EXECUTIVE SUMMARY

Churchill Engineering, Inc (CEI) inspected the bridge located on Bartlett Road spanning the Beaver Dam Brook within the Town of Plymouth, Massachusetts on February 19, 2010. A previous Structures Inspection Field Report was completed on April, 12 1999 by Beta Group, Inc. A copy of the previous report was made available Churchill Engineering, Inc. prior to conducting the inspection and is included within this report. This structure also impounds water from the outlet of Fresh Pond by way of flash boards between the southern end of the East and West Abutments and a center pier. The dam is known as Fresh Pond Dam and is registered with the US Army Corps of Engineers as 7-12-239-26 and the Massachusetts Office of Dam Safety as MA01029.

The bridge is considered in satisfactory condition. However, this assessment ignores deficiencies that cannot be corrected by remedial repairs. Deficiencies to the approach alignment, limited bridge width and lack of sidewalk are not expected to be corrected without the complete replacement of the structure. Hence, this assessment and the following recommendations are for the continued use of the bridge until a more permanent solutions are developed.

The superstructure is a concrete deck supported on concrete encased steel stringers / girders considered in satisfactory condition. The underside of the deck exhibits minor cracking throughout with spalling of concrete limited to the encasement of the stringers / girders. Some oxidation of the exposed stringer/ girder flanges was observed although no section loss was noted. The wearing surface upon the deck is map cracked but otherwise in satisfactory to fair condition.

The substructure consists of concrete breast and wing walls also considered in satisfactory condition. Both North and South Brest walls exhibited minor scaled regions approximately 24" in height along the waterline. A cold joint in the cast in place concrete was observed along the East breast wall. The wing walls on the southern elevation and a center pier form the structure impounding the Outlet from Fresh Pond. These walls were found to be in satisfactory / fair condition. The Northeast and Northwest wing walls appear to have been constructed at a date later than the rest of the structure. A review of the previous inspection report yields that these walls have been installed after the last inspection of April 12, 1999. These walls are considered to be in good condition.

The approaches to the bridge have suffered significant settlement of up to 3". The alignment of the approaches and width of the bridge is not considered to meet current standards. The bridge rail is currently provided by guard rail unsupported over the span. Support for the bridge rail is provided by guard rail post along the transitions. Hence, the bridge rail, transitions and approach guard rail are not expected to conform to current standards.

Although not included in the scope of work, misalignment of the flash boards impounding water along the south elevation was noted. We understand this dam is owned by the Town and as a result the department responsible for the dam should be advised that corrective action may be required.

Recommendations by CEI include the following:

- ***Repair of settled pavement at the approaches***
- ***Continued monitoring of settlement at Northern limits of West abutment***
- ***Design and installation of bridge railing and transitions conforming to current AASHTO standards.***
- ***Installation of traffic barrier along the approaches***
- ***Installation of regulatory / warning signage due to limited bridge width***

PREFACE

The assessment of the general condition of the bridge is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report unless reported otherwise.

In reviewing this report, it should be realized that the reported condition of the bridge is based on observations of field conditions at the time of inspection, along with data available to the inspection team.

It is critical to note that the condition of the bridge depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the bridge will continue to represent the condition of the bridge at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

_____

Authorized/Licensed Professional's Signature

Richard M. Churchill, P.E.
Massachusetts License No.: MA 40696
Principal
Churchill Engineering, Inc.

TABLE OF CONTENTS

SECTION 1

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The Town of Plymouth Massachusetts has retained Churchill Engineering, Inc. to perform a visual inspection and develop a conditions assessment report for the bridge which carries Bartlett Road over the Beaver Dam Brook (Outlet from Fresh Pond) in Plymouth, Massachusetts.

1.1.2 Purpose of Work

The purpose of this investigation is to inspect and assess the present condition of the bridge and appurtenant structures in accordance with Federal Highway Administration (FHWA) National Bridge Inspection Standards (NBIS).

The investigation is divided into three parts: 1) obtain and review available reports, investigations, and data previously submitted to the owner pertaining to the bridge and appurtenant structures; 2) perform a visual inspection of the bridge; 3) prepare and submit a final report presenting a condition assessment of the bridge, including recommendations and remedial repairs.

1.2 Description of Project

1.2.1 Location

The Bridge is located on Bartlett Road spanning Beaver Dam Brook (Outlet from Fresh Pond), within the Town of Plymouth, Massachusetts. The bridge is at Latitude 41.5432 N degrees and Longitude -70.3363W degrees.

1.2.2 Owner/Maintainer

The owner of the bridge is the Town of Plymouth, Massachusetts. The point of contact concerning the bridge is the Town Engineer, Mr. Sid Kashi PE, and can be contacted at 11 Lincoln Street Plymouth, MA 02360. The bridge is maintained by the Town of Plymouth's Department of Public Works and can be contacted at this same address.

1.2.3 Description of the Bridge

The bridge is a single span of approximately 7'-8" spanning Beaver Dam Brook (Outlet from Fresh Pond). The date of construction is unknown and there were no plans for the structure available to CEI at the time of inspection. The superstructure consists of longitudinal concrete encased steel girders / stringers supporting a concrete deck. The width of the concrete deck is approximately 18'-0" supporting two lanes of traffic. The wearing surface on the deck consists of approximately 2" of bituminous concrete pavement. The end of the girders, bearings and bridge seat are encased in concrete and obscured from view. The substructure is reinforced concrete including both breast walls and wing walls. The Northeast and Northwest wing walls appear to be

of later construction than the rest of the bridge. A review of the previous inspection report of April 12, 1999 indicates these walls have been installed after the date of the previous report. The southern elevation forms a dam impounding water from Fresh Pond. Flash boards are supported by both the Southeast and Southwest wing walls and a center pier. This dam is known as Fresh Pond Dam and registered with the US Army Corps of Engineers as 7-12-239-26 and the Massachusetts Office of Dam Safety as MA01029.

SECTION 2

2.0 INSPECTION

2.1 Visual Inspection

The bridge was inspected on February 19, 2010. At the time of the inspection, the weather was clear and in the 40's. No significant rainfall had occurred the week prior to the inspection. Hence, water level within Beaver Dam Brook was considered seasonal normal pool. Photographs to document the current conditions of the bridge were taken during the inspection and are included in Appendix A. Underwater areas were not inspected. A copy of the structures field inspection report is included in Appendix B.

2.2 Superstructure

The deck slab and supporting girders / stringers were considered in satisfactory condition. Some spalling of the concrete encasement of the girders / stringers revealed surface oxidation on the exposed surfaces. However, section loss at these locations was not noted. Sounding of the remaining encasement yielded some hollow spots along to bottom of the flanges concentrated were cracking was observed. Otherwise the encasement was considered sound. The underside of the deck exhibits minor cracking throughout with spalling of concrete limited to the encasement of the flanges of the girders / stringers. Sounding of the underside of the deck between the girders / stringers did not yield hollow spots, voids, delaminations or other signs of distress. The wearing surface upon the deck was map cracked but otherwise found to be in satisfactory to fair condition.

2.3 Substructure

The substructure was found to be in satisfactory condition. Minor scaling within 2 feet of the waterline was observed at both the East and West breast walls. A cold joint was observed along the East breast wall with some minor hairline cracking and honeycombing noted in both breast walls. Some additional scaling and minor spalling was observed in the south end of the West breast wall at the support location of the flash boards. Hence, both breast wall were considered in satisfactory condition. The majority of the Southeast and Southwest wing walls could not be observed due the impoundment and the resulting accumulation of silt. The exposed portion of the walls were considered to fair condition. However, misalignment of a number of flash boards supported at the center pier were noted. It is suggested the Town authority responsible for the maintenance of the dam be advised corrective action may be necessary. The Northeast and Northwest wing walls appear to have been constructed relatively recently. A review of the previous inspection report of April 12, 1999 indicated these walls were constructed of dry laid rubble masonry and were in poor condition. The current walls appear to be constructed of reinforced concrete constructed after April 12, 1999 and are considered in good condition. However, some settlement in the pavement at the Northwest wing wall and the West approach indicate lateral movement or migration of fines within the supporting soil may be occurring. However, the settlement may also have been the result of poor compaction of the retained soil at the time of construction of the Northwest wing wall.

2.4 Channel and Channel Protection

Channel and channel protection were considered in satisfactory condition. Beaver Dam Brook is a meandering stream flowing below the bridge carrying Bartlett Road at a low velocity. No significant rain events occurred within a week of the inspection. Hence, the water surface elevation at the time of the inspection was considered at seasonal normal pool. The banks of unlined channel both up and downstream of the structure were noted to exhibit minor erosion although stream aggradation and channel misalignment were not observed. Signs of channel scour or other streambed degradation were not observed and probing below the substructure did not yield signs of undermining.

2.5 Approaches

The approaches to the bridge were considered in poor condition. Roadway alignment of both approaches is located along a curve with a bridge width of 18' for two lanes of traffic. The east approach pavement exhibited minor alligator cracking with roadway settlement of 1 – 2 " at the East abutment. The West approach pavement exhibits similar cracking. However, an approximate 2' wide x 3' long section of pavement has settled 2 – 3" and the Northern edge of the West abutment. Speculation as to the causes of this settlement is offered above. Settlement of the remainder of the West approach diminishes towards the centerline and then increases to up to 1 inch from the center line towards the south elevation.

2.6 Traffic Safety

The bridge railing is provided by steel guard rail section unsupported along the approximate 8' length of the structure. The current support condition of the bridge rail is not considered to provide adequate protection for vehicular traffic. Approach guardrails and end treatments are present although the guard rail posts appear out of plumb or otherwise misaligned. Hence, they not considered to comply with current standards or provide adequate protection to vehicular traffic on the bridge.

SECTION 3

3.0 ASSESSMENT & RECOMMENDATIONS

3.1 General Assessment

In general, the bridge carrying Bartlett Road over the Beaver Dam Brook (Outlet from Fresh Pond) is in satisfactory condition. This assessment ignores the deficiencies that cannot be corrected with remedial repairs. Assessments of individual elements of the structure are presented above. The following recommendations are provided to address deficiencies noted above to allow for the continued use of the structure while more permanent solutions are developed.

- The April 12, 1999 inspection report recommended an annual inspection of the bridge be conducted. CEI concurs with this recommendation based upon the advanced condition of some of the deficiencies noted within the inspection report.
- Alignment of the roadway at both approaches, the limited width of the bridge and the lack of a pedestrian sidewalk are beyond the scope of remedial repairs. Correction of the above deficiencies would appear to require replacement of the structure. Hence, the Town of Plymouth may find it advantageous to consider such needs in their capital planning.

3.2 Approaches

- Repair of the settled pavement of both approaches is recommended.
- CEI recommends continued monitoring of the settlement at the Northern limits of the West abutment to determine if movement is ongoing.

3.3 Traffic Safety

- The bridge rail should be evaluated for conformance with current AASHTO standards. CEI recommends a revised bridge rail design be developed and secured to the superstructure. The approach guard rail should be reviewed for compatibility with the revised bridge rail.
- If the current approach guard rail is determined to be compatible with the revised bridge rail, then the damage to the guard rail on the Northern side of the East Approach should be repaired.
- Due to the limited width of the Bridge, approximately 18 feet, regulatory / warning signage is recommended. Signage should be placed along both approaches in accordance with current standards.

3.4 Cost Estimate

• Annual Inspection	$ 3,000.00
• Complete Replacement	
o Engineering	$ 250,000.00
o Construction	$2,360,000.00
• Remedial Repairs	
o Bridge Rail Post Design	$ 1,500.00
o Bridge and Approach Guard Rail	$ 22,083.00

o Pavement Repairs	$	9,600.00
o Signage	$	452.00

FIGURES

CHURCHILL ENGINEERING, INC.
CONSULTING ENGINEERS

18 Main Street Ext., Suite 202
Plymouth, MA 02360

FIGURE 1
Locus Plan
Bartlett Road over Beaver Dam Brook
Plymouth, Massachusetts

APPENDIX A
Photographs

Figure 1. North Elevation

Figure 2 South Elevation

Figure 3. East Approach

Figure 4. West Approach

Figure 5. Bridge Deck

Figure 6. Underside Bridge Deck

Figure 7. East Breast Wall

Figure 8. West Breast Wall

Figure 9. Northeast Wing Wall

Figure 10. Northwest Wing Wall

Figure 11. Delamination and Cracking Concrete Encasement

Figure 12. Scaling and Spalling West Breast Wall South End

Bartlett Road over Beaver Dam Brook

Figure 13. Misaligned Flash Boards

Figure 14. Misaligned Flash Boards
Bartlett Road over Beaver Dam Brook
Plymouth, MA

Figure 15. View Upstream

Figure 16. View Downstream

Figure 17. Settlement East Approach

Figure 18. Settlement West Approach

Figure 19. Unsupported Bridge Rail

Figure 20. Misaligned Bridge Rail

Bartlett Road over Beaver Dam Brook