CAMP MEETING AVENUE OVER TRENTON LINE (CSX)
STRUCTURE NO. 1850-160
MONTGOMERY TOWNSHIP, SOMERSET COUNTY
PRELIMINARY DESIGN SUBMSISION REPORT

BRIDGE REHABILITATION REPORT AND SHPO DOCUMENTATION

Submitted to:

New Jersey Department of Transportation
1035 Parkway Avenue
Trenton, New Jersey 08625

Submitted by:

The Louis Berger Group, Inc.
30-A Vreeland Road
Florham Park, New Jersey 07932

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A. INTRODUCTION

This project is a part of the Department's statewide program to rehabilitate twenty seven (27) structurally deficient bridges of an "orphan" bridge status, that carry local roads over a railroad.

Camp Meeting Avenue Bridge was evaluated last in June 2004 and its overall condition was rated critical and structurally evaluated as "deficient and functionally obsolete, requiring high-priority replacement". The appraisal ratings for structural evaluation, deck geometry and approach roadway alignment indicate a Sufficiency Ratio of 6.5 and according to the Federal Coding Guidelines for bridge evaluation, the bridge is "basically intolerable requiring high priority of corrective action or replacement." Subsequent inspections revealed continued deterioration at an accelerated rate, that prompted the Department to prioritize rehabilitation of this structure by its complete replacement.

Since the age of the bridge is more than 100 years, it may be of historic significance. As such the Department decided also to gather historical information pertaining to the original design and construction of the bridge, analyze such data and present it to the State Historic Preservation Officer (SHPO).

Therefore this report combines historic design study, engineering analysis and design recommendations that, upon the concurrence by the SHPO and Department will be used to prepare final design and contract documents for the replacement of the Camp Meeting Avenue Bridge.

B. BACKGROUND RESEARCH

The purpose of this task is to gather historical information pertaining to the original design and construction of the Camp Meeting Avenue Bridge and analyze this information in order to identify the character defining features that could make it a contributing resource to the significance of the Port Reading Railroad and Blawenburg Historic District. If character defining features are identified, they will be considered by the engineering design team for possible replication or emulation using both historic and modern materials.

Additional objectives are to understand and explain the overall design rationale for the bridge and answer several specific questions posed by the historical consultation process that are pertinent to such an understanding:

(1) Why was the bridge built with a Howe pony steel truss?
(2) How is the design of the bridge related to the physical setting?
(3) How is the design of the bridge related to railroad operating requirements?
(4) How was the design of the bridge related to the "evolving engineering technology" developed?
(5) Was the practice of steel truss in bridge construction as represented by Camp Meeting Avenue Bridge used elsewhere by the P&R or other railroads?

Answers and discussion to each of the specific questions posed above, with reference to the source of the information is presented in Section C.

Research for gathering railroad engineering literature was conducted at the libraries and websites, information on historic railroad lines in New Jersey provided by the NJ Historic Preservation Office, and notes and photographs of similar bridges along the Trenton Line were obtained from a field inspection of those structures.

C. HISTORIC STRUCTURE DESIGN STUDY

Overview of Bridge Type and Design

The skewed three-span rivet-connected Howe pony truss bridge is supported on ashlar abutments and metal bents consisting of toe-out angles. The lateral bracing on the bents was added in 1914. A Howe truss works on the opposite principle of the more common Pratt truss. The verticals are in tension, and the diagonals and counters are the compression members. The chords, verticals and diagonals are composed of toe-out angles while the counters are dimensioned plate. The original floor beams, which have been replaced at least twice, were built up. The floor beams are perpendicular to the roadway, not the abutments. The most unusual design detail of the trusses is the use of a small panel at either end of each truss which allowed for equal sizing of each pair of skewed trusses. The bridge has been strengthened with welded knee braces on the inside of the trusses and plate welded to the top chord. The stringers and flooring were originally wood, but they have been replaced with steel stringers and an asphalt wearing surface. A modern beam guide rail protects the inner face of the trusses.

William Howe (1803-52) of Massachusetts was granted a truss patent in 1840 that used metal rods as the vertical members of what was otherwise a simple timber parallel-chord, cross-braced truss. The configuration used easy-to-erect and readily prefabricated components that could be assembled on site and adjusted via threaded connections at the rod ends. Little skilled labor was involved in assembling and erecting this truss type, and it became an immediate success.

The Camp Meeting Avenue Howe pony truss bridge was designed by the Philadelphia & Reading Railroad Chief Engineer's Office in 1889. In addition to being one of the few documented examples of a Howe pony truss bridge in the state, it ranks as the oldest railroad-related span in Somerset County. Why a Howe truss was used is not documented, but it may relate to the decision to reuse the existing substructure which divided the bridge into three spans. The use of the small panels at the end of each truss in order to keep each pair of trusses the same length is also an unusual design detail. In 1914 the bracing between the bent posts was added as were the concrete piers, and in 1982 most of the floor beams and stringers were replaced.

Lowest initial project cost was the primary concern with new railroad bridge construction. A dramatic drop in price of steel in 1870's made steel bridges including plate girders, trusses and arches very popular choice. Generally, only bridges in urban areas were given stylized architectural detailing at extra cost, and then, on a limited basis. Maintenance cost was seldom a design consideration for steel railroad bridges; in the case of railroad bridge replacements and new overhead highway bridges for grade crossing elimination, such as the Camp Meeting Avenue Bridge, the most important consideration was limiting project costs resulting from interruption of train service during construction. In flat open areas, temporary tracks could be inexpensively laid on rented land to bypass the construction site. But for the most part, the railroads developed astonishingly fast and innovative methods of bridge construction without diverting the traffic.

The trusses were shop-built by steel bridge fabricators and delivered to the site on flat rail cars and then lifted and placed on the piers and abutments by one or more derrick cars. Wooden planks were used as deck over uncommon built-up steel-beam floor system. Apparently the whole structure system was chosen to expedite the construction by minimizing the field work. Built-up floor beams connected to the trusses, wooden stringers placed on floor beams and wooden planks over stringers, without any need of formwork or cast-in-place concrete. Same is true for the two built-up bents over masonry foundations.

Brief history of Trenton Line construction and operation

The National Railway or National Air Line Railroad was a planned railroad between New York City and Washington, DC around 1870. Part of it was eventually built from New York to Philadelphia by the Delaware and Bound Brook Railroad and the Delaware River Branch of the North Pennsylvania Railroad, leased by the Philadelphia and Reading Railway in 1879. The line was intended to provide an alternate to the various monopolies that existed along the route, specifically the United New Jersey Railroad and Canal Companies and their Camden and Amboy Railroad, and as such underwent a long struggle to be built.

The first two sections were chartered in New Jersey as the Hamilton Land Improvement Company and Millstone and Trenton Railroad, forming half of the New Jersey route. The Millstone and Trenton Railroad was authorized to build a line from Trenton northeast to Millstone, and the Hamilton Land Improvement Company could build six miles anywhere in the state, which was enough to bridge the gap from Millstone to the Central Railroad of New Jersey at Bound Brook.

The Camp Meeting Avenue bridge was constructed for the Philadelphia and Reading Railroad at Skillman, site of the state's epileptic village. A non-extant station was located to the southwest of the bridge. The rail right-of-way was chartered in 1870 and built as the Delaware & Bound Brook Railroad by the Central Railroad of New Jersey in 1873-1875 as an alternative double-track route between New York and Philadelphia. The line was acquired by the Reading Railroad, and was used for both freight and passenger service until the 1970s when the line went bankrupt. The right-of-way passed to Conrail which found it useful for freight service displaced from Amtrak's Northeast Corridor which is the old Camden & Amboy (Pennsylvania Railroad after 1873) route. The Skillman Road overpass is also one of the oldest grade crossing elimination bridges in the region. This is at least the second bridge at the crossing.

Conrail was formed on April 1, 1976 as a federally-funded takeover of the major railroad companies in the Northeast, all of which were financially failing. Against all predictions, Conrail managed to turn a profit, and on August 22, 1998, most of Conrail's track was split between two newly-formed Conrail subsidiary limited liability companies: 42% to New York Central Lines, to be operated by CSX, and 58% to Pennsylvania Lines, to be operated by Norfolk Southern.

Responses to Questions Posed by Historical Consultation Process

(1) Why is the bridge built with a steel truss?

The reason for this practice is simply economy. Achieving the best economy and therefore the most efficient design for a given set of site conditions and constraints often requires engineers to analyze the cost-effectiveness of various materials and methods of construction in combination with one-another. A dramatic drop in price of steel in 1870's made steel bridges including plate girders, trusses and arches very popular choice.

Erection of bridges without falsework has always been a goal of bridge builders. Falsework requires expensive materials and labor and is prone to damage or destruction by storms. The development of the thru truss bridge was driven by the desire to eliminate the need for falsework. The length of the main span of the Bridge, 41.5 feet, did not require the truss bridge, which is usually used for much bigger spans, but the desire to reuse the then existing substructures determined the three span configuration.

(2) How is the design of the bridge related to the physical setting?

The physical setting, or site constraints, except in unusual cases, is the primary factor governing the design of a bridge. Site considerations include both the natural physical characteristics of the site such as topography and subsurface conditions, and manmade features such as roads, utilities and type of development present at or adjacent to the site.

The combination of the required height over the tracks and the need to limit the height to make the side road connections without overly steep approach grades, dictated a bridge as flat and shallow as possible. These constraints eliminated deck spans and arches from consideration for the main span,

A well known engineering textbook from the period states:

> "The simple slab is used for spans from 12 to 30 feet, the through girder for spans from 30 to 55 feet and the deck girder for spans from 40 to 60 feet. The deck girder usually proves more economical than the through girder whenever there is sufficient headroom to permit the use of girders below the floor" (Hool and Kinne 1924:397).
>
> "The fact that the deck girder requires a deeper floor system, resulting in the necessity of raising the grade line, is often a determining factor in choosing the type to be used" (Hool and Kinne 1924:414).

For the Camp Meeting Avenue Bridge, the right-of-way was developed by the Reading Railroad in the mid-1870s. It is located in a sparsely developed rural portion of the county in an area known as Skillman, location of the state's "epileptic village." A station was located on the south side of the bridge. When it was removed is not known but it is depicted on a 1955 county map.

(3) How is the design of the bridge related to railroad operating requirements?

As previously discussed, the design of the bridge is directly related to the operating requirements of the railroad in that the steel truss spans over the tracks were utilized intentionally to avoid the expensive interruption of train traffic. Hirschthal addresses this issue:

> "The problem presented by the necessity of replacing bridges on a railroad is one whose solution requires a design or plan contemplating a minimum disturbance of railroad traffic. Until recent years, this consideration made it imperative that steel bridges be replaced by new structures of a similar material, because of the rapidity and facility of erection as compared with concrete bridges cast in place" (Hirschthal 1926:527).

> "In the design of railroad structures replacing those in use the main consideration is to cause a minimum disturbance of traffic. This factor frequently far out-balances economy in the design of the structure itself, for the differences in the cost of the trackwork or temporary construction for two different types of design may constitute a large percentage of the total cost of construction" (Hirschthal 1923:384).

> "Frequently the problem of grade crossing elimination involves the same conditions as does that of replacement, in so far as it precludes any disturbance of railroad traffic. The solution, in the event of concrete design in such situations, is precast members similar to the design for bridge replacement" (Hirschthal 1926:527).

> "In replacing [overhead highway bridges] by means of precast units, it is possible to maintain traffic both on the railroad and the highway except for the short time necessary to set the units on the abutments. At the same time the use of falsework is unnecessary" (Hirschthal 1926:588).

In a discussion of grade separation projects on lines with heavy traffic, G.H. Wilsey, Engineer for the railroad construction contracting firm of Foley Brothers of New York City states: "of major importance - the maintenance of traffic on both railroad and highway... can change a simple job into a tedious one which may take three or four times longer than would the same amount of work on a new location" (Wilsey 1933:142).

(4) How is the design of the bridge related to the "evolving engineering technology"?

The Camp Meeting Avenue Bridge represents "evolving engineering technology" and is representative of the economical and innovative construction technique utilized for quick and un-interruptive of railroad schedules and to eliminate need for traffic detours. William Howe based his design on the limited stress analysis information available at that time, the first designer to do so since previous trusses were inadaptable to analysis (Edwards 1976:156-157). The Howe truss used metal vertical tension rods and timber diagonal compression members. This joint use of metal and wood materials for bridge components, called a "combination truss," was a significant transitional feature in the eventual development of an all-metal truss. The popularity of the Howe truss resulted, in part, from its comparatively simple erection. The Howe truss design eliminated the need for skilled carpenters to notch and peg wooden jointed bridges by using threaded iron rods for verticals and simple junction boxes as connections (Kemp and Anderson 1987:19). As bridge historian Eric DeLony wrote, "The Howe truss may be the closest that wooden-bridge design ever came to perfection. For simplicity of construction, rapidity of erection, and ease of replacing parts, it stands without rival" (DeLony 1994:11).

The absence of architectural stylization of the components indicates that no concern for aesthetics was warranted. Maintenance cost was seldom a design consideration for steel railroad bridges; in the case of railroad bridge replacements and new overhead highway bridges for grade crossing elimination, such as the Camp Meeting Avenue Bridge, the most important consideration was limiting project costs resulting from interruption of train service during construction. In flat open areas, temporary tracks could be inexpensively laid on rented land to bypass the construction site. But for the most part, the railroads developed astonishingly fast and innovative methods of bridge construction without diverting the traffic.

The production method of truss bridges is the result of advances made throughout all the sectors of industry during the Industrial Revolution. This includes development of new materials: cast iron, wrought iron, steel; methods of production of structural elements; modes of transportation of bridge elements throughout the country by wagon, boat, railroad, and truck; and finally methods of assembly: pin connected, riveted, shop welded, and field welded.

(5) Was the practice of using steel truss in bridge construction as represented by Camp Meeting Avenue Bridge used elsewhere by the P&R or other railroads?

During the 1840s iron bridge building in America made impressive strides. In 1845 Richard Osborne, a London-born Irish-emigrant engineer working for the Philadelphia & Reading Railroad, built the country's first all-iron railroad bridge. It was known as the Manayunk Bridge, after the Philadelphia neighborhood in which it was built, and consisted of three lines of Howe trussing reaching thirty-four feet across a small stream. A single line of that trussing was donated to the Smithsonian Institution in 1911; today it serves as part of the exhibit of the *John Bull*, an early steam locomotive.

A period of rapid experimentation with the new material ensued. In 1847 Frederick Harbach built an iron Howe truss on the Western Railroad (later the Boston & Albany) near Pittsfield, Massachusetts. Pennsylvania Railroad bridge across the Susquehanna at Rockville, was finished in 1849. Each span of the 23-span, 3670-foot-long bridge was a wooden Howe truss with iron ties combined with arches, and either the truss or the arch was capable of supporting the whole load by itself. In 1850's Amasa Stone Howe's brother-in-law became President of the Lake Shore and Michigan Southern Railroad and the city's first millionaire. Stone, who, with some justification considered himself a bridge designer, and whose company had previously constructed at least 20 bridges using Howe truss, sketched out a new bridge. Basically it was old Howe truss with years of success, but all of the components of Stone's new bridge design were to be made of wrought-iron.

Assessment of Character Defining Features

The Camp Meeting Avenue over Trenton Line is listed as a historical structure in Blawenburg Historic District (NR Reference - #88000632. The Camp Meeting Avenue Bridge is eligible for the Register of Historic Places per SHPO Opinion on 10/31/2005.

On the basis of a research conducted from a historical engineering perspective, the Camp Meeting Avenue Bridge does possess characteristics which distinguish it someway, but the type of construction was common at the time. The first bridge constructed using Howe truss was in 1845 and the truss type was very common in covered bridges. About 15% of extant covered bridges use Howe truss system.

The bridge taken as a whole could be considered to represent a type of highway overpass bridge used by the railroads for grade elimination projects undertaken during the late 19^{th} century. Specifically, it is a good example of a Howe truss application with a modification using small spacer panels added to each truss to compensate for the skew.

D. ENGINEERING ANALYSIS

1. Assessment of the Integrity of the Extant Structure

The subject structure, built in 1889, has gone through major repairs and rehabilitations in 1914, 1922 and 1950. The bridge is in critical condition and considered structurally deficient due to poor condition of the superstructure and substructure, and low inventory rating. HS-20 Truck type inventory rating is 6 Tons while according to Department's Recording and Coding Guidelines, minimum acceptable rating is 14 Tons for the ADT of more than 500. The bridge is currently load posted for 10 tons for the Type 3 truck. The truss and stringers show extensive section losses, collision damages and bent members. The bridge is also functionally obsolete due to substandard deck geometry and lateral and vertical underclearances. It was recommended that this structurally deficient bridge be programmed for replacement.

The existing bridge has an overall length of 104' and an overall width of 15.9'. It has one main center span over the tracks and two approach spans. All three spans consist of rivet-connected skewed Howe pony truss with counters supported on ashlar abutments and steel bents. Small spacer panels in the truss were added to compensate for the skew. The floor beams are perpendicular to the road. All, except a few of the built-up floor beams and the flooring system have been replaced but the original 1889 truss components are still the main load bearing components.

The steel built-up bent type piers are supported on concrete pedestals. These piers have substandard lateral clearance from the railroad tracks and exhibit extensive section loss and impact damages.

Also, the Cycle No. 10 Report, dated June 11, 2004 rated the overall bridge condition as "critical," and structurally evaluated the bridge as "deficient and functionally obsolete, requiring high-priority replacement." Subsequent inspections revealed continued deterioration. The bridge is structurally deficient due to low ratings at both, inventory and operating levels.

The appraisal ratings for structural evaluation, deck geometry and approach roadway alignment indicate that according to the Federal Coding Guidelines for bridge evaluation, the bridge is "basically intolerable requiring high priority of corrective action or replacement."

Findings from previous inspection reports also indicate that the deck was in serious condition due to the extensive section loss of the load bearing steel members, impact damages, medium to large cracks and loss of pointing in the masonry of abutments.

To correct these deficiencies the existing structure must be widened and the loading capacity of existing members increased to raise structural ratings. However, the deck widening is impractical because of thru-truss type superstructure, since the trusses project above the deck. To increase the loading capacity of critical members is also impractical, since these have almost 100% section loss and impact damages at several locations.

The Bridge is posted as One Lane Bridge with "Yield to Oncoming Traffic" Signs, while the approach roadways are striped for two lane traffic with roadway pavement width of approximately 20.5 feet.

2. Inventory and Design Parameters

Camp Meeting Avenue presently functions as a two-lane rural road and is classified as a Rural Collector roadway. To benefit the safety of motorists, bicyclists and pedestrians, the bridge replacement project will also include bridge widening and modifications to the approach roadway comprising minor change in vertical roadway geometry. The required minimum underclearance for bridges over non-electrified tracks is 23'- 0" and lateral clearance of 18'. Camp Meeting Avenue Bridge has substandard vertical as well as lateral clearances.

The proposed bridge will use steel truss framing system, similar to that of the existing, to replicate one of its character defining features. The steel bent piers will be removed to provide minimum lateral clearance for railroad operations. The proposed abutments will be located at 18' from the centerline of the tracks and offset from the existing abutments and a single span truss bridge may be constructed with a span of approximately 75 feet.

The proposed profile will be developed for the design speed of 30 MPH, provide smooth riding surface by eliminating the existing angle points and to minimize the structural depth of the bridge superstructure. The resulting vertical underclearance will maintain at least the existing 21'-2".

3. Bridge Building Technology

Lowest initial project cost was the primary concern with new railroad bridge construction. Maintenance cost was seldom a design consideration for steel railroad bridges; in the case of railroad bridge replacements and new overhead highway bridges for grade crossing elimination, such as the Camp Meeting Avenue Bridge, the most important consideration was limiting project costs resulting from interruption of train service during construction. In flat open areas, temporary tracks could be inexpensively laid on rented land to bypass the construction site. But for the most part, the railroads developed astonishingly fast and innovative methods of bridge construction without diverting the traffic.

The proposed trusses will be of the length and tonnage that will permit using modern high capacity erection cranes. Since there are no major constrains for the cranes working from the ground, this method will be the most practical and expeditious in view of current erection technology. The cranes may be placed on the both sides of the tracks for erecting trusses and floor beams. The trusses and beams may be transported to the bridge site via tracks or by trucks along the Camp Meeting Avenue.

4. Original Character Defining Features

The historical background research findings indicated that this structure was built with no intention to convey a historical importance as evident by its lack of aesthetic features. The original character defining features of the bridge are trusses and built-up bents. Due to lateral clearance requirements and site constraints, the geometrical features of the existing piers are not possible to duplicate. However, an attempt will be made to visually emulate the superstructure. The proposed truss elements could be of similar configuration and detailing as the existing truss, so that the original character is preserved.

E. BRIDGE REPLACEMENT DESIGN CONSIDERATIONS

1. Horizontal Alignment

The existing bridge provides a roadway width between the guide rails (curb-to-curb) of 14 feet. The width of approach pavement is 20.5 feet, striped for two lanes of 8.5 feet. The resulting condition is hazardous to the traffic, as it truly constricts traffic to one lane on the bridge. As the bridge is slated for replacement, a wider bridge should be constructed.

Matching the width of the approach pavement would still leave a substandard condition on the bridge. Therefore it is proposed to provide a lane width of 11 feet in each direction bordered with a nominal one-foot shoulder, rendering a curb-to-curb width on the bridge of 24 feet. As the proposed trusses will project above the roadway in a manner emulating the existing configuration, the guide rails will be designed to extend for the entire length of the bridge similar to the existing arrangement. The resulting wider pavement adjacent to the bridge will be then gradually transitioned to the existing roadway pavement.

2. Vertical Alignment

The profile of Camp Meeting Avenue constitutes a crest vertical profile at the crossing over the railroad tracks. Approximate existing grades, based on the topographic survey, from east to west are +4.4%, +5.9%, +0.2% (bridge), -4.5% and -2.9%. It appears that the profile does not follow a vertical curve; rather it has angle points at the bridge with an unsafe stopping sight distance for the posted speed of 30 MPH resulting in uncomfortable driving.

Since the bridge will be replaced and the roadway widened, it is desirable to also improve the vertical profile.

The most desirable improvement would call for raising the vertical underclearance over the tracks to 23 feet and provide a vertical crest curve for a design speed of 35 MPH, since the posted speed just west of the bridge is 30 MPH.

Such an improvement would result in extensive roadwork extending approximately 400 feet on each side of the bridge and in undesirable right-of-way impacts due to a raised profile. This undoubtedly would increase the construction cost and cause impacts beyond that contemplated by the Department for the rehabilitation program of the "orphan bridges".

Alternately, if the proposed vertical underclearance maintains at least the existing 21'-2" and the vertical crest curve is designed for a speed of 30 MPH, the resulting roadway work can be limited to a distance of 150' to 180' beyond the bridge limits.

Adopting this concept, no adverse impacts would ensue and construction cost would commensurate with the intent of the project. As a result, this latter improvement alternative will be recommended. Nevertheless, it will be also recommended to post the speed at the bridge to 25 MPH and keep the existing warning signs for reduced speed and "Yield to Oncoming Traffic".

3. Geotechnical Design Considerations

The existing abutments are of stone masonry, most likely gravity type construction. The foundation conditions and configuration are unknown. To determine soils conditions, a subsurface exploration program was developed and two soils borings were lowered from the roadway in the vicinity of the existing abutments. Details of the program with results and foundation recommendations are presented in the Geotechnical Foundation Engineering Report (see Appendix).

The borings identified similar soils conditions at both abutments. The soils above the level of the track bed consist of gravel fill, underlayed by layers of clayey silt transitioning to clayey siltstone. The strata below the track bed consist of weathered rock classified as claystone or silty claystone. Rock was cored to a depth of 20' to 25', yielding rock quality designation of very poor to poor.

The proposed structure will locate the abutments between the existing pier bents and abutments. The pier bents will be removed, however removing the abutments might be expensive and it is considered unnecessary, except for the top portion as necessary for roadway construction and grading. Constructing a new full height abutment might require foundations that most likely would conflict with existing footings and compromise stability of the existing abutments.

Since the contemplated superstructure will consist of two thru trusses, they can be conveniently supported by columns at each end, which in turn will be founded on drilled shafts installed from the track bed into the rock strata.

The recommended shaft diameter is 3 feet with the minimum depth of embedment of 16.5 feet. After removal of existing pier bents, the space between the tracks and existing abutments will be adequate for installing the shafts.

The column above the drilled shaft can be cast-in-place monolithically with abutment curtain wall and wingwalls to retain the fill that will be placed in the space between existing and proposed abutments. These walls will require a nominal footing only, as they will span horizontally between the columns and may be also anchored to the existing stone masonry.

4. Superstructure Design Considerations

A single span structure envisioned for this bridge replacement will have a span length of approximately 75 feet. An economical superstructure type in this case might be steel 'I' beam acting compositely with reinforced concrete slab, or precast prestressed box beams of adjacent or spread configuration with one course composite deck slab.

A construction depth of such system would be at least 48-inch which would exceed the existing construction depth between top of roadway and bottom of Howe truss by a minimum of 2 feet. Implementing the required structural depth would therefore necessitate raising of vertical profile, causing the undesirable impacts discussed above under Vertical Alignment.

If a thru-truss type superstructure is used, the effective construction depth can be as shallow as that in the existing bridge. Furthermore, based on the principles of context sensitive design, a steel thru-truss framing system, similar to the existing Howe pony truss, will replicate one of the original character defining features of the Camp Meeting Avenue Bridge.

F. DESIGN RECOMMENDATIONS

It is recommended to replace the Camp Meeting Avenue Bridge in its entirety with a single span structure on the same alignment. The roadway traffic will be detoured and a detour plan developed, but the railroad traffic under the bridge will be maintained and protected during reconstruction.

The new bridge will provide for 24-foot wide curb-to-curb roadway, striped for two 11-foot wide lanes and two 1-foot wide shoulders. The resulting bridge pavement width will be transitioned back to the existing 20.5-foot wide pavement.

The roadway approaches and bridge vertical alignment will be re-profiled to provide a vertical crest curve designed for a speed of 30 MPH with touch-down curves that will transition to the existing approach roadway grades. The bridge vertical underclearance will be at least 21'-2".

The bridge superstructure will consist of two thru-trusses with floor beams and stringers that will carry a cast-in-place concrete slab. The trusses will be prefabricated trusses by "Steadfast Bridges" or "Continental Bridge" or other equivalent system with the truss members of a similar configuration and visual appearance as the existing Howe pony trusses. Namely, the arrangement of diagonals and counters may be evaluated by using "Steadfast Bridges" Link Style Truss with "X" braces or a similar truss design.

It is further recommended to use four drilled shaft foundations that in turn will support four columns, one at each end of truss. The columns will be provided with cast-in-place curtain wall and wingwalls to constitute a bridge abutment.

The preliminary bridge and roadway plans included in the Appendix present the recommended scheme. The Construction cost for this scheme is estimated at $1,350,000.00.

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APPENDIX

PHOTOS OF THE CAMP MEETING AVENUE BRIDGE

PHOTO- 1

DESCRIPTION:

Bridge Elevation, looking south.

PHOTO- 2

DESCRIPTION:

General underdeck view, looking west.

PHOTO- 3

DESCRIPTION:

Bridge Approach, looking east.

PHOTO- 4

DESCRIPTION:

Bridge Approach, looking west.

PHOTO- 5

DESCRIPTION:

East Abutment and Bent, looking east.

PHOTO- 6

DESCRIPTION:

West Abutment

PHOTO- 7

DESCRIPTION:

East Abutment:
Loss of mortar, cracked and settled masonry stones, especially under truss supports.

PHOTO- 8

DESCRIPTION:

Northwest Wingwall:
Loss of mortar and cracks in the masonry with loose stones.

PHOTO- 9

DESCRIPTION:

North Fascia Truss: Looking west.

PHOTO- 10

DESCRIPTION:

General condition of Bent members, excessive rust and loss of section.

NEW JERSEY HISTORIC BRIDGE DATA SHEET

NEW JERSEY HISTORIC BRIDGE DATA

STRUCTURE # 1850160 **CO** SOMERSET **OWNER** UNKNOWN **MILEPOINT**

NAME & FEATURE INTERSECTED CAMP MEETING ROAD OVER CONRAIL (N.Y BRANCH) **FACILITY** CAMP MEETING ROAD

TOWNSHIP MONTGOMERY TOWNSHIP

TYPE PONY TRUSS **DESIGN** HOWE **MATERIAL** Ferrous

 # SPANS 3 **LENGTH** 104 ft **WIDTH** 14 ft

CONSTRUCTION DT 1889 **ALTERATION DT** 1914 **SOURCE** CONRAIL RECORDS

DESIGNER/PATENT CHIEF ENG. OFF. P&R RR **BUILDER** UNKNOWN

SETTING / CONTEXT The narrow bridge carries one lane of traffic over 2 active tracks of ConRail's main freight line known as the New York Branch. The right-of-way was developed by the Reading Railroad in the mid-1870s. It is located in a sparsely developed rural portion of the county in an area known as Skillman, location of the state's "epileptic village." A station was located on the south side of the bridge. When it was removed is not known, but it is depicted on a 1955 county map.

1995 SURVEY RECOMMENDATION Eligible **HISTORIC BRIDGE MANAGEMENT PLAN (EVALUATED)** Yes

CONSULT STATUS Individually Eligible.

CONSULT DOCUMENTS SHPO Letter 6/30/95

SUMMARY The rivet-connected skewed 3-span Howe pony truss with counters overpass on ashlar abutments and 1914 steel bents is an example of an uncommon truss type. It is an unconventional design with small spacer panels added to each truss to compensate for the skew. The floor beams are perpendicular to the road. Even though all but a few of the built-up floor beams and the flooring system have been replaced, the 1889 bridge survives as a good example and unusual example of its type.

INFOR MATION

Bibliography:
Conrail Records.
NJDOT Plan File: 6118 (45.95).
Gibb, Hugh. "Brotherly Love - Philadelphia Style," Bulletin of the National Railway Historical Society, 39, No. 6, 1974, pp. 21-43.

Physical Description: The skewed three-span rivet-connected Howe pony truss bridge is supported on ashlar abutments and metal bents composed of toe-out angles. The lateral bracing on the bents was added in 1914. A Howe truss works on the opposite principle of the more common Pratt truss. The verticals are in tension, and the diagonals and counters are the compression members. The chords, verticals, and diagonals are composed of toe-out angles while the counters are dimensioned plate. The original floor beams, which have been replaced at least twice, were built up. The floor beams are perpendicular to the roadway, not the abutments. The most unusual design detail of the trusses is the use of a small panel at either end of each truss which allowed for equal sizing of each pair of skewed trusses. The bridge has been strengthened with welded knee braces on the inside of the trusses and plate welded to the top chord. The stringers and flooring were originally wood, but they have been replaced with steel stringers and an asphalt wearing surface. A modern beam guard rail protects the inner face of the trusses.

Historical and Technological Significance: The Howe pony truss bridge was designed by the Philadelphia & Reading Railroad Chief Engineer's Office in 1889. In addition to being one of the few documented example of a Howe pony truss bridge in the state, it ranks as the oldest railroad-related span in Somerset County. Why a Howe truss was used is not documented, but it may relate to the decision to reuse the existing substructure which divided the bridge into three spans. The use of the small panels at the end of each truss in order keep each pair of trusses the same length is also an unusual design detail. In 1914 the bracing between the bent posts was added as were the concrete piers, and in 1982 most of the floor beams and stringers were replaced. Despite its over 100 years of active service, the bridge is extremely well preserved and ranks as one of the distinctive pony truss spans in the state.

The bridge was constructed for the Philadelphia and Reading Railroad (Reading) at Skillman, site of the state's epileptic village. A non-extant station was located to the southwest of the bridge. The rail right-of-way was chartered in 1870 and built as the Delaware & Bound Brook Railroad by the Central Railroad of New Jersey in 1873-1875 as an alternative double-track route between New York and Philadelphia. The line was acquired by the Reading Railroad, and was used for both freight and passenger service until the 1970s when the line went bankrupt. The right-of-way passed to Conrail which found it useful for freight service displaced from Amtrak's Northeast Corridor which is the old Camden & Amboy (Pennsylvania Railroad after 1873) route. The Skillman Road overpass is also one of the oldest grade crossing elimination bridges in the region. This is at least the second bridge at the crossing.

Boundary Description and Justification: The bridge is evaluated as individually distinguished for its technological significance. It is adjacent to the campus of the State's Skillman Training School for Boys, but it is not near historic buildings associated with the early history of that facility. The boundary is limited to the substructure and superstructure of the bridge itself.

PHOTO: 101:29-37 (10/10/91) REVISED BY (DATE): QUAD: Rocky Hill

CAMP MEETING AVENUE OVER TRENTON LINE (CSX)
STRUCTURE NO. 1850-160
MONTGOMERY TOWNSHIP, SOMERSET COUNTY

GEOTECHNICAL FOUNDATION ENGINEERING REPORT

Prepared for:
New Jersey Department of Transportation
1035 Parkway Avenue
Trenton, New Jersey 08625

Prepared by:
The Louis Berger Group, Inc.
30 Vreeland Road, Building A
Florham Park, New Jersey 07932

October, 2006

SUBSURFACE INVESTIGATIONS

1 Field Investigations

Berger developed a program of subsurface exploration that was executed in July, 2006. The boring contract was performed by Site-Blauvelt Engineers, between July 17 and 18, 2006. The program included 2 structural borings near the existing bridge abutments. The location of these borings is shown on the attached bridge plan. The borings with their designation and the depths are listed below:

Boring No.	Structure	Depth of Boring
B-1	West Abutment	47.5 feet
B-2	East Abutment	44.0 feet

Continuous sampling with SPTs was carried out for the first 11 feet, and thereafter sampling was continued with SPTs at regular 5 feet intervals unless rock was encountered. Borings were extended into rock by rock coring using NX-size. Holes were terminated in moderately to slightly weathered Salty Clay stone.

Groundwater was not encountered during boring of these two borings.

The boring logs are attached.

2 Laboratory Investigations

Upon completion of the fieldwork, a laboratory program was developed by Berger, which included the following tests:

Test type	Number of tests
Moisture content	9
Atterberg limits	3
Gradation to Sieve # 200	8

The laboratory tests were performed by Site-Blauvelt Engineers, Inc. in August 2006. The results are attached.

3 SUBSURFACE CONDITIONS

The top of the existing roadway grade is approximately at elevation El. +147 and the ground at railroad is at El. ±122. Following is a brief description of the subsurface conditions. These conditions are also indicated on the attached schematic transverse soil profile.

The subsurface conditions at the west and east abutments, respectively are represented by borings B-1 and B-2.

No foundation data is available for the existing abutments. It is assumed that the bottom of the existing abutments is approximately at elevation El. +116. The borings were terminated approximately 22 feet (B-1) and 18 feet (B-2) feet below the existing ground. Based on the borings, similar subsurface conditions were noted at the abutment locations

Based on the information from the borings, three generalized layers were identified:

Stratum 1: **Fill:** Approximately ten feet (10 ft) thick layer of fill was encountered. Fill consist mainly of coarse to fine reddish brown gravel with some clayey silt. The Standard Penetration Value (N-Value) in this layer ranged from 4 to 12, indicating loose to medium dense compactness of the material.

Stratum 2: **Clayey Silt (CL/ML):** A layer of clayey silt mixed with varying amounts of sand and gravel was noted underlying the fill material. This layer is approximately 4 feet in thickness and generally transitions to extremely weathered clay Siltstone. The "N-Value" in the clayey silt layer is on the order of 4 whereas, higher N-values in excess of 50 were noted in the extremely weathered rock.

Stratum 3: **Silty Claystone/Claystone:** The Silty Claystone/Claystone was encountered in both the borings. It generally occurred at an approximate elevation El.+123. The layer consists of moderately to slightly weathered rock, medium hard to hard with very closely spaced fractures. The boring was extended into this layer by coring. The total core recovery (TCR) ranged between 83% and 100% and the rock quality designation (RQD) ranged between 0 and 47%.

Groundwater was not encountered during the drilling of these borings.

FOUNDATION DESIGN AND RECOMMENDATIONS

Foundation Type

Drilled shafts are recommended to be used as foundations for the abutments of the proposed bridge. Based on the anticipated structural load, using four shafts, two for each abutment, a design axial capacity of 70 tons per shaft is considered adequate. The required minimum depth of embedment of the shaft to achieve the required geotechnical axial capacity was estimated by using axial capacity analysis software. The lateral stability of the shaft will be governed by the maximum allowable deflection at the top of the shaft that may be extended to the bearing elevation. Limiting the deflection to an inch, the associated maximum applied lateral load and the minimum required depth of embedment of the shaft was estimated by using lateral pile analysis software. Using these analyses, the minimum required depth of embedment of the shaft was established. Use of 3 feet diameter concrete shaft drilled through the claystone is considered adequate.

Spread footing foundations, though feasible based on the existing subsurface conditions, are not practical. As the existing abutments are expected to remain in place, the available area to build a new footing necessary to support a full height abutment is insufficient. Using four drilled shaft columns, two at each abutment is therefore recommended due to potential conflict with existing gravity foundations.

Geotechnical Axial Capacity and Lateral Stability Analysis

Geotechnical Axial Capacity: The use of 3 feet diameter concrete shaft installed in Silty Claystone to a minimum depth of embedment of 16.5 feet is estimated to yield an anticipated allowable design axial capacity of 70 tons. Based on an average ground elevation at El. +122.0, the bottom of the shaft will be located at elevation El. +105.5. The allowable design axial capacity is based on a safety factor of 3 of the ultimate axial capacity. The static axial capacity has been determined using APILEPlus Computer Program (Ref. 1).

Geotechnical Lateral Stability: In order to examine the pile behavior under lateral loading, lateral pile analysis was performed using LPILEPLUS$^{5.0}$ Computer Program (Ref. 2). The analysis indicates that with the shaft installed to elevation El.+105.5 and when subjected to an applied lateral load on the order of 9.5 kips, the top of the shaft deflects on the order of one inch. If the maximum allowable deflection of the shaft at the top is limited to an inch, the resulting maximum allowable applied lateral load is 9.5 kips.

Seismic Design Considerations

The acceleration coefficient to be used is A = 0.18 and the Seismic Performance Category (SPC) is B. Soil profile Type I is considered adequate with a site coefficient of S = 1.0. A seismic coefficient k_h =0.5A is recommended for use in conjunction with the Mononobe-Okabe method of analysis to calculate maximum lateral earth pressure (Ref. 3).

Summary of Axial Capacity and Lateral Stability Analysis

Foundation Type	3 feet diameter concrete shaft
Average Ground Elevation	El. 122.0
Anticipated Axial Design Capacity	70 Ton
Factor of Safety	3
Top of the Shaft	El. 145
Minimum Tip of the Shaft	El. 105.5
Minimum Depth of embedment	16.5 ft
Total Length of the Shaft	39.5 ft
Maximum Allowable Shaft Head Deflection	1 inch
Maximum Lateral Load	9.8 Kip

REFERENCES

1. Computer Program APILEPlus, Version 4.0, ENSOFT, Inc., 2004.
2. Computer Program LPILEPlus, Version 5.0, ENSOFT, Inc., July 2004.
3. American Association of State Highway and Transportation officials, Standard Specifications for Highway Bridges – AASHTO, 17th Edition, 2002.

BORING LOGS &
LABORATORY TEST RESULTS

The Louis Berger Group, Inc. 30 Vreeland Road, Building A Florham Park, NJ 07932	# Drilling Log	**BORING NO.: B-1** Page 1 of 2

PROJECT: Camp Meeting Ave Bridge over Trenton Line **PROJECT LOCATION:** Montgomery Twp, New Jersey

STATION: 12+79.00 **REFERENCE LINE:** Camp Meeting Ave Bridge Baseline **GROUND ELEVATION (ft.):** 147

OFFSET: R 5.0 **DRILLING METHODS:** 7-1/4" HSA, 4-1/4" Soft Rock Bit

BORINGS BY: SITE-Blauvelt Engineers **DATE STARTED:** 7/18/2006

INSPECTOR: Anna Fyodorova **DATE FINISHED:** 7/18/2006

GROUNDWATER ELEVATION (DEPTH) (ft.)
0 Hr. (not encountered) **DATE:** 7/18/06 12:50
24 Hr. **DATE:**
P.P. Installed (ft.)

DEPTH (ft)	DRILL RUN TIME (min)	SAMPLE NO.	SAMPLE DEPTH (ft)		BLOWS ON SPOON 0-6 (in)	6-12 (in)	12-18 (in)	18-24 (in)	REC (in)	USCS	SOIL DESCRIPTION AND STRATIGRAPHY	DEPTH OF STRATUM (ft)
											8" ASPHALT CONCRETE over 8" SUBBASE (Dark brownish gray F GRAVEL, some cf Sand).	
		S-1	1	3	5	4	4	5	18		FILL: Reddish brown (10R 3/4) mottled light brown (5YR 5/2) to moderate brown (5YR 4/4) SILT, little cf Sand, little f Gravel (angular).	1.4
		S-2	3	5	5	7	5	4	11		FILL: Reddish brown (10R 3/4) CF GRAVEL, some Silt, damp.	3.0
5												
		S-3	5	7	10	5	5	3	14		...mottled green (5GY 5/2) below 5 ft.	
		S-4	7	9	4	4	4	4	14		...with 4"-thick brown (5YR 4/4) Silt layer at 7.9 ft.	
		S-5	9	11	5	3	3	6	14		...light brown, greenish brown, and brown below 9 ft.	
10												
										ML	Red-brown (10R 3/4) Clayey SILT, little cf Sand, little f Gravel (RESIDUAL SOIL).	12.0
15												
		S-6	15	17	20	27	34	41	24		Red-brown (10R 3/4) Clayey SILTSTONE, extremely to highly weathered, soft; fractured (PASSAIC FORMATION).	15.5
											Red-brown (10R 3/4) SILTSTONE, little white f Sand, extremely to highly weathered, soft; very closely-spaced (0.5" o.c.) fractures along subhorizontal bedding planes.	18.5
20												
		S-7	20	20.8	50	50/3"	-	-	9			
											Red-brown (10R 3/4) Silty CLAYSTONE, moderately to slightly weathered, hard; very closely-spaced (0.5"-2" o.c.) fractures: J = 0° to 20°, VN, Mn, Su, Pl, S, VC-C (PASSAIC FORMATION).	22.0
25												

Nominal I.D. of Drive Pipe :		--
Nominal I.D. of Split Barrel Sample :		1-3/8 ins
Weight of Hammer on Drive Pipe :		--
Weight of Hammer on Split Barrel Sampler :	(cathead)	140 lbs
Drop of Hammer on Drive Pipe :		--
Drop of Hammer on Split Barrel Sampler :		30 ins

Soil descriptions represent a field identification using the Burmister System of Classification unless otherwise noted.
All dimensions are in feet unless noted otherwise.

The subsurface information shown hereon was obtained for the State design and estimate purposes. It is made available to authorized users only that they may have access to the same information available to the State. It is presented in good faith, but is not intended as a substitute for investigations, interpretation or judgement of such authorized users.

The Louis Berger Group, Inc.

Approximate Change in Strata ————————
Inferred Change in Strata — — — — — — —

The Louis Berger Group, Inc. 30 Vreeland Road, Building A Florham Park, NJ 07932	# Drilling Log	**BORING NO.: B-1** Page 2 of 2

PROJECT: Camp Meeting Ave Bridge over Trenton Line **PROJECT LOCATION:** Montgomery Twp, New Jersey

STATION: 12+79.00 **REFERENCE LINE:** Camp Meeting Ave Bridge Baseline **GROUND ELEVATION (ft.):** 147

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GROUNDWATER ELEVATION (DEPTH) (ft.)
0 Hr. (not encountered) **DATE:** 7/18/06 12:50
24 Hr. **DATE:**
P.P. Installed (ft.)

DEPTH (ft)	DRILL RUN TIME (min)	SAMPLE NO.	SAMPLE DEPTH (ft)		BLOWS ON SPOON 0-6 (in)	6-12 (in)	12-18 (in)	18-24 (in)	REC (in)	USCS	SOIL DESCRIPTION AND STRATIGRAPHY	DEPTH OF STRATUM (ft)
	5:00	R-1	24.5	27.5	RQD	=	0%		33		Red-brown (10R 3/4) Silty CLAYSTONE, moderately to slightly weathered, hard; very closely-spaced (0.5"-2" o.c.) fractures: J = 0° to 20°, VN, Mn, Su, Pl, S, VC-C (PASSAIC FORMATION).	
	6:00				Rec.	=	91%					
	9:00											
	5:00	R-2	27.5	32.5	RQD	=	0%		57		Medium dark gray (N4) CLAYSTONE (MARL), calcaerous, thinly laminated, moderately weathered, hard; Ca-filled healed fractures along subhorizontal bedding planes/laminations: J = 0°, VN (H), Ca, Fi, Pl, SR, VC; (Gradational bottom contact).	28.6
	4:00				Rec.	=	95%					
30	4:00											
	6:00										Dark gray (N3) CLAYSTONE, slightly calcaerous, moderately weathered, medium hard to hard; Ca-filled fractures: J = 0°, N, Ca, Fi, Pl, SR, VC.	31.1
	6:00											
	4:00	R-3	32.5	37.5	RQD	=	7%		55		...with iron oxide staining on fracture planes at 32.5 ft.	
	1:00				Rec.	=	91%				...gray (N5-N6), non-calcaerous below 33.7 ft.	
35	1:00										Pale brown (5YR 5/2) medium- to coarse-grained Silty SANDSTONE, highly weathered, hard; J = 45°, N-MW, Cl+Ep, Pf, Pl, SR, VW.	34.3
	5:00										Gray (N4) SILTSTONE, non-calcaerous, moderately weathered, hard; J1 = 90°, VN, Fe, Su, Wa, R, C; J2 ~15°, T, Fe, Su, Wa, R, VC.	35.6
	1:00											
	2:00	R-4	37.5	42.5	RQD	=	47%		60		...closely-spaced fractures below 37.5 ft.; (Gradational bottom contact).	
	2:00				Rec.	=	100%				Red-brown (10R 3/4) Silty CLAYSTONE, slightly weathered, hard; J = 0°, 45°, 65°, 90°, No to Fe+Ca, Su, Pl, S, Pl, C.	38.5
40	4:00										...below 40': J1 (typical) = 30°, No, Pl, S, Pl, C; J2 (@~41') = 45°, N, Ca, Fi, Pl, S, W; (Gradational bottom contact).	
	3:00											
	4:00											
	3:00	R-5	42.5	47.5	RQD	=	35%		60		Gray (N4) CLAYSTONE (MARL), calcaerous, slightly weathered, hard; one-half of fractures Ca-filled: J = 20-25°, VN (H), Ca, Fi, Pl, S, VC-C.	42.8
	2:00				Rec.	=	100%					
45	1:00										Red-brown (10R 3/4) Clayey SILTSTONE, non-calcaerous, slightly weathered, hard; scattered 50° to 75° dipping, very narrow to wide, Ca-healed fractures: V/J (@46.5') = 75°, W (H), Ca, Fi, Pl, S, Pl, VW.	44.5
	2:00											
	2:00											
											Bottom of Boring at 47.5 feet.	47.5
50												

Nominal I.D. of Drive Pipe :		--
Nominal I.D. of Split Barrel Sample :		1-3/8 ins
Weight of Hammer on Drive Pipe :		--
Weight of Hammer on Split Barrel Sampler :	(cathead)	140 lbs
Drop of Hammer on Drive Pipe :		--
Drop of Hammer on Split Barrel Sampler :		30 ins

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All dimensions are in feet unless noted otherwise.

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The Louis Berger Group, Inc.

Approximate Change in Strata ————————
Inferred Change in Strata — — — — — — —

The Louis Berger Group, Inc.
30 Vreeland Road, Building A
Florham Park, NJ 07932

Drilling Log

BORING NO.: B-2

PROJECT: Camp Meeting Ave Bridge over Trenton Line **PROJECT LOCATION:** Montgomery Twp, New Jersey

STATION: 14+09.00 **REFERENCE LINE:** Camp Meeting Ave Bridge Baseline **GROUND ELEVATION (ft.):** 148

OFFSET: R 6.0 **DRILLING METHODS:** 7-1/4" HSA, 4-1/4" Soft Rock Bit

BORINGS BY: SITE-Blauvelt Engineers **DATE STARTED:** 7/17/2006

INSPECTOR: Anna Fyodorova **DATE FINISHED:** 7/17/2006

GROUNDWATER ELEVATION (DEPTH) (ft.)
0 Hr. (not encountered) **DATE:** 7/17/06 15:40
24 Hr. **DATE:**
P.P. Installed (ft.)

DEPTH (ft)	DRILL RUN TIME (min)	SAMPLE NO.	SAMPLE DEPTH (ft)		BLOWS ON SPOON 0-6 (in)	6-12 (in)	12-18 (in)	18-24 (in)	REC (in)	USCS	SOIL DESCRIPTION AND STRATIGRAPHY	DEPTH OF STRATUM (ft)
											2'-2" ASPHALT CONCRETE (no subbase).	
		S-1	2	4	1	2	2	2	19		FILL: Orange-brown (5YR 5/6) Silty CLAY, trace f Sand.	2.1
5		S-2	4	6	2	2	3	4	7		...~3" AC fragment at 4.2 ft.	4.5
											FILL: Grayish red (5R 4/2) SILT, some f Gravel (angular).	5.2
		S-3	6	8	7	7	5	3	9		FILL: Red-brown (10R 3/4) CF GRAVEL (angular), some Clayey Silt.	
		S-4	8	10	6	3	4	6	13			
10		S-5	10	12	2	3	4	3	14	ML	Yellow-brown (5YR 4/4-10YR 5/4) Clayey SILT, low (medium) plasticity, scattered iron oxide spotting in matrix.	10.1
15										SM	Red-brown (10R 3/4) CM SAND, some cf Gravel (disintegrated bedrock) (RESIDUAL SOIL).	14.0
		S-6	15	17	16	12	22	19	18			
20											Grayish black (N2), light brown (5YR 6/4), and dark brown (10YR 4/2) Silty CLAYSTONE to Clayey SILTSTONE, highly weathered, soft; fractured (PASSAIC FORMATION).	18.5
		S-7	20	22	14	20	30	29	24			
25	5:00	R-1	24	29	RQD	=	21%		56		continued on next page	23.8

Nominal I.D. of Drive Pipe :		--
Nominal I.D. of Split Barrel Sample :		1-3/8 ins
Weight of Hammer on Drive Pipe :		--
Weight of Hammer on Split Barrel Sampler :	(cathead)	140 lbs
Drop of Hammer on Drive Pipe :		--
Drop of Hammer on Split Barrel Sampler :		30 ins

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The Louis Berger Group, Inc.

Approximate Change in Strata ————
Inferred Change in Strata – – – – –

The Louis Berger Group, Inc. 30 Vreeland Road, Building A Florham Park, NJ 07932	**Drilling Log**	**BORING NO.: B-2** Page 2 of 2

PROJECT: Camp Meeting Ave Bridge over Trenton Line **PROJECT LOCATION:** Montgomery Twp, New Jersey

STATION: 14+09.00 **REFERENCE LINE:** Camp Meeting Ave Bridge Baseline **GROUND ELEVATION (ft.):** 148

OFFSET: R 6.0 **DRILLING METHODS:** 7-1/4" HSA, 4-1/4" Soft Rock Bit

BORINGS BY: SITE-Blauvelt Engineers **DATE STARTED:** 7/17/2006

INSPECTOR: Anna Fyodorova **DATE FINISHED:** 7/17/2006

GROUNDWATER ELEVATION (DEPTH) (ft.)
0 Hr. (not encountered) **DATE:** 7/17/06 15:40
24 Hr. **DATE:**
P.P. Installed (ft.)

DEPTH (ft)	DRILL RUN TIME (min)	SAMPLE NO.	SAMPLE DEPTH (ft)		BLOWS ON SPOON 0-6 (in)	6-12 (in)	12-18 (in)	18-24 (in)	REC (in)	USCS	SOIL DESCRIPTION AND STRATIGRAPHY	DEPTH OF STRATUM (ft)
	5:00				Rec.	=	93%				Black (N1) to grayish black (N2) SILTSTONE, moderately weathered, medium hard to hard; very closely-spaced fractures: J = 5° to 55°, No to Ca, Fi, Pl, S, VC; (Gradational bottom contact) (PASSAIC FORMATION).	
	5:00											
	7:00											
	8:00										Blackish red (5R 2/2) CLAYSTONE, moderately to slightly weathered, hard; fractures: J (typical) = 10-15°,VN, No or Mn, Fi, Pl, S, VC (1.5" o.c.).	28.1
30	2:00	R-2	29	34	RQD	=	10%		60			
	9:00				Rec.	=	100%				...slightly calcaerous below 30 ft.	
	2:00											
	4:00											
	4:00										Gray (N5) to dark gray (N2) CLAYSTONE (MARL), slightly weathered, hard; very closely-spaced fractures dipping 25° to 30°.	33.4
35	4:00	R-3	34	39	RQD	=	17%		50			
	4:00				Rec.	=	83%				Grayish red (5R 4/2) Silty CLAYSTONE, slightly calcaerous, moderately to slightly weathered, hard; fractures dipping 15°.	34.8
	4:00										...dark reddish brown (10R 3/4) below 35.3 ft.; with fractures: J = 15°,VN (H), Ca, Fi, Pl, S, VC-C.	
	4:00										...calcite nodule/vein fragment 1/2"-diameter at 37.5 ft.	
	3:00											
40	2:00	R-4	39	44	RQD	=	25%		60			
	3:00				Rec.	=	100%					
	3:00											
	5:00											
	3:00										...non-calcaerous below 43 ft.; fracture: J(@43') = 85°, VN (H), Mn, Fi, Pl, SR.	
45											Bottom of Boring at 44 feet.	44.0
50												

Nominal I.D. of Drive Pipe :		--
Nominal I.D. of Split Barrel Sample :		1-3/8 ins
Weight of Hammer on Drive Pipe :		--
Weight of Hammer on Split Barrel Sampler :	(cathead)	140 lbs
Drop of Hammer on Drive Pipe :		--
Drop of Hammer on Split Barrel Sampler :		30 ins

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Approximate Change in Strata ————————
Inferred Change in Strata — — — — — — —

SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION					GRAIN SIZE DISTRIBUTION				PLASTICITY						VOLUMETRIC PROPERTIES			COMPACTION CHARACTERISTICS							
BORING NUMBER	SAMPLE NUMBER	DEPTH (FT.)	ELEVATION (FT.)	SOIL GROUP (USCS SYSTEM)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY COLLOIDS (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	SPECIFIC GRAVITY (* INDICATES ASSUMED VALUE)	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (PCF) (+ INDICATES REMOLDED SAMPLE)	VOID RATIO	DEGREE OF SATURATION (%)	TYPE OF TEST	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)	CALIFORNIA BEARING RATIO-CBR (%)	pH	ORGANIC CONTENT (%)	MAXIMUM DENSITY (PCF)	MINIMUM DENSITY (PCF)
B-1																									
	S-1	1-3		SC	17	42	41		29	20	9	-.48		15.7											
	S-3	5-7		GM	58	29	13							10.5											
	S-5	9-11		GM	43	39	18							15.6											
B-2																									
	S-1	2-4		CL-ML	0	8	92		28	21	7	0.67		25.7											
	S-2	4-6		GM	42	42	16							14.3											
	S-3	6-8		GP-GM	52	40	8							11.2											
	S-4	8-10		GC	46	38	16		43	22	21	-.39		13.8											
	S-5	10-12												21.6											
	S-6	15-17		SM	24	62	14							14.0											

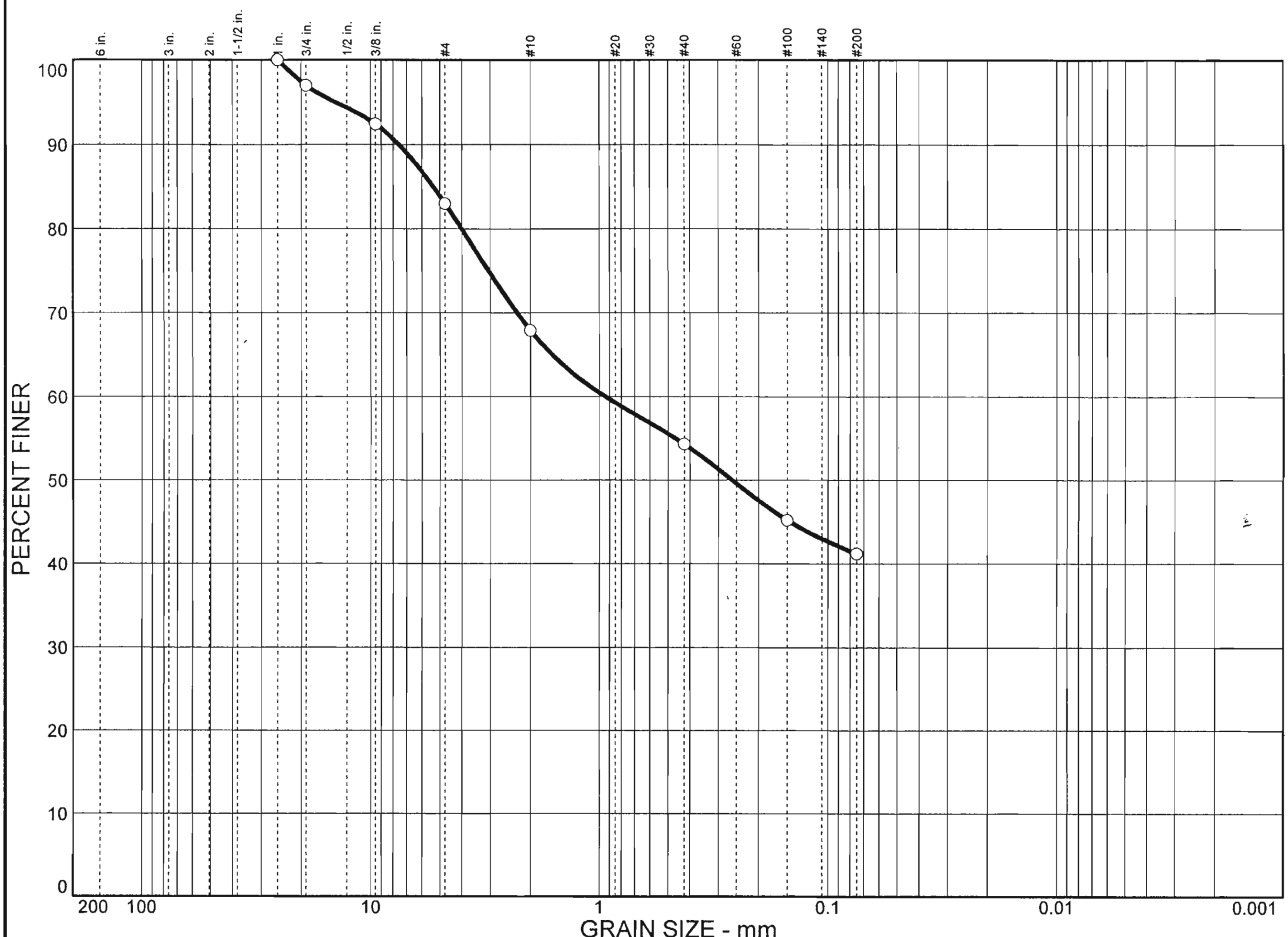
SITE-Blauvelt Engineers, Inc.

DRAWN: RNR DATE: 8/17/2006
CHECKED: DATE:

CAMP MEETING AVENUE OVER TRENTON LINE
SOMERSET COUNTY, MONTGOMERY TWP, NJ

FILE NO. NJ11330
TABLE NO. 1

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	17.0	41.8	41.2	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	29	20	5.35	0.942	0.262					

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN C/M/F SAND AND SILT LITTLE F/C GRAVEL	SC	A-4(1)

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.
Project: CAMP MEETING AVENUE OVER TRENTON LINE
SOMERSET COUNTY
○ **Source:** B-1 **Sample No.:** S-1 **Elev./Depth:** 1-3

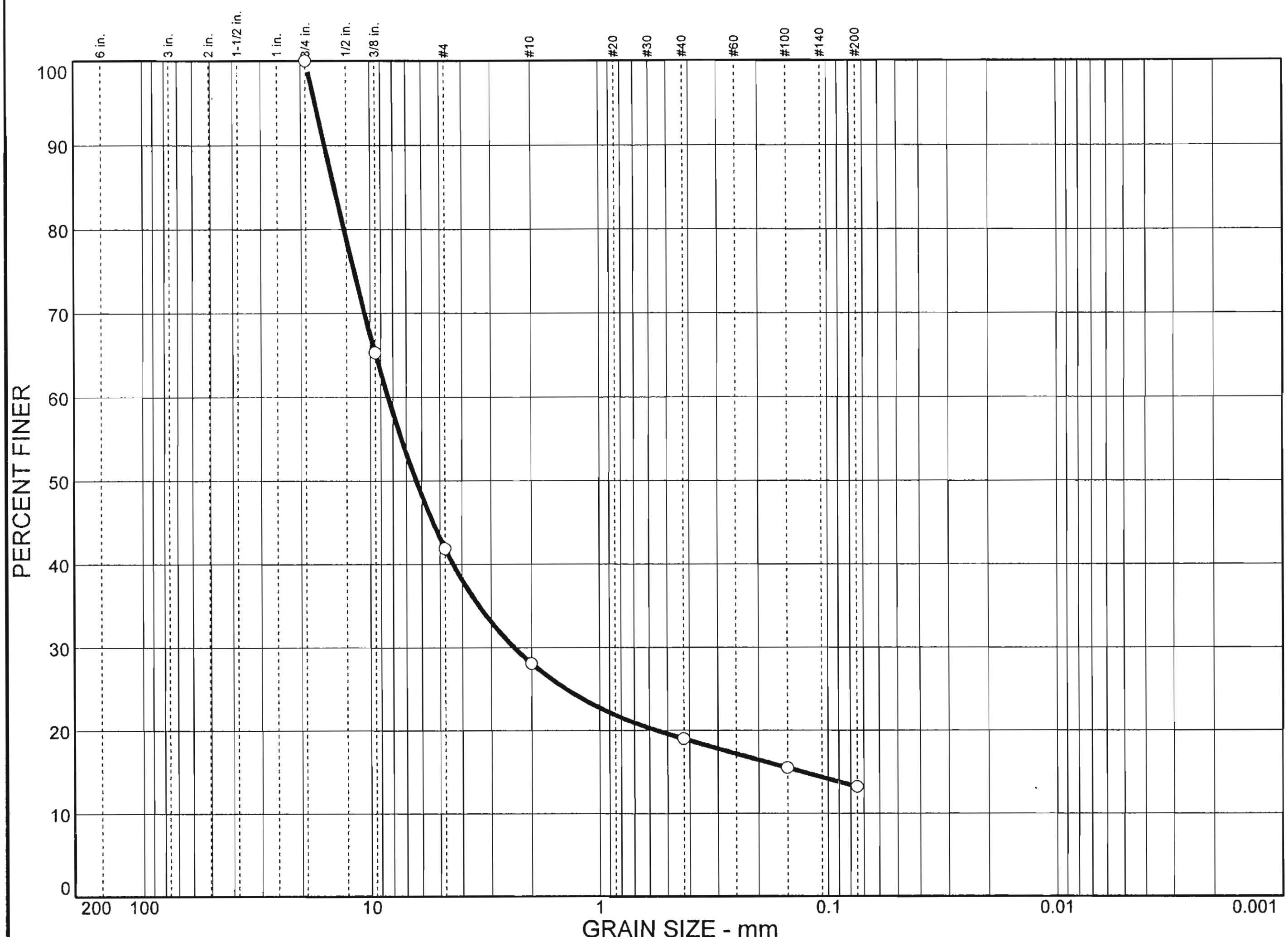
Remarks:
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 1

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	58.1	28.7	13.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			14.3	8.38	6.34	2.38	0.129			

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN FINE GRAVEL SOME C/M/F SAND LITTLE SILT	GM	A-1-a

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.
Project: CAMP MEETING AVENUE OVER TRENTON LINE
SOMERSET COUNTY
○ **Source:** B-1 **Sample No.:** S-3 **Elev./Depth:** 5-7

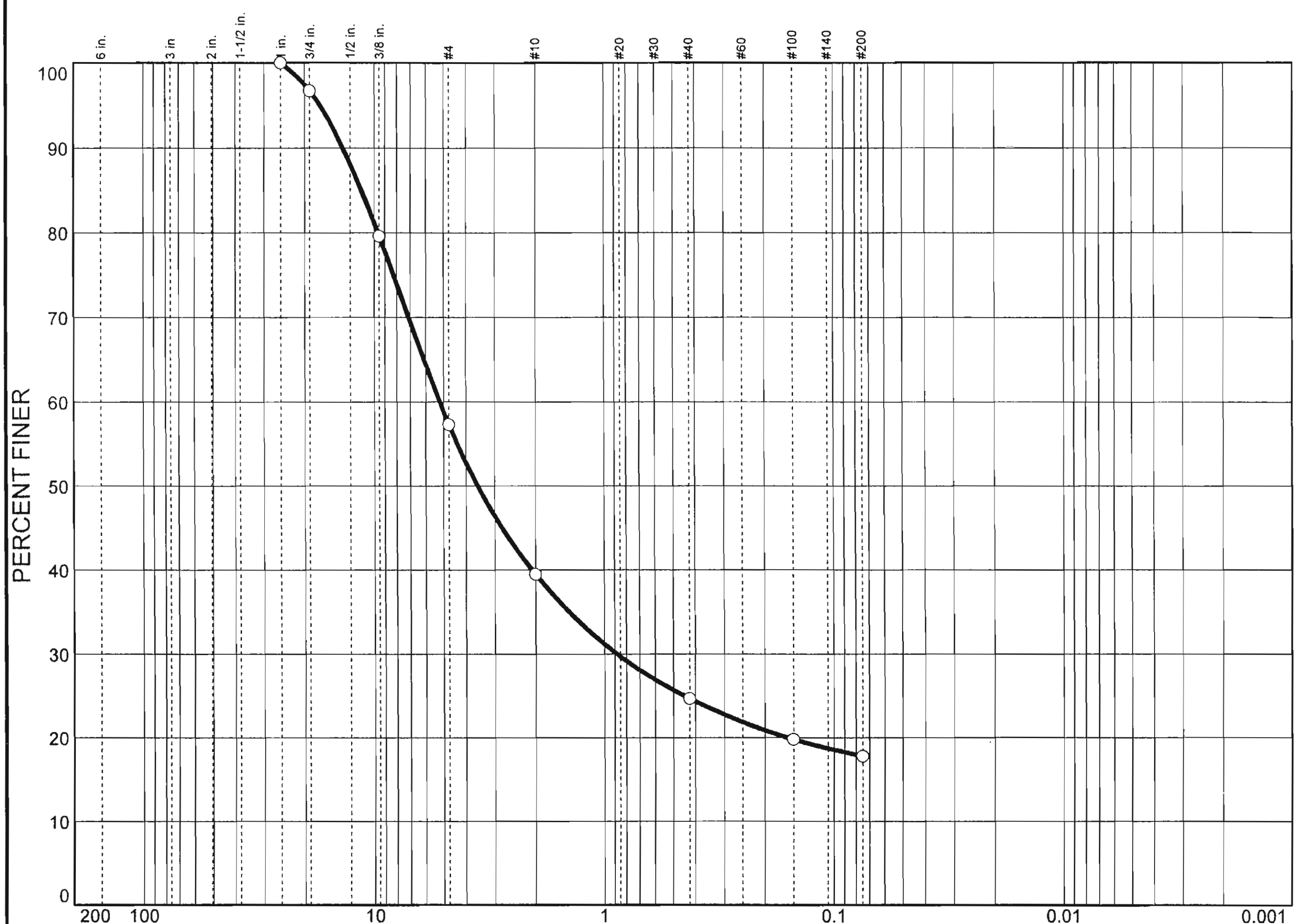
Remarks:
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 2

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	42.7	39.5	17.8	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			11.4	5.21	3.56	0.882				

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN F/C GRAVEL AND C/M/F SAND LITTLE SILT	GM	A-1-b

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.

Project: CAMP MEETING AVENUE OVER TRENTON LINE

SOMERSET COUNTY

○ **Source:** B-1 **Sample No.:** S-5 **Elev./Depth:** 9-11

Remarks:

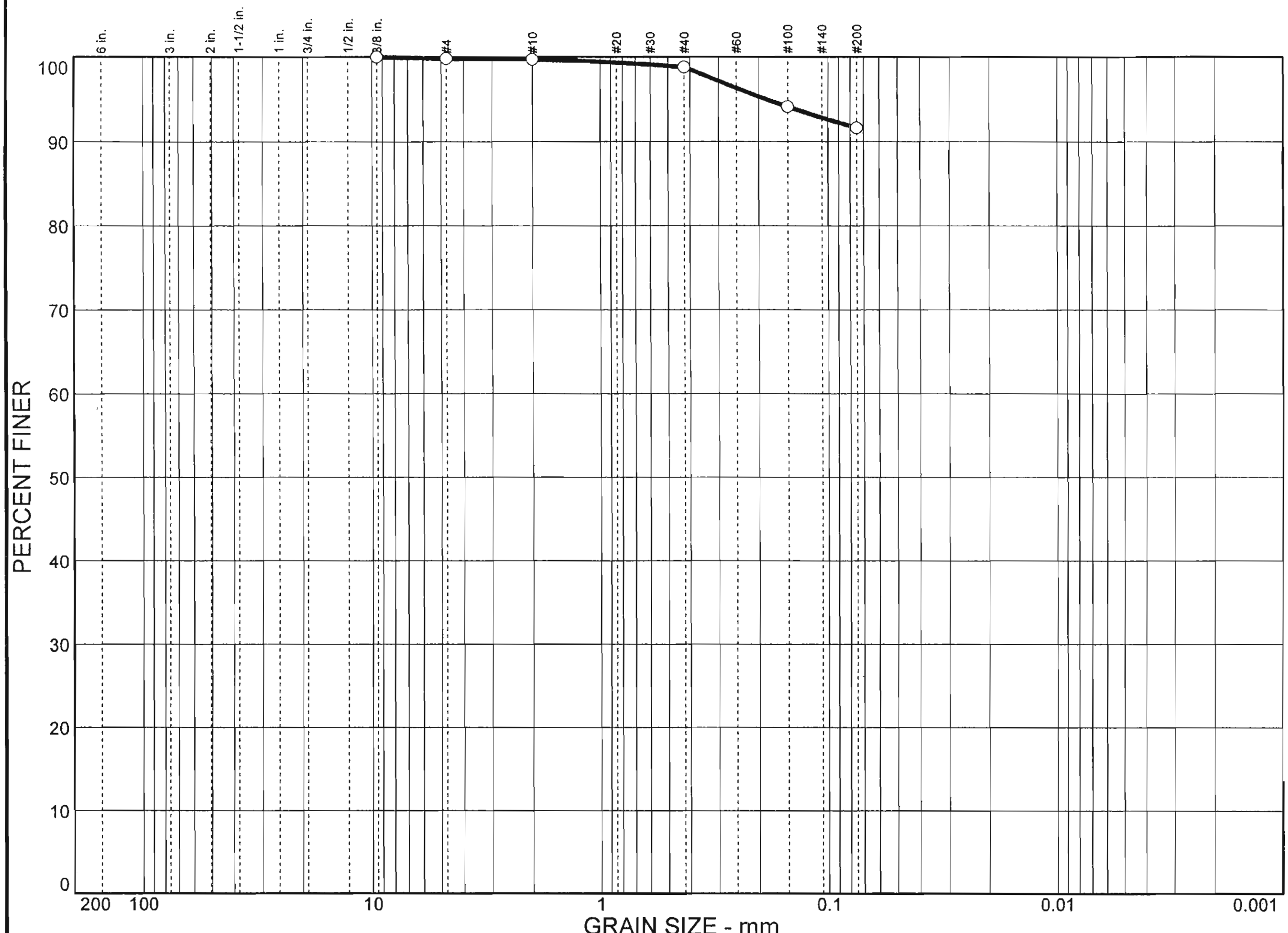
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 3

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.2	8.2	91.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	28	21								

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN SILT FEW F/M SAND	CL-ML	A-4(6)

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.
Project: CAMP MEETING AVENUE OVER TRENTON LINE
SOMERSET COUNTY
○ **Source:** B-2 **Sample No.:** S-1 **Elev./Depth:** 2-4

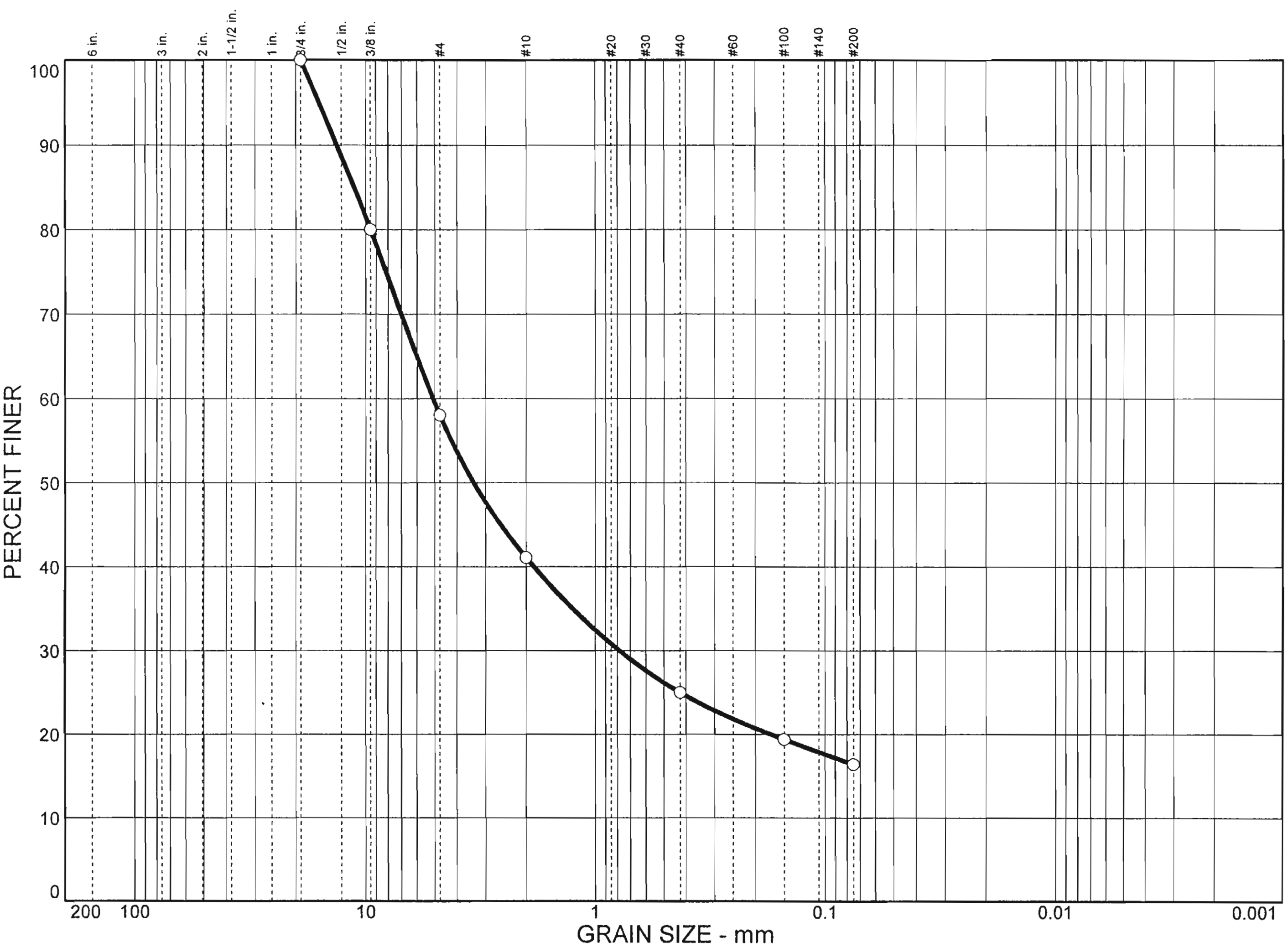
Remarks:
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 4

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	42.0	41.6	16.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			11.2	5.10	3.39	0.785				

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN FINE GRAVEL AND C/M/F SAND LITTLE SILT	GM	A-1-b

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.
Project: CAMP MEETING AVENUE OVER TRENTON LINE
SOMERSET COUNTY
○ **Source:** B-2 **Sample No.:** S-2 **Elev./Depth:** 4-6

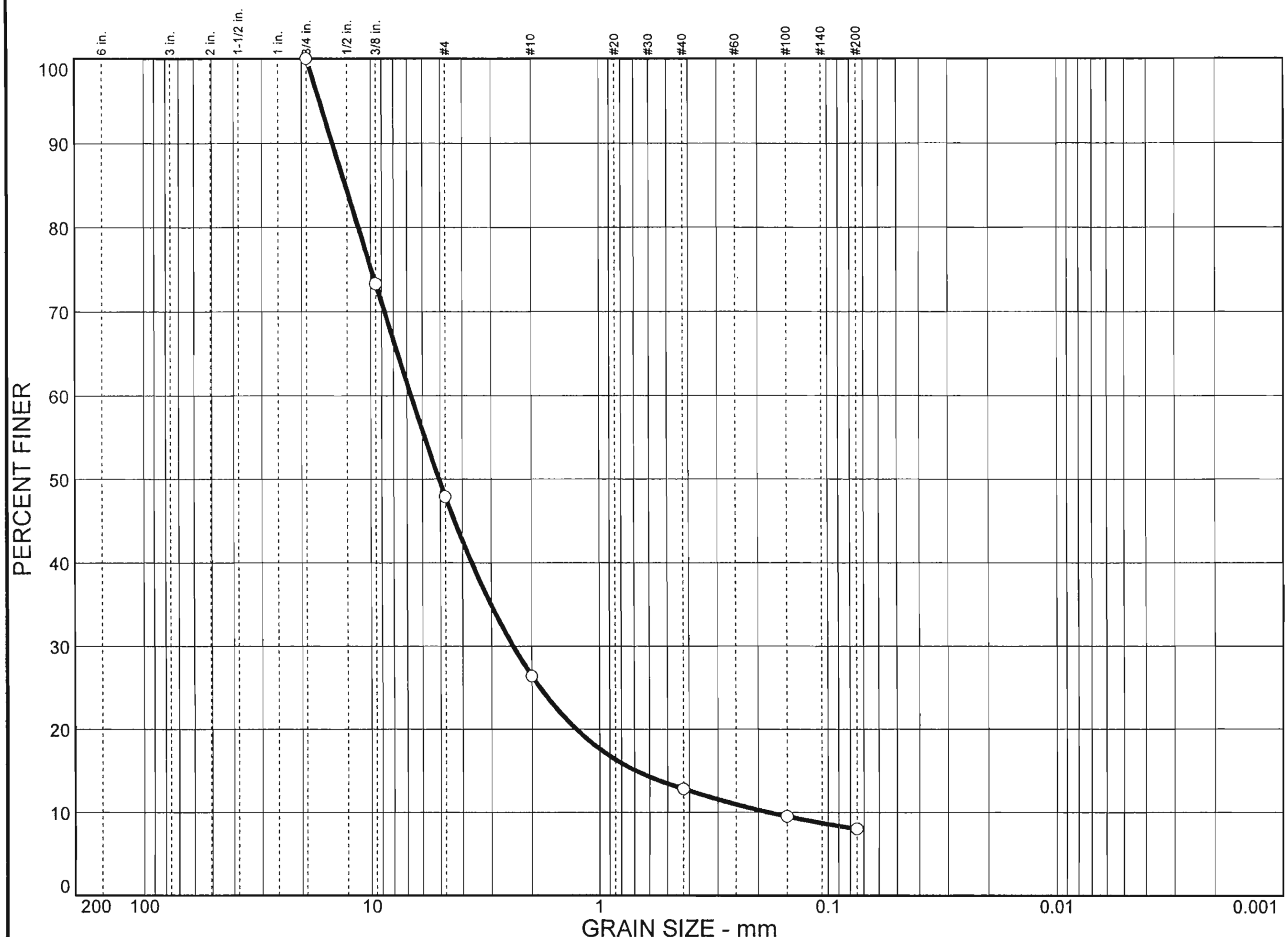
Remarks:
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 5

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	52.1	39.9	8.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			12.9	6.71	5.06	2.41	0.688	0.182	4.78	36.94

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN C/M/F SANDY FINE GRAVEL FEW SILT	GP-GM	A-1-a

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.

Project: CAMP MEETING AVENUE OVER TRENTON LINE

SOMERSET COUNTY

○ **Source:** B-2 **Sample No.:** S-3 **Elev./Depth:** 6-8

Remarks:

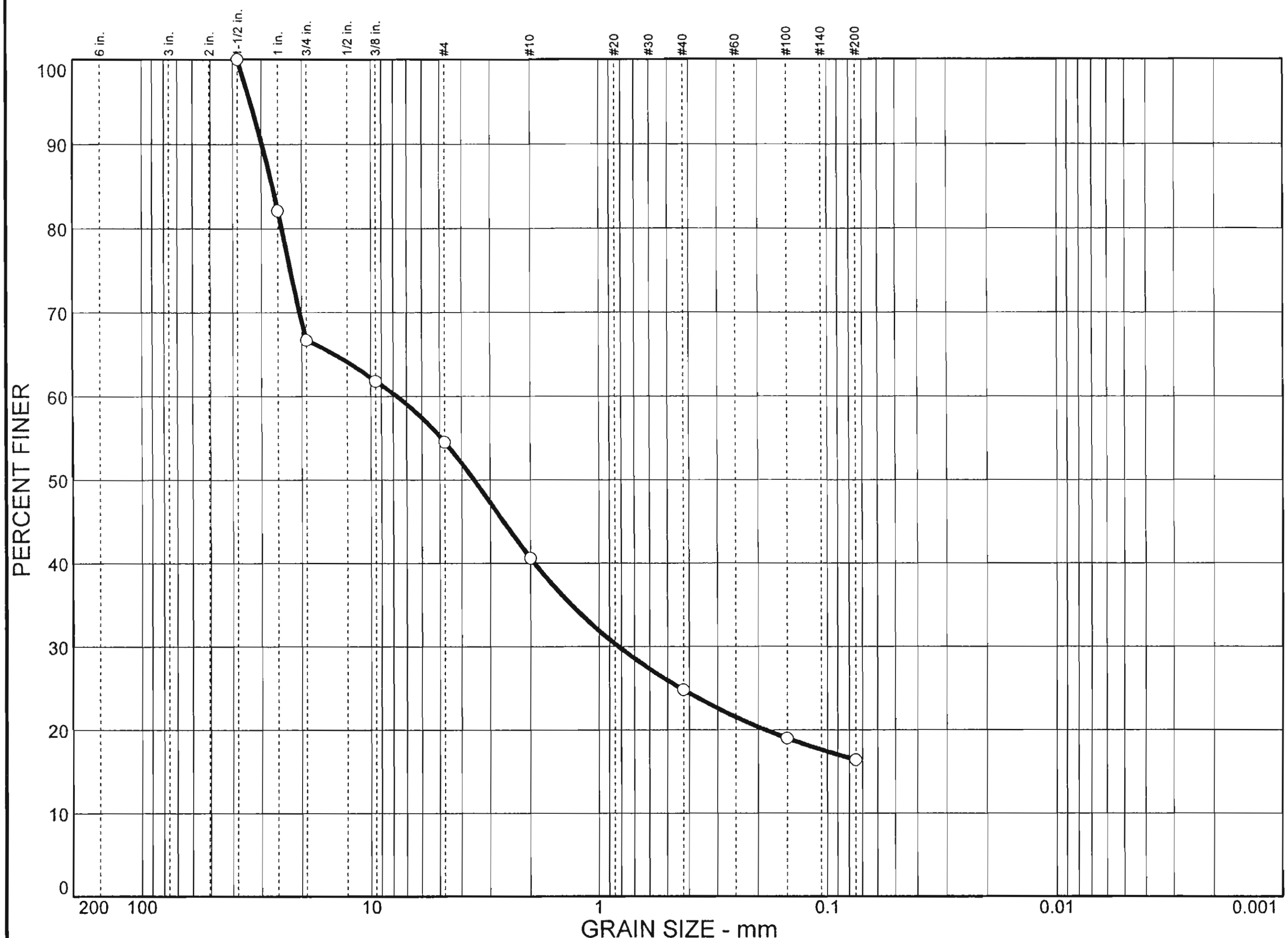
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 6

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	45.5	38.1	16.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	43	22	26.8	7.72	3.54	0.825				

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN C/F GRAVEL AND M/C/F SAND LITTLE SILT	GC	A-2-7(0)

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.

Project: CAMP MEETING AVENUE OVER TRENTON LINE

SOMERSET COUNTY

○ **Source:** B-2 **Sample No.:** S-4 **Elev./Depth:** 8-10

Remarks:

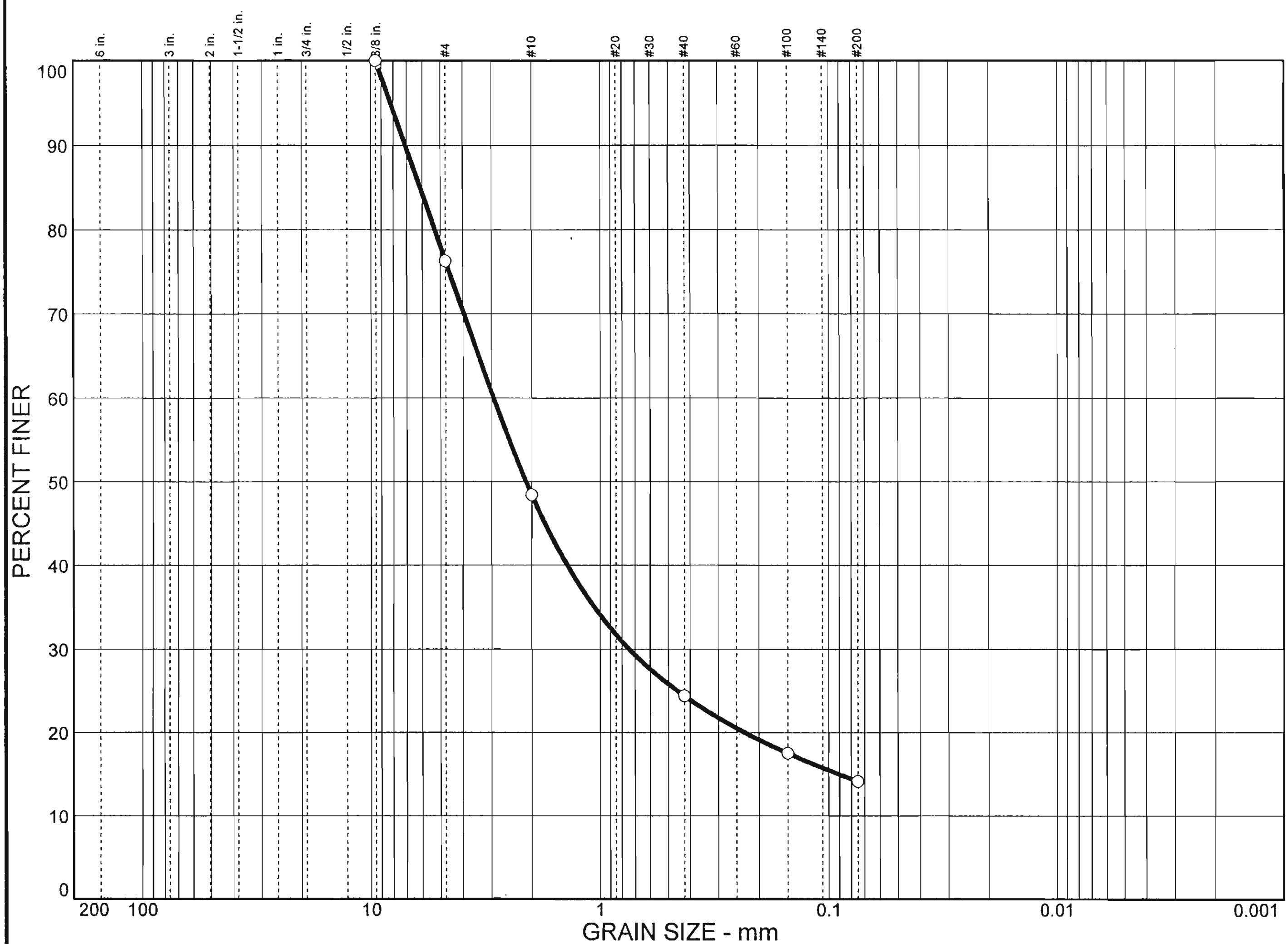
○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 7

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	23.7	62.2	14.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.12	2.94	2.12	0.746	0.0908			

MATERIAL DESCRIPTION	USCS	AASHTO
○ BROWN C/M/F SAND LITTLE FINE GRAVEL LITTLE SILT	SM	A-1-a

Project No. NJ 11330 **Client:** THE LOUIS BERGER GROUP, INC.

Project: CAMP MEETING AVENUE OVER TRENTON LINE

SOMERSET COUNTY

○ **Source:** B-2 **Sample No.:** S-6 **Elev./Depth:** 15-17

Remarks:

○

Particle Size Distribution Report

SITE-BLAUVELT ENGINEERS, INC.

Figure 8

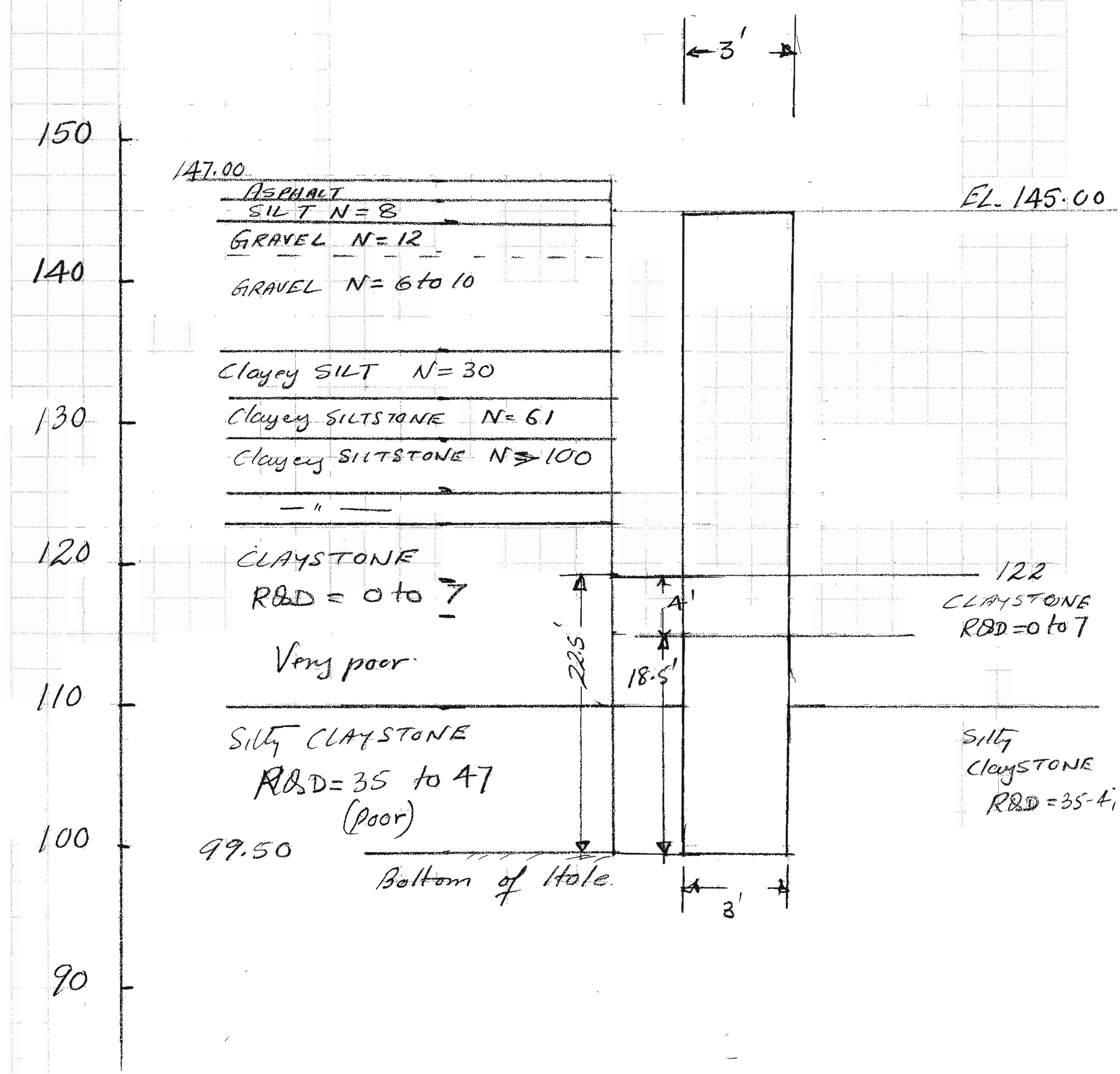
THE LOUIS BERGER GROUP, INC.

PREPARED BY Pc DATE 09/15/06 SHEET NO. ______ OF ______

CHECKED BY ______ DATE ______ CAMP MEETING AVENUE PROJECT CC-1081

SUBJECT SHAFT ANALYSIS- AXIAL & LATERAL CAPACITY ANALYSIS

TYPICAL SUBSURFACE CONDITIONS
Reference Boring- B-1



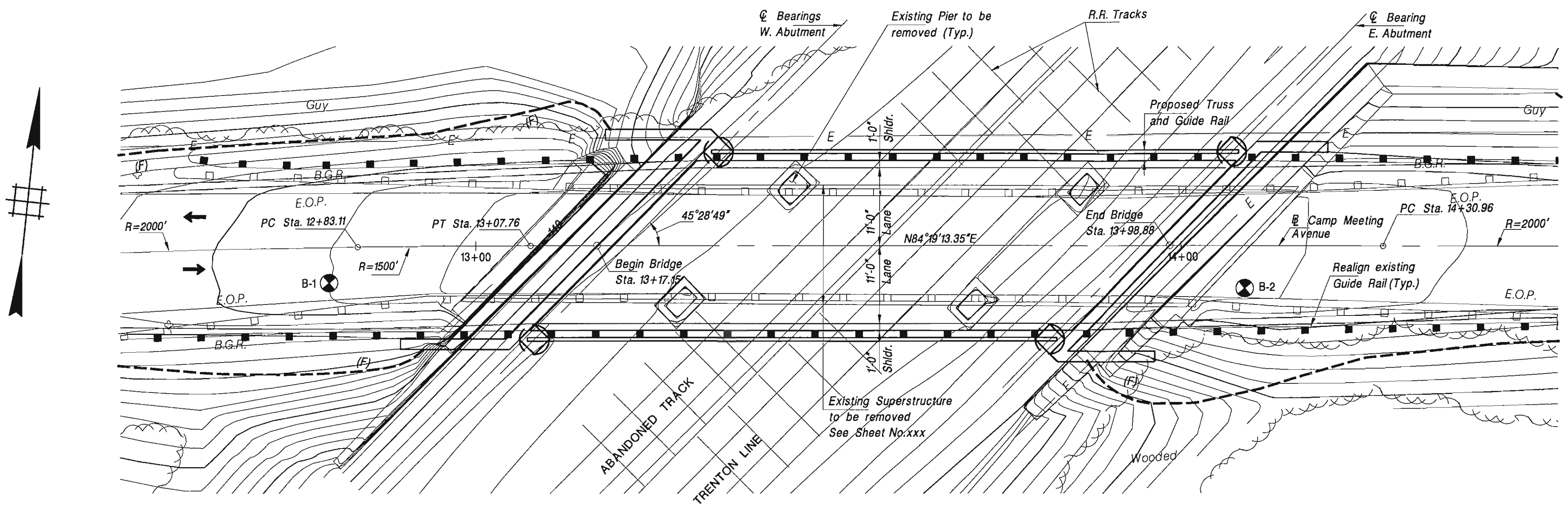
PROPOSED BRIDGE DRAWINGS

STATE	FEDERAL PROJECT	SHEET	TOTAL SHEETS
NJ			

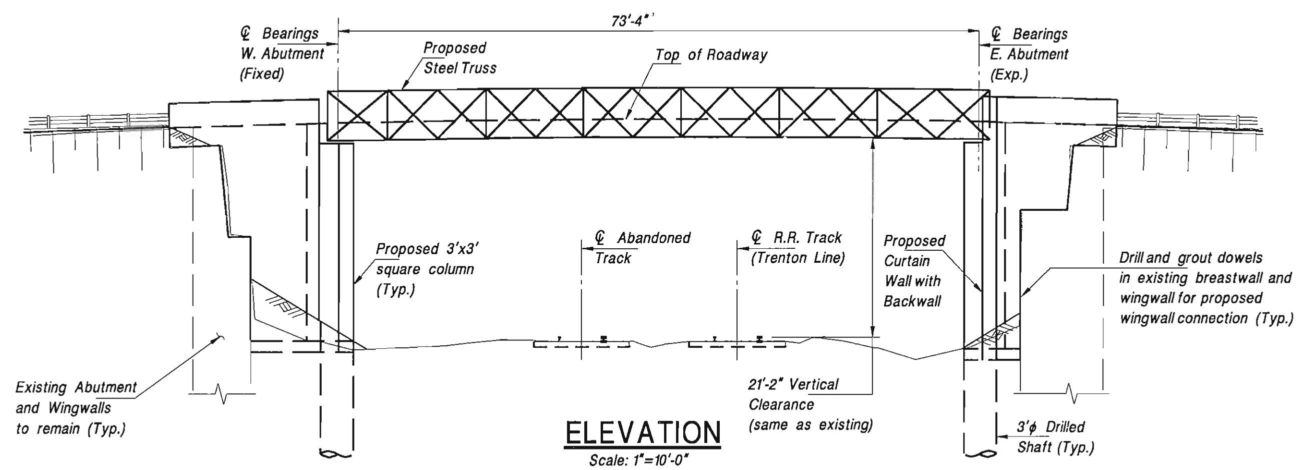
STRUCTURE NO. 1850-160

STRUCTURE NAME
CAMP MEETING AVENUE OVER TRENTON LINE (CSX)

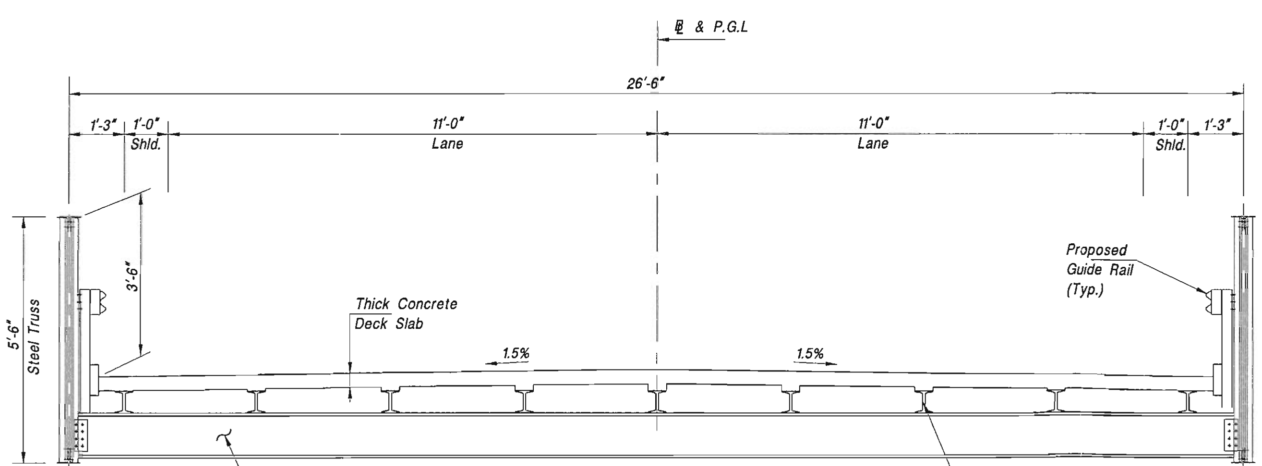
TOWNSHIP OF MONTGOMERY **COUNTY OF SOMERSET**



PLAN
Scale: 1"=10'-0"



ELEVATION
Scale: 1"=10'-0"



DECK SECTION
Scale: ½"=1'-0"

GENERAL NOTES

1. Design Specifications

(a) 2004 AASHTO LRFD Bridge Design Specifications Second Edition, with current Interims, as modified by Section 3 of the NJDOT Design Manual for Bridges and Structures.

2. Construction Specifications

(a) 2001 NJDOT Standard Specifications for Road and Bridge Construction as modified by the Special Provisions.

3. Live Load

(a) AASHTO designated HL-93 or NJDOT Permit Vehicle, whichever governs.

4. Concrete Design Stresses

(a) Specified Design Compressive Strength (f'c)

(In accordance with the Retest Limit for Pay-Adjustment Items as specified in Table 914-4 of the NJDOT Standard Specifications and as may be modified by the Special Provisions)

Class A .... 4,000 psi
Class B .... 3,000 psi

(The retest limit for non-pay-adjustment items shall be as specified on the last line of Table 914-4 of the NJDOT Standard Specifications and as may be modified by the Special Provisions)

5. Reinforcement Steel

(a) ASTM A615M (Grade 60) (fs) = 20 ksi

6. Superstructure

(a) Dead load includes a 30 psf provision for a future 2" thick concrete overlay protective system on the bridge deck.

(b) Structural Steel: "Steadfast Bridges" Link Style Truss or equivalent, AASHTO A572 painted. The floor will be a 20 gage galvanized composite floor deck.

NOTES:

1. Vertical Datum is based on 1988 NAVD.

LEGEND:

– – – – – Toe of Slope

B-2 Boring Location

CONTROL SECTION		JOB NO.	
DES. BY		CHK. BY	
DWN. BY			
EST. BY		CHK. BY	
SPEC'S BY			
IN CHARGE OF			

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

GENERAL PLAN & ELEVATION
SHEET 1

CR 602
CAMP MEETING AVENUE
MONTGOMERY TOWNSHIP

RR MP 45.95
SOMERSET COUNTY

REVISION	BY	C'K'D.	DATE

LOUIS BERGER GROUP, INC.
JULIUS HAAS
P.E. N.J. LIC. NO. 32169

BRIDGE SHEET NO. 1 OF 2

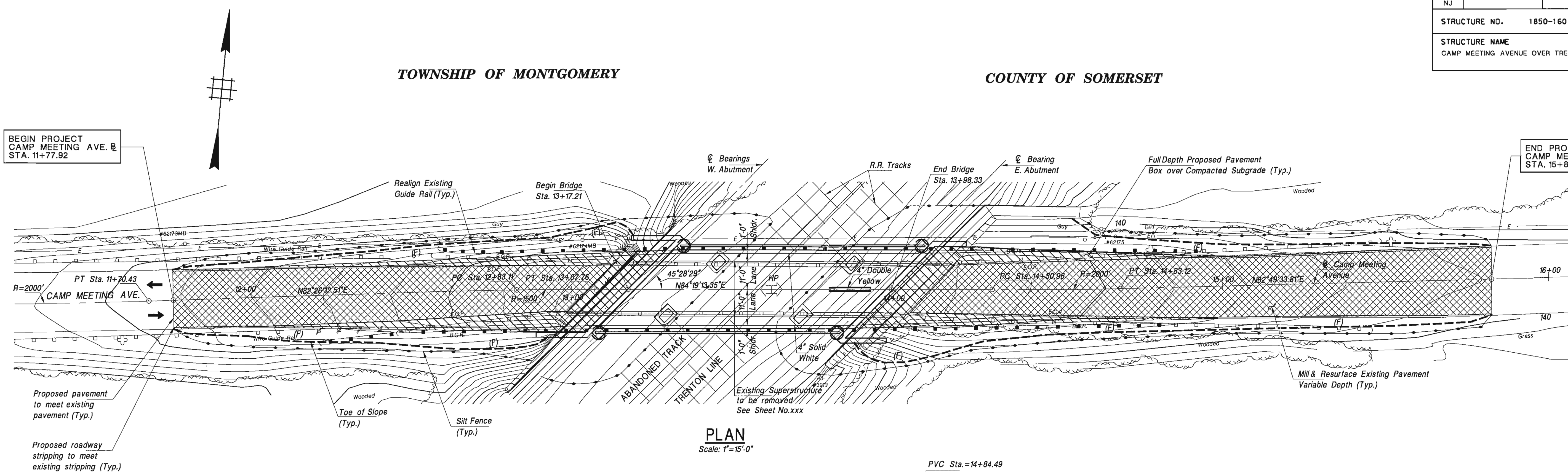
mhusain 10/4/2006 P:\CC1081\desn\1081GPE01.dgn

STATE	FEDERAL PROJECT	SHEET	TOTAL SHEETS
NJ			

STRUCTURE NO. 1850-160

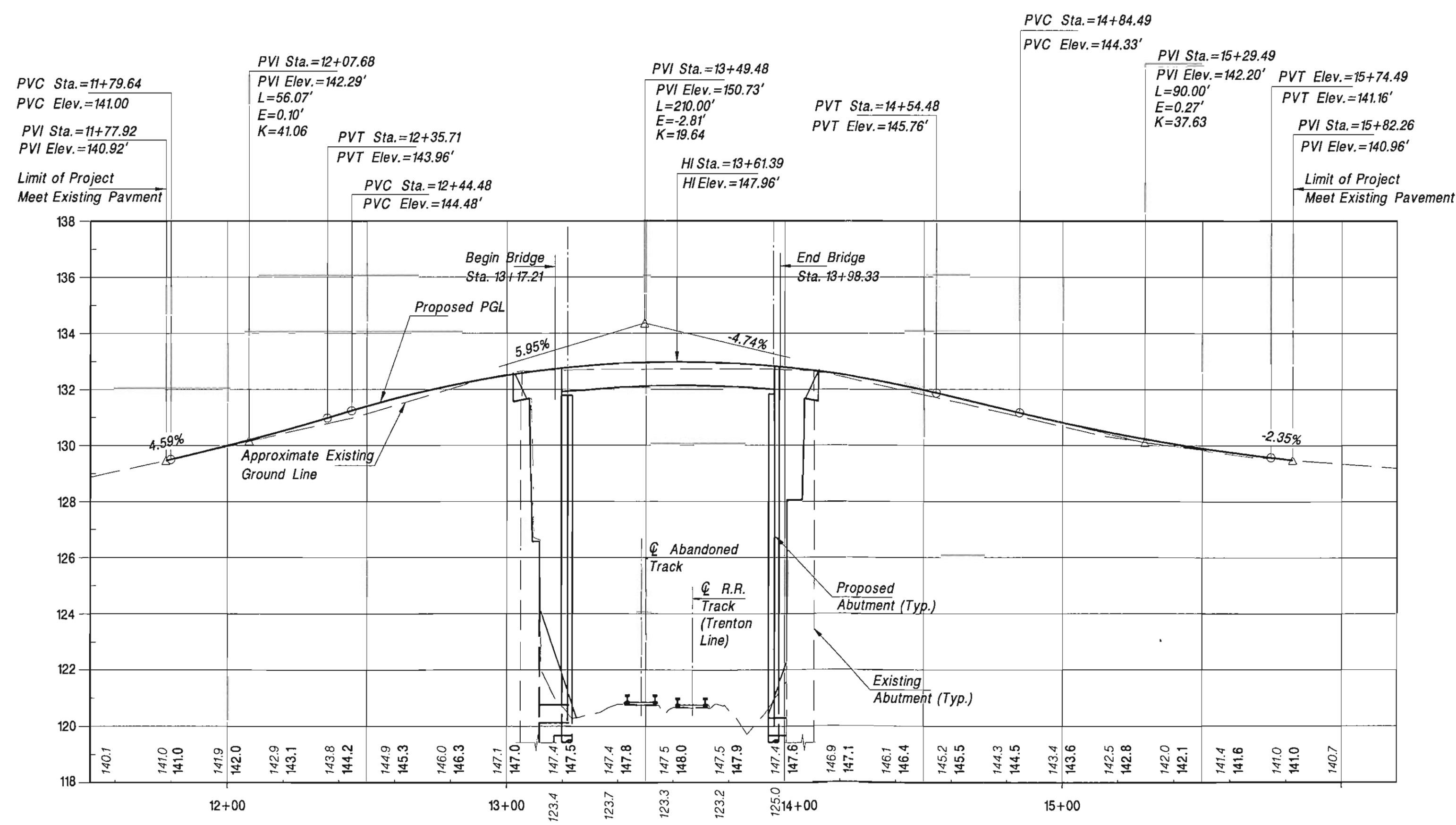
STRUCTURE NAME
CAMP MEETING AVENUE OVER TRENTON LINE (CSX)

TOWNSHIP OF MONTGOMERY **COUNTY OF SOMERSET**



PLAN

Scale: 1"=15'-0"



CAMP MEETING AVENUE PROFILE

(DESIGN SPEED V=30 MPH)
Scale: Hor. 1"=30'-0"
Scale: Ver. 1"=3'-0"

LEGEND:
- Milling
- Proposed Full Depth Pavement
- Toe of Slope
- Silt Fence
- Proposed Guide Rail
- Existing Guide Rail

NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

CONSTRUCTION PLAN
SHEET 1

CR 602 RR MP 45.95
CAMP MEETING AVENUE SOMERSET COUNTY
MONTGOMERY TOWNSHIP

LOUIS BERGER GROUP, INC.
JULIUS HAAS
P.E. N.J. LIC. NO. 32169

BRIDGE SHEET NO. 2 OF 2

REVISION	BY	C'K'D.	DATE

CONTROL SECTION		JOB NO.	
DES. BY			
DWN. BY		CHK. BY	
EST. BY		CHK. BY	
SPEC'S BY			

IN CHARGE OF

$USER$ $DATE$ $FILEL$