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LETTER OF TRANSMITTAL

Document No. TTA-0066

To: **Alabama Department of Transportation**

Date: 3/20/17 **Job No.** 15-1101-0300

Attention: Edwin Perry, PE

Re: MRB - Constructability, Cost and Schedule Assessment of Bayway Construction Methods

WE ARE SENDING YOU: ☒ Attached ☐ Under separate cover via _____ the following items:
☐ Change Order ☐ Prints ☐ RFI ☐ Drawings ☐ Specifications ☐ Copy of letter ☐ Contract
☐ Work Authorization Order

Copies	Date	No.	Description
1	3/20/17	TTA-0066	MRB - Constructability, Cost and Schedule Assessment of Bayway Construction Methods

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Remarks: This is the official transmittal for this report. The draft memorandum was sent via email back on February 14, 2017.

FROM: Patrick Hickox, PE

COPY TO: File…/contracts/HDR
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Steve Flukinger, PE
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If enclosures are not as noted above, please notify sender immediately

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A THOMPSON HOLDINGS, INC. COMPANY

Project: I-10 Mobile River Bridge and Bayway Widening Project

Subject: Assessment of Top Down Construction vs. Dredging for Construction of New Bayway Bridge Structures Between Existing Structures

To: Thompson Engineering and HDR, Inc.

From: Armeni Consulting Services, LLC

Date: February 13th, 2017

Introduction:

The purpose of this study is to analyze the estimated cost and schedule impact differential between the "top down" construction method and the use of conventional floating equipment via a dredged channel. There have been various methods of top down construction implemented in past construction projects (Figures 1&2), however the basic principle is that no equipment is placed at the water or ground level, but rather the equipment operates off a temporary platform on piles just ahead of the completed structure.

Figure 1 – LA-1 Phase 1A (LaDOTD)

Figure 2 – Isle of Palms (SCDOT)

The use of conventional floating equipment to build the bridge (similar to that which was used for the original construction of the bayway) would require dredging in various areas throughout the areas between the two bayway structures in order to achieve a recommended open channel depth of 10' and width of 120' between the existing bridges (Figures 3&4). It is to be noted that even with the use of a dredged channel, some form of top down construction may still be required for construction of the pile caps and superstructure due to the restriction of space between the two existing bridges. Depending on the selected design alternative, the piles will also block barge access within the channel once they are installed. Therefore, the major benefit for the dredged channel option is for the installation of the pile foundations.

Figure 3 – Dredging Operation

Figure 4 – Floating Pile Driving Operation

Construction Cost Impact:

In order to compare the cost differential between the alternatives, an arbitrary length of Bayway structure was chosen at 6,000 LF. This was then used to develop general quantities for this study (Table 1).

Bridge Design Assumptions for Study		
Length =	6,000	FT
Width =	74.5	FT
Area =	447,000	SF
Bent Spacing =	65	FT
Number of Bents =	92	EA
Number of Piles =	368	EA

Table 1 – Bridge Design Assumptions for Study

Using this information, along with details from past similar projects, general quantities were generated for the top down jump trestle method (Table 2). For the dredging quantities (Table 3), water depths were used from the seafloor measurements taken during the ongoing geotechnical exploration program. More accurate estimation of quantities will require an updated bathymetric survey. For areas that would need dredging where the current water depth was less than 10', an average current depth was calculated out to be 5.33'.

Jump Trestle Quantities		
Length =	6,000	FT
Span Length =	32.50	FT
Number of Spans =	185	EA
Number of Piles =	370	EA
Trestle Area =	168,000	SF

Table 2 – Jump Trestle Quantities

Dredging Quantities		
Length =	6,000	FT
Width =	120	FT
Avg. Current Depth =	5.33	FT
Dredge Depth =	10.00	FT
Dredge Volume =	124,533	CY

Table 3 – Dredging Quantities

The cost for each option was developed using HCSS HeavyBid estimating software, which generates cost based on equipment rental rates, labor rates, material rates, taxes, etc.

For the jump trestle method, 3 spans worth of trestle material was assumed and "jumped" forward, with the permanent pile materials being fed by the bridge behind. The majority of the cost is comprised of the installation and removal (or "jumping") of pipe piles, cap beams and track girders using a crawler crane.

The dredging and disposal costs were based of a subcontract price of $10/CY. In addition to this cost, marine equipment was time-spanned for the duration of the pile driving activities for a true apples-to-apples comparison. This includes a crane barge, various deck barges, tug boat time and tug operator and deckhand time.

Estimated Costs for Each Method				
	Quantity		Unit Cost	Cost
Top Down Construction =	447,000	SF	$ 5.56	$ 2,485,457
Dredged Channel =	447,000	SF	$ 4.06	$ 1,814,820

Table 4 – Estimated Costs for Each Method

Based on the cost results above in Table 4, the top down construction method has a $1.50/SF price increase when compared to the use of a dredged channel. For 6,000 LF of bridge, this reflects a relative $670,000 dollar differential in costs. For the full length of the structure, this will be $3.6 million in differential.

Schedule Impact:

As previously mentioned above, the main operation that benefits from the use of a dredged channel method is the pile driving operation. This is important to note when comparing the two options.

When using the top down method, typically the pile driving remains on the critical path for the majority of the construction duration. This is due to the pile driving operation being slowed by the installation of the temporary trestle piles to go along with the permanent piles. In addition, it is inefficient for the pile driving operation to get far ahead of the deck construction, resulting in a long "train" of trestle and increased temporary material costs.

Use of a dredged channel greatly benefits the pile driving operation, in that it only has to focus on installation of permanent piles and is not slowed down by the installation of trestle. This results in the pile driving operation not remaining on the critical path, but rather the construction of the remaining CIP concrete deck.

To compare how much of an impact it may have on the schedule, a basic CPM schedule was put together based on the quantities used in the cost analysis above which represents 6,000 LF of bridge. This does not represent an entire construction duration, but only compares the activities affected by the method (Figure 5).

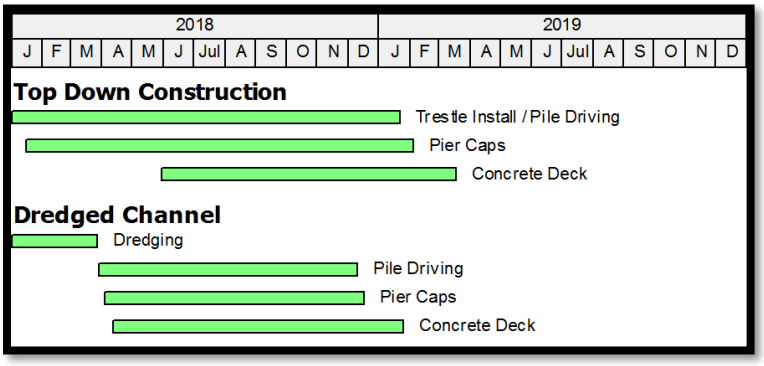

Figure 5 – Schedule Comparison

The result of the study shows an approximate savings of 10% on the construction schedule through use of the dredged channel. For example, if the entire construction duration for the bayway was to be 36 months using top down construction, it would take about 33 months using the dredged channel method. This would represent 3 months of schedule savings.

Conclusion:

In closing, it is our opinion that ALDOT consider obtaining a dredge permit for an access channel based on the potential $1.50/SF or $3.6 million total cost savings and 10% schedule savings. This would allow the contractor more flexibility in their specific means and methods thus reflecting a cost and schedule savings to the project.