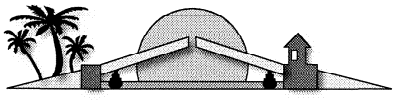
HEAVY MOVABLE STRUCTURES, INC.



NINTH BIENNIAL SYMPOSIUM
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MOVABLE VERSUS FIXED – WITTPENN BRIDGE REPLACEMENT

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OWNERSHIP/PUBLIC USE and MANAGEMENT

HMS NINTH BIENNIAL SYMPOSIUM - Ownership/Public Use/Management

MOVABLE VERSUS FIXED – WITTPENN BRIDGE REPLACEMENT

By Dayi Wang, P.E., Ph.D.[1], Lynne M. Baumann, P.E.[2], Feraidoon Kashani, P.E.[3]

ABSTRACT

The existing Wittpenn Bridge, one of the "Tri-Hack" vertical lift bridges over the Hackensack River in Hudson County New Jersey near New York City, is functionally obsolete and structurally deficient. As one of the elements of the NJDOT Portway Corridor, the existing Wittpenn Bridge/approaches/interchanges will be replaced.

NJDOT and FHWA asked JE/Sverdrup to provide a Technical Report in response to 23 CFR 650H section 650.809 of the Federal Aid Policy Guide, to demonstrate that the movable bridge alternative is more favorable than the fixed bridge alternative, considering social, economic, environmental and engineering impacts. A cost benefit analysis was also a necessary part of the evaluation.

A life-cycle cost analysis was performed for a 100-year design life. The following were considered: initial construction costs (for structures and roadway, demolition, utility relocation, hazardous material, right of way, maintenance of traffic, mobilization, etc.), operation costs (of life-time mechanical and electrical operation and routine repairs), rehabilitation cost (of major rehabilitation of mechanical and electrical systems), maintenance and inspection costs (of life-time structure maintenance, painting, re-decking, etc.), and user costs (due to traffic delay). Preliminary design was made for the movable and fixed alternatives to provide equal level of service. The cost comparison was based on present worth, using a discount rate of 4 percent. The construction cost estimates utilized information from previous projects, previous bids, historical cost data, and NJDOT past experience. The results showed that the movable alternative had a much higher cost for the main span, for its initial construction and operation/maintenance/user costs. However, for the same navigational vertical clearance requirement, the fixed alternative providing 135' vertical clearance resulted in a much larger project/structure limit, and higher costs for the approaches, right of way, and impact on adjacent communities. The total life-cycle cost favored the movable alternative. The proposed new movable alternative provides higher vertical clearance in closed position, reduces 75% of the openings, and reduces the user cost experienced with the existing bridge.

Other factors that may not be easily translated to dollar values were also brought to the evaluation, such as degree of satisfaction to the project needs, environmental/hazardous materials impact, culture/historical resource impact, air quality/noise control impact, and community accessibility/ramp slope, etc.

Wittpenn Bridge life-cycle cost along with project need provided an example of how to document a movable alternative being more desirable than a fixed alternative in a major metropolitan area. Movable bridges can be both functionally advantageous and cost-effective.

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INTRODUCTION

The Wittpenn Bridge, one of the "Tri-Hack" vertical lift bridges over the Hackensack River, was built in 1930, with a major rehabilitation performed in 1957. It is a key component of NJDOT's Portway Corridor, carrying State Highway Route 7 to the Newark/Jersey City Turnpike (County Route 508) and NJ Turnpike Interchange 15W on the west, and U.S. Routes 1&9 Truck, and S.H. Route 139 to the east. It provides a key connection from the west to the Holland Tunnel and New York City, as well as business and industrial areas within Jersey City. It also serves as a main truck route for traffic serving industries in the greater Kearny/Meadowlands area.

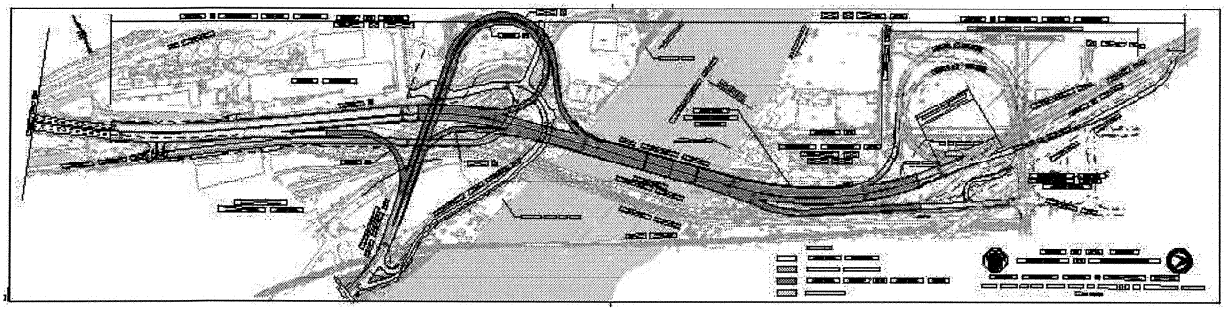

FIG. 1. Plan of the Project

The existing Wittpenn Bridge and Fish House Road Interchange is functionally obsolete and structurally deficient. As part of the Portway Project, NJDOT proposes to reconstruct the existing Wittpenn Bridge/approaches/interchanges to eliminate structural deficiencies and substandard features, and to improve traffic operations and safety aspects of the Wittpenn Bridge including the interchange at Fish House Road and Charlotte Circle (Fig. 1).

NJDOT and FHWA have asked for a Technical Report in response to 23 CFR 650H section 650.809 of the Federal Aid Policy Guide, which requires "A fixed bridge shall be selected whenever practicable. If there are social, economic, environmental or engineering reasons which favor the selection of a movable bridge, a cost benefit analysis to support the need for the movable bridge shall be prepared as a part of the preliminary plans."

Two alternatives are evaluated – a Mid-level Movable Bridge Alternative ("Movable Alternative") and a High-Level Fixed Bridge Alternative ("Fixed Alternative").

A full comparison of the two Alternates addresses not only the initial cost, but also the cost over the life of the structure. Other impacts considered in the total evaluation for the two alternatives include: Environmental, Community, Aesthetics & Cultural Resources, Air Quality and Noise, and compatibility with the Portway Corridor.

THE EXISTING BRIDGE

The existing bridge (Fig.2 and Fig.3) is 2,169-feet long with fourteen deck-girder and three through-truss approach spans, two tower spans, and a 209 feet vertical lift span. The west eight piers including all the

river piers and the pier and west abutment used to span Fish House Road, are shared by the adjacent freight bridge, CSX Corporation / Conrail.

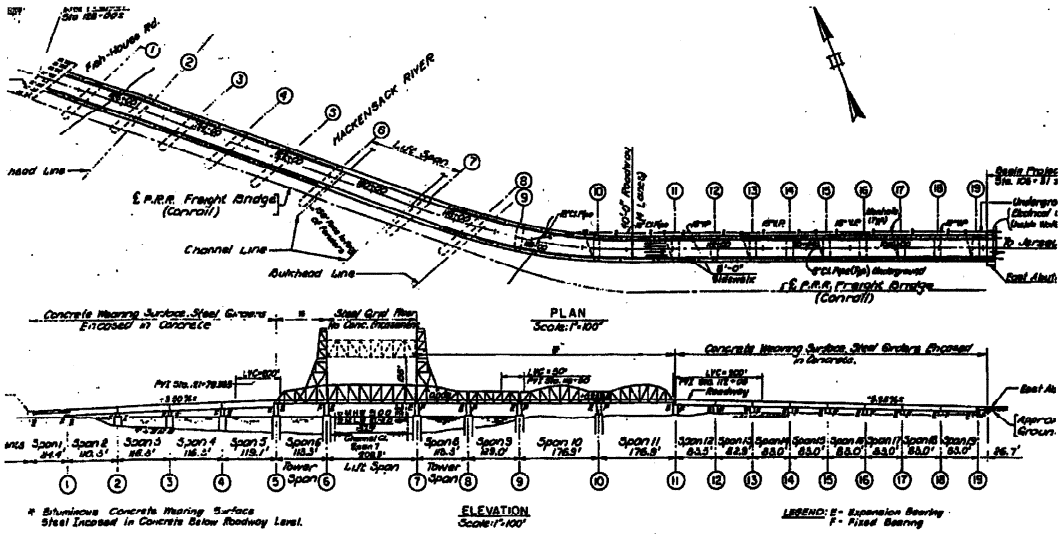

FIG. 2. Plan of Existing Bridge

FIG. 3. Photo of Existing Bridge

The vertical lift span provides approximately 35 feet vertical clearance above Mean High Water (MHW) in the closed position and 135 feet when opened. The fender system is continuous through the PATH and CSX/NS bridges, providing a 158 ft wide navigation channel (Fig.4).

FIG. 4. Triple Hack Bridges in Open Position

The existing highway, bridge and corridor within the project limits present operational, physical and safety problems that need to be resolved. The bridge is functionally obsolete and structurally deficient and needs to be replaced. The existing roadway is undivided, 40 feet curb to curb, carrying four narrow lanes of traffic with abrupt curvature on the east approach, with high fatal accident rates reported. The existing bridge also carries two 8 feet wide sidewalks (Fig. 5).

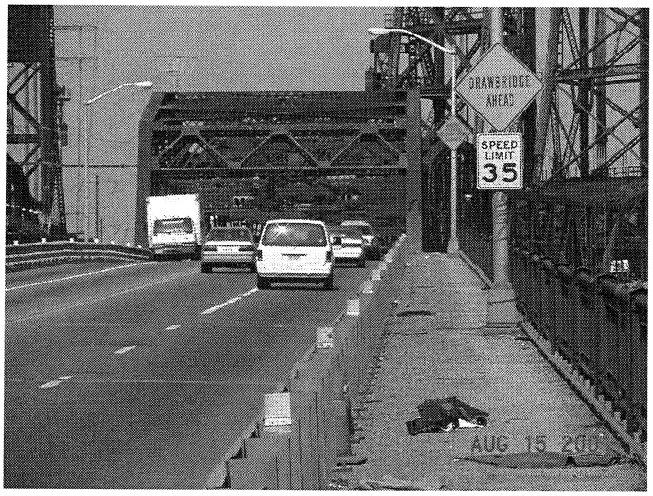

FIG. 5. Existing Bridge with Substandard Geometry

In order to solve the aforementioned problems and deficiencies, NJDOT proposes the replacement of Wittpenn Bridge and related approach interchange to:

- Eliminate structural deficiencies and substandard features
- Improve traffic operations and safety aspects of the Wittpenn Bridge including the interchange at Fish House Road and Charlotte Circle
- Increase the efficiency of overall traffic flow on Route 7
- Respond to future growth as part of the Department's Portway Project.
- Minimize vehicular and navigation conflicts.

PROJECT NEEDS

Among all the project needs, the following are the major items that define and differentiate the fixed and movable alternatives:

- **Vertical Navigation Clearance:** All the bridges across the Hackensack River in this area have a maximum vertical clearance of 135 feet. These bridges include the Lincoln Highway Bridge (movable, downstream), the Pulaski Highway Bridge (fixed, downstream), the other two "Triple Hack Bridges" - the Path and CSX bridges (movable, downstream), and the "Lower Hack Bridge" (movable, upstream). USCG required that this maximum vertical clearance of 135 feet should be maintained for any bridge replacement. For the movable bridge alternative, it is desirable to increase the vertical clearance in closed position to 70 feet. The bridge opening statistics indicated that this would reduce more than 75% of the bridge openings and reduce the user cost (Table 1).

TABLE 1. Vessel Height Survey

Vessel Height Up To (ft)	35	40	45	50	55	60	65	70	75	80	85	90	95	100+
May-01			1	7	1	15	7	3	2	4		2	2	
Mar-01		5		5	2	14	1	5		3		4		5
Feb-01		1		6		5	5	5				1		1
May-00			1	1		32	7	12		1		3	1	
Apr-00				4		25		9		1				
Jan-00			1	5		9		2		1				6
Dec-99				1		13	2	2				1		2
Sep-99				1	1	10	1	2		3	2			4
Aug-99			1		3	14		1	3	2	1	3	1	4
Jul-99			4	1	9	15	1	3	1					3
Jun-99				8	1	8	1	2		1	2			2
May-99	1	1	1	3		5	2	1				1		4
Apr-99	1			3		12	13	2		1				2
Mar-99				5		11	3	2	2				1	2
Feb-99		1	2	2	1	15	2	2				2	1	4
Jan-99	1	7	8	3		9	1							2
Totals	**3**	**15**	**19**	**55**	**18**	**212**	**46**	**53**	**8**	**17**	**5**	**17**	**6**	**41**
% of total	0.6	2.9	3.7	10.7	3.5	41.2	8.9	10.3	1.6	3.3	1.0	3.3	1.2	8.0
Cumulative %	1	3	7	18	21	63	71	82	83	87	88	91	92	100

- **Horizontal Navigation Clearance:** Existing 300 feet navigation channel to be maintained. Also 158 feet face to face of fender through the structure to be maintained. The extension of existing fender systems, which are shared with adjacent CSX and PATH vertical lift bridges, control the navigable clearance below the structures.
- **Minimum Design Speed:** Rt. 7 – 50 MPH desirable, 45 MPH minimum. Fish House Road – 40 MPH desirable, 35 MPH minimum. Ramps: 25 MPH. For the fixed bridge alternative, the maximum grade corresponding to the design speed and the vertical navigation clearance requirement result in a significant increase of the structure limit and make the access to some local industries impossible.
- **Design Life:** Per NJDOT design manual, the design life is 100 years.
- **Traffic Design Requirement:** Based on the existing data, the following are used for Rt. 7: 2025 Two-Way, 40,850 ADT, 20% Trucks.
- **Constructibility/MPT:** Construction of the bridge off line will allow the existing bridge to remain in operation during construction of the new bridge. Construction of the approaches will be staged to minimize impacts to existing traffic operations.
- **Adjacent Structure/Other Portway Projects:** The project is part of the Portway Corridor, including the reconstruction of Charlotte Circle, the St. Paul's Avenue Viaduct, and a Tonnele Circle flyover couplet. The new main span is adjacent to CSX and PATH vertical lift bridges that share fender systems with the existing Wittpenn Vertical Lift Bridge. The CSX structure also shares foundation with the existing Wittpenn Bridge. Fish House Road passes below PATH and over CSX for the Movable Alternative. Fish House Road passes over both CSX and PATH for the Fixed Alternative.
- **Safety Improvement:** Both Alternatives improve geometry and provide median barrier, guide rail, sidewalk, and access for operation and inspection. For the Movable Alternative, this would include safety gates and warning lights.
- **Interchange Improvements:** Both Alternatives improve connection between Fish House Road and Route 7 by way of standard ramp movements.
- **Navigation Control:** Both Alternatives provide navigation lights and clearance gage per USCG specification.
- **Environmental:** Consideration is given to the fact that the project is located in an ecologically sensitive area from the construction over the Hackensack River and sections of tidal wetland ditches located in the area of the proposed Fish House Road interchange.
- **Cultural/Historic Resources Requirement:** Consideration is given to the fact that the existing bridge was recommended individually eligible for the National Register of Historic Structures. Higher impact is expected for the Fixed Alternative.
- **ROW:** Consideration is given to the Right-of-Way cost.
- **Access Control:** The access for companies on Fish House Road is restricted under the Fixed Alternative. The Owens-Corning driveway on Route 7 will be permanently closed. A portion of existing Fish House Road will remain to service existing properties within the limits of the interchange. However, an at-grade intersection with this portion is not feasible due to elevation differentials. Traffic traveling north on Fish House Road heading towards these remaining properties must use the interchange to the west and make a U Turn. The same interchange must be used to access Rt. 7 eastbound from these remaining properties. Direct access to Rt. 7 eastbound and westbound will be provided from the CSX facility on Fish House Road via ramps between the CSX Fish House Road yard and the supplemental yard.
- **Operation:** The Movable Alternative is currently proposed to be manned similarly to the existing bridge, by 3 full time operators at 24 hours a day and 7 days a week basis. However, it

is proposed that during the design phase, the Department consider reducing staff because of the reduction in the number of openings and state of the art equipment used to control traffic and open the bridge.

MOVABLE ALTERNATIVE

This alternative would replace: (a) the existing vertical lift bridge with a new movable bridge located immediately north of the existing bridge, (b) the existing east and west approaches including the Fish House Road Interchange with new structures and grade separated roadways.

The following are the main features of this alternative:

- The Rt. 7 profile has a high point near the centerline of navigation channel. The new vertical lift bridge provides 70 ft vertical clearance over Mean High Water in the closed position and 135 ft in the open position, and is projected to require approximately 63 openings per year at this higher elevation.
- The structure lengths are:
  - Rt.7 – 3051 feet
  - Fish House Rd – 959 feet
  - Ramps for interchange – 3169 feet
- The roadway lengths are:
  - Rt.7 – 1804 feet
  - Fish House Rd – 558 feet
  - Ramps for interchange – 1821 feet
- The roadway grades are: (a) Rt. 7 west approach – 4% maximum, (b) Rt. 7 east approach – 4% maximum, (c) Fish House Road – 6.5% maximum, (d) Ramps – 6% maximum.
- Accesses to the local industry are provided.
- The new vertical lift bridge has (a) lightweight deck, (b) steel box/steel truss superstructure, (b) steel tower, (c) drilled shaft foundations, and (d) tower-drive mechanical/electrical systems.
- The new approach superstructures are assumed to be composite plate girders.
- The new abutments, piers, and retaining walls are of concrete.
- The foundations are on H-piles and/or drilled shafts
- The new structures are located to allow for maintenance and protection of traffic during construction.
- The new Fish House Road structures are under the PATH bridge and over CSX rail facilities.
- Retaining walls are used where structure height would be less than 25 ft above existing profile.
- The new bridge has a pier protection system extending from the existing fender system for the adjacent CSX and PATH vertical lift bridges.
- A ramp connection from Route 7 to Newark Avenue is provided.
- Design exceptions are not anticipated.

FIXED ALTERNATIVE

Developed to provide the same traffic movements provided by the Movable Alternative, this alternative would replace: (a) the existing vertical lift bridge with a new fixed bridge located immediately north of the existing bridge, (b) the existing east and west approaches including the Fish House Road Interchange with new structures and grade separated roadways.

The following are the main features of this alternative:

- The Rt. 7 profile has a high point near the centerline of navigation channel. The new fixed bridge provides 135 ft vertical clearance over Mean High Water.
- The structure lengths are:
  - Rt.7 – 4790 feet
  - Fish House Rd – 2370 feet
  - Ramps for interchange – 5949 feet
- The roadway lengths are:
  - Rt.7 – 1683 feet
  - Fish House Rd – 591 feet
  - Ramps for interchange – 1621 feet
- The roadway grades are: (a) Rt. 7 west approach – 5% maximum, (b) for Rt. 7 east approach – 5% maximum, (c) Fish House Road – 6% maximum, (d) Ramps – 6% maximum.
- Accesses to some of the local industry and properties are closed due to the high roadway profile.
- The new fixed main span is a parallel through truss structure, utilizing high strength steel.
- The new approach superstructures are assumed to be composite plate girders.
- The new abutments, piers, and retaining walls are of concrete.
- The foundations are on H-piles and/or drilled shafts
- The new structures are located to allow for maintenance and protection of traffic during construction.
- The new Fish House Road structures are over both the PATH bridge and CSX rail facilities.
- Retaining walls are used where structure height would be less than 25 ft above existing profile.
- The new bridge has a pier protection system extending from the existing fender system for the adjacent CSX and PATH vertical lift bridges.
- A ramp connection from Route 7 to Newark Avenue is not feasible under this scheme. To accomplish this movement the ramp profile down grade would approach 9%. The ramp bullnose cannot be moved further west without compromising the channel vertical clearance. Major modifications to Newark Avenue/1&9(T) intersection are not possible due to its proximity to the Pulaski Skyway, CONRAIL, and PATH railroad bridges that are within 150 feet of the intersection and the railroad siding over Newark Avenue that is approximately 400 feet east of the intersection.
- Design exceptions are not anticipated.

INITIAL CONSTRUCTION COSTS

All cost estimates are based on year 2001 dollars. The initial construction cost estimates include costs of utilities, ROW, Hazardous Materials, MPT, and other contingencies, as stated in NJDOT Procedures Manual Section 4.2.1. The itemized construction cost estimates are shown in Table 2. The total construction cost is $317 million for the Movable Alternative and $398 million for the Fixed Alternative.

The following factors are noteworthy when comparing and evaluating the construction costs.

Main Span Cost

The Movable Alternative has a higher main span construction cost due to the complexity of building an expensive movable structure, towers, foundation, mechanical equipment, electrical equipment, traffic control gates and operator's house.

Project Limit and Structure Limit

The large volume of truck traffic along the corridor restricts the optimum profile grade for the crossing. The Movable Alternative utilizes a grade of 4%, whereas the Fixed Alternative utilizes a 5% grade. Due to the additional vertical clearance required, the Fixed Alternative results in extension of structural project limits by approximately 3000 feet over the Movable Alternative for the total length along Rt. 7 and Fish House Road. For the Fixed Alternative, a majority of Fish House Road becomes an elevated structure thereby increasing construction cost.

High Substructure Costs

The soil condition in this area is poor and subject to environmental contamination. Stratified silty clay is intermingled with, and underlain by, organic swampy deposits in an erratic pattern that makes separation extremely difficult. In addition, fill materials ranging in character from suspected toxic industrial waste to granular soil have been dumped in varying thickness at various points in the area. The tidal marsh and overlying fill are mixed to such an extent that separation into individual types is impossible. Based on available boring information, the depth of bedrock on the east approach is between 75 and 90 feet below Mean High Water, and the bedrock on the west approach varies from 99 to 114 feet below Mean High Water. The existing soils appear unsuitable to support the anticipated pier loads for either of the proposed bridge alternatives. Due to the great depth of weak river deposits and the heavy loads of the proposed structures, the foundations are proposed to be bearing type drilled shafts and H-piles supported by the bedrock. High piers, up to 70 feet and 135 feet above Mean High Water for Movable and Fixed Alternatives, respectively, result in high substructure costs. The unit costs are higher for the Fixed Alternative, for taller piers, heavier reaction and larger foundations than for the Movable Alternative. This high substructure cost normally suggests that a more economical design may be achievable by using longer spans. However, the steep profile of the fixed bridge makes this difficult.

Approach and Interchange Substructure Cost

The substructure unit costs are higher for Fixed Alternative due to high piers (up to 65 feet higher near the river span) requiring more material, greater foundation bearing capacity requirement, larger lateral stiffness requirement with height, and more seismic design requirement and associated detailing.

Fish House Road Additional Cost

For the Fixed Alternative, Fish House Road becomes a much longer elevated structure spanning over the existing CSX rail facilities and PATH bridges. In order to provide for the Fish House Road to Rt. 7 eastbound movement, a critical component to the Portway Corridor, the entire ramp must also be put on structure spanning PATH and the CSX rail facilities.

Utility Relocation Cost

The project area is in a highly industrialized area with numerous utility facilities involved, both overhead and underground as noted under Existing Conditions herein.

While the footprints of the two alternatives are similar, the impacts to the utilities within the project limits do vary. The Fixed Alternative requires significant additional relocation of PSE&G's High Tension Towers due to the higher roadway profile.

TABLE 2. Initial Construction Costs (Million $)

Alternative	Movable	Fixed
Main River Span		
Superstructure	17.4	5.1
Substructure	17.7	7.8
Mechanical, Electrical and Related	22.4	
Fender Systems	8.0	8.0
Demolition and Miscellaneous	5.8	5.6
sum	71.3	26.4
West Approach		
Superstructure	16.0	24.3
Substructure	23.3	31.8
Demolition and Miscellaneous	5.7	6.7
Ramp Superstructure	8.4	11.5
Ramp Substructure	6.7	10.4
Ramp Demolition and Miscellaneous	0.9	1.2
Embank., Wall, Sheetings, Fills, etc.	12.9	15.3
sum	73.9	101.2
East Approach		
Superstructure	12.0	21.9
Substructure	15.2	24.2
Demolition and Miscellaneous	3.1	5.5
Ramp Superstructure	0.6	5.5
Ramp Substructure	0.4	5.0
Ramp Demolition and Miscellaneous	0.1	0.6
Embank., Wall, Sheetings, Fills, etc.	15.6	31.5
sum	47.0	94.1
Fish House Road		
Superstructure	5.9	14.8
Substructure	4.7	13.3
Demolition and Miscellaneous	1.5	3.7
Embank., Wall, Sheetings, Fills, etc.	6.9	8.1
sum	19.0	39.9
Utility Relocation Cost	15.0	25.0
Hazardous Material Cost	8.9	10.1
Right of Way Cost	9.1	9.5
Project subtotal	244.1	306.3
Maintenance of Traffic 5%	12.2	15.3
Mobilization 10%	24.4	30.6
Miscellaneous & Contingency 15%	36.6	45.9
Total Construction Cost	317	398

The higher roadway profile at the crossing with Route 7 as well as the additional impacts as a result of Fish House Road being almost entirely on structure to carry the roadway over the existing PATH rail facilities will likely require the complete relocation of the High Tension crossing to the west where the grade differential is more favorable. The Fixed Alternative will also require additional underground relocations due to the increase in overall structure limits and quantity and height of retaining walls.

Significant utility relocation costs can be avoided as there will be an opportunity to coordinate some relocations on the east approach with the Route 1&9(T) project that will be completed prior to this project. Many of these utilities can be relocated to locations that will accommodate the Wittpenn bridge construction.

It should be noted that the Movable Alternative will not provide the opportunity to carry any relocated utilities on structure. None are currently being accommodate by the existing structure.

LIFE CYCLE COSTS

A full comparison of the two alternatives addresses not only the initial cost, but also the cost over the life of the structure. The evaluations are based on the assumption of a new structure being designed to last for 100 years. The different structure types have very different life cycles and therefore both operational and user costs have been evaluated to compare the alternatives. The itemized life cycle cost estimates are shown in Table 3. The total additional life cycle costs are $45 million for Movable Alternative and $25 million for the Fixed Alternative, with present value of life cycle cost and 4% discount rate considered. Again, the main attention is on the differential between the two alternatives.

Construction of Route 1 & 9 (T) Delay Cost

On the east side of the project, the NJDOT project 1 & 9 (T) is currently under design based on the assumption that the proposed Movable Alternative will be accepted for the new Wittpenn Bridge. The Fixed Alternative, with its higher elevation, has a significant impact on what has been coordinated. The two projects will need to be re-sequenced and constructed concurrently in order to avoid costly temporary construction, causing the loss of design progress and delay in construction schedule. It has been estimated that progressing the Fixed Alternative would result in a one-year delay in the start of the 1 & 9 (T) construction contract with corresponding one-year escalation in construction costs.

Operation and Maintenance Costs

Movable Alternative has significant life cycle costs for bridge operation and maintenance. The bridge opening is estimated at approximately 63 times per year, and with state of the art equipment and machinery, it should be able to be operated by one full time operator and still respond to navigational requirements of operating on demand. However the cost for staffing the bridge has been maintained at the current level of three people full-time. In addition, movable structures have power and lubrication requirements that have been included in the annual maintenance costs. Three major rehabilitations for both the electrical and mechanical systems have been estimated at 25, 50 and 75 years of life.

Painting and Re-Decking Costs

Deck replacement every 25 years, and painting every 15 years have also been included for each alternative.

Traffic Delay Costs

For the Movable Alternative, traffic is periodically disrupted and delayed along Route 7 approaching the Wittpenn Bridge due to the bridge opening. This user cost is estimated to have a 3.3 million dollar present worth. For the Fixed Alternative, there is no traffic delay cost.

TABLE 3. Life Cycle Costs (Million $)

Alternative		Movable	Fixed
Construction Cost		317	398
Affected Portway Construction Cost			
	Rt. 1 & 9T 1 Year Delay		8.8
	sum		8.8
Operation and Maintenance Cost			
	Mechanical and Electrical Operation	29.3	
	Mechanical and Electrical Maint. and Rehab.	2.6	
	Structure Maint., Painting	1.7	2.9
	Re-decking	7.8	13.6
	sum	41.3	16.6
User Cost			
	Highway - traffic delay due to Bridge Opening	3.3	
	sum	3.3	
Total Life Cycle Cost		362	424

OTHER EVALUATION CRITERIA

There are other factors need to be considered in the overall evaluation, which are difficult to convert directly to dollar cost values.

Impact on The Environment

Construction of the Movable Alternative will result in the disturbance of an estuarine emergent wetland area along the eastern shore of the Hackensack River and several sections of tidal wetland ditches located in the area of the proposed Fish House Road interchange. The Fixed Alternative will impact the same ecologically sensitive areas as the Movable Alternative. However, because the footprint of disturbance to Route 7 for the Fixed Alternative extends further to the east and west than the Movable Alternative, additional impacts to ecologically sensitive areas are possible. Considerable areas of freshwater wetlands are present on both sides of Route 7 along the proposed western extension of the Fixed Alternative. Any widening or rerouting of Route 7 in this area will result in the disturbance of some of these wetland

areas. Bridge support structures in the Hackensack River are not expected to differ appreciably for both Alternatives, so impacts to open waters and aquatic resources are expected to be the same.

Hazardous Materials

For both Alternatives there is a potential for soil and groundwater contamination within the Route 7/Wittpenn Bridge project area. Commercial and industrial facilities have long histories of land use that may have impacted the surrounding soil and groundwater in the project area. NJDEP has listed four sites in Kearny on the Known Contaminated Sites List. Contamination due to metals, poly-aromatic hydrocarbons, pesticides, polychlorinated biphenyls and petroleum hydrocarbon compounds are typically associated with trucking facilities and construction equipment storage as those located in the project corridor. Groundwater contamination, which may include PHCs, volatile organic compounds, and metals, may also be present at sites in the project corridor. Six industrial locations are identified as potentially contaminated sites, in addition to those potentially contaminated sites located in Jersey City will be addressed as part of the Routes 1 and 9 (T) Project.

The Fixed Alternative has a greater area of disturbance than the Movable Alternative generating larger quantities of potentially contaminated excavated material. Consequently, construction costs related to hazardous materials would be higher for the Fixed Alternative.

Quantities for excavated material for both Alternatives are estimated. The Movable Alternative would generate approximately 108,000 cubic yards of excavated material and the Fixed Alternative would generate approximately 122,884 cubic yards. Based on professional knowledge and experience, it is estimated that 70 percent of the excavated material can be reused on site as fill material, 25 percent would be disposed of off site as hazardous waste, and 5 percent would be disposed of off site as ID-27 material.

Socio-Economics

Socioeconomic impacts may result from both Alternatives. ROW acquisition in Jersey City will be addressed as part of the Routes 1 and 9 (T) project. The project is located in a highly developed urbanized area and land use along the study corridor is predominantly commercial/industrial. Active and former industrial facilities, construction equipment storage facilities, trucking facilities, and railroad maintenance facilities are located in the area affected by the project. The project is integral to the Portway Corridor that will have a positive economic affect in the area. Vacant land parcels with histories of industrial/commercial land use are also present. Commercial property will be acquired in their entirety under both Alternatives and other partial acquisitions will affect properties along the corridor. Potential full and partial property acquisitions for both Alternatives are identified in the study.

The Fixed Alternative requires a greater partial taking at the Owens Corning/Trumbell Facility, increasing the right-of-way acquisition cost. Consequently, construction costs related to socio-economics would be higher for the Fixed Alternative.

Impact on the Community

The Fixed Alternative has a greater negative impact to those companies in the immediate vicinity of the Fish House Road interchange which cannot get direct access to Route 7 east and would be required to take Route 7 west approximately 1 mile to the next interchange and make a U-turn.

Aesthetics & Cultural Resources

Background research at the State Historic Preservation Office (SHPO) has identified several historic architectural resources listed in or determined eligible for the National Register of Historic Places within the Area of Potential Effects. As a result of an historic architectural survey for the U.S. Routes 1 & 9 Truck Improvement Project completed in 2000, the Wittpenn Bridge over Hackensack River was recommended individually eligible for the National Register. SHPO concurred with this recommendation, stating further that the Wittpenn Bridge is a contributing resource to the New Jersey Railroad Bergen Cut Historic District, which includes the Pennsylvania Railroad Harsimus Bridge. Finally, the SHPO opined that the Wittpenn Bridge is also one of four movable bridges that "collectively warrant serious consideration as the Hackensack River Lift Bridges Historic District." The SHPO will offer a formal opinion of eligibility on the status of the Hackensack Lift Bridges Historic District upon review of the cultural resources investigation for this project. It is the consultant's opinion that a historic district does exist; therefore, the critical issue associated with this project will be the assessment and mitigation of adverse effects caused by the bridge replacement project.

For the Movable Alternative, replacement of the Wittpenn Bridge will result not only in an adverse historic effect to the bridge but an adverse effect to the New Jersey Bergen Cut Historic District and the Hackensack River Lift Bridges Historic District. To mitigate the adverse effect, an appropriate program of documentation can be undertaken and appropriate design considerations for the replacement bridge should be implemented. A context sensitive bridge design would include construction of a new movable bridge of similar materials, color, height and appearance as the remaining bridges in the historic district.

Given the amount of fill that has been imported for the industrial development of the area, the archaeological investigation for the Movable Alternative would primarily involve determining the depth of disturbances and potential for buried surfaces within the alignment. This information would then be compared with the depth of the project footprint in order to assess the potential effects to buried surfaces that may contain archaeological resources. The same effort would be involved with the Fish House Road Interchange alternative.

For the Fixed Alternative, the adverse effects, mitigation measures and design considerations are the same as for the Movable Alternative. However, replacing a National Register-eligible movable bridge with a fixed bridge is inappropriate mitigation. A fixed bridge would also be out of character within the historic context of the Hackensack River Lift Bridges Historic District. If this alternative were chosen as the preferred then it would require mitigation that would exceed documentation of the eligible bridge.

The Fixed Alternative would require similar archaeological investigations as the Movable Alternative. However, the potential for impact on buried surfaces that could contain archaeological resources would be greater with the Fixed Alternative given the lengthier alignment. This also applies to the longer Fish House Road Interchange associated with this alternative.

Air Quality and Noise

Substandard roadway conditions produce sufficient delays, congestion and result in excessive emissions. Carbon monoxide is produced in greater volume at lower speeds. The Fixed Alternative has steeper roadway grades at each approach than the Movable Alternative and would be more difficult to maintain "cruise-speeds" in these areas, producing higher CO levels for the Fixed Alternative.

There would be openings necessary associated with the Movable Alternative for marine traffic. An estimated 63 openings a year, or approximately 5.3 times per month are expected. This number of openings per month would greatly reduce the effect currently being produced with the low-level movable bridge and is estimated to have a minimal effect on local or regional air quality as would the Fixed Alternative.

There are minimal noise sensitive receptors within project limits. The Federal Highway Administration (FHWA) has established noise guidelines for several land use activities. Within project limits, there are Category C, or commercial land use activities present. Outside project limits in Jersey City (east of the Wittpenn Bridge), are a number of Category B, or residential properties. Generally, noise levels are known to travel farther where there are no obstructions. Therefore, when a noise source is lifted, noise levels from that source can be heard further. Both bridge options will lift the bridge deck higher than under existing conditions. The Fixed Alternative would provide a 135-foot clearance while the Movable Alternative is proposed to have a 70-foot clearance in the closed position. Noise levels generated by vehicles traveling over the Fixed Alternative would be higher at sensitive receptors outside project limits. Conversely, it is expected that commercial properties directly adjacent to the bridge will experience increased noise levels with the Movable Alternative over the Fixed Alternative. This is due to the fact that the deck height is closer to the commercial properties in the Movable Alternative than with the Fixed Alternative.

EVALUATIONS AND CONCLUSIONS

A matrix summarizing the comparison of the ability of each Alternative to respond to the project needs and the life cycle cost is given in Table 4. The Movable Alternative is recommended as it responds to all the project needs and has the lowest life cycle cost.

The higher profile for a fixed structure results in both greater initial construction costs and drastic change in appearance/function of the crossing. The advantages normally found in a fixed bridge alternative are offset by the height needed to maintain navigation in this location and by the associated longer structure/project limits. The steeper grade of the Fixed Alternative is not recommended for this road with heavy truck usage, and the structure profile does not respond to the historic nature of the vertical lift corridor it traverses.

Wittpenn Bridge life-cycle cost along with project need provided an example of how to document a movable alternative being more desirable than a fixed alternative in a major metropolitan area. Movable bridges can be both functionally advantageous and cost-effective.

TABLE 4. Evaluation Matrix

Alternative	Movable	Fixed
Project Needs:		
Remove structural deficiency	Yes	Yes
Meet current design standard	Yes	Yes
Improve traffic operations and efficiency in Route 7	Yes	Yes
Provide direct access to and from Fish House Road	Yes	Yes
Respond to future growth as part of Portway Project	Yes	Yes
Improve safety aspects	Yes	Yes
Provide navigation clearance	Yes	Yes
Minimize vehicular & navigation traffic conflicts	Improved	Eliminated Completely
Effects:		
Environmental impact	Moderate	Moderate
Hazardous materials impact	Moderate	High
Culture/Historical resource impact	Moderate	High
Right of way impact	Moderate	Moderate
Air quality and noise control	Moderate	Moderate
Community - maintain access for companies on Fish House Road to Rt. 7	Yes	No
Community - provide feasible ramp connection from Rt. 7 to Newark Avenue	Yes	No
Initial Construction Cost	$317,000,000	$398,000,000
Life Cycle Cost - 100 years	$362,000,000	$424,000,000
Overall Evaluation	Recommended	Not Recommended

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