IPSWICH RIVER
ENGINEERING, INC.
STRUCTURAL ENGINEERS

June 23, 2011

Mr. John S. Mangiaratti, Assistant Town Manager
TOWN OF WESTFORD
55 Main Street
Westford, Massachusetts 01886

RE: **REPORT OF OBSERVATIONS AND RECOMMENDATIONS FROM THE VISUAL STRUCTURAL CONDITION EVALUATION OF THE WESTFORD TOWN FARM BUILDING**
35 Town Farm Road - Westford, Massachusetts 01886
Ipswich River Engineering, Inc. Project No.: IR-0387

Dear John:

Ipswich River Engineering, Inc. (IREI) has been retained by the Town of Westford, hereafter referred to as the *Town* in this report, to perform a visual structural condition evaluation of the existing timber framed, two-story Westford Town Farm building located at 35 Town Farm Road in Westford, Massachusetts. In this report, the Westford Town Farm building, in its entirety, will be referred to as the *Town Farm Building*. Currently, the *Town Farm Building* appears to be used by the Town of Westford Parks and Recreation Department for their various offices, program spaces, and meeting space. In general, the purpose of this visual structural evaluation was to view the exposed portions of the existing timber floor, roof and wall framing and the existing foundation walls of the *Town Farm Building* and to look for visible structural issues, structural distress, and structural damage.

On March 14, 2011 IREI meet with you and Bill Kenison of the Westford Engineering Department at the *Cottage* to perform a initial preliminary walk-through of the *Town Farm Building* to get an initial viewing of the *Town Farm Building's* existing floor framing exposed to view, and to discuss the scope of services that the Town of Westford would like IREI to provide the Town in this visual structural evaluation. After this meeting, IREI prepared and issued their ***Agreement for Structural Engineering Services No. IR11-PA294***, dated March 16, 2011, hereafter referred to as the *Agreement*, for the Town of Westford to authorize IREI to perform the requested structural engineering services. As discussed with the Town, and in accordance with the above referenced IREI *Agreement* between IREI and the Town of Westford, IREI's anticipated scope of structural engineering evaluation to be performed on the exposed portions of the existing timber framing and the exposed portions of the foundations of the *Town Farm Building* to determine, if possible, the following:

- Observe and review the physical condition of the exposed portions of the existing floor, wall and roof framing where it is exposed to view and evaluate areas and types of visible structural damage or deterioration in the existing timber framing members, components and systems, if any is visible.
- Observe and review the apparent physical structural condition of the portions of the existing foundation systems where they are exposed to view to look for areas and types of visible structural damage, distress, or deterioration in the existing foundation components and systems in the *Town Farm Building*, if any is observed.
- Where possible and exposed to view IREI will gather field data on the existing timber framing members and foundation system in this building for use by IREI in their survey and evaluation of the apparent structural conditions of the existing timber framing and building structure; and whether or not it appears there are issues associated with the at the existing *Town* operations/uses of the *Town Farm Building.*
- Look for areas of existing timber framing and/or the foundations systems where additional investigation and/or the removal of the existing finishes is recommended for follow-up and in-depth structural evaluation, review of the existing structural systems, and design of the recommended structural repairs to be performed under the next Phase of this project;
- IREI will prepare a written report outlining IREI's field observations and their professional opinions and recommendations; IREI's professional recommendations on areas of the building structure that appear to warrant further and more in-depth evaluation; and the general scope and intent of recommended structural repairs and future phase design work based on IREI's field observations and preliminary structural evaluation on the *Town Farm Building.*

On May 24 2011, IREI returned to the *Town Farm Building* to perform their visual structural evaluation and assessment of the existing *Town Farm Building* structure, including the timber framing systems and foundation wall systems exposed to view. In this report IREI will present and outline their field observations, findings and IREI's professional opinions and recommendations regarding the observed visible structural conditions of the existing *Town Farm Building* at the time of their field work. The professional opinions of IREI, as presented in this report, are based on visual observations and IREI's professional structural engineering experience only; with no destructive testing, demolition of interior or exterior finishes, or in-depth investigative exploration performed at this time. For clarity in this report, the various structural components of the various portions of the *Town Farm Building* will be presented and discussed separately.

For clarity in this report, the exterior wall of the *Town Farm Building* closest and parallel to Town Farm Road will be referred to as the *front* of the *Town Farm Building.* All references to *left, right,* and *rear* are when one is standing on Town Farm Road looking at the front wall of the *Town Farm Building.*

➢ **General Overview of the Westford Museum Cottage:**

The *Town Farm Building* is located adjacent to the railroad tracks on Town Farm Road. Based on IREI's field observations and discussions with the *Town*, the *Town Farm Building* appears to have been constructed in three phases consisting of the following three portions:

- The *original* two and one-half story front portion of the *Town Farm Building* is the right-most portion of the building and is located on the right side of the lot closest to the railroad tracks. The *Town Farm Building* is a brick masonry structure approximately 40 feet wide by 38 feet deep that has two full stories, with a Third floor level with short height exterior knee walls and sloped ceilings (i.e. the ceilings are the underside of the gable roof structure). This building was observed to have a full height Basement level. This portion of the building is a brick farmhouse style structure with timber framed floor framing and a timber framed gable roof. The *Town* advised IREI that this portion of the building was constructed in 1838 and was the original portion of the *Town Farm Building*. The gable roof on this portion of the building is oriented front to back (i.e. perpendicular to Town Farm Road), the gable end walls oriented parallel with Town Farm Road. In this report, this 1838 brick farmhouse portion of the *Town Farm Building* will be referred to as the *Farmhouse*. The *Farmhouse* is rectangular in plan and has a full Basement level, with the Basement headroom height being approximately 7'-0". The roof structure on the *Farmhouse* is a simple, timber framed gable roof system. In general, the existing perimeter walls of the *Farmhouse* appear to be multi-wythe non-reinforced brick walls. IREI observed that it appears that wood furring had been installed directly on the interior faces of the exterior brick walls; and the interior plaster finish is attached to the furring. It appears that some of the exterior brick walls serve as the bearing walls for the floor and roof structure. There is a single story shed roof portion of this building along the rear gable wall of the building. The roof structure of this portion of the building was concealed by finished and IREI could not gain access to the crawl space below the floor level to view the floor framing of this portion of the building.
- The second portion of the *Town Farm Building* appears to be a two-story timber framed structure with a timber framed gable roof structure that is located at, and attached to, and accessible from the *left* side of the *Farmhouse*. The *Town* advised IREI that this portion of the building was constructed in the late 1800's. Given the age of this portion of the building IREI would anticipate that the exterior timber framed walls of this portion of the building are balloon framed given the age and configuration of the building. This portion of the *Town Farm Building* is rectangular in shape with overall outside dimensions of approximately 35 feet (width) by 26 feet (depth); and has a full Basement level and a full walk-up Attic level. This portion of the building appears to have been constructed as the first addition to the original *1838 Farmhouse* and in this report this portion of the building will be referred to as the *Late 1800's Addition*.
- The third portion of the *Town Farm Building* is the single-story shed roof configuration timber framed structure located at the left side of the lot. The *Town* advised IREI that this portion of the building was originally constructed in the early 1900's as an addition to the *Farmhouse* and the *First Addition*. In this report, this portion of the building will be referred to as the *Early 1900*

Addition. The roof framing at this section of the building was concealed by finishes and not exposed to view.

Attached to this report is ***Appendix A – Figures and Photos*** that includes representative photos taken by IREI that document some of the structural conditions and issues observed by IREI during their field work at the *Town Farm Building*. Figures from this ***Appendix*** will be referred to in this report.

➢ **Observations and Comments on the Roof & Attic Floor Structure of the *Farmhouse*:**

The following are IREI's observations, comments and recommendations based on their field observations of the timber framed roof and Attic Floor structure of the *Farmhouse*:

- The Attic space above the flat portion of the ceiling of the *Farmhouse* was able to be viewed from the existing small opening located in the ceiling framing. Given the physical size and apparent load capacity of the existing Attic Floor joists, IREI chose not to access this Attic space for safety; and IREI only viewed the portions of the underside of the existing roof structure and ceiling framing systems in this portion of the building that was able to be viewed from the hatch.
- The gable roof structure of the *Farmhouse* was observed to be framed with rough hewn timber rafters that appear to be framed into the sides of a rough hewn timber ridge board by means of mortise and tenon joints – refer to ***Appendix A – Figure 1***. IREI anticipates that the bottom ends of these gable roof rafters bear on and are supported by the top of the brick masonry sidewall bearing walls along the left and right sidewalls of the *Farmhouse*. However, the bottom ends of these rafters could not be directly viewed because of the interior timber framed knee walls at the Third Floor level. IREI did observe a significant amount of damage and water staining to the interior plates finish at the underside of both the sloped and flat portion of the Third Floor level ceilings – refer to ***Appendix A – Figure 2*** and ***Figure 3***. The observed plaster damage is significant and indicates apparent substantial amount of water leaking through the roof shingles. IREI is not sure whether the leak is currently leaking or whether this water damage occurred at some time in the past. IREI's concern is that there could be a significant potential of structural damage to the timber roof framing elements in these areas from long term water leakage and decay. IREI recommends that the *Town* have all of the existing damaged plaster finishes removed from all the walls and ceiling surfaces (both flat and sloped portions of the ceilings) at the Third Floor level so that the underlying timber roof structure can be closely reviewed and inspected for timber damage and determine whether the roof framing must be repaired and reinforced.
- When viewed from the exterior of the building, the gable roof framing of the *Farmhouse* was observed to have significant deflection and dishing from the apparent undersized timber roof framing for the snow loads that occur on the roof. Numerically, the existing gable roof rafters, at the observed sizes, configuration and spacing in the *Farmhouse* roof system, are minimal and appear structurally insufficient to support the current code required snow loads and the actual snow load magnitudes that occur on the roof based on current timber design standards and criteria (i.e. within allowable stress levels for the timber). However, this existing gable roof system

appears to have functioned for over 170 years in its current configuration. In fact, this past winter, and the recent winter of 1995-1996, saw near record snowfalls in the area and this existing gable roof system appears to have supported the roof snow loads without collapsing. However, number wise IREI cannot back this up performance within the allowable timber stress levels in the framing members. What this indicates is that under snow loads this existing roof structure and the various timber connections are well into the factors of safety for the allowable member strength and stress levels and the observed deflection and dishing of the roof system indicates insufficient stiffness of the roof members under the snow load. Therefore, from a structural engineering analysis point of view (i.e. numerically) IREI cannot confirm or certify that the existing gable roof framing of the *Farmhouse* is capable of supporting either the code required snow loads or the actual likely snow load magnitudes in its current configuration without significant reinforcement or replacement. Based on IREI's experience during last winter and the winter of 1995-1996, the magnitude of the snow loads on the roofs of buildings was very often near and in some instances exceeded the code required uniform snow loads. One option to reduce the magnitude of the snow loads able to collect on the roof system would be by replacing the existing asphalt shingle roof surface with a standing seam metal roof system. Metal roof surfaces, with no snow guards along the roof eaves to impede the snow from sliding off the metal roof panels, provide a smooth slippery roof surface that reduces the likelihood and magnitude of snow accumulation on the gable roofs. Metal roof surfaces are common on old farmhouses and barns in New England for that reason – in general, the metal roof surface reduces the snow loads on a roof. However, given IREI'S observations of the condition, configuration and sizes of the roof system IREI recommends reinforcing this roof framing.

➢ **Observations & Comments on the Roof & Attic Floor Structure of the *Late 1880's Addition*:**
The Attic Level of the *Late 1800's Addition* is a walk up Attic with a full stairway to gain access. The underside of the gable roof framing had no finish materials applied to it and was fully exposed to view. The Attic Floor was observed to not have any floor finishes; with the timber floor board sheathing exposed to view. The following are IREI's observations, comments, and recommendations based on field observations of the roof and Attic Floor framing structure of the *Late 1800's Addition*:

- IREI observed that the existing gable roof framing of the *Late 1800's Addition* appeared to be full 2 inch by 7 inch sloped gable rafters spaced at approximately 2'-0" on center in general - refer to **Appendix A – Figures 4** and **5**. Numerically, the existing gable roof rafters at the observed size and spacing in the *Late 1800's Addition* roof system is structurally insufficient to support the current code required snow loads and the actual snow load magnitudes based on current timber design standards and criteria (i.e. within allowable stress levels for the timber). However, this existing gable roof system appears to have functioned satisfactorily for over 100 years in its current configuration. In fact, this past winter, and the recent winter of 1995-1996, saw near record snowfalls in the area and this existing gable roof system appears to have supported the roof snow loads without collapsing. However, number wise IREI cannot back this up performance within allowable timber stress levels. What this indicates is that under snow loading this existing

roof structure and the various timber connections are well into the factors of safety for the allowable member strength and stress levels. Therefore, from a structural engineering analysis point of view (i.e. numerically) IREI cannot confirm or certify that the existing gable roof framing of the *Late 1800's Addition* is structurally capable of supporting either the code required snow loads or the actual likely snow load magnitudes in its current configuration without reinforcement or modifications.

- IREI observed tha only a few of the rafters had existing Collar Ties between the top ends of these roof rafters within the top third of the rafter span. At a minimum, IREI would recommend installing new 2x8 *Spruce-Pine-Fir No. 2 or Better* grade timber Collar Ties within the top third of the rafter span to tie the top ends of the rafters together to increase the structural continuity of the roof framing system.
- IREI observed that the existing Attic Floor joists in the *Late 1800's Addition* appeared to be 1-3/4 inch by 5-1/2 inch timber floor joists spaced at approximately 2'-0" on center in general. Numerically, the existing Attic Floor joists at the observed size, spacing and apparent spans in the *Late 1800's Addition* appear to structurally insufficient to support the current code required live load for any typical commercial use floor loading (typically the minimum commercial loading is 50 pounds per square foot for Office use loading) based on current timber design standards and criteria (i.e. within allowable stress levels for the timber) without reinforcing. Therefore, from a structural engineering analysis point of view (i.e. numerically) IREI cannot confirm or certify that the existing Attic Floor framing of the *Late 1800's Addition* is structurally capable of supporting any commercial use floor loading in its current configuration without significant reinforcement or modification.

▹ Observations and Comments on the First and Second Floor Level Floor Structure of the *Late 1800's Addition*:

The following are IREI's observations, comments, and recommendations based on field observations of the existing Second Floor level floor structure of the *Late 1800's Addition*:

- In general, the First and Second Floor level floor framing of the *Late 1800's Addition* was concealed by finishes by the finish ceilings and the floor finishes. However, IREI did not observe any significant signs of settlement or excessive deflection of the portions of these floors at the time of their visit and the Second Floor level floor framing in this section of the building appeared fairly stiff.
- IREI observed in the limited location below the Second Floor Bathroom the existing Second Floor framing appeared to be full size rough cur 2x8's at approximately 16 inches on center. These floor joists observed appeared to span parallel to the front and rear walls of the addition.
- IREI observed that at the existing Second Floor framing directly below the Second Floor Bathroom the plumbing contractor that installed the waste line for the toilet saw cut and removed large portions of the timber floor joists in this section of the floor system to install the waste line. This has resulted in significant structural damage and weakening of several floor joists in this portion of the floor structure in this area of the floor – refer to **Appendix A – Figure 6. This**

framing condition is structurally unacceptable and should be shored up as required immediately to prevent a localized structural collapse of the floor system – the shoring should remain in place until this section of the floor framing has been repaired/corrected.

➢ **Observations and Comments on the Second Floor Level Floor Structure of the *Farmhouse*:**

The following are IREI's observations, comments, and recommendations based on field observations of the existing Second Floor level floor structure of the *Farmhouse*:

- In general, the entire Second Floor level floor framing of the *Farmhouse* was concealed by finishes on both the top and bottom surfaces and therefore unable to be directly viewed or evaluated. However, IREI did not observe any significant signs of structural failure, excessive floor deflections, or noticeable distress at the time of their site visit.
- At the rear portion of the Second Floor of the *Farmhouse* the Parks and Recreation Department has installed several rowing machines on the floor for training. The floor framing under this section of the Second Floor level was concealed by finishes on both the top and bottom and therefore not exposed for viewing. In IREI's professional opinion this section of Second floor did not appear to be excessively bouncy and did not exhibit excessive deflection. However, in order to adequately review and evaluate the capacity of this portion of the floor framing would require removal of the existing finishes to expose the framing elements. IREI would not recommend putting any type of weight lifting equipments or weights or any type of aerobic activity or training on this floor system unless the framing is further investigated.
- In general, IREI would anticipate that given the age of the building and the general framing conditions that were able to be viewed that numerically, the existing Second Floor framing at this section of the *Farmhouse* would be found to be structurally insufficient to support the current workout/gymnasium use code required floor live loading based on current timber design standards and criteria (i.e. within allowable stress levels for the timber - number wise IREI cannot back this up within allowable timber stress levels). What this likely indicates is that under the current floor loading this existing floor structure and the various timber connections are likely into the factors of safety for the allowable member strength and stress levels. Therefore, from a structural engineering analysis point of view (i.e. numerically) without exposing a significant portion of the floor framing IREI cannot confirm or certify that this portion of the existing Second Floor framing in the *Farmhouse* is structurally capable of supporting the code required floor live load for the current use of the space .

➢ **Observations and Comments on the First Floor Level Floor Structure & Basement Level of the *Farmhouse*:**

The following are IREI's observations, comments, and recommendations based on IREI's field observations of the existing First Floor level timber floor structure and the Basement space of the *Farmhouse*:

- IREI observed several locations where the base of the non-preservative treated timber posts that support the timber First Floor level floor beams bear directly on the top of the concrete Basement Floor slab (refer to **Appendix A – Figure 7**) without any steel or iron bearing plates to isolate the timber from the concrete. The bases of these timber posts appeared to have deteriorated and punky from being in contact with the concrete slab and the moisture from the slab wicking up the posts over time. These damaged posts should be removed and replaced with either new preservative treated timber posts set on steel bearing plates or steel pipe of tube columns. However, prior to installing the replacement posts the existing footings (if any are present) must be investigated and replaced if not found to be sufficient to support the post loads. In addition, at several locations the timber floor beams that these posts support show significant signs of structural distress and need to be repaired, replaced, or reinforced. This work will require analysis of the existing structure to determine the post/footing loads.
- IREI observed that in general the majority of the existing First Floor level floor framing of the *Farmhouse* appeared to have been constructed with full size 3 inch wide by 4 inch depth timber floor joists spaced at approximately 20 to 24 inches on center – refer to **Appendix A – Figures 8, 9 and 10**. IREI observed these floor joists are flush framed into the sides of various sized timber floor beams that are supported on a combination of stone columns and timber posts. Some of the timber posts appeared to have been added at some time in the past and were likely not part of the original floor framing. These existing flush framed joist-to-beam connections are achieved by mortise and tenon type framing connections. The ends of these joists are notched at the bottom edge resulting in an approximately two (2) inch depth tenon that extend into rectangular mortises cut into the sides of the timber floor beams. The notched tenon ends of these floor joists at the face of the floor beam reduce the structural shear capacity of the joists by approximately 50% from the shear capacity of the joist if the joist ends were full depth. This shear strength reduction is the result of the concentration of tension and shear stresses in the joist occurring at the reentrant corner of the notch at the end of the joist. These mortise and tenon type timber framing connections were a very common framing connection in timber framed structures of this type and age. However, based on IREI's experience these mortise and tenon connections between the floor joists and beams are often problematic and are not capable of transferring the floor loads (for office and corridor occupancies) to the supporting beams. In general, numerically, the existing First Floor framing at this section of the *Farmhouse* appears to be structurally insufficient to support the current office and Corridor use code required floor live loading based on current timber design standards and criteria (i.e. within allowable stress levels for the timber). What this indicates is that under the current floor loading this existing floor structure and the various timber connections are likely well into the factors of safety for the allowable member strength and stress levels. Therefore, from a structural engineering analysis point of view (i.e. numerically) IREI cannot confirm or certify that this portion of the existing First Floor framing in the *Farmhouse* is structurally capable of supporting the code required floor live load for the current use of the space.
- IREI observed that someone has installed two supplementary timber floor beam lines supported on posts in an apparent attempt to reduce the span of some of the 3x4 floor joists in these two

floor areas. These beam lines appeared oriented perpendicular to the floor joists at approximately mid-span of the spans.

- Near the electric panel at the front left corner of the Basement, IREI observed an approximately 6 foot length cantilever on one of the First Floor beams. This cantilevered beam end is not structurally adequate and the end of the cantilevered beam should have a temporary shoring post installed immediately to prevent a structural failure of this beam. In addition, IREI observed significant horizontal shear cracks in the sides of this beam along its length indicating that the beam is in a state of failure – see **Appendix A – Figure 10.** These shear cracks are located at the bottom of the mortises cuts into the sides of the beams that support the ends of the floor joists. These horizontal cracks in the floor beam appear to be indicative of structural shear failure of the beams as a result of the stress concentrations occurring at the bottom corners of the mortises in combination with the apparent overloading of the beams which are undersized for the floor loads imparted on them and further reduced by the mortise cuts.
- **IREI observed numerous locations along the various timber First Floor beams in the *Farmhouse* where horizontal and sloping shear cracks (see Appendix A – Figure 8 and Figure 10) have developed. It is IREI's professional opinion that these damaged floor beams with the shear cracks are in a state of structural failure and must be repaired, reinforced or replaced. IREI strongly recommends that the *Town* install continuous temporary shoring lines parallel and below these damaged floor beams and the tenoned ends of the floor joists immediately. These temporary shoring lines must support the bottom of the failed floor beams as well as supporting the tenoned ends of the floor joists on each side of the floor beams to eliminate the loading on the tenoned ends. It is IREI's professional opinion that these lines of temporary shoring should be installed immediately to prevent a complete structural failure and collapse of the floor system. This temporary shoring should remain in place until these insufficient floor joist connections and damaged floor beams have been repaired, corrected, or replaced.**
- At the right rear portion of the First Floor framing IREI observed that the timber floor beam has excessive deflection at the mid-portion of the beam length. The beam deflection was significant enough that someone had installed wood shims (approximately ¾ inch thick shims) in the bottom of the mortise cuts in the sides of the beams (see **Appendix A – Figure 9**) that support the tenoned ends of the flush framed floor joists to fill the gap caused by the beam deflection. As noted above this beam is structurally deficient. **IREI strongly recommends that the *Town* install continuous temporary shoring lines parallel and below this damaged floor beam and the tenoned ends of the floor joists on each side of the beam immediately. This temporary shoring line must support the bottom of the failed floor beams itself as well as supporting the tenoned ends of the floor joists on each side of the floor beams to eliminate the loading on the tenoned ends. It is IREI's professional opinion that this line of temporary shoring should be installed immediately to prevent a complete structural failure and collapse of the floor system. This temporary shoring should remain in place until these insufficient floor joist connections and damaged floor beam have been repaired, corrected, or replaced.**

➢ **Observations and Comments on the Foundation Walls of the *Town Farm Building*:**
The following are IREI's observations, comments, and recommendations based on IREI's limited field observations of the existing Porch timber floor structure and the existing foundation walls of the *Porch Addition:*

- IREI observed numerous locations on the exposed portions of the existing stone foundation walls along exterior perimeter of the *Town Farm Building* where the mortar joints have deteriorated leaving wide open joints between the stones – refer to **Appendix A – Figure 14**. IREI recommends that all open and deteriorated mortar joints in the stone foundation walls be cleaned, prepared and repaired as soon as possible to prevent continued and further structural damage from ice riving of the joints by water freezing during the winter months. The continued repeated freeze-thaw cycles will likely cause structural damage to the stone work that will end up causing major damage that will be expensive to repair. Simple repair of the mortar joints now will likely be money well spent and should significantly reduce the potential for further decay and damage of these foundation walls.

➢ **Observations and Comments on the Roof, Floor and Stairway Structure of the *Farmhouse* Front Porches and Stairways:**
Along the front gable wall of the *Farmhouse*, closest to Town Farm Road, IREI observed that there is timber framed exterior porch structure at the First and Second Floor levels of the *Farmhouse.* There is a covered timber framed roof structure above the Second Floor level of the Porch that appears to serve as an emergency egress from the Third Floor level of the *Farmhouse.* The following are IREI's professional observations, opinions, and comment related to the existing front Porch structure:

- IREI observed that the timber railings/guards (see **Appendix A – Figure 12** and **Figure 13**) along the First and Second Floor levels of the Porch and the stairways at the First and Second Floor levels have numerous missing vertical members and areas of timber damage. This existing railing/guard systems in their current condition and configuration do not appear to be structurally sufficient to support the code required horizontal railing/guard loads. IREI recommends that these railings/guards be replaced with new railing/guard systems capable of meeting the structural and architectural requirements of the building code immediately because of the potential for someone leaning against these railings/guards causing a failure of the rail/guard resulting in personal injury or worse. IREI recommends that these flights of timber framed stairs be replaced with new railing/guard systems capable of meeting the structural loading (gravity and horizontal loads) and architectural requirements of the building code immediately because of the potential for someone being hurt by a structural failure of the existing stairways. IREI recommends that the *Town* retain an Architect as soon as possible to review the egress issues of the *Farmhouse*, these Porches/stairways and the Town Farm building in general, determine whether these existing Porches and Porch stairways at the front of the *Farmhouse* are means of egress for the current *Town* use and whether the porches and stairways meet the

dimensional requirements for the Porches, stairways, and means of egress, and provide the *Town* with their professional opinion on those issues.

- At the roof level of this front Porch structure IREI observed a single pipe railing/post system that appears to serve as a safety railing for the roof level Porch and Stairway. This existing pipe railing/guard system is structurally inadequate to support the code required horizontal loads on the railing/guard and the railing/guard system has only a horizontal top rail with no vertical members between the porch roof and the horizontal rail to prevent a small person or child from falling through the railing/guard. This existing pipe railing/guard system is both a structural issue and a huge safety issue and must be replaced immediately because of the potential for someone leaning against these railings/guards falling two stories to the ground. IREI recommends that the *Town* retain an Architect as soon as possible to review this issue and provide recommendations to the *Town*.
- The floor and roof structures of the front Porch floors and roof, and there connection to the face of the *Farmhouse* front brick wall could not be viewed or evaluated because they are concealed by existing finishes. When the existing finishes are removed, the framing and connections should be viewed and evaluated.

➢ General Observations and Comments on the Exterior Brick Walls of the *Farmhouse*

The following are IREI's observations, comments, and recommendations based on IREI's field observations of the existing exterior brick walls of the *1838 Farmhouse:*

- IREI observed that it appears that the exterior faces of the brick surfaces of the *Farmhouse* exterior walls have been sandblasted at sometime in the past (refer to **Appendix A – Figure 11**). In general, it appears that this sandblasting has removed the protective finish surface on the brick that prevents moisture from migrating into the exposed interior portion of the brick. IREI recommends that the *Town* retain a qualified Architect or masonry/restoration specialist as soon as possible to visit the *Farmhouse*, view the sandblasted brick surfaces, and provide the *Town* with their professional recommendations for the repairing the mortar joints (i.e. tuckpointing) in the brick and options for applying some type of suitable masonry sealer material to seal the exterior of the brick to reduce moisture penetrating the brick. Sealing the exterior face of the brick appears to be in need to be applied to minimize the potential for additional and future damage due to ice riving from freeze-thaw cycles of water in any open or cracked mortar joints and the brick elements themselves. This is preventative maintenance which is money well spent by the *Town* to reduce the potential for future significant structural damage to these exterior brick walls.

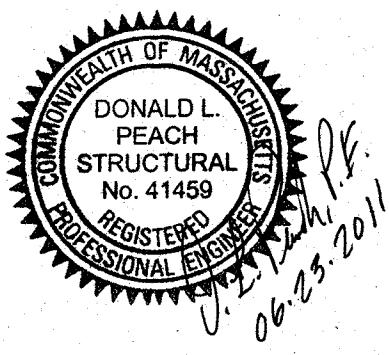
In the Westford Town Farm building IREI observed significant structural inadequacies, distress, and damage of the First Floor framing that has resulted in visible signs of structural distress, damage and failure in numerous floor framing members (both floor joists and floor beams). It is the professional opinion of IREI that the observed structural failure of the noted components of the designated portions of the First Floor framing systems is the result of a combination of the age, configuration, and the mortise and tenon type flush framed framing connections used between the floor joists and the floor beams.

These mortise and tenon connections between floor joists and floor beams result in significant decreases in the structural capacities of both the joist and beam members because of the resulting stress concentrations at the reentrant corners of both the mortises and tenons. In IREI's professional opinion lines of temporary shoring beams and jack posts should be installed in the Basement level to support the damaged framing members until the design and installation of the properly designed permanent floor framing repairs, reinforcement and replacements have been completed. These temporary shoring systems should be installed immediately to prevent potential structural collapse of the timber floor framing. The railings on the front Porch floor and roof levels are an immediate safety concern and issue that should be replaced immediately because of the potential for personal injury or worse.

IREI trusts that this report satisfies the Town of Westford's needs at this time. If you or any members of the various *Town* departments, boards, and commissions have any questions and/or comments on this report please do not hesitate to call or email. IREI would like to thank you and the Town of Westford very much for retaining the firm to perform the above referenced structural engineering services for the Town.

Respectfully submitted,
IPSWICH RIVER ENGINEERING, INC.

Donald L. Peach, P.E., President



APPENDIX A - FIGURES & PHOTOS

Figure 1 – *Farmhouse* - Main Roof Framing & Ridge Board

Figure 2 – *Farmhouse* - Damaged Ceiling Finishes

Figure 3 – *Farmhouse* - Damaged Ceiling Finishes

Figure 4 – *First Addition* - Roof Framing

Figure 5 – *First Addition* - Roof Framing

Figure 6 – *First Addition* – Damaged 2nd Floor Framing by Plumbing

Figure 7 – *Farmhouse* – Timber Damage at Base of Basement Post

Figure 8 – *Farmhouse* - Apparent Shear Cracks in 1st Floor Timber Beam

Figure 9 – *Farmhouse* – Excessive Deflection in Timber 1st Floor Beam

Figure 10 – *Farmhouse* – Shear Cracks at Bottom of Beam Mortise Cuts

Figure 11 – *Farmhouse* – Sandblasted Brick Surface

Figure 12 – *Farmhouse* – Damaged Front Timber Railings

Figure 13 – *Farmhouse* – Structurally Deficient Exterior Stairway

Figure 14 – *Late 1800's Addition* – Open Mortar Joints in Foundation Wall