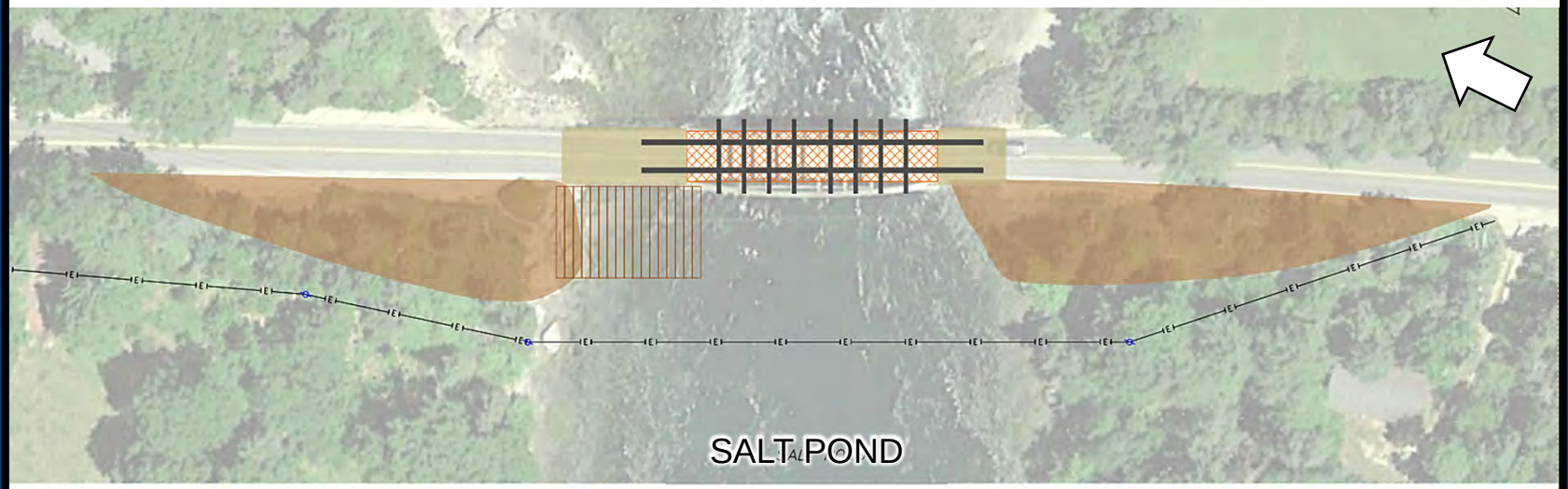

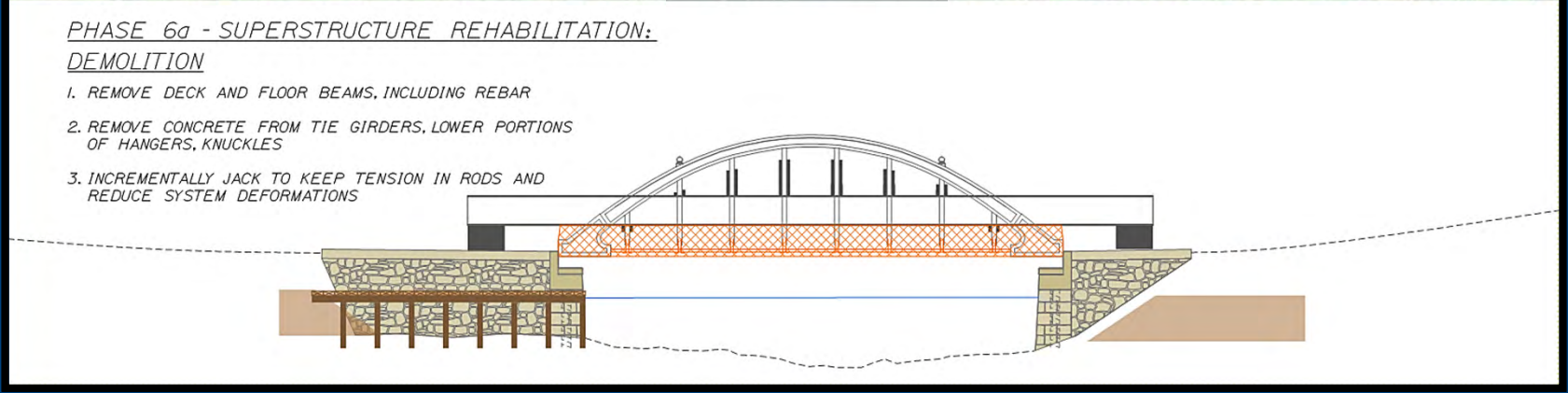

Construction Approach

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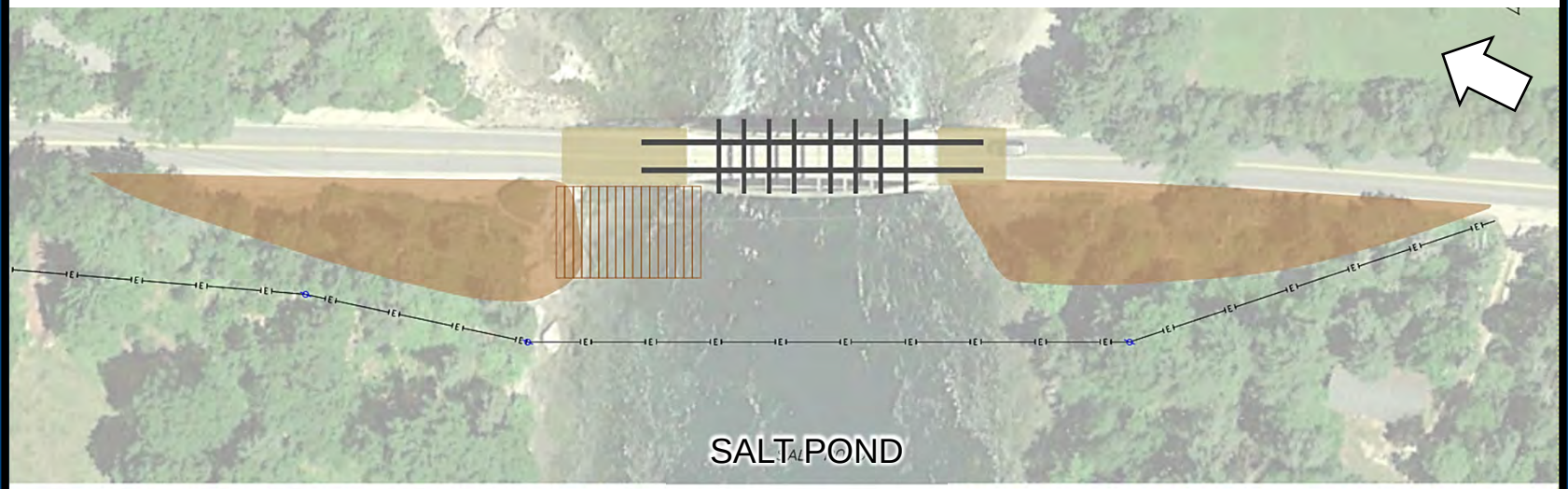
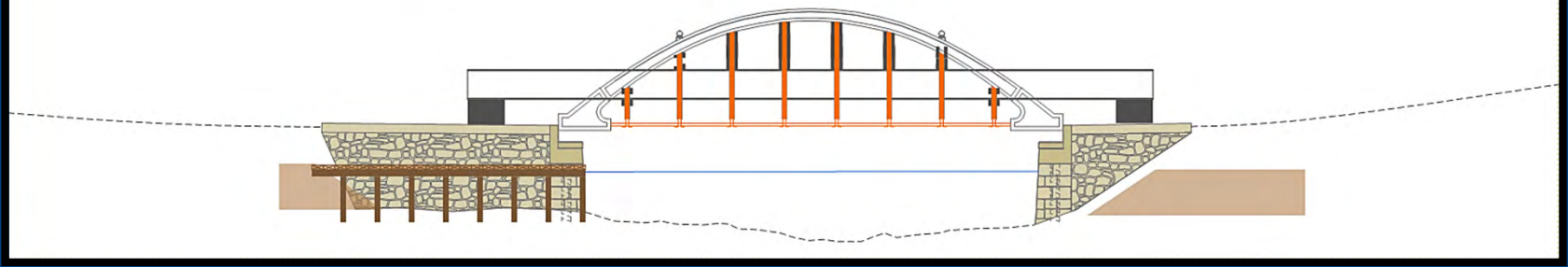


PHASE 6b - SUPERSTRUCTURE REHABILITATION:
HANGER RECONSTRUCTION

1. RECONSTRUCT HANGERS WITH ADDITIONAL REINFORCEMENT



Construction Approach

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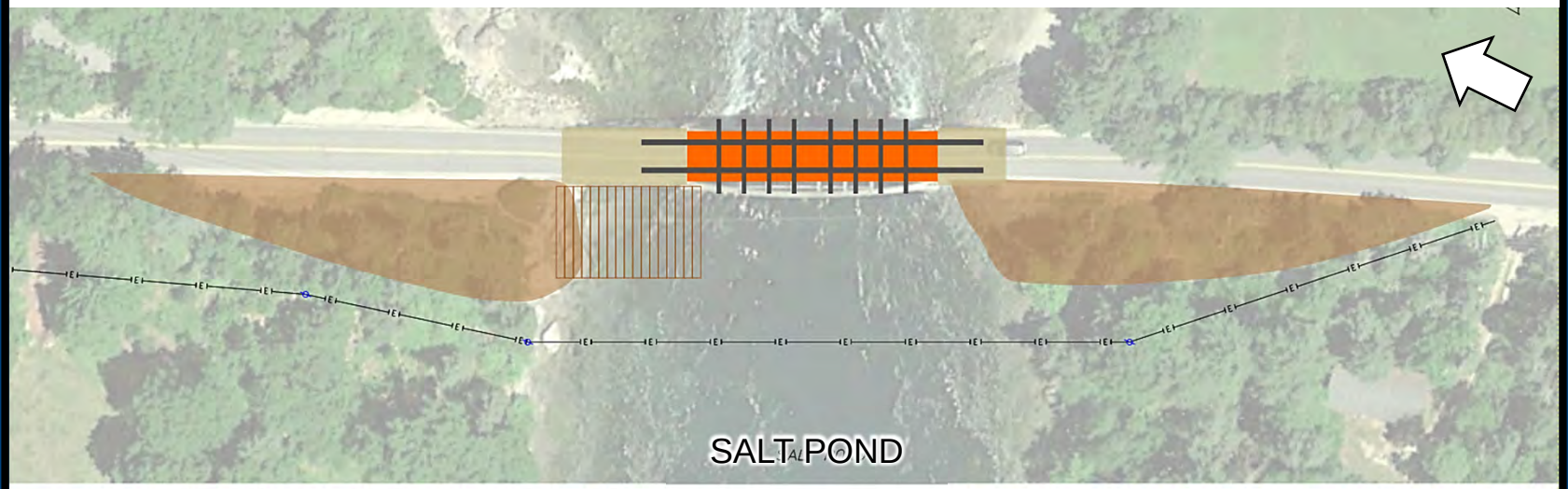

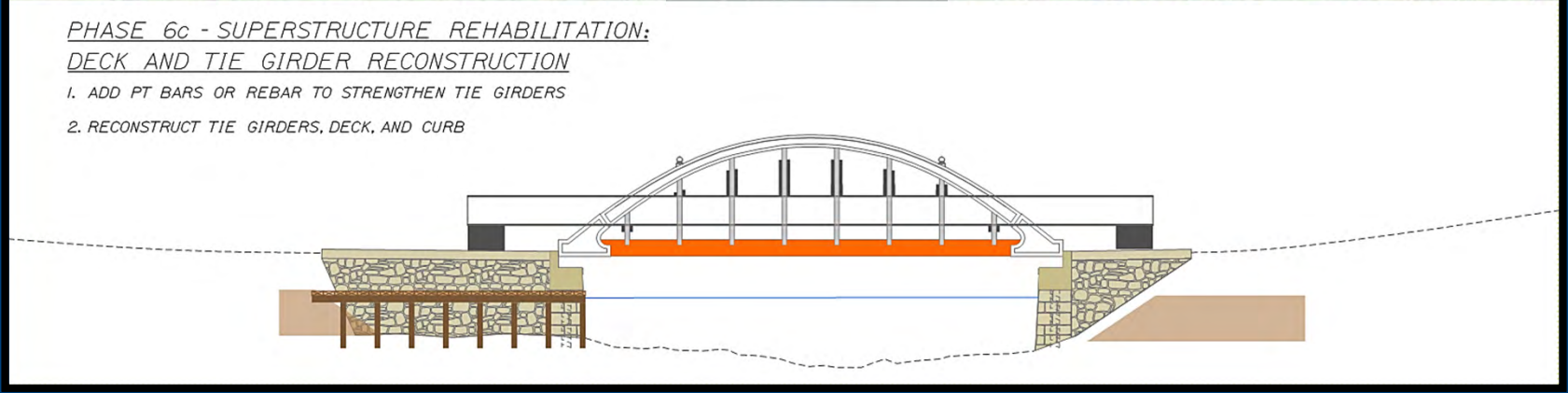

Construction Approach

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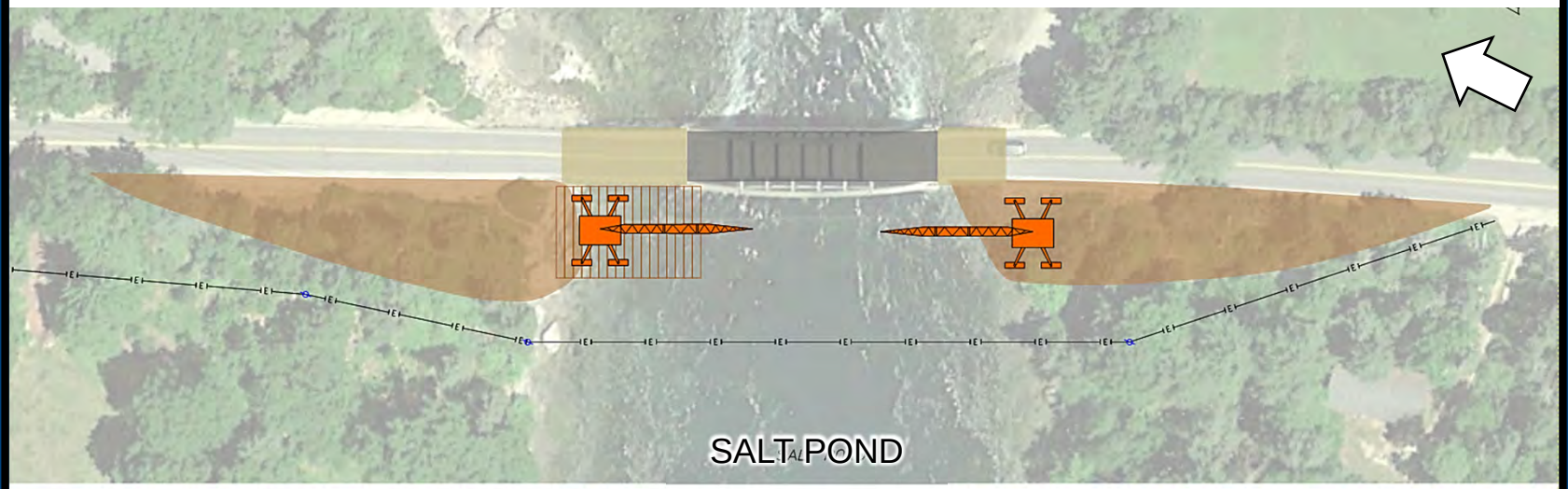

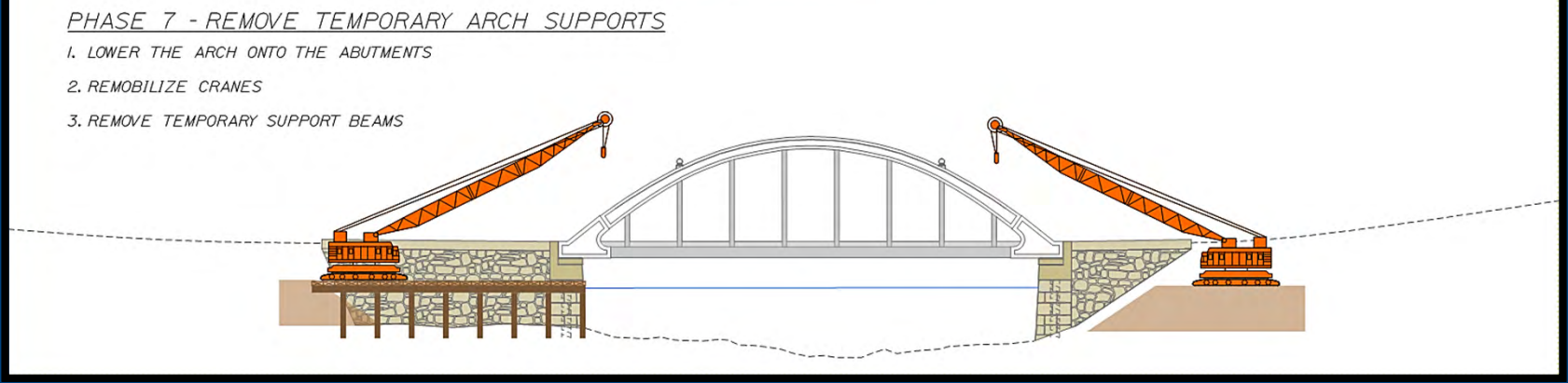

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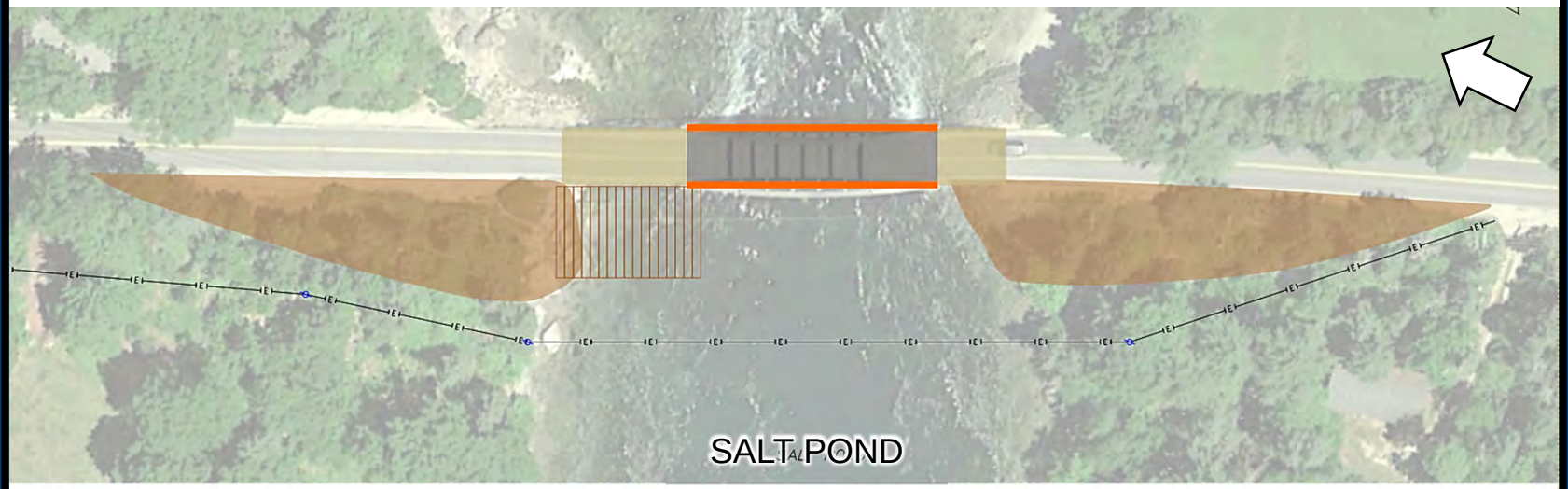
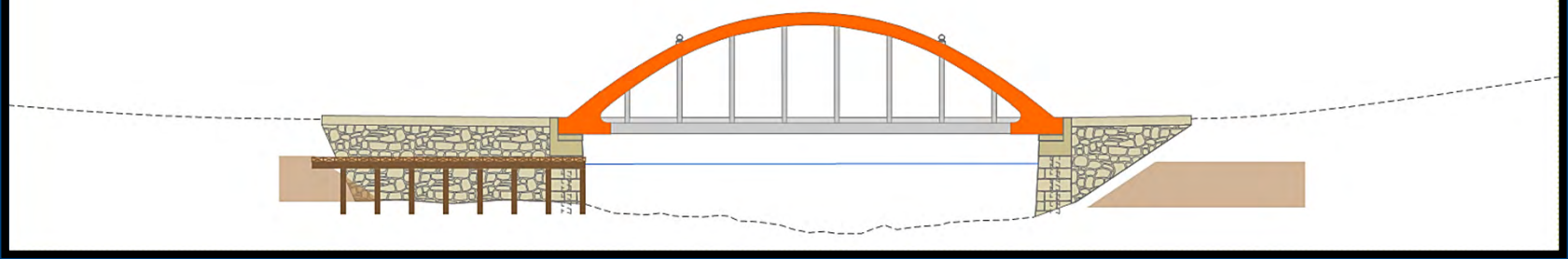


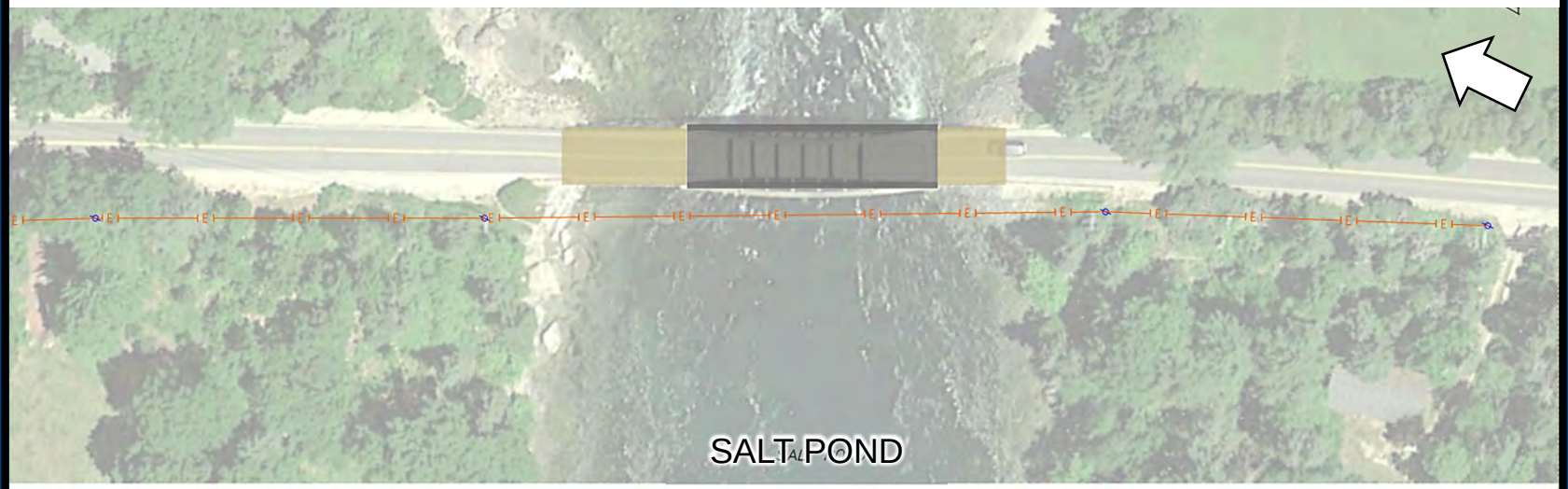
PHASE 8 - SUPERSTRUCTURE REHABILITATION
CONCRETE PATCHING
1. CHIP AND PATCH ARCH RIB AND HANGERS



Construction Approach

Assumed Construction Sequence

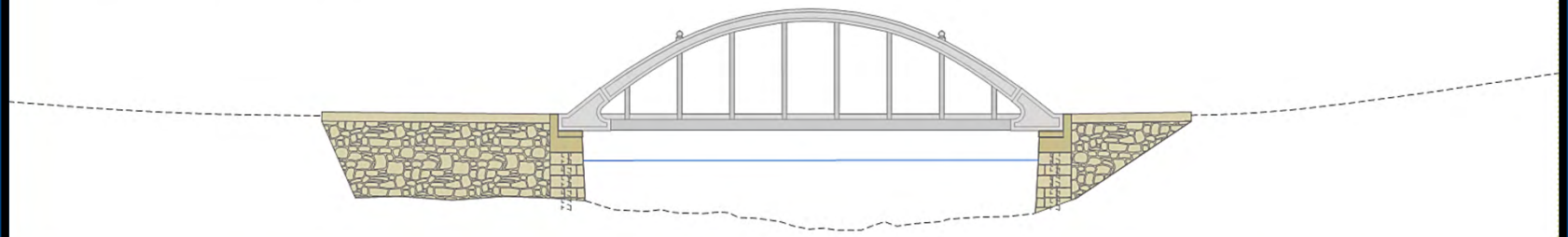
NOTE: The construction approach will be selected by the contractor. These graphics depict one possible approach. The construction approach selected by the contractor may be different and may result in increases in cost, schedule and impacts.



PHASE 9 - FINAL CLEANUP AND SITE RESTORATION

1. REMOVE TEMPORARY EMBANKMENTS AND TRESTLE

2. RESET THE OVERHEAD UTILITIES



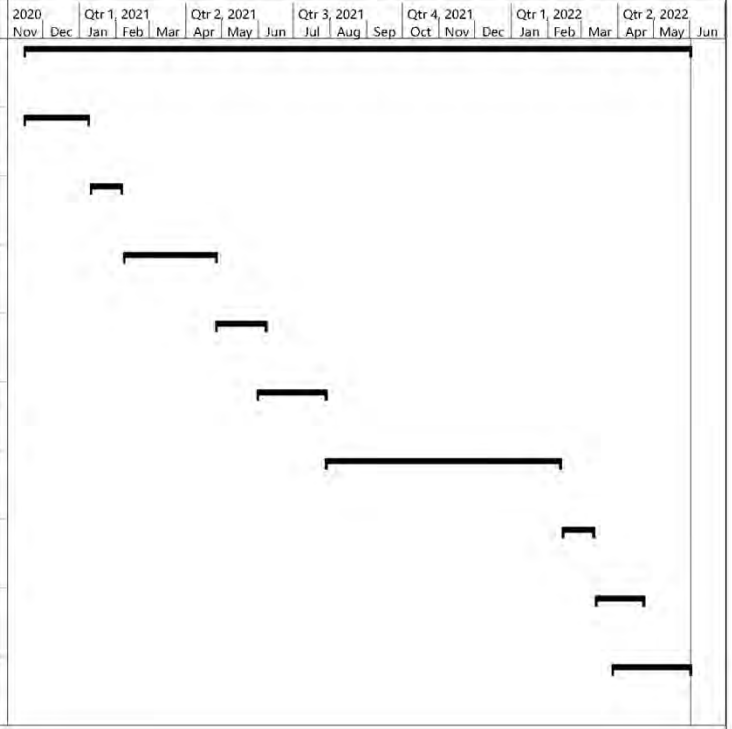
Construction Schedule

Base Bridge Rehabilitation

- Approximately 1.5 to 2 years of construction
  - Assumes November to March in-water work windows
  - Assumes no winter shutdowns
  - Work begins ~Fall 2020, project complete ~Summer 2022

(last revised 11-14-2017)

Task Name	Start	Finish
CONSTRUCT BASE BRIDGE REHABILITATION OPTION	**Mon 11/16/20**	**Wed 6/1/22**
Phase 1 - Utility Relocation	**Mon 11/16/20**	**Fri 1/8/21**
Phase 2 - Temporary Embankments & Trestle	**Mon 1/11/21**	**Fri 2/5/21**
Phase 3 - Substructure Rehabilitation: Retaining Walls & Approaches	**Mon 2/8/21**	**Mon 4/26/21**
Phase 4 - Construct Temporary Arch Supports	**Tue 4/27/21**	**Mon 6/7/21**
Phase 5 - Substructure Rehabilitation: Abutment Reconstruction	**Tue 6/1/21**	**Wed 7/28/21**
Phase 6 - Superstructure Rehabilitation	**Thu 7/29/21**	**Fri 2/11/22**
Phase 7 - Remove Temporary Arch Supports	**Mon 2/14/22**	**Fri 3/11/22**
Phase 8 - Superstructure Rehabilitation: Concrete Patching	**Mon 3/14/22**	**Fri 4/22/22**
Phase 9 - Final Cleanup and Site Restoration	**Mon 3/28/22**	**Wed 6/1/22**



Construction Schedule

Schedule Increase Associated with Other Items

- Sidewalk Addition: Adds ~2 months to schedule.
- Raise Bridge for Future Sea Level Rise: Adds ~1 month to schedule.
- Temporary Bridge: Adds ~5 months to schedule.

With all three optional items included the total construction duration is estimated to increase by ~8 months.

Construction Cost

Bridge Rehabilitation

- Estimated Construction Cost = $8.7 Million

CONCEPTUAL COST SUMMARY - REHABILITATION		
COMPONENT	**TOTAL**	
Bridge Superstructure	$	2,070,000
Bridge Substructure & Retaining Walls	$	1,430,000
Temporary Works	$	2,790,000
Roadway Reconstruction	$	400,000
Miscellaneous Components	$	540,000
Sidewalk Addition	$	200,000
Raise Bridge for Future Sea Level Rise	$	500,000
On-Site Temporary Detour Bridge	$	700,000
ESTIMATED CONSTRUCTION COST:	**$**	**8,700,000**

Alternatives Matrix

Evaluation Criteria		Bridge Rehabilitation	
		Alt. 1a: Rehabilitation In-kind	Alt. 1b: Rehabilitation with Sidewalk
Description & Cost	Alternative Description	Rehabilitate Existing Bridge (approaches, superstructure, substructure)	Rehabilitate Existing Bridge (approaches, superstructure, substructure, add sidewalk)
	Structure Type	Concrete Tied Arch	Concrete Tied Arch, Adjacent Pedestrian Bridge
	Anticipated Service Life	50 years	50 years
	Total Bridge Deck Area (Square Feet)	2,880	3,430
	Total Life Cycle Cost (100 yr Period)	TBD (requires replacement or alternate concept cost to complete)	TBD (requires replacement or alternate concept cost to complete)
	Construction Cost (2019 Dollars)	$8.5 Million	$8.7 Million
	User Costs	N/A	N/A
Project Impacts	Archeological	TBD	TBD
	Architecture	TBD	TBD
	Environmental	TBD	TBD
	Site Conditions	TBD	TBD
	Construction	TBD	TBD
Community Needs		TBD	TBD
Other		TBD	TBD

Next Steps

Approach to Evaluating Rehabilitation:

- Steps 1 & 2: Identify, assess & short list initial options
- Step 3: Assess constructability, schedule, impacts, longevity & cost
- Step 4: Identify most suitable rehabilitation strategy

- Next BAC meeting
  - Present roadway traffic metrics and approach to project requirements.
  - Begin discussion of On-site versus Off-site detours.
    - Emergency Vehicles
- Note: Steps 1 through 4 may be revisited as the project develops

Discussion