FINAL SUBMISSION

Investigation of Settlement and Upheaval at the Jefferson Memorial
National Mall & Memorial Parks

WASHINGTON, D.C.

PMIS 128232

January 30, 2008

PREPARED FOR

National Park Service
National Capital Region
1100 Ohio Drive, SW
Washington, D.C. 20242

PREPARED BY

HNTB Architecture Inc.
1615 M Street, NW
7th Floor
Washington, DC 20036
Phone: (202) 654-7525
Fax: (202) 654-1000

Monitoring Period: November 2006 - December 2007

HNTB

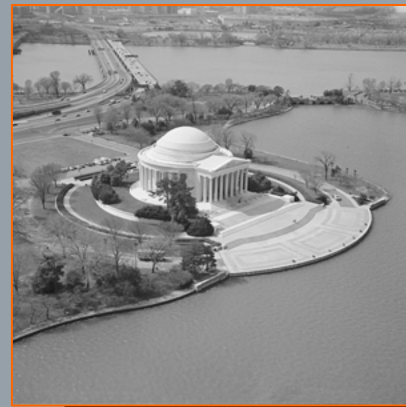


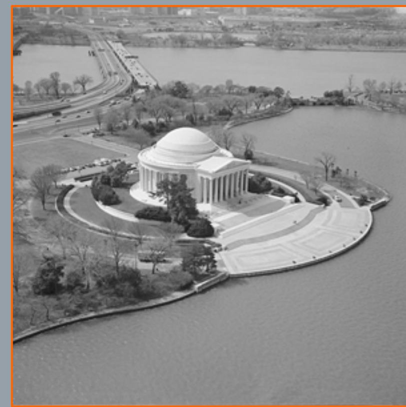
TABLE OF CONTENTS

HNTB

TABLE OF CONTENTS

List of Figures

List of Tables



1. INTRODUCTION

INVESTIGATION OF SETTLEMENT AND UPHEAVAL AT THE JEFFERSON MEMORIAL

1. INTRODUCTION

I. EXECUTIVE SUMMARY

The Jefferson Memorial is a monument to the third President of the United States, Thomas Jefferson. It is located in the West Potomac Park Historic District and is part of the National Mall & Memorial Parks (NAMA). The Memorial consists of a dome-like structure reminiscent of the Roman Pantheon and is surrounded by concentric walls and pathways. It was constructed from 1939-1943 and has undergone several changes since then, both cosmetic and structural. The structural changes were necessitated by continual settlement and consolidation of the soft soils present on site.

Since early 2006, there have been differential settlements between the Circular Roadway and the North Plaza which is supported on piles. This movement has caused tripping hazards and requires temporary asphalt patching at a rate of approximately 0.5" every three months according to information provided by National Park Service (NPS) maintenance staff. In addition, the Ashlar Seawall has undergone noticeable settlement, particularly on the west side.

The purpose of this study was to investigate the vertical movement of the seawall and areas on grade immediately surrounding the Jefferson Memorial, and to explore alternatives for repair. The assessment included site visits, subsurface investigation, periodic surveys, video monitoring of drainage pipes, a review of historical information, and interviews with retired NPS engineers. Seven test borings were drilled in the basement and around the Memorial to obtain stratigraphy information and collect samples for lab testing. Instrumentation devices including inclinometers, piezometers, and tiltmeters were used to collect monthly monitoring data on the North Plaza and Ashlar Seawall. The information collected was used to analyze potential causes for the movements and to formulate repair alternatives.

The Ashlar Seawall, which is approximately 490 ft in length, is displaying continuing settlement. We propose three preliminary alternatives to underpin the seawall. In two of these alternatives, micropiles would be drilled through the seawall and soft soils to rock. In a third alternative, either micropiles or driven piles can be used which requires additional structural work, excavation, and dewatering. In addition, to address the differential movements at interfaces between the structural slab of the North Plaza and adjacent walkways, we propose creating a transition slab with flexible joints to accommodate continuing settlements. A cost estimate for each alternative is included in this report.

We recommend continued monitoring of the instrumentation on site including tiltmeters, piezometers, and inclinometers, as well as continued reading of the survey monitoring points. We also recommend that additional measurements of joints on the North Plaza be taken to document lateral movement of the plaza. The proposed repairs for the Ashlar Seawall do not address the potential lateral movement experienced by the Ashlar Seawall and the North Plaza. We recommend that additional solutions be devised to address the lateral movement of the plaza and seawall.

We are providing this executive summary solely for purposes of overview. Any party that relies on this report must read the full report. This executive summary omits several details, any one of which could be very important to the proper application of the report.

II. SCOPE

Our services included subsurface exploration, visual survey, instrumentation and monitoring, and development of geotechnical engineering design recommendations. The objective of this study was to establish the potential causes of the recent settlement of the Ashlar Seawall. In addition, differential settlement has occurred at the east and west contact between the Circular Roadway and the North Plaza structural slab on piles. Movement has occurred at the aggregate sidewalk on the west elevation of the terrace level and at the Northwest Stairs at the western end of the Ashlar Seawall. Our scope included evaluating this movement and providing a report of findings with photo descriptions and recommendations for repair strategies.

This report contains the results of the site visits to the Memorial, review of historical documentation, interviews with retired NPS engineers, video investigation of drainage pipes, and monitoring of survey points. The report also includes the results of the site investigation through soil test borings, identification of locations where movement has occurred, a discussion of possible causes for the recent movements, and three alternative remediation schemes for the Ashlar Seawall.

III. SITE DESCRIPTION

The Jefferson Memorial is located in West Potomac Park Historic District and falls under the jurisdiction of the National Park Service, National Mall & Memorial Parks. The structure sits on the southeast shore of the Tidal Basin, at the southern terminus of the Sixteenth Street cross-axis of the Washington Monument Grounds on axis with the White House. A vicinity map is shown in Figure 1. The Memorial was designed by John Russell Pope in 1937 and later modified by his successor firm of Eggers and Higgins. It was constructed between 1939 and 1943, and was dedicated in 1947. The design of the grounds can be attributed to Frederick Law Olmstead, Jr., who was appointed project landscape architect in 1938. Figure 2 shows a plan view of the Memorial.

The Jefferson Memorial is founded on a network of deep foundations and grade beams that are arranged radially. The main structure, the Stylobate Wall, and the Terrace Wall are supported by 443 cast-in-place Raymond piles, 88 twenty-four-inch concrete caissons, and 103 sixteen-inch concrete caissons. The surrounding roads and grass areas are on grade. The Ashlar Seawall to the north of the Memorial is supported by vertical and battered timber piles. The North Plaza was initially constructed on grade, but in 1969-1970 it was demolished and reconstructed as a structural slab on grade beams and piles. Figure 2 shows the foundation layout for the main structure, including buttresses constructed during the North Plaza rehabilitation in 1969-1970. The figure does not show the North Plaza foundations. Figure 3 illustrates the foundation types for the Memorial and its appurtenant structures.

IV. SUMMARY OF AVAILABLE INFORMATION

For this study, the National Park Service furnished data and materials from their archives. Documents range from recent survey and monitoring information, to historic plans and photos. Construction Drawings and As-Built Drawings were supplied which show various repairs to the Jefferson Memorial. Reports include historic soil borings, lab testing, and analysis of consolidation settlements.

In addition to these resources, National Park Service personnel were available to answer questions about the site and provided support during site visits. Also, we were supplied with contact information for two retired NPS engineers. They provided their recollections of work done on the Memorial, especially of the North Plaza reconstruction in the 1969-1970 period.

V. PROJECT TEAM

HNTB Architecture
1615 M Street
Washington, DC 20036
202-628-7525

Schnabel Engineering, LLC
510 East Gay Street
West Chester, PA 19380
610-696-6066

Greenhorne and O'Mara
Survey Division
6110 Frost Place
Laurel, MD 20707
301-982-2800

Magnolia Plumbing
600 Gallatin Street NE
Washington, DC 20017
202-829-8510

Faithful + Gould
Cost Estimating
1725 Duke Street, Suite 200
Alexandria, VA 22314
703-684-6550

FIGURE 1 – VICINITY MAP

REFERENCE: TERRAIN NAVIGATOR PRO 2007, JEFFERSON MEMORIAL, WASHINGTON, DC.

1/28/08 09:17 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\51JEFF_MEM_MAP.DWG IMAGES: G:\DRAFTING\ORTHOPHOTOS\VA\WASHINGTON DC\JEFFERSON MEMORIAL.TIF;

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

VICINITY MAP
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED NSF
DRAWN JG
CHECKED
PMIS/PKG NO. 128232
DATE 1/30/08
DWG NO. 808/80284

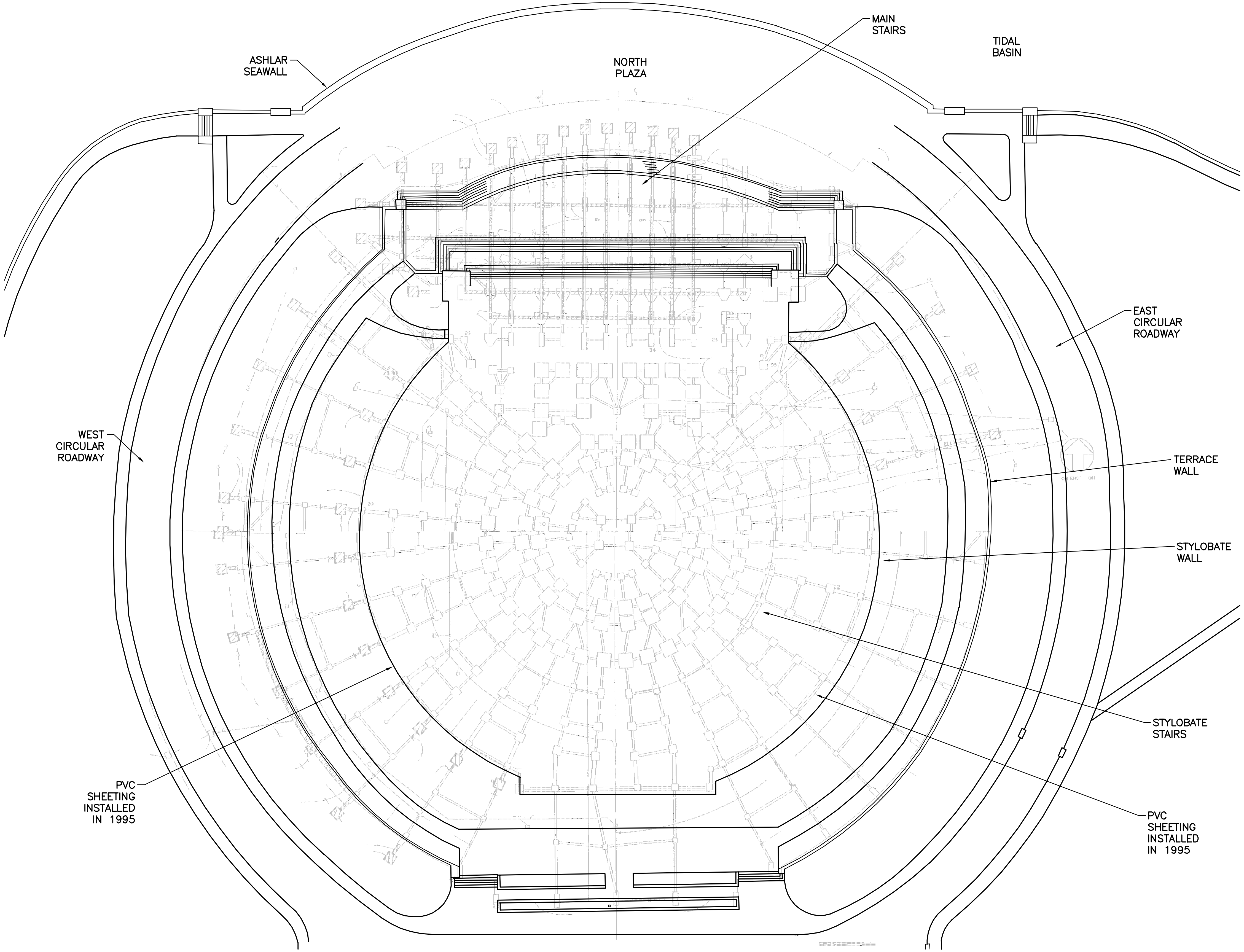


FIGURE 2 – PLAN VIEW & FOUNDATION LAYOUT

30 0 30 60
SCALE OF FEET

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA, 1988
FOUNDATION PLAN WAS ADAPTED FROM CONSTRUCTION DRAWINGS BY STORCH ENGINEERS, 1969

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

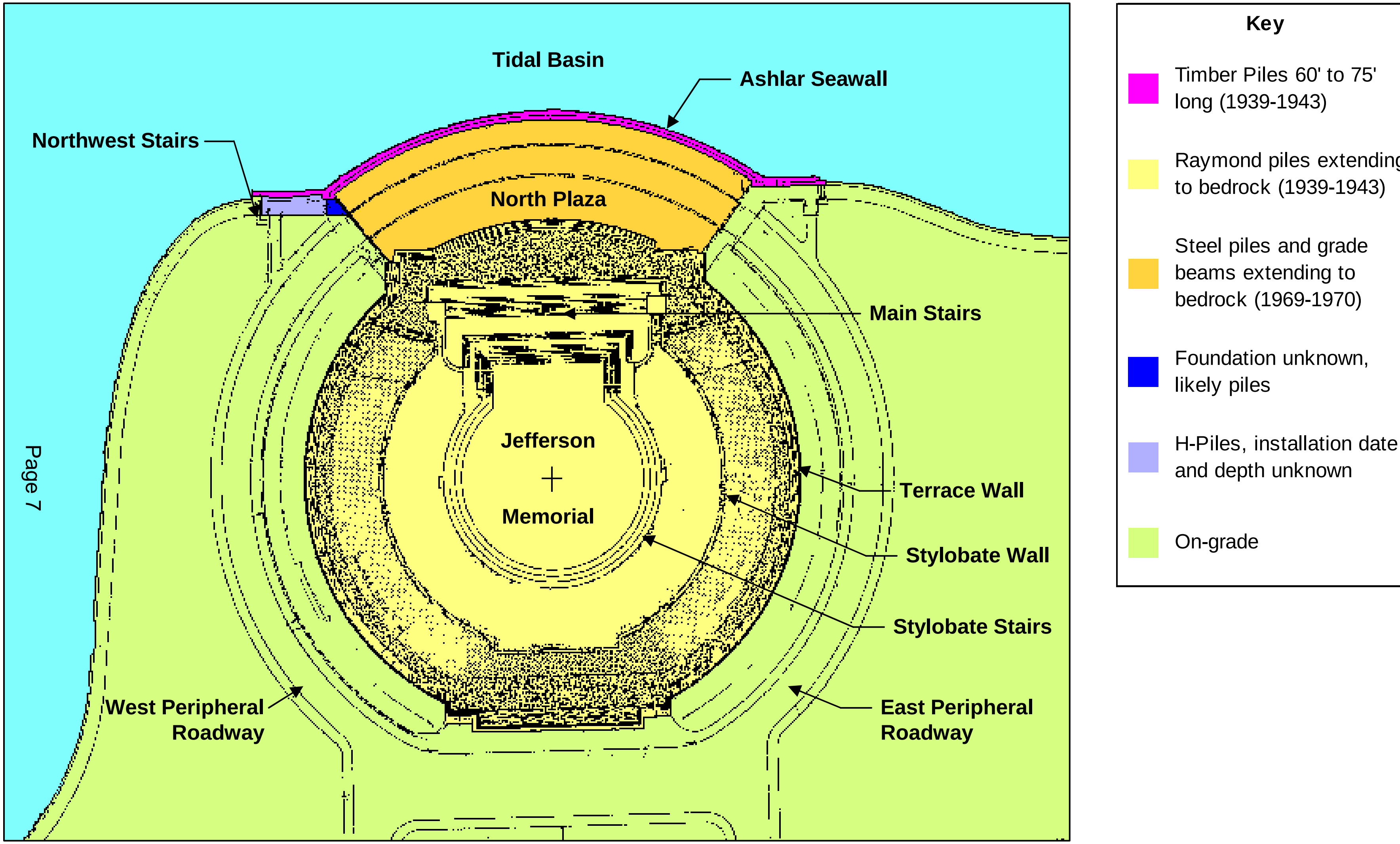
PLAN VIEW & FOUNDATION LAYOUT
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PKG/PMS NO.
128232
DATE
1/30/08
DWG. NO.
808/80284



Reference: Base plan provided by Storch Engineers, 1969

Figure 3. Jefferson Memorial Foundation Types

VI. REFERENCES

Christie, Douglas W., and Hugh S. Lacy. "Deep Foundations in Washington, DC." Deep Foundations Institute 31st Annual Conference on Deep Foundations (2006): 3-18.

Einhorn Yaffee Prescott, McMullan & Associates, Inc., Stephenson & Good, A. Morton Thomas and Associates, Inc., and Schnabel Engineering. Jefferson Memorial Specific Tests and Evaluations of Stylobate Mall. 1992.

Fugate, Jeffrey N. "City Study: Washington D.C." (2005) 23 May 2007 <http://ocw.mit.edu/NR/rdonlyres/Architecture/4-175Fall-2005/1915607E-48BF-40E8-89FB-0D931E5AA5C9/0/washingtondc.pdf>.

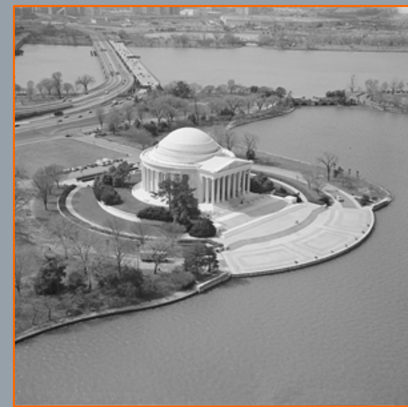
Heine, Cornelius W. A History of National Capital Parks 1953 24 May 2007 <http://www.cr.nps.gov/history/online_books/nace/adhi.htm>.

Historic American Buildings Survey, Jack Boucher. 20. Aerial view from the northeast. Jack Boucher, photographer; February 1992. HABS DC, WASH, 453-20

National Park Service, "Environmental Assessment." Thomas Jefferson Memorial Security Improvement Project (2002). 11 May 2007 <http://www.nps.gov/archive/thje/ea>.

Prothero, Sally, Audrey Tepper, Stephen Lorenzetti, Maureen Joseph, Nancy J. Brown, and Jennifer Hanna. "Thomas Jefferson Memorial: National Park Service Cultural Landscapes Inventory." 1998, Revised 2001. 12 Feb 2007 <http://www.nps.gov/archive/thje/cli/cli_general_information.pdf>.

Storch Engineers, Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures. 1965.



2. HISTORICAL INFORMATION

2. HISTORICAL INFORMATION

I. OVERVIEW

Since the Jefferson Memorial's construction in 1939-1943, it has sustained noticeable ground settlement. The Memorial itself, as well as the surrounding plazas, walls, circular roadways, and seawalls, has exhibited distress in varying magnitudes as a result of this ground movement. Through the years, several repairs were made to the appurtenant structures of the Memorial. In addition, minor repair operations were conducted to ensure public safety and aesthetics.

In order to understand and analyze the current movements of the seawall, plaza, sidewalks, and stairs, several sources of historical information were utilized. Studying previous construction documents, plans, photos, and letters helped to identify trends in the visual distress exhibited by the Memorial, and clarify the historical problems that occurred. Interviews with retired National Park Service Engineers aided in understanding the North Plaza rehabilitation in 1969-1970. Table 1 lists the documents provided to us for use on this project:

Table 1. Data and Materials Furnished by NPS

Historical Documents		Dated	NPS File No.
1	Tidal Basin Core Borings Proposed Jefferson Memorial (1 of 5) Drawings	1937-1938	808_41914
2	Jefferson Memorial Plan of Walk and Steps (1 of 2) Drawings	September 1939	808_41913
3	Jefferson Memorial Subsurface Conditions Sections (1 of 1)	February 1940	808_20005
4	Settlement Data Jefferson Memorial (1 of 2)	April 1940 and 1941	808_41910
5	Realignment of Sea Wall at Tidal Basin (1 of 2) Drawings	July 1940	808_20013
6	Historical Photos	1940-1968	
7	Detail Drainage Outlets thru Ashlar Faced Seawall (1 of 1) Drawings	March 1941	808_20012
8	Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial (1 of 177), Storch Engineers	March 1965	801_D-13
9	Jefferson Memorial Interior Column Repair (2 of 6) Drawings, Storch Engineers	March 1965	808_20020
10	Jefferson Memorial Plan Settlements and Movements (1 of 1) Drawings	March 1966	808_41015
11	Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial (1 of 61) Drawings, Storch Engineers	November 1968	808_40001
12	Report on Supplemental Condition Survey for Peripheral Approaches and Appurtenant Structures, Jefferson Memorial (1 of 40), Storch Engineers	January 1969	801_D-12
13	Renovate Jefferson Memorial and Reconstruct Roadway (1 of 12) Drawings	September 1972	808_41001B
14	Safety Railing Tidal Basin (1 of 2) Drawings	May 1973	808_41000
15	Jefferson Memorial Existing Conditions Survey - AutoCAD Drawings (10 sheets), Dewberry & Davis, and Greenhorne & O'Mara	December 1988	808_80218

Historical Documents		Dated	NPS File No.
16	Historic American Buildings Survey (HABS) Photos B&W (103 photos)	1991-1995	
17	Stylobate Mall Repairs Jefferson Memorial	June 1993	808_41008A
18	Historic American Buildings Survey (HABS) Drawings (26 sheets)	1994	
19	Restoration of Entrance Steps and Plaza, Jefferson Memorial (1 of 35)	January 1998	808_41011
20	Surface Monitoring and Analysis - March through April 2006, United States Geological Survey (USGS) and Lachel Felice Associates	March & April 2006	
21	Photos of Current Movement and Survey Monitoring by NPS	2006	

In addition to the information in Table 1, we had access to documents prepared in part by Schnabel Engineering Associates during previous studies. These items are listed in Table 2.

Table 2. Data and Materials Obtained by Schnabel Engineering

Additional Historical Documents		Dated
1	Preservation and Restoration of the Jefferson Memorial - Phase I Report, Einhorn Yaffee Prescott and Hartman-Cox Architects	1990
2	Preservation and Restoration of the Jefferson Memorial - Phase IIA Report 80% Submission, Einhorn Yaffee Prescott and Hartman-Cox Architects	1992
3	Jefferson Memorial Specific Tests and Evaluations of Stylobate Mall - Final Submission, Einhorn Yaffee Prescott	1992
4	Jefferson Memorial Plaza Sidewalk and Roadways - Preliminary Recommendations, Schnabel Engineering Associates	1996
5	Jefferson Memorial Layout and Grading Plan, 100% Submittal - Schnabel Engineering Associates	1996

II. SURVEY DATUM

For this report and the surveys conducted herein, the vertical datum used was the North American Vertical Datum of 1929 (NAVD 29). The North American Datum of 1927 in the Maryland State System of Plane Coordinates was used for the Horizontal Datum. The elevations used in this report are based on NAVD 29 unless otherwise noted. As a point of reference, the North Plaza ranges in elevation from approximately EL 6.5 to 7.3.

When the Jefferson Memorial was constructed in 1938, the survey datum used was Low Water Datum- Washington Harbor (LWD). The elevations contained in the reports by Storch Engineers in 1965 and 1969, and all documents prior to this use the LWD. To convert LWD to NAVD 29, 1.41 feet was subtracted from the LWD elevation.

III. RELEVANT HISTORY

i. Information Obtained from Historical Documents

The following is a summary of relevant information extracted from the documents listed in Tables 1 and 2. It is listed in chronological order.

1) Tidal Basin Core Borings Proposed Jefferson Memorial (1 of 5) Drawings, Army Corps of Engineers, 1937-1938

    a) Drawings show borings and subsurface exploration completed by the Army Corps of Engineers prior to the Jefferson Memorial construction
    b) Information was utilized to obtain top of rock elevations throughout the site

2) Jefferson Memorial Plan of Walk and Steps (1 of 2) Drawings, Frederick Law Olmsted, Landscape Architect, 1939

    a) Drawings show east section of Ashlar Seawall and Northeast Stairs
    b) Grading study which indicates the proposed seawall location

3) Jefferson Memorial Subsurface Conditions Sections (1 of 1) 1940

    a) Drawing shows sections along the Jefferson Memorial with stratigraphy based on the soil borings completed by the Army Corps of Engineers in 1937-1938

4) Settlement Data Jefferson Memorial (1 of 2) 1940-1941

    a) Shows settlement measurements taken from 1939 to 1940 and describes repairs to tie beams at the Terrace Wall during Memorial construction

5) Realignment of Sea Wall at Tidal Basin (1 of 2) Drawings, Olmsted Brothers, 1940

    a) Drawings show sections through Ashlar Seawall and Rubble Seawall
    b) Drawings include layout of piles and new configuration of seawall
    c) Information was used to obtain the geometry of the seawalls and the location of seawall piles for micropile remediation alternatives

6) Historical Photos 1940-1968

    a) Photos during the Jefferson Memorial construction and historical repairs
    b) Show timber piles being used for the Ashlar Seawall
    c) Used in this report to estimate the length of the seawall timber piles and approximate fill thickness on the west Circular Roadway placed during construction of the Memorial

7) Detail Drainage Outlets thru Ashlar Faced Seawall (1 of 1) Drawings 1941

    a) Drawing shows drain pipes beneath roadway and thru Ashlar Seawall
    b) This drawing also provides a radius length measured from the center of the Memorial to the Ashlar Seawall

8) Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial (1 of 177), Storch Engineers, 1965

    a) This report includes the following:
        i) Subsurface investigations, geology, and stratigraphy of the site

ii) Survey data with vertical and horizontal movements since the construction of the Memorial
iii) Laboratory testing and analysis
iv) Physical conditions of the structure and adjacent areas
v) Proposed solutions for repair of the North Plaza, Main Stairs, Stylobate and Terrace Walls, and surrounding areas

9) Jefferson Memorial Interior Column Repair (2 of 6) Drawings, Storch Engineers, 1965

   a) Shows details for proposed interior column repair, expansion joints at Main Stairs, and Terrace Wall reconstruction

10) Jefferson Memorial Plan Settlements and Movements (1 of 1), Storch Engineers, 1966

   a) Shows settlement and movements of Memorial, matches Plate F-2 from Storch Engineers report, 1965

11) Rehabilitation of Peripheral Approaches and Appurtenant Structures, Jefferson Memorial (1 of 61), Storch Engineers Drawings 1968

   a) Design drawings show the following proposed repairs:
      i) Adjustment of corners of Stylobate Wall at entrances to the lower level of Memorial
      ii) Pile-supported buttress for Stylobate Wall and Terrace Wall to provide lateral support
      iii) Demolition of North Plaza and replacement with structural slab on piles
      iv) Construction of new tie beams and buttresses beneath Main Stairs
      v) Removal and resetting of 12 capstones on the west end of the Ashlar Seawall
   b) The drawings include subsurface boring logs for 13 soil borings conducted as part of the Storch Engineers study in 1965

12) Report on Supplemental Condition Survey for Peripheral Approaches and Appurtenant Structures, Jefferson Memorial (1 of 40), Storch Engineers, 1969

   a) This is a follow-up to the study and report completed by Storch in 1965. It contains additional investigations and revised findings and conclusions

13) Renovate Jefferson Memorial and Reconstruct Roadway (1 of 12), National Park Service, 1972

   a) As-Constructed Drawings show the following repairs:
      i) Removal and resetting of areas of the Main Stairs
      ii) Adjustment of joint spacing on Main Stairs
      iii) Removal of concrete walk approaching Northwest Stairs and construction of exposed aggregate concrete walk
      iv) Resetting and replacement of corners of Stylobate Wall at entrances to the lower level of Memorial
      v) Removal and replacement of wearing surface as the terrace level of the Main Stairs
      vi) Construction of curbs and gutters in south parking area
      vii) Jacking of Northwest Stairs
   b) These drawings were used to obtain as-constructed elevations of the Circular Roadway and information about the completed repairs

14) Safety Railing Tidal Basin (1 of 2), National Park Service, 1973

   c) Drawings show the following proposed repairs:
      i) Removal and reconstruction of capstones and walkway along the rubble seawall
      ii) Removal and construction of new walkway in some areas along the southern shore of the Tidal Basin
      iii) Placement of topsoil and sod along the west rubble wall and in other areas along the southern shore of the Tidal Basin
      iv) Construction of safety railing along Rubble Seawall

15) Jefferson Memorial Existing Conditions Survey - AutoCAD Drawings (10 sheets), Dewberry & Davis, and Greenhorne & O'Mara, 1988

   a) Divided the Jefferson Memorial and vicinity into 10 quadrants for surveying
   b) Established 10 benchmarks with northings, eastings, and elevations
   c) Utilized North American Vertical Datum of 1929 and North American Horizontal Datum of 1927
   d) AutoCAD drawings show several existing survey points and existing features of the Memorial
   e) Used in this report as the base drawing for the survey monitoring and figures

16) Preservation and Restoration of the Jefferson Memorial - Phase I Report, Einhorn Yaffee Prescott (EYP) and Hartman-Cox Architects, 1990

   a) Contains detailed chronology of the Memorial since June 1934
   b) Geotechnical inspection as part of this report in 1988 did not reveal signs of settlement of the walls or superstructure
   c) The report recommends further surveying in Phase II to verify onsite conditions, including surface drainage, and structural and geotechnical integrity
   d) The report indicates that Phase II would involve interdisciplinary analysis, including geotechnical and structural investigations

17) Historical American Buildings Survey (HABS) Photos B&W (103 photos) 1991-1995

   a) Photos of the Memorial and surrounding areas

18) Preservation and Restoration of the Jefferson Memorial - Phase IIA Report, Einhorn Yaffee Prescott (EYP) and Hartman-Cox Architects, 1992

   a) This 80% draft report contains information on the structural monitoring of several columns, expansion joints, and portico roof

19) Jefferson Memorial Specific Tests and Evaluations of Stylobate Mall - Final Submission, Einhorn Yaffee Prescott (EYP), 1992

   a) Project team included the following:
      i) Einhorn Yaffee Prescott - Architecture and Engineering
      ii) McMullan & Associates, Inc. - Consulting Structural Engineers
      iii) Stephenson & Good - Landscape Architects
      iv) Morton Thomas and Associates, Inc. - Consulting Civil Engineers
      v) Schnabel Engineering Associates - Geotechnical Engineers
   b) Report included the following information:
      i) Review of landscape design and existing conditions of plants
      ii) Irrigation study
      iii) Geotechnical study including history of problems and alternative solutions

    iv) Stylobate Mall drainage and recommendations for sheet piling
    v) Cost estimate and impact analysis

20) Stylobate Mall Repairs Jefferson Memorial, National Park Service, 1993

    a) As-Constructed Drawings show the following repairs (recommended in the EYP 1992 report above):
        i) Addition of granite edge strips to Stylobate Stairs
        ii) Installation of new storm drainage manholes
        iii) Demolition of existing sheeting and installation of new PVC sheeting beneath Stylobate Stairs
        iv) Removal and replacement of some landscaping
        v) Installation of Irrigation System

21) Historic American Buildings Survey (HABS) Drawings (26 sheets), 1994

    a) Sketches of the Memorial and surrounding areas

22) Jefferson Memorial Plaza Sidewalk and Roadways, Preliminary Recommendations-Schnabel Engineering Associates, 1996

    a) Preliminary recommendations regarding trip hazards around the Memorial, description of subsurface conditions and laboratory testing, and alternative solutions to arrest settlements on the surrounding roadways and sidewalks

23) Jefferson Memorial Layout and Grading Plan, 100% Submittal - Schnabel Engineering Associates, 1996

    a) Drawings show the following information:
        i) Proposed layout and grading plan for the site
        ii) Proposed concrete sidewalk detail
        iii) Existing asphalt patches and cracks on the sidewalks and surrounding roads
        iv) Proposed demolition and paving of North Plaza and surrounding roads
        v) Soil boring and hand auger log

24) Restoration of Entrance Steps and Plaza, Jefferson Memorial (1 of 35), National Park Service 1998

    a) Construction Drawings which show the following proposed repairs:
        i) Demolition of exposed aggregate paving on North Plaza (1.5 to 2”) and replacement with new aggregate topping
        ii) Reparation of Northwest Stairs
        iii) Reparation of Concrete Walk and Curb
        iv) Removal of Existing Planters
        v) Removal of setting bed and shims on North Stairs
        vi) Resetting of North Stairs with new setting bed and dowels
    b) Drawing shows existing HP 14x89 piles along the walkway between the Northwest Stairs and the North Plaza
    c) These drawings were used to compare to current settlement information; however, they are to be used with caution since they are not As-Constructed Drawings

25) Surface Monitoring and Analysis - March through April 2006, United States Geological Survey (USGS) and Lachel Felice Associates, 2006

   a) Survey conducted in March and April 2006 of several points on the North Plaza and Ashlar Seawall. A relative benchmark was used for the survey, but not recorded; therefore, it was not possible to correlate these data to other survey efforts

26) Photos of Current Movement and Survey Monitoring by NPS, 2006

   a) Photos from March and April 2006 of the North Plaza and surrounding areas
   b) National Park Service Personnel conducted a survey in March 2006 to determine if there was continual movement on the North Plaza and Ashlar Seawall. They used one of the benchmarks from the Dewberry & Davis survey in 1988

ii. Interviews with Retired NPS Engineers

We contacted two retired NPS engineers: Dean Robinson and Tom Birmingham, who were designers during the 1965-1970 period when the Storch reports were issued and construction took place on the North Plaza.

a) Interview with Mr. Tom Birmingham

On Monday, November 20, 2006, Dr. Jesús Gómez, P.E., and Helen Robinson, P.E. interviewed Mr. Tom Birmingham at his home in Washington, D.C. The following list contains relevant information provided by Mr. Birmingham:

1) Mr. Birmingham worked for the National Park Service from 1945 until 1975 when he retired.

2) He suggested checking the NPS offices in Harper's Ferry as well as 11th & L Streets NW in Washington, D.C., for additional information. The latter is where his files used to be stored.

3) Mr. Birmingham's main role in the Jefferson Memorial North Plaza construction was to review the work of fellow engineer Mr. Dean Robinson. Mr. Birmingham was not present on site during the construction. Mr. Robinson made weekly visits.

4) Vehicular use on the North Plaza was restricted after it was reconstructed in 1970.

5) When asked if he remembered when the installation of the light poles at the edges of the North Plaza occurred, Mr. Birmingham suggested that the Potomac Electric Power Company (PEPCO) might have a record of the installation.

6) When discussing the current movements at the Jefferson Memorial, Mr. Birmingham commented that ever since it was constructed, the Memorial has been moving in a north-west direction. He believes the depressions which form on the west side of the Memorial in the grass areas are a result of the material "not being well compacted when it was placed." However, we have not seen evidence in historical documents or photos to support this statement.

7) According to Mr. Birmingham, the North Plaza slab was poured directly against the ground surface.

8) Mr. Birmingham provided a packet of miscellaneous information that he had saved from when he worked on the Memorial. The documents were all versions of the historical information that NPS had provided for this study.

b) Interview with Mr. Dean Robinson

On Tuesday, November 21, 2006, Dr. Jesús Gómez, P.E., and Helen Robinson, P.E. interviewed Mr. Dean Robinson by phone. After obtaining Mr. Robinson's permission, the interview was recorded using a Digital Voice Recorder. The information obtained from the phone call is documented below:

1) Mr. Robinson was involved with the redesign of the North Plaza when Storch Engineers was retained to design the stabilization of the front stairs of the Memorial in 1969-1970. Mr. Robinson indicated that the proposed design would have cost $1.5 million to construct, while the available budget was $1.1 million. Mr. Robinson assisted with the redesign to reduce costs.

2) Mr. Robinson recalled that when driving piles on the North Plaza, they would penetrate under their own weight for 40 feet, then were lightly driven through 20 feet of stiff material. These piles were reportedly driven to bedrock.

3) In reference to the buttress piles, Mr. Robinson described 18" diameter pipes driven to 100 feet reaching bedrock, then filled with W18 beams, rebar cages, and concrete.

4) Mr. Robinson noted that the movement of the Ashlar Seawall is not surprising, and it has been constant since the Northwest Stairs repair. He explained that the Northwest Stairs and certain rubble seawall segments had been jacked back into place after settlement, and that the jacks were embedded in concrete as a temporary fix. There was the perception when the work was being done on the North Plaza in 1969-1970 that the seawall needed repairs.

5) Mr. Robinson stated that the North Plaza was designed for an HS-15 loading and with the idea that there would be a follow-up contract to replace the Ashlar Seawall. He indicated that the North Plaza slab is 12 inches thick, and has radial and circumferential expansion joints. The slab is not tied down ("floating on grade beams") so that sections of it could be removed with minimal disruption to the tourists and visitors to the Memorial when the seawall was repaired.

6) According to Mr. Robinson, the Ashlar Seawall is supported on piles that are likely embedded 40 to 60 feet and reaching stiffer soil, but not driven to bedrock. He believes that the seawall piles are concrete but could possibly be timber.

7) Mr. Robinson stated that after the 1969-1970 repairs, bi-annual surveys were being conducted to monitor the movement. That data may have been lost when records were transferred to the Denver Service Center.

8) According to Mr. Robinson, in 1983 repair plans for the roof of the Memorial showed evidence of movement of the dome.

9) Mr. Robinson recalled that in the year 1977, handicapped access ramps were constructed at the same time as the light poles were installed on the plaza. He suggested that horizontal and vertical survey points be taken on the light poles to assess lateral movement since their installation.

10) Mr. Robinson indicated that a study of dome movements was done using tiltmeters. Mr. Robinson was not involved in this survey.

11) Mr. Robinson indicated that he knows several of the contractors and site supervisors who worked on site and could provide their contact information if desired.

iii. Photographic Record

The historical photos provided to us by the National Park Service were of significant help in understanding the construction and rehabilitation of the Jefferson Memorial. Of particular interest are the photos showing timber piles being used for the foundation of the Ashlar Seawall. Construction Documents (NPS File No. 808_20013) indicate that concrete piles were to be used, but the photos clearly show timber piles being driven.

Other photos were useful to establish the chronology of various events. Appendix A contains a selection of relevant photos of the total of 162 high quality black and white photos that were provided to us.

iv. Seawall Pile Type and Length

Previous reports indicate that the deep foundations of the Memorial bear on bedrock, which is encountered approximately from 85 to 100 feet below the ground surface of the peripheral roads. Historical photos of construction of the Ashlar Seawall foundation were examined to determine the length of the timber piles.

Figure 4 is a view of the pile driving rig used for installation of the seawall piles. The dimension shown was estimated based on the ladder rungs, workers, and crane mats visible in the photo.

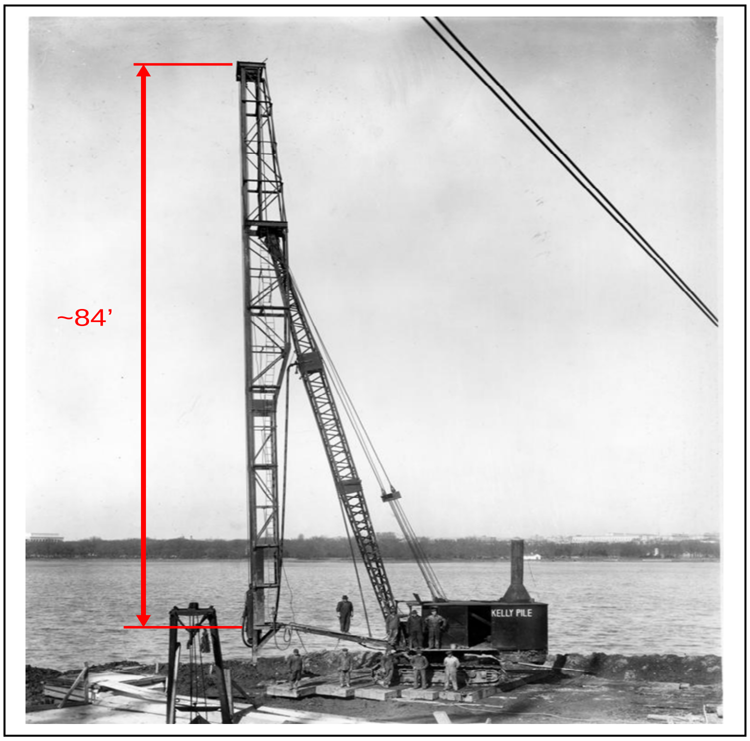


Figure 4. Pile Driving Rig Used for Timber Pile Installation for Ashlar Seawall
(Photo Dated 2-4-1941)

Figure 5 is a view looking west from the eastern end of the Ashlar Seawall. It shows timber piles installed for the seawall and the pile rig in the background. From this and other photos, we concluded that the timber piles were installed following a plan layout very similar to that shown in the original design drawings. However, the original design drawings showed concrete piles, and did not provide minimum lengths.

Figure 5. View of the Memorial During Construction (Photo Dated 2-4-1941)
Foreground: Already Installed Timber Piles for the Ashlar Seawall
Background: Pile Rig Installing Timber Piles (See Figure 6)

Figure 6 is a detail of the pile rig in Figure 5 and depicts the estimation of the pile length. The photo suggests that the pile is being set up for driving and had not penetrated in the soil. Therefore, we estimated that the pile was approximately 70 feet long. From two other historical photos of stacks of piles lying on the ground, it appears that the pile lengths were variable and may have ranged between 60 and 75 feet. Figures 5 and 7 show that the pile cut-off elevations were close to the bottom of the wall footing, and that they had stickup lengths of about 3 to 8 feet before cut-off. Considering a total pile length of 60 to 75 feet, a cut-off length of 3 feet, and the bottom of wall footing at approximately EL -3, the tips of the piles may have reached EL -60 to -75.

Based on the information on depth to top of rock along the North Plaza collected during our subsurface exploration and during previous explorations (see Boring Cross Section C-C in Appendix B), the elevation of the top of Disintegrated Rock is about EL -80 or lower. Therefore, it is our conclusion that the piles did not reach the top of hard rock. The implication is that the piles are not bearing on the rock stratum, and are surrounded by soft soils that are undergoing consolidation. The consolidation causes downdrag forces to act on the timber piles, resulting in settlement. This is consistent with the opinion of Mr. Dean Robinson reported previously. The available photos also show that the timber piles were driven without trimming the bark and may not have been treated.

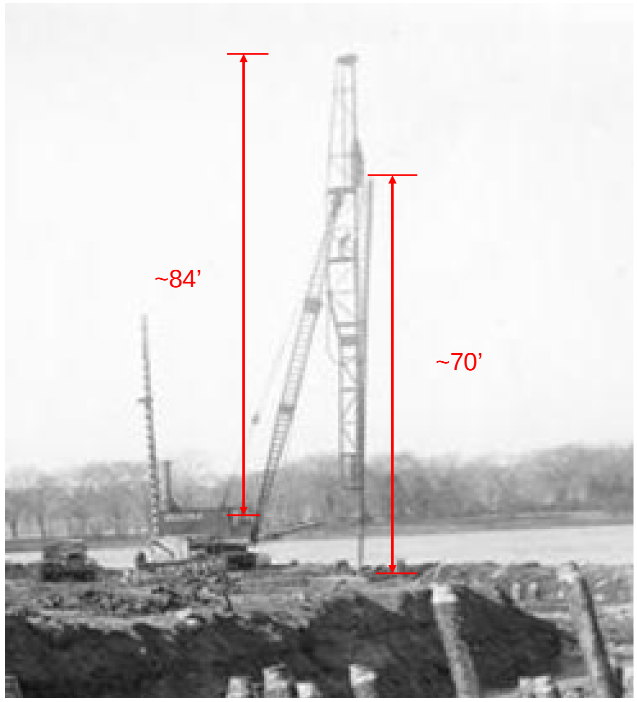


Figure 6. Detail of Pile Driving Rig and Pile Being Prepared for Driving
(Photo Dated 2-4-1941)

Figure 7. Timber Piles Cut Off to Prepare for Footing Connection
(Photo Dated 3-3-1941)

v. Timeline of Relevant Events

Date	Event
June 1934	The Thomas Jefferson Memorial Commission was created.
March 1937	13 Wash borings completed by the Corps of Engineers to determine depth of bedrock.
August 1938	14 Test borings completed with rock cores and soil samples (Core Borings 51-67).
August 1938	Examined survey data of site to determine if there was any lateral movement. None was found, but it was acknowledged that it would occur if the silt was “unevenly loaded.”
December 6, 1938	Application for permit to change the alignment of the seawall and shoreline.
December 15, 1938	Groundbreaking ceremony for the Jefferson Memorial.
December 16, 1938	Contract for foundation work was awarded to the Raymond Concrete Pile Company.
December 19, 1938	Began filling the Tidal Basin directly west of the Memorial with 10,000 cubic yards of fill.
January 23, 1939	Raymond Pile Company began driving piles.
April 1939	Foundation work progressing; difficulty keeping caissons vertical while advancing through "rotten" rock overlying hard rock.
April 1939	"The Evening Star reported that the beginnings of construction of the superstructure would be delayed because of subterranean water which flowed through fissures in the bedrock under the construction site. Because of the water flow 80 to 90 feet below the surface, each caisson had to be waterproofed before the pouring of reinforced concrete for the foundations could begin." (EYP 1990)
July 28, 1939	The Raymond Concrete Pile Company completed the installation of 443 cast-in-place Raymond piles, 88 twenty four-inch caissons, and 103 sixteen-inch caissons.
November 1939	The cornerstone was laid by FDR. "Little fill was added between the stylobate steps and the stylobate because they were waiting for construction to begin on the Pentagon. After that started, all the fill that could be used would be available." (EYP 1990)
December 1939	Reference is made to quality control of materials and methods indicating some type of observation and testing was in place during construction.
May 1940	"McShain Company (general contractor) reported to NPS that the foundations of the Memorial between the Memorial and the stylobate wall and the stylobate wall and the terrace walls had sunk. There was a settlement of all the fill outside the old breakwater wall, and the wall itself had been pierced and broken up by the driving action of the piling." (EYP 1990)

Date	Event
May 1940	"After investigating the beams between the stylobate wall and the main structure, NPS reported to the architects that 'where the fill has amounted to as much as 13 feet, the beams have gone down at the center span from 11 to 19 inches, indicating that there is structural failure in all of these beams. The long 30-foot beams between the stylobate wall and the terrace wall have all failed on the west side where the beams rested on new fill.' No lateral movement had occurred in any of the piles but the failure of the beams between the stylobate and terrace walls had raised the pile cap under the terrace wall. The reports do not indicate, however, what action was taken to straighten out the situation." (EYP 1990)
June 1940	The seawall details were approved for construction.
Sept 1940	"The seawall contractors, Potts and Callahan Contracting Company, Inc. began to excavate on the east side of the Memorial and to fill on the west side." (EYP 1990)
Jun-Sept. 1941	"The settlement levels of the west riprap base seawall were studied, although no report was made." (EYP 1990)
Dec 1941	Seawall construction was 97% complete; the setting of the seawall's west rubble wall was completed. "The seawall's stone work was completed except for cleaning and minor finishing. The placing of the fill in the west area and behind the west rubble wall was still going on." Total seawall lengths included 775 feet of rubble wall east of the Memorial, 500 feet of ashlar wall southwest of the Memorial, and 925 feet of rubble wall west and southwest of the Memorial. (EYP 1990)
1941	"Serious cracking of the columns west of the N-S expansion joint supporting the main steps had occurred in 1941. Column 30 was removed and replaced, and Columns 7, 8, and 9 were reported on this drawing to be cracked, but these cracks are not apparent today." (Storch 1965)
1942	"To correct for settlement during construction, the Rubble Sea Wall west of the Memorial was jacked up in 1942 and a 6" high concrete coping was placed on top to bring this wall to its design elevation." (Storch 1965)
Summer 1942	"The construction of the Memorial was completed." (EYP 1990)
1942-1943	"In the basement of the Memorial a system of steel cables was placed in an attempt to arrest lateral movements of certain column bases and tops." (Storch 1965)
April 1943	"Settlement had occurred in the terrace wall by April 1943, between Pile Caps 280 and 290, ranging to as much as 0.59 feet. While not documented, it is remembered by the maintenance department that this wall was jacked up and additional concrete was placed beneath it." (Storch 1965)
1943	"The Maintenance Department reports that the main marble steps were 'reset' in 1943." (Storch 1965)
1951	"By 1951, settlement of the fill adjacent to the N-W corner of the main approach steps had caused severe cracking of the sidewalk between the roadway and the main Memorial approach steps. This cracked portion of sidewalk was removed entirely and was not replaced." (Storch 1965)
May 1958	"Marble steps were reset. A tool is kept at the Memorial for use of the National Park Service police or the Maintenance Department to adjust the gaps in these stairs, keeping them at a safe width." (Storch 1965)

Date	Event
1965	Storch Engineers was retained to provide a Structural and Subsoil Analysis Report, Subsurface Investigations, a Soil Testing Program, and Construction Drawings, Specifications and Estimates.
February 1965	"Thirteen machine borings, ranging in depth from 72.8 feet to 110.2 feet, were made during February 1965. Two of these were made in the Tidal Basin. Five test pits were dug to depths of 3 to 7 feet." (Storch 1965)
January 1969	Storch report was reissued and updated.
July 11, 1969	Contract is awarded for work on Jefferson Memorial Grounds to Draw Construction, Inc. "During the nine-month contract period, work will be done to stabilize the movement of the main approach steps which face the Tidal Basin, and the memorial walls which have been steadily shifting since the early 1940s." (EYP 1990)
October 19, 1969	The Jefferson Memorial was closed to the public and Draw Construction began work.
September 5, 1970	The Memorial was reopened to the public. "The renovation consisted mainly of installing buttress piling and struts beneath the terraces, steps and front roadway of the Memorial. Following this work, the roadway, sidewalks, and terraces were reconstructed and the grounds landscaped." (EYP 1990)
Sept. 1972	Removed and replaced several marble steps, replaced exposed gravel aggregate wearing surface, planted shrubs, NW steps were repaired.
May 1973	Replaced sections of seawall cap and sidewalks, placed topsoil and sod along west side of Tidal Basin, and installed safety railings.
December 1988	Existing Conditions Survey. Vicinity was divided into 10 quadrants and surveyed by Dewberry & Davis and Greenhorne & O'Mara. Includes top of wall elevations and bathymetry.
February 1990	Inspection of civil engineering/site conditions affecting the Memorial in Phase I of report by Hartman-Cox Architects. Several aesthetic and drainage issues were noted, but the inspection did not reveal any signs of settlement of the Memorial structure. Recommends periodic monitoring and further study in Phase II of report. Very good chronology which details Memorial history.
June 1992	Phase II report (Hartman-Cox Architects) to determine the cause for cracking at the top of Column 54, the stone joint openings along the front Pediment, and an explanation for movement occurring at the expansion joints of the Main Steps. Monitored for one year and presented observations - mostly related to temperature. Recommend monitoring program of 4 to 5 years.
December 1992	Report by Einhorn Yaffee Prescott, McMullan & Associates, Stephenson & Good, A. Morton Thomas and Associates, and Schnabel Engineering Associates to evaluate the existing storm drainage, landscaping, soils, and sheetpiling of the Stylobate Mall of the Jefferson Memorial. Recommend replacing sheet piling, cleaning drainage outlets, and replacing certain landscaping plants.
June 1993	As-constructed drawings for Stylobate Mall repairs carrying out recommendations of above report (see Sheet 3 of 30 for limits of construction). Protected trees during construction, re-routed several storm drains. Demolished existing sheeting and installed new PVC sheeting.

Date	Event
February 1996	Schnabel Engineering Associates' report on the plaza sidewalk and roadways around the Memorial. Detail sheets showing curb inlet protection and concrete sidewalk slopes. Schnabel Engineering Associates recorded tripping hazards.
January 1998	Demolition of exposed aggregate paving, granite steps, marble steps and marble pavers and replacement. Additional repair to section at sidewalk adjacent to seawall. Removed existing plaza and replaced with exposed aggregate concrete.
February 2006	Police report from off-duty police officer who was jogging along seawall and noticed a difference in elevation between the seawall and the North Plaza.
March 2006	NPS recorded survey data.
April 2006	Lachel Felice memo suggesting that drag on piles resulting from soil mass moving away from the Memorial may be the cause of the movement, and suggests that the cause for soil loss could be a storm drain or drain pipe.

Note: Storch 1965 refers to the "Study and Report for Rehabilitation of Peripheral Approaches and Appurtenant Structures," Storch Engineers, 1965.
EYP 1990 refers to "Preservation and Restoration of the Jefferson Memorial - Phase I Report," Einhorn Yaffee Prescott and Hartman-Cox Architects, 1990.

vi. Historical Fill Placement

To understand the settlement and ground movements taking place at the memorial, it is important to approximately quantify the amount of fill that was placed on site. Relevant information available in historical documents is summarized in the following paragraphs.

a) Land Reclamation of East and West Potomac Parks

The Jefferson Memorial is located in West Potomac Park which was a river flat and marsh prior to 1792 (Storch 1965). In accordance with the McMillan plan, when the East and West Potomac parks were created, an area of 327 acres was reclaimed through the dredging of the Washington Channel to establish East Potomac Park. The work was completed in 1927, and by 1932 East Potomac Park was developed as a tourist camp and golf course (Storch 1965). West Potomac Park was created from hydraulic dredging of the swampy regions southwest of the Washington Monument (Heine 1953). It was completely reclaimed and graded by 1908, and by 1922 it was developed and the Lincoln Memorial-Reflecting Pool complex was completed (Storch 1965).

Although the Jefferson Memorial is located on the south bank of the Tidal Basin, this area is considered part of the West Potomac Park historic district and was reclaimed along with West Potomac Park. Figure 8 shows the configuration of the east bank of the Potomac River before the land reclamation took place, and Figure 9 exhibits the present day layout (1991).

An environmental assessment by the National Park Service in 2002 states the following: "soils within the site have been substantially altered by the placement of fill material. In 1882, a project to improve navigation of the Potomac River transformed marshes and tidal flats into 600 acres of riverside recreational areas" (NPS 2002).

The reclamation of East and West Potomac Parks is quantified by Christie et al. (2006): "A layer of urban fill is present throughout the city. Deep fills are present at the west end of the Mall west of the Washington Monument and include dredge spoils. Fill is 20 to 25 ft thick at the west side of the Monument, and increases to 30 to 40 ft at the Lincoln Memorial."

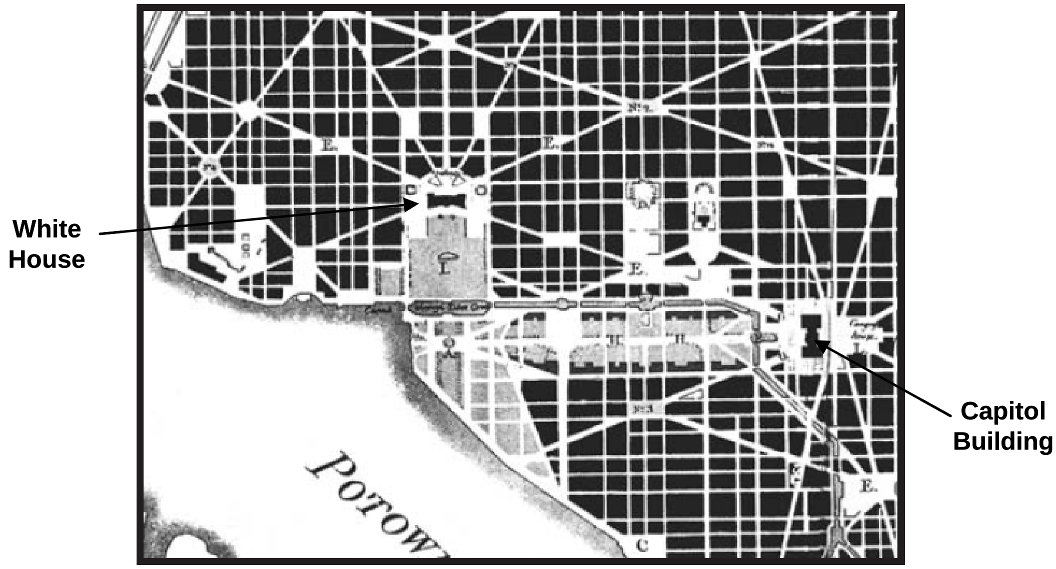


Figure 8. L'Enfant's Plan for Washington, 1791 (Fugate 2005)

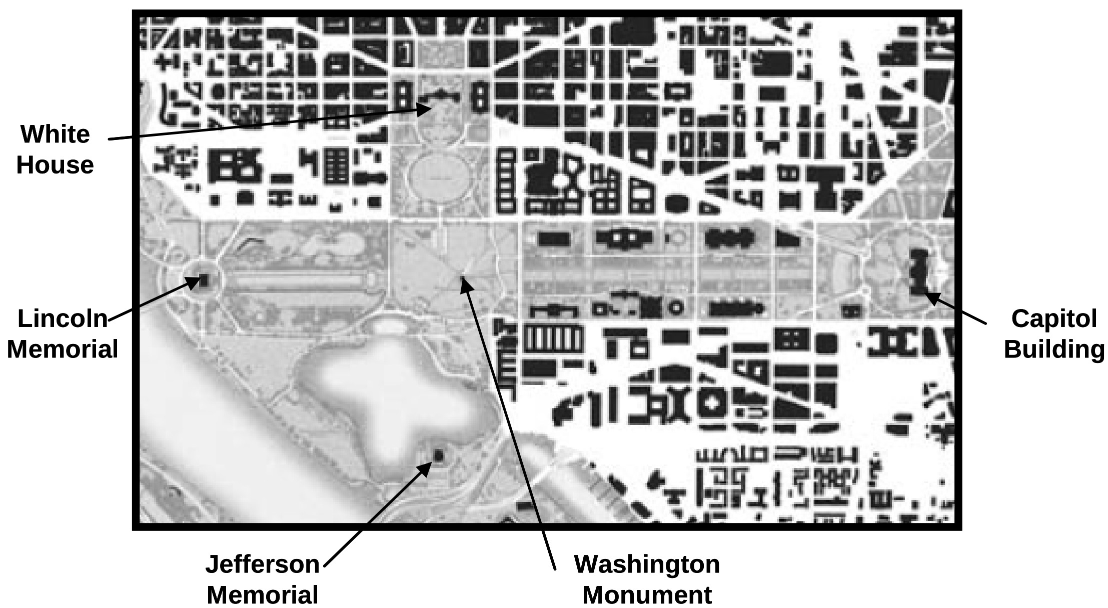


Figure 9. Modern-Day Washington, 1991 (Fugate 2005)

b) Fill Placement for Construction of the Memorial

The planned location for the Jefferson Memorial necessitated a modification of the existing seawall configuration along the Tidal Basin. Figure 10 shows the old seawall configuration. On the northeast side of the site, material was removed and the new seawall was installed south of

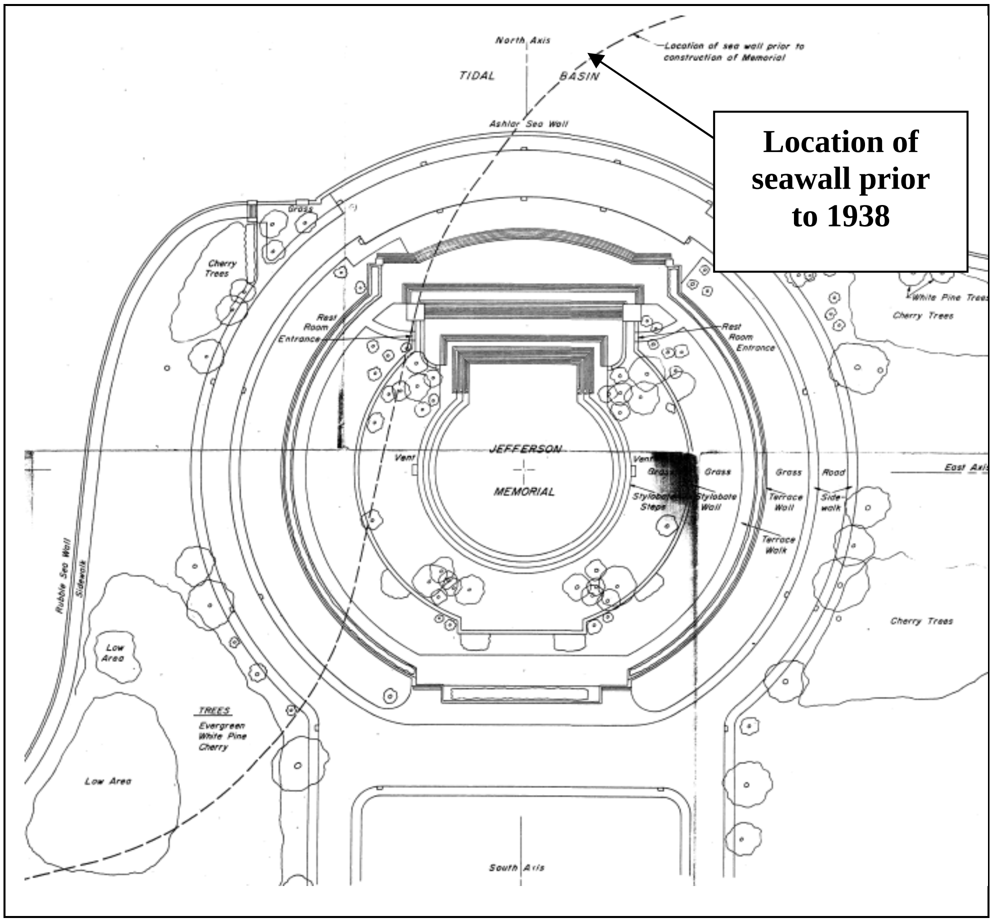


Figure 10. Location of Seawall Prior to 1938, Adapted from Plate F-1, Storch (1965)

the existing wall. On the northwest side, fill was placed into the Tidal Basin to bring the area up to grade, and a new seawall was installed north of the existing wall.

The point where the old seawall alignment and the Ashlar Seawall intersect is located roughly at the midpoint of the Ashlar Seawall. The old seawall west of this point was not removed before the filling operation.

Filling was done in several stages. The filling of the Tidal Basin as required to construct the caissons, piles, and caps was completed by June 30, 1939. This area encompassed the Terrace Wall. The work required to bring the area behind the new west seawall up to grade was commenced shortly after July 1940. The area beneath the Circular Roadway was filled from approximately EL -11.4 to +9.1 (adjusted to NAVD 29 from EL -10 to +10.5 reported in Storch 1965). Overall, fills up to 30 to 40 feet deep were placed for reclamation and grading for the Memorial site. These fills were placed over the soft, highly compressible alluvial soils extending down to about EL -80 to EL -95, where bedrock is encountered (EYP 1992).

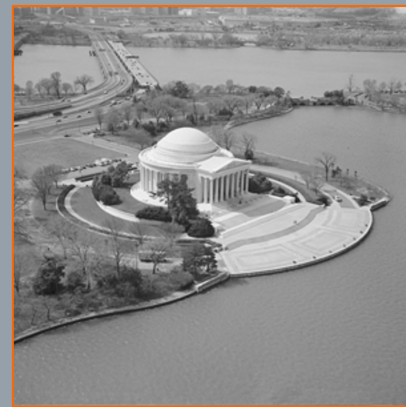
c) Additional Fill Placement

Since the Memorial's construction, the land surrounding the Stylobate Wall has undergone settlement. This settlement is particularly pronounced on the northwest side of the park, corresponding with the location of the larger fill thickness. Periodically, additional fill was placed on the western portion of the site. The quantity of material added is relevant because it resulted in additional settlements due to its weight.

The report by Einhorn Yaffee Prescott et al. states that approximately 400 yd^3 of fill were placed in 1968 and about 500 yd^3 in 1978 to bring the west side of the Memorial up to grade. "The extent and depths of fill placements are not known, although it was estimated that an average of 5 to 6 inches of fill would have covered the entire Stylobate Mall area on each occasion" (EYP 1992). Mr. Dean Robinson, retired engineer for the National Park Service, recalled that during the reconstruction of the North Plaza in 1969-1970, an average of two feet of material was placed: approximately one foot of gravel fill, and one foot of concrete for the plaza slab.

d) Fill Placement Based on Exploratory Borings

The exploratory borings performed during the course of this investigation showed fill thicknesses ranging from 23.5 to 13.5 feet. In the area of the North Plaza, the elevation of the bottom of probable fill ranged from about EL -19 at the western end of the plaza to EL -6 at the eastern end of the plaza. It must be noted that the present elevation of the bottom of the fill is likely lower than the original ground surface elevation due to settlement of the original soils under the added fill weight. For further detail on the exploratory borings performed, refer to Section 4 of this report.



3. VISUAL SURVEY OF THE SITE

HNTB

3. VISUAL SURVEY OF THE SITE

I. AREAS OF CONCERN

i. Ashlar Seawall

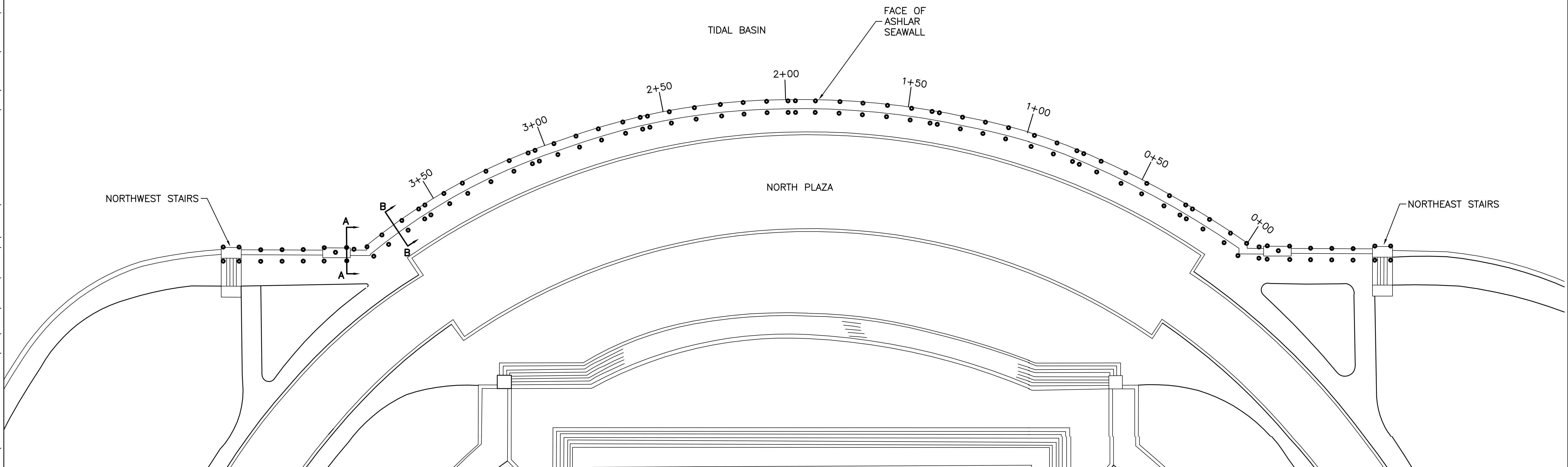
The Ashlar Seawall forms the southern boundary of the Tidal Basin and runs along the North Plaza of the Jefferson Memorial. It is a cast-in-place concrete stub wall supported on timber piles and faced with stone. The seawall was constructed in 1941 and is approximately 490 feet in length. The arced portion is 378 feet long, and the two horizontal extensions to the east and west of the arc are approximately 56 feet each. Figure 11 is a plan view depicting the approximate seawall timber pile layout and stationing along the seawall that is based on the available historical information (NPS File No. 808_20013). Figure 12 shows sections through the Ashlar Seawall also obtained from historical documents. The wall is comprised of 10 wall segments separated by joints spaced at 50 or 60 feet. The wall segment joints correspond with every 8 or 10 capstones as shown in Figure 13.

In February 2006, a United States Park Police officer noticed differential movement between the capstone of the Ashlar Seawall and the exposed aggregate concrete paving of the western portion of the North Plaza. In October 2006, Schnabel personnel accessed the site for a visual survey. Schnabel measured the approximate distance between the top of the North Plaza and the top of the seawall capstone at 20 locations. In March 2007, Schnabel visited the site again and repeated the measurements. These measurements are not the primary source of settlement data for the seawall. They are rather a qualitative indication of movement over time. These measurements were compared to the survey data collected by Greenhorne & O'Mara for further verification of the movements. The data indicates that the wall settlement with respect to the North Plaza continues. It is not known when the relative movement between the wall and the North Plaza started. However, according to Park staff, no movement was noticed before the Fall of 2005.

For the visual survey, the seawall capstone blocks were numbered as shown in Figure 13. Figure 14 is a plan view of Seawall Capstone #2, which is on the west end of the arced portion of the seawall, and is located at a point where the vertical movements visually appear to be the largest. The figure shows horizontal and vertical measurements of the distance between the seawall capstone blocks and the North Plaza taken on different dates. The vertical measurements were taken from the top of the seawall capstone to the finished plaza surface and indicate the location of the seawall capstone below the North Plaza. Horizontal measurements are from the edge of the capstone to the edge of the North Plaza slab.

As noted above, the Ashlar Seawall is comprised of 10 wall segments. At the joints between wall segments, the capstones of the Ashlar Seawall are displaced with respect to each other, indicating relative movement and/or rotation between the seawall segments. It should be noted that the wall segment located between Capstones #7 and #14 has visibly rotated outward with respect to the two adjacent segments. Also, the wall segment between Capstone Blocks #15 and #22 shows relative movement with respect to the wall segment immediately to the east. It is not possible to ascertain when these movements occurred. However, there is historical documentation (NPS File No. 808_40001) suggesting that the capstones were reset (and likely re-aligned) in 1972.

Figure 15 is a plan view showing the north edge of the seawall capstones at each joint in the seawall to display the relative rotation that has taken place between the seawall segments. Figures 16 and 17 are photos of the Ashlar Seawall and North Plaza interface.



LEGEND
EXISTING 16" ø TIMBER PILE

FIGURE 11 – ASHLAR SEAWALL TIMBER PILE LAYOUT

20 0 20 40
SCALE OF FEET

NOTE;
EXISTING TIMBER PILE LOCATIONS WERE ESTIMATED FROM NPS DRAWING NO. 808_20013 "REALIGNMENT OF SEAWALL AT TIDAL BASIN" JULY 1940.

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

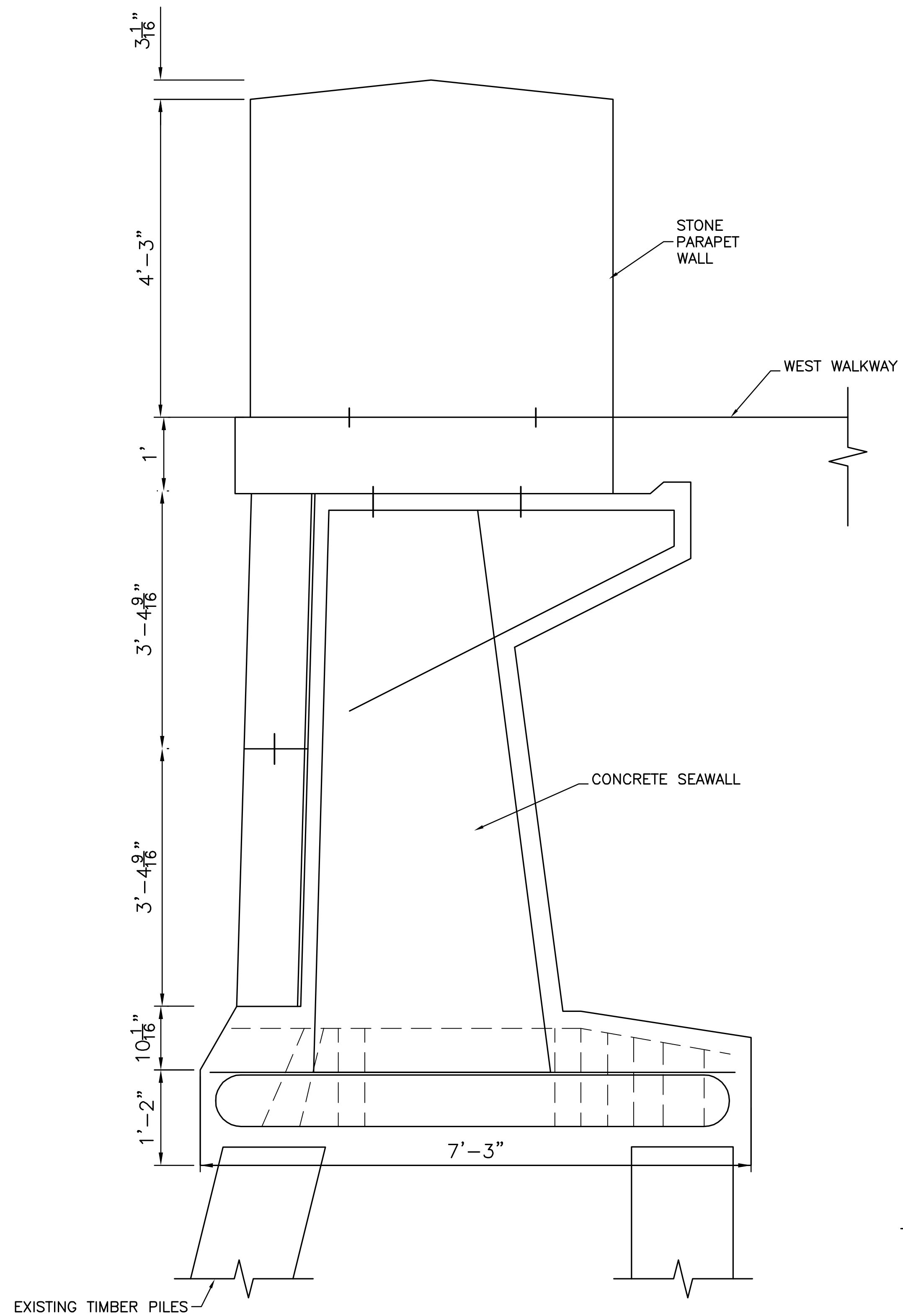
ASHLAR SEAWALL TIMBER PILE LAYOUT
TITLE OF DRAWING

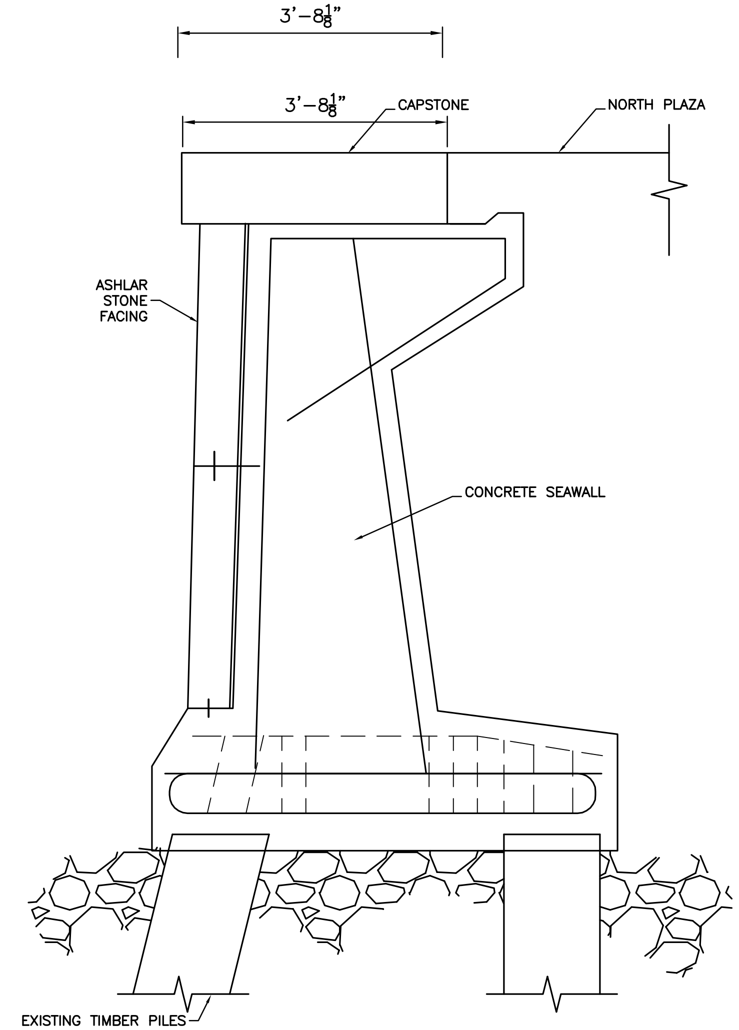
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED NSF
DRAWN JG
CHECKED
PKIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284





SECTION B-B

FIGURE 12 – ASHLAR SEAWALL SECTIONS

16 0 16 32
SCALE OF FEET

REFERENCE: NPS DRAWING NO. 808_20013
"REALIGNMENT OF SEAWALL AT TIDAL BASIN" JULY 1940.

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

ASHLAR SEAWALL SECTIONS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

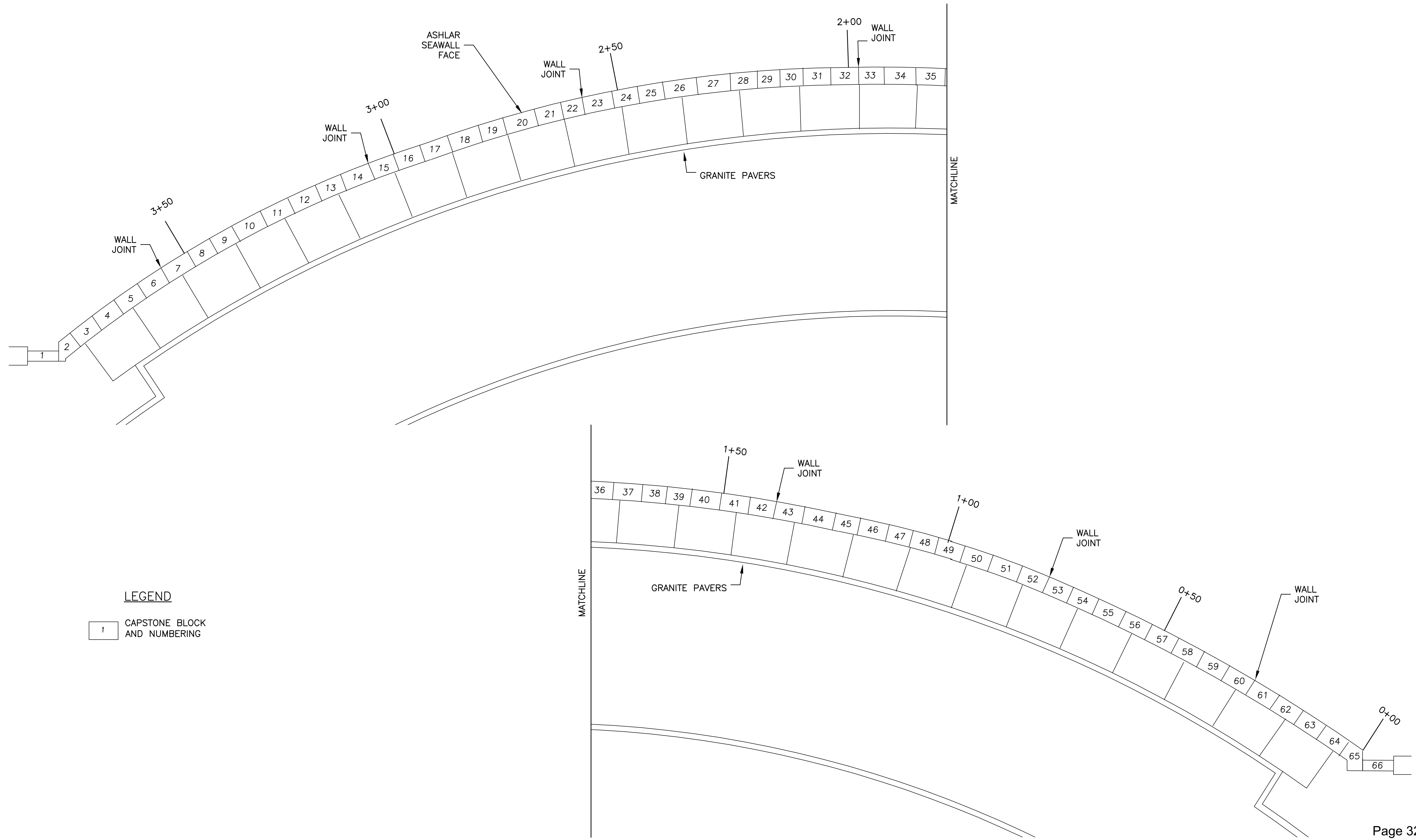


FIGURE 13 – SEAWALL CAPSTONE NUMBERING

10 0 10 20
SCALE OF FEET

1/28/08 13:34 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30BLOCKS_NUMBERED.DWG

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

SEAWALL CAPSTONE NUMBERING
TITLE OF DRAWING

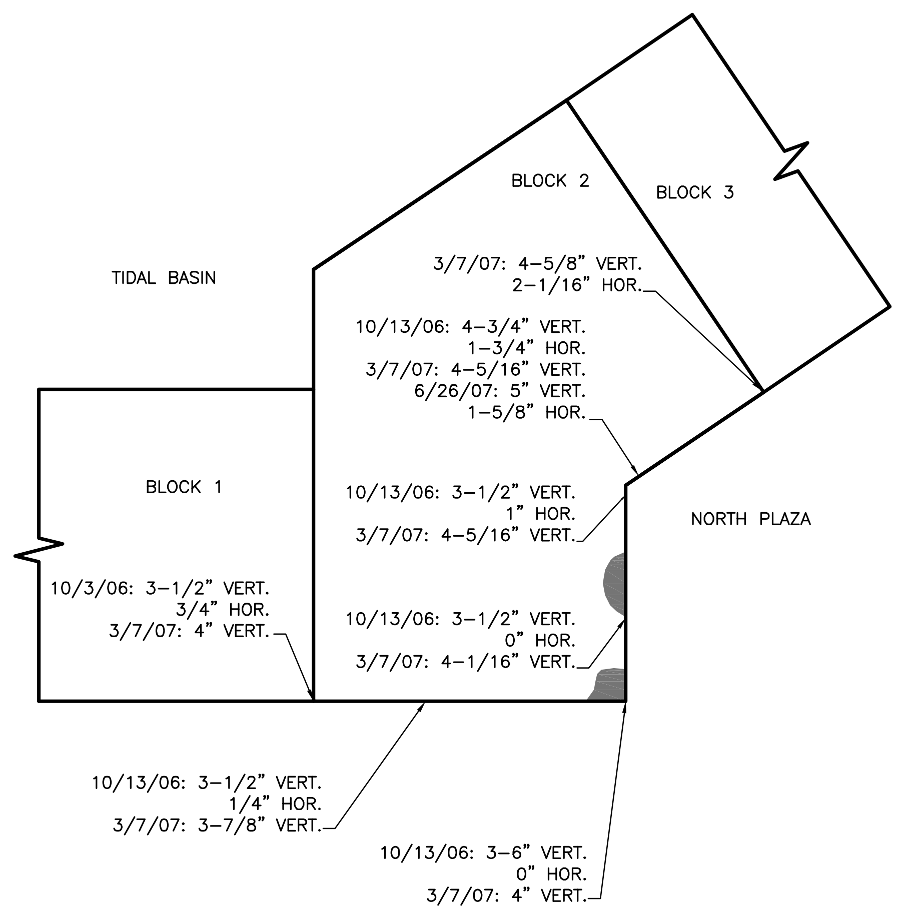
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

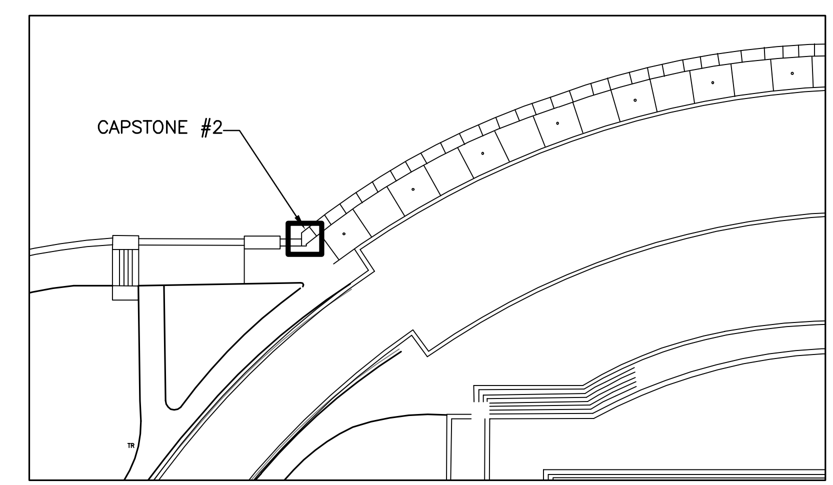
JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

NOTES:
- THE MEASUREMENTS SHOWN CORRESPOND TO THE VERTICAL AND HORIZONTAL DISTANCE BETWEEN THE NORTH PLAZA AND THE SEAWALL CAPSTONES
- VERTICAL MEASUREMENTS ARE FROM TOP OF CAPSTONE TO THE FINISHED PLAZA SURFACE
- HORIZONTAL MEASUREMENTS ARE FROM THE EDGE OF THE CAPSTONE TO THE EDGE OF THE NORTH PLAZA SLAB



MEASUREMENTS AT SEAWALL CAPSTONE #2
NTS



PLAN VIEW OF SEAWALL CAPSTONE LOCATION
NTS

FIGURE 14 – SEAWALL CAPSTONE #2

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

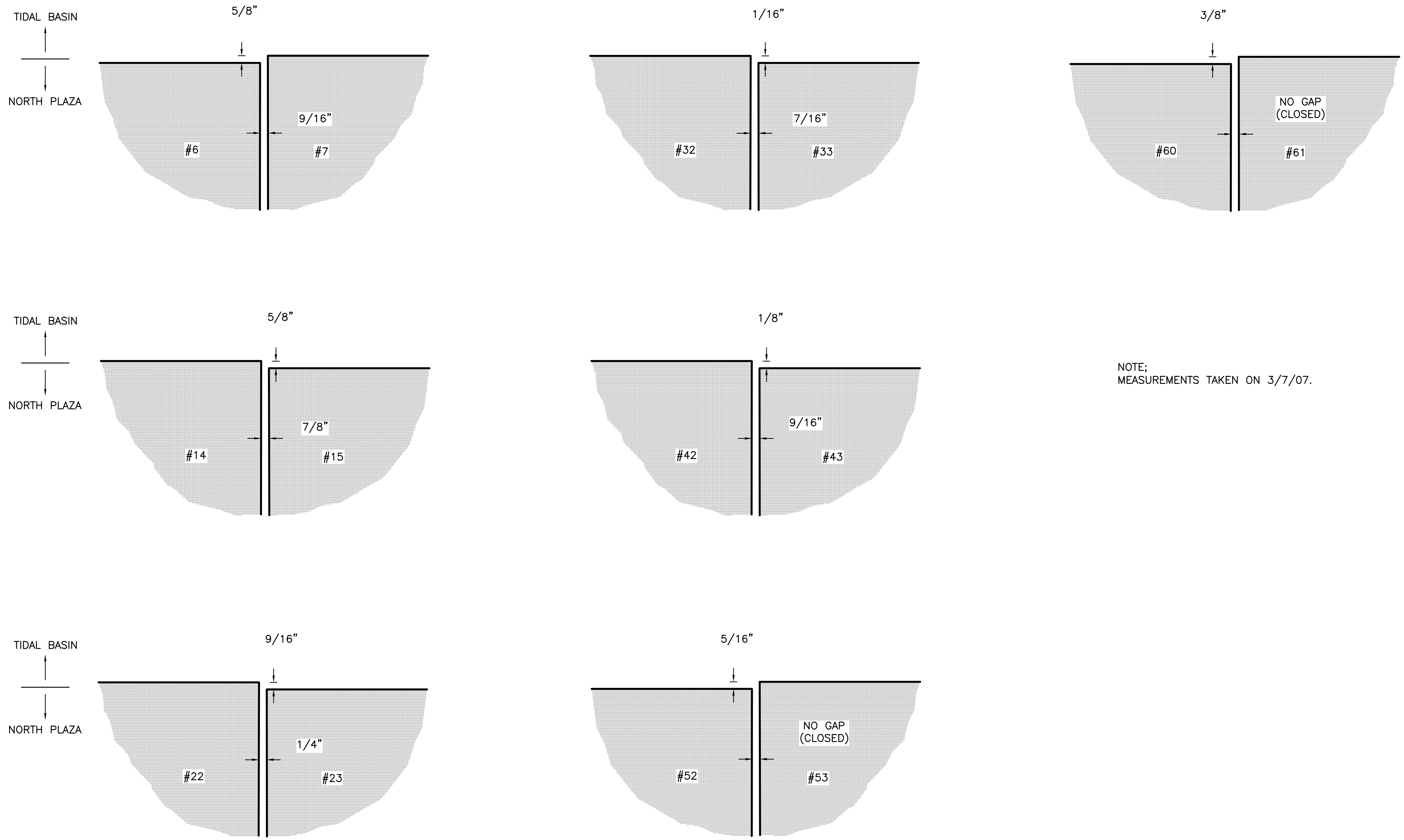
SEAWALL CAPSTONE #2
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284



NOTE;
MEASUREMENTS TAKEN ON 3/7/07.

FIGURE 15 – PLAN VIEW SEAWALL CAPSTONES AT JOINT LOCATIONS

A/E FIRM
HNTB
ARCHITECTURE

SCHNABEL
ENGINEERING

Mark	Sheet	REVISION	Date	Initial

CAPSTONES AT JOINT LOCATIONS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

Figure 16. View Standing on the Ashlar Seawall Looking West (3-29-07)

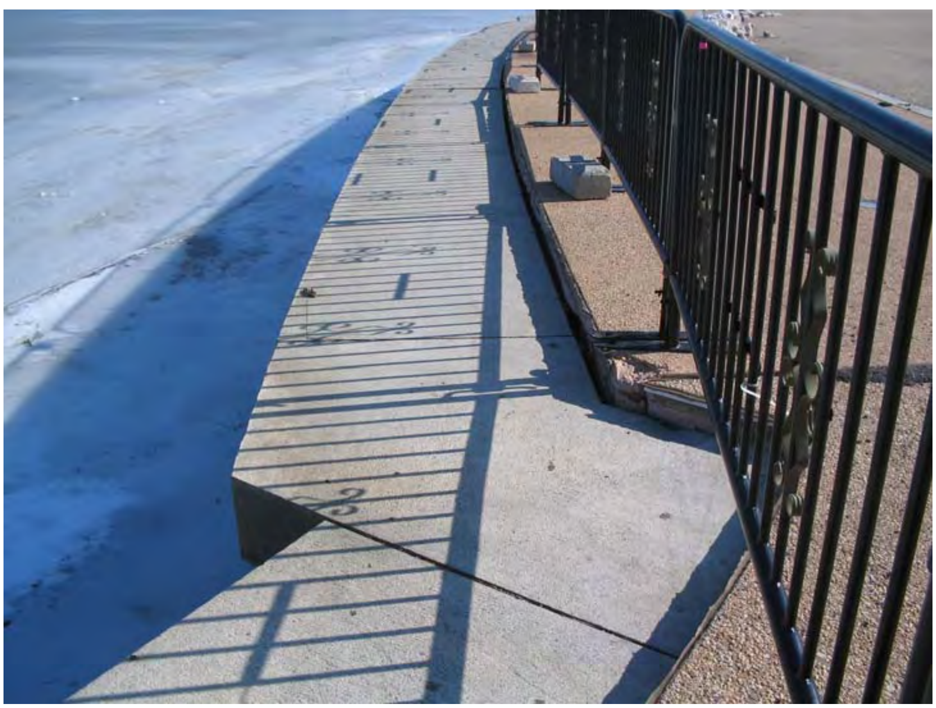


Figure 17. Standing on the North Plaza Looking East at Ashlar Seawall (2-28-07)

ii. North Plaza

The North Plaza of the Jefferson Memorial was originally constructed as a slab on grade in 1939-1943, and consisted of an asphalt road bordered by concrete sidewalks as shown in Figure 18. The plaza settled, and showed considerable damage in the years following the Memorial's construction. Figure 19 shows the North Plaza condition in 1964.

One area that exhibited notable distress was the southwest corner of the North Plaza at its intersection with the Main Stairs. Figure 20 shows this location in 1951 when the slab cracked severely due to settlement of the North Plaza. Based on the dimensions of the objects in this photo, Schnabel estimated the relative settlement of the North Plaza with respect to the Memorial structure supported on deep foundations to be about 1 to 1.5 feet in 1951. The settlement of the North Plaza may have been even larger toward the center of the Plaza. The sections across the North Plaza contained in the 1969 Storch report (NPS File No. 801_D-12) suggest settlement of the North Plaza of approximately 2 feet by 1968. It is also possible that regrading of the North Plaza occurred between its original construction and 1968, and that the total settlement of the North Plaza was larger than two feet.

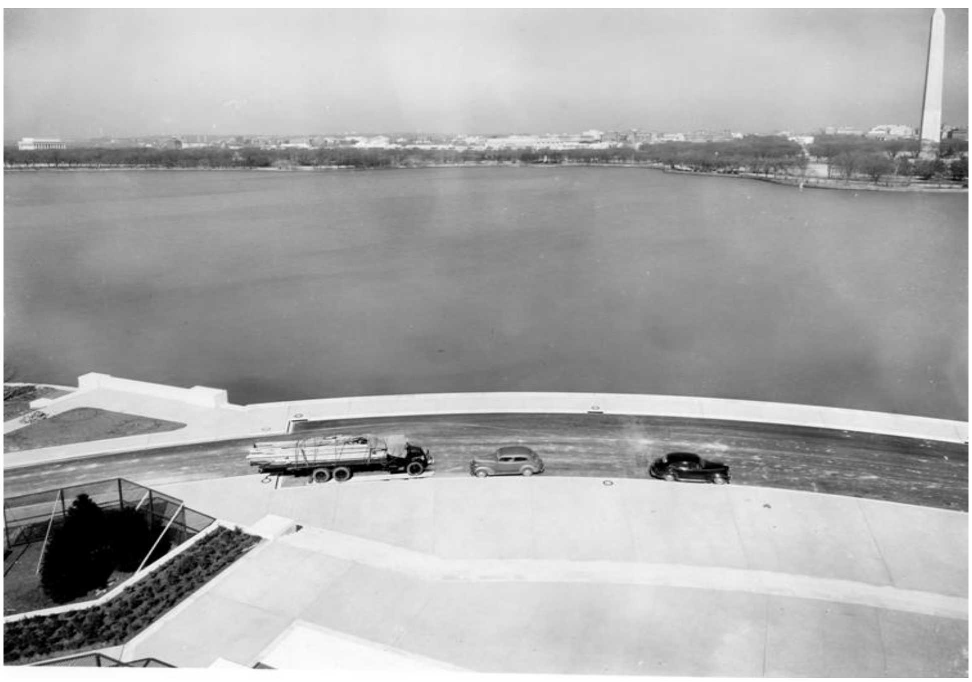


Figure 18. View of North Plaza, Standing on the Main Stairs Looking North Toward the Tidal Basin (Photo Dated 2-4-1942)

Figure 19. View of North Plaza, Standing on the West End and Looking Northeast Toward the Tidal Basin (Photo Dated 2-17-64)

Figure 20. Southwest Corner of Main Stairs at North Plaza (Photo Dated 2-13-51)

According to the Storch report, portions of the North Plaza were removed when it began cracking in 1951 and were not repaired until 1969-1970 when the North Plaza was entirely demolished and replaced with a structural slab on a system of piles and grade beams. Figure 21 shows the corner prior to the repairs in 1969 and Figure 22 depicts its appearance in October 2006.

Figure 21. Southwest Corner of Main Stairs at North Plaza (Photo Dated 2-17-64)

Figure 22. Southwest Corner of Main Stairs at North Plaza (10-13-06)

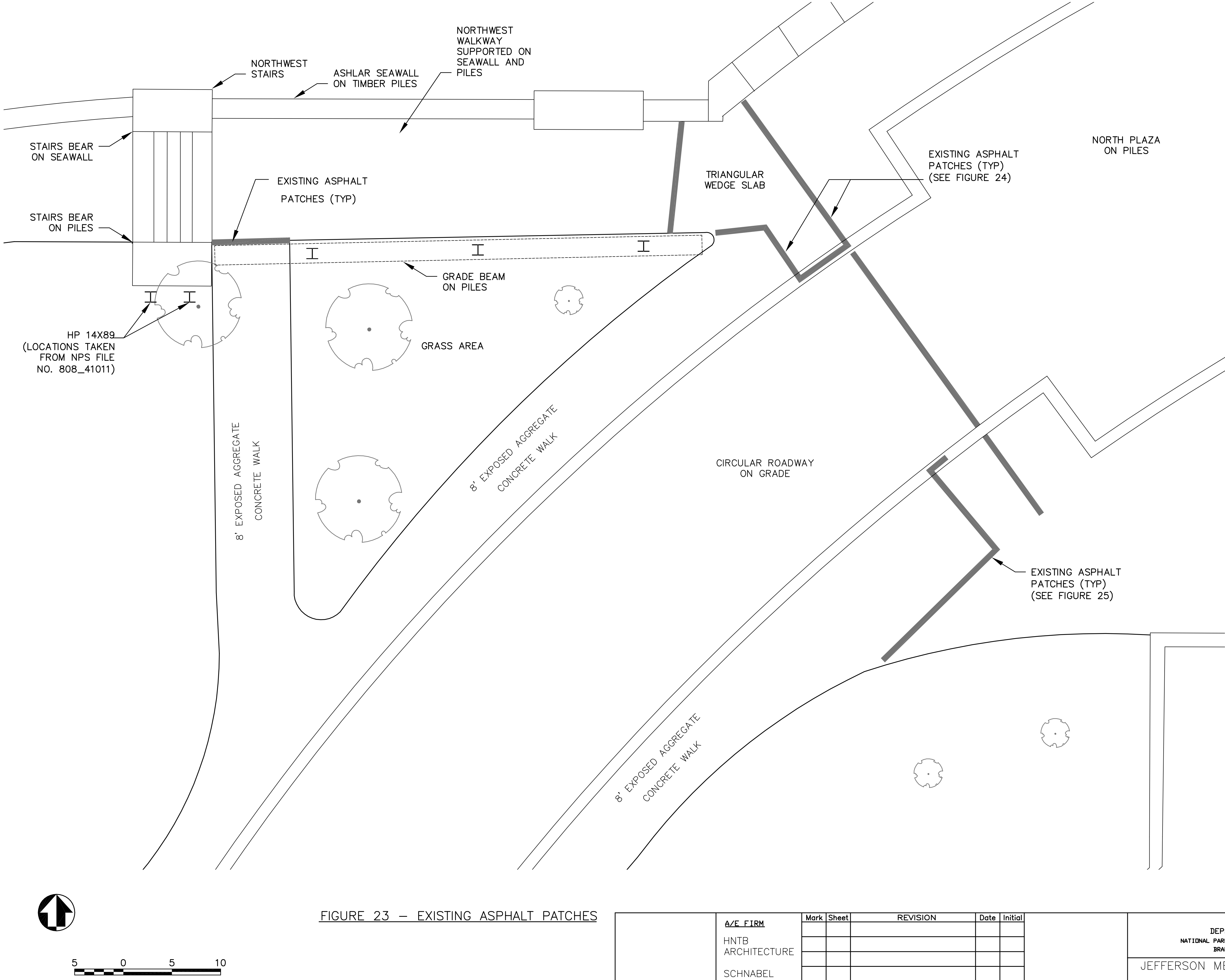


FIGURE 23 – EXISTING ASPHALT PATCHES

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

EXISTING ASPHALT PATCHES
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
SMF
DRAWN
JG
CHECKED
PKIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 14:28 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\51ASPHALT.DWG

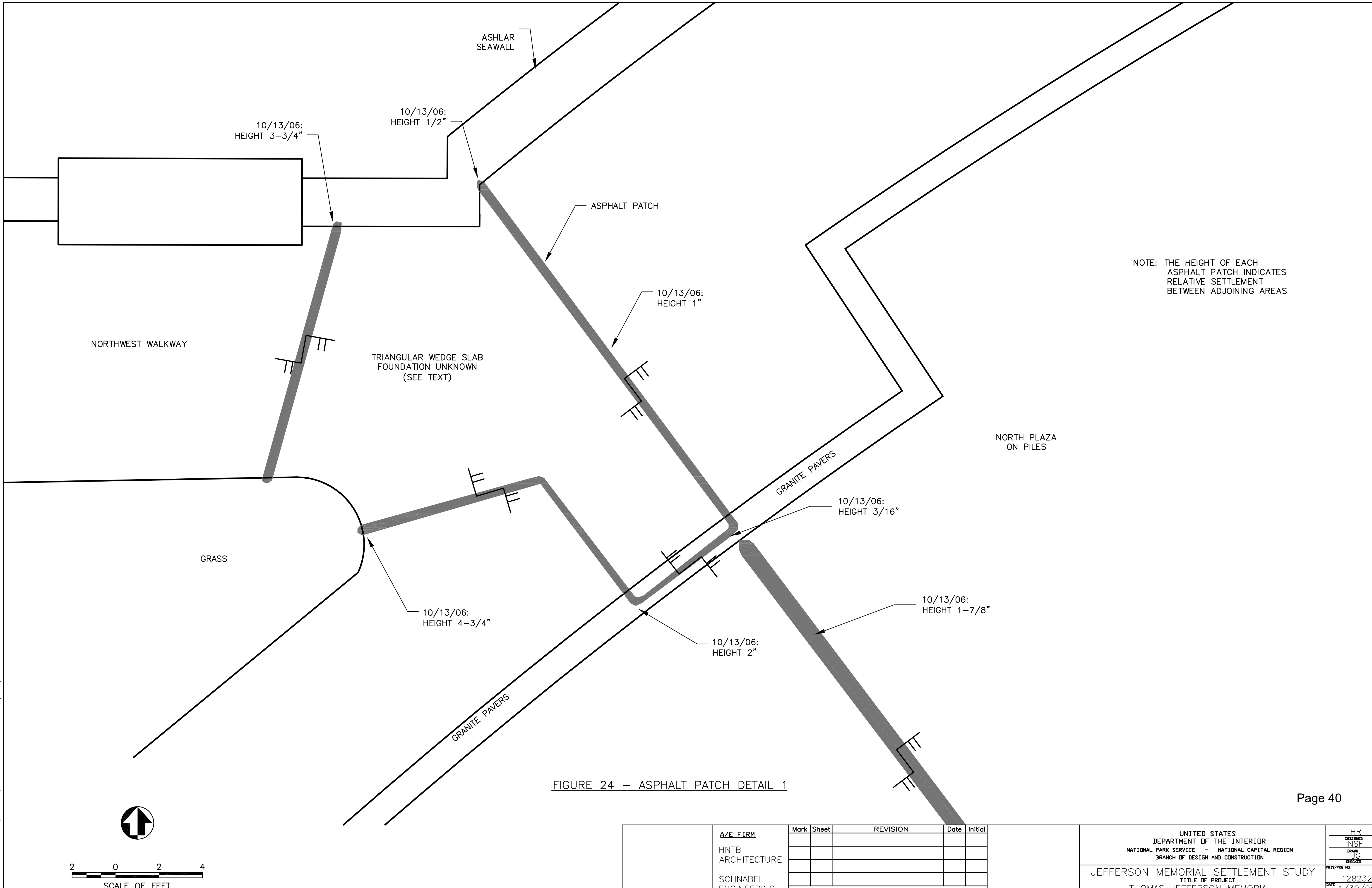


FIGURE 24 – ASPHALT PATCH DETAIL 1

1/28/08 10:49 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30WESTWALK.DWG

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

ASPHALT PATCH DETAIL 1
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PKIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

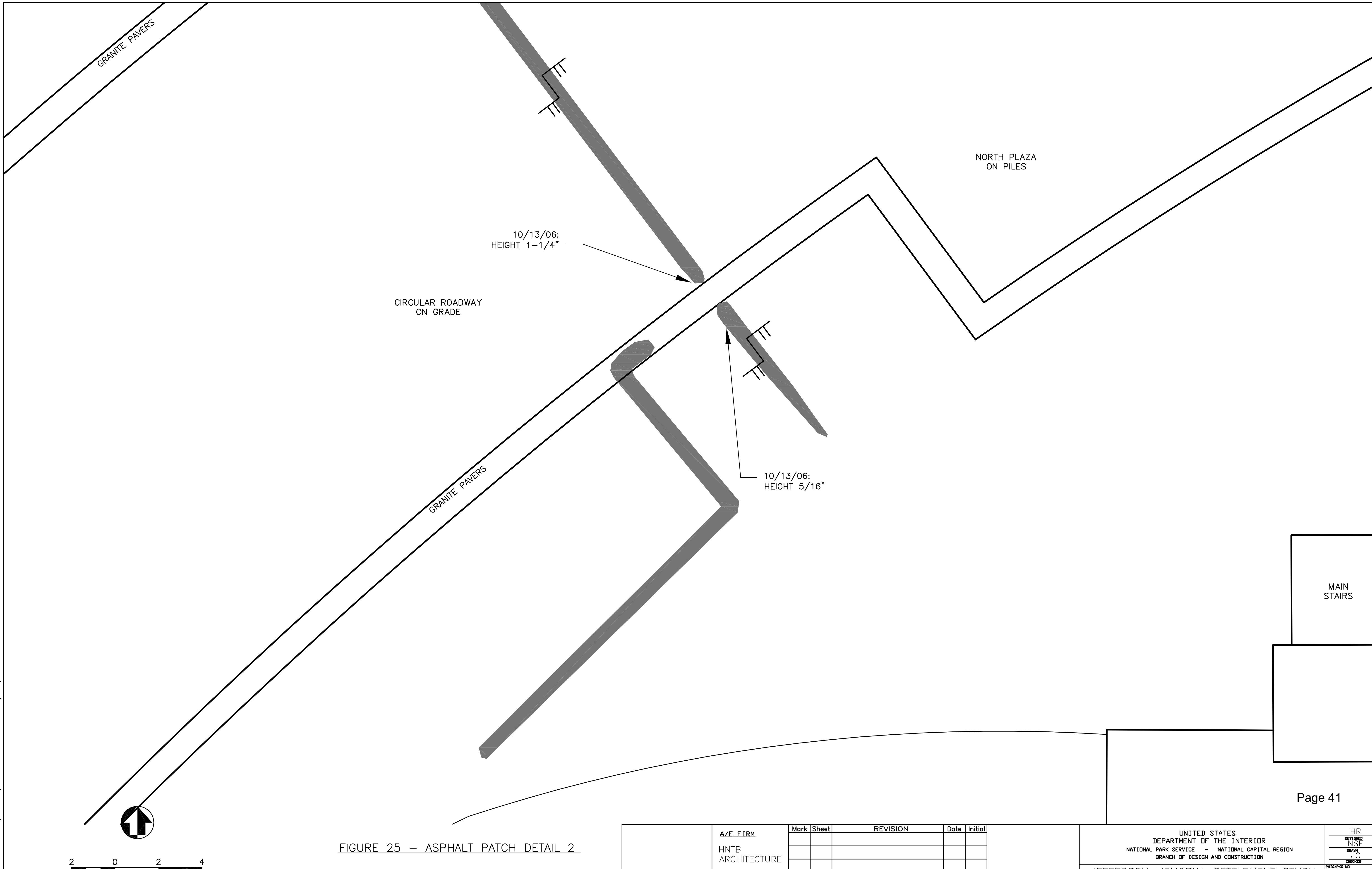


FIGURE 25 – ASPHALT PATCH DETAIL 2

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

ASPHALT PATCH DETAIL 2
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PKIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 10:49 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30WESTWALK.DWG

When the plaza was reconstructed in 1969-1970, it was paved with exposed aggregate concrete and regular concrete colored red-brown. Thereafter vehicles were prohibited from driving around the Memorial (Prothero 2001). In 1999-2000, the entire North Plaza and surrounding roads were restored. The North Plaza was milled to the structural slab, paved with a new exposed aggregate concrete, and the road was made flush with the sidewalks. Granite blocks mark the location of the old concrete curbs to preserve the historical integrity of the peripheral roads and plaza. Due to the settlement that the Circular Roadway had experienced, and according to the Storch documents (1965-1969), a 150-foot long portion of the Circular Roadway adjacent to the west end of the Plaza was filled to meet the Plaza grade. To the east of the Plaza, the backfill wedge over the Circular Roadway was about 20 feet long. Presently, there is differential settlement between the Circular Roadway on grade and the North Plaza structure on piles. This differential settlement is much more pronounced on the west side, and has necessitated frequent asphalt patching to mitigate trip hazards. Park maintenance personnel have informed us these locations require additional patching at the rate of approximately 0.5 inches every three months and that this frequent patching is only a recent necessity. Figures 23, 24, and 25 show the approximate location of the patches and the estimated height measured during the visual survey by Schnabel in October 2006. Figures 26 and 27 are photos taken during our site visits.

Figure 26. Asphalt Patches on North Plaza and Circular Roadway Interface (9-12-06)

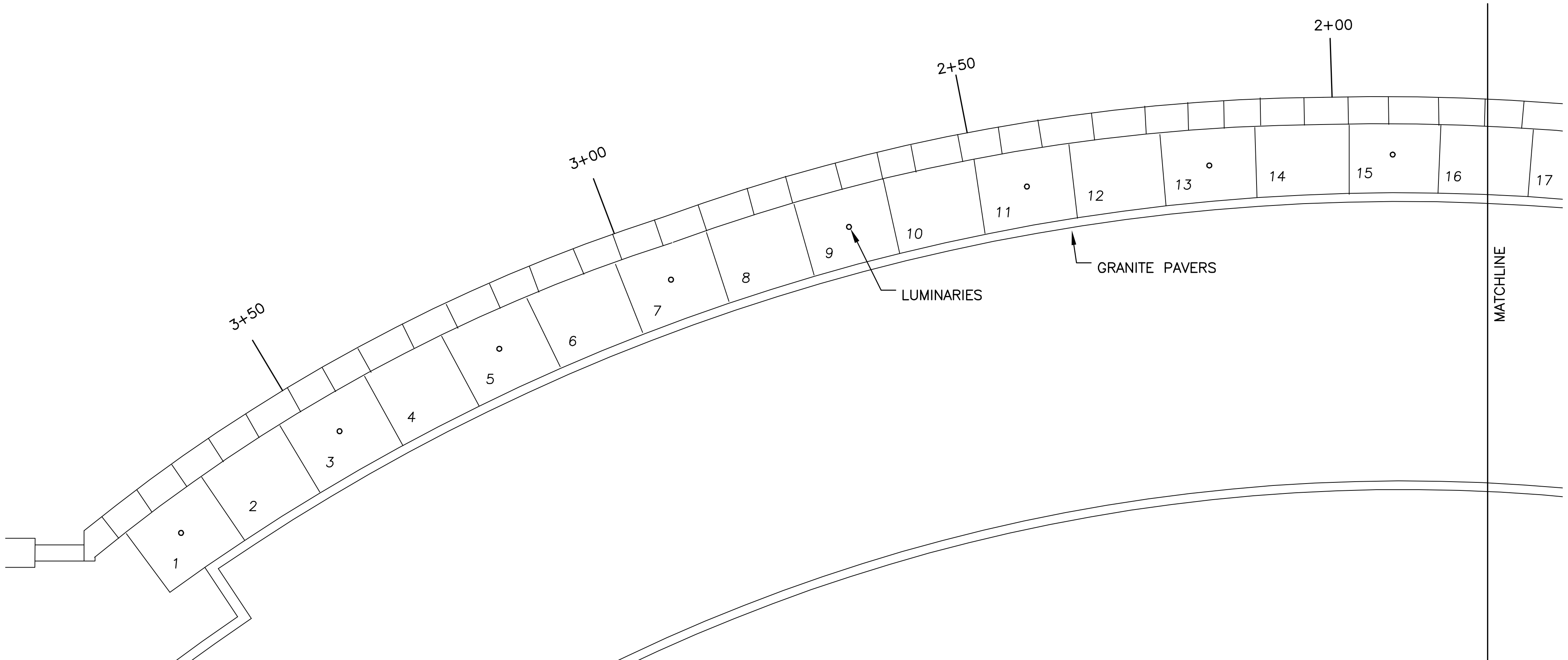
Figure 27. Asphalt Patches on North Plaza and Circular Roadway Interface (10-12-06). Note “bulge” in grassy area suggesting the presence of a grade beam on piles.

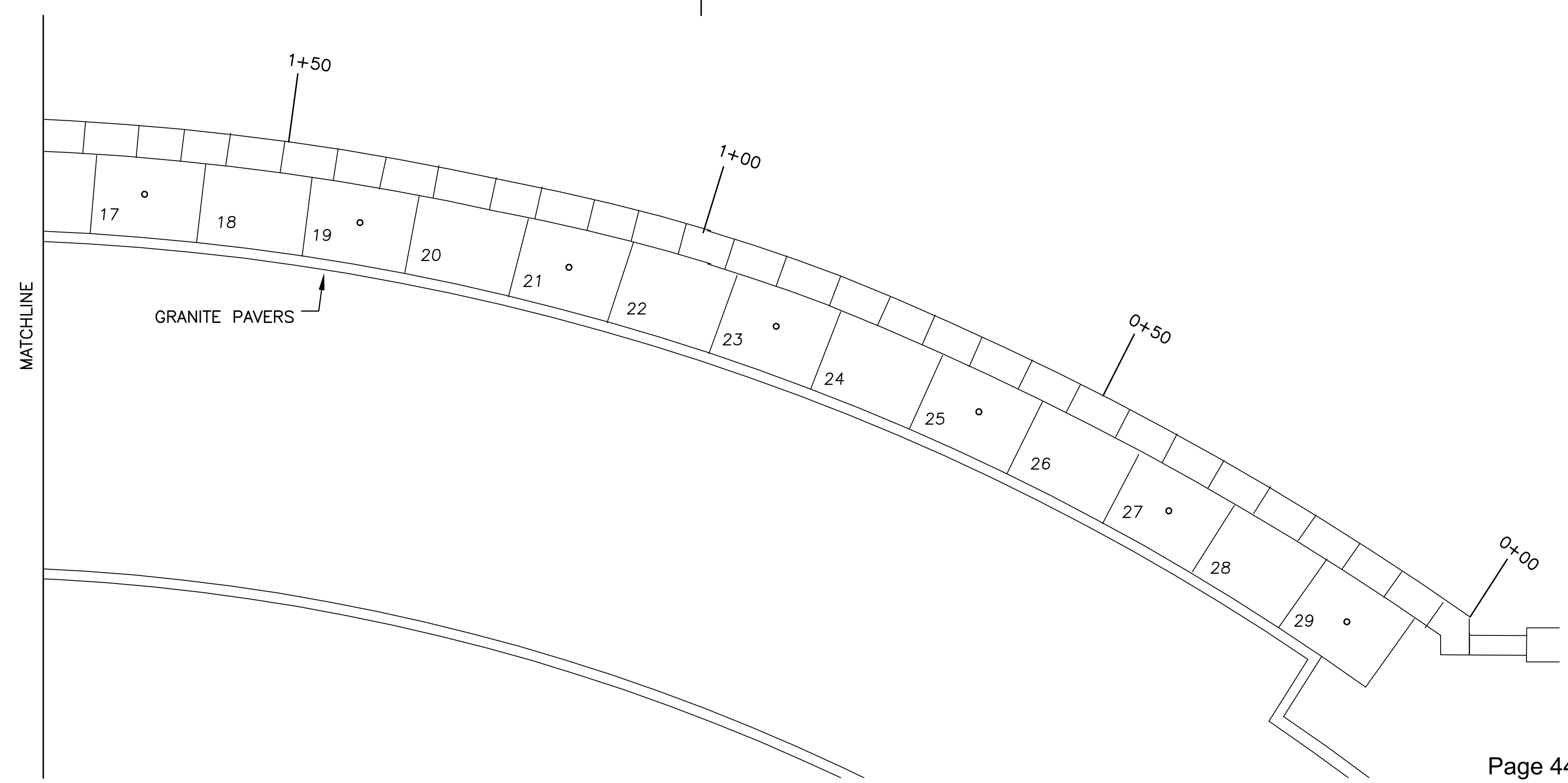
When walking along the North Plaza during the visual survey, Schnabel personnel noticed cracking in the exposed aggregate in many locations. Where the plaza borders the seawall, the orange-colored exposed aggregate concrete sectors contain flush-mounted luminaires. These luminaires are 8 inches in diameter and are approximately located at the center of the exposed aggregate sectors. Almost every sector that contains a luminaire has cracks which extend through the luminaire in a direction perpendicular to the seawall. Figure 28 shows the sectors with Schnabel’s numbering system. Four sectors had cracks which were larger, or showed a distinctive pattern, and they are depicted in Figure 29. Schnabel believes that these cracks are due to the temperature-induced stresses in the 1 to 2 inch thickness (information provided by NPS maintenance personnel) of the exposed aggregate concrete used on the North Plaza, and are not related to the observed movement of the seawall and the Circular Roadway. Figure 29 also shows the typical dimensions for the granite paving stones on the North Plaza.

The North Plaza has numerous expansion joints running both north-south and east-west as shown in Figure 30. During the visual surveys in October 2006 and March 2007, the joint opening between the North Plaza and the Main Stairs was measured. As indicated by Figure 31, the joints appear to be widening in the direction of the Tidal Basin. Figure 32 shows the joint between the Southwest corner of the Main Stairs and the North Plaza. The joint appears to have widened toward the northwest. However, it is important to note that additional monitoring data is necessary to establish whether the Plaza is undergoing continuing lateral movement, or if the joint opening is due to temperature effects or other phenomena.

iii. Basement

During the visual survey in October 2006, Schnabel personnel performed a visual inspection of the unfinished portions of the basement in two areas. Observations are included in Figures 33 and 34. Schnabel accessed the first area beneath the Main Stairs which is used for storage. In





LEGEND

PAVED SECTORS AND NUMBERING

FIGURE 28 – NORTH PLAZA PAVED SECTOR NUMBERING

10 0 10 20
SCALE OF FEET

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

NORTH PLAZA PAVED SECTOR NUMBERING
TITLE OF DRAWING

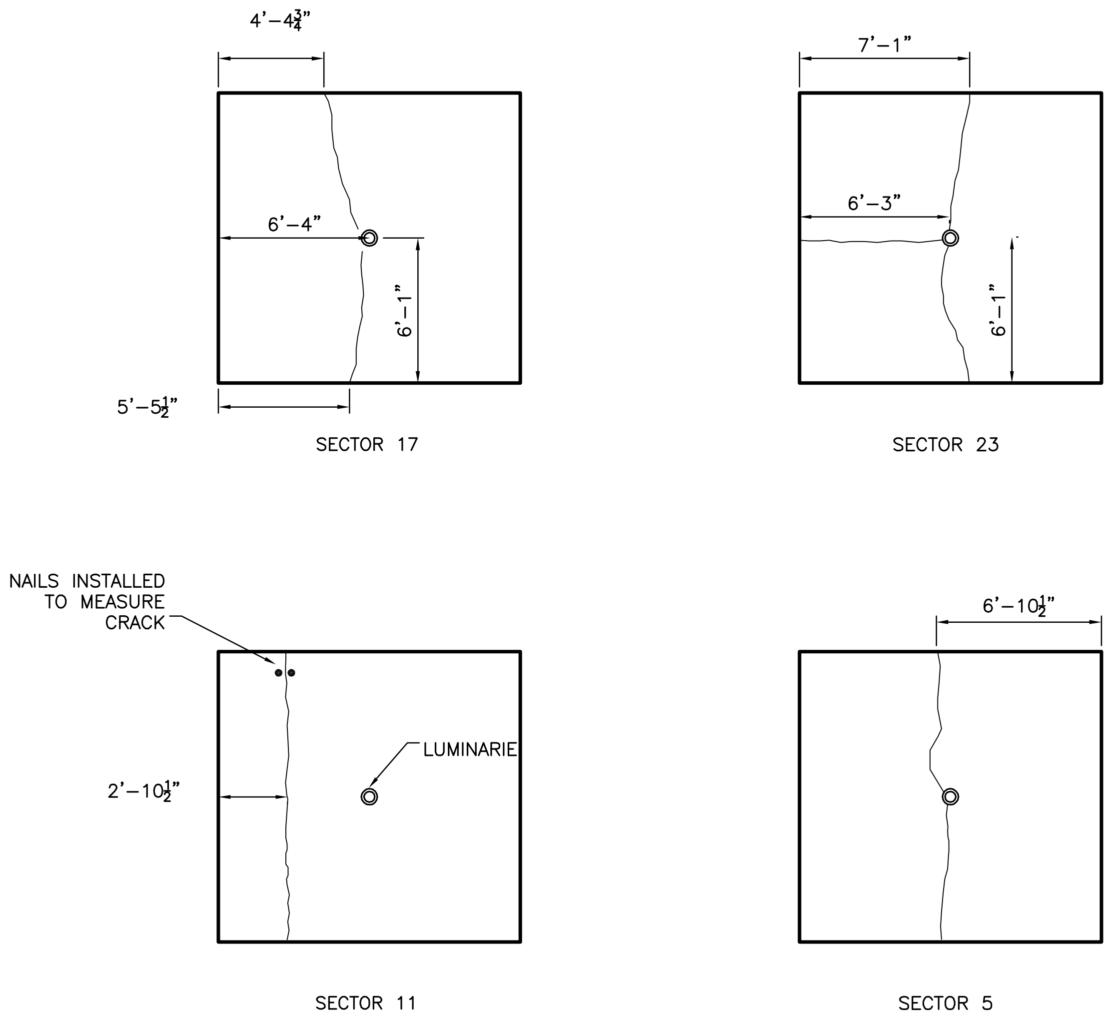
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

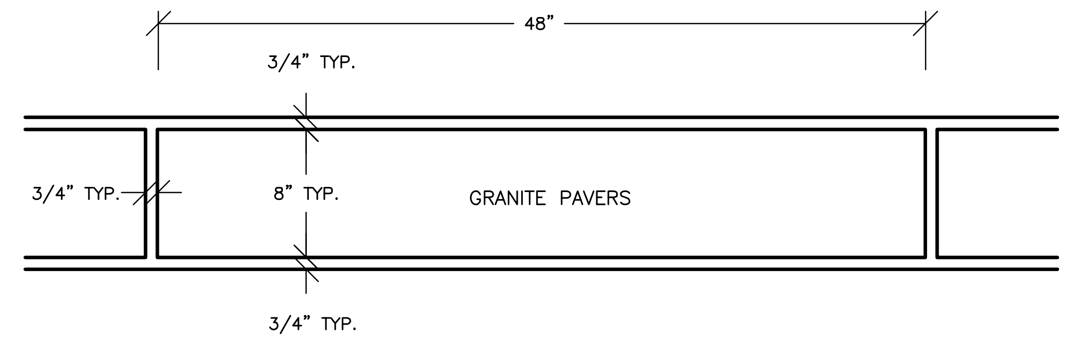
JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

1/28/08 13:34 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30BLOCKS_NUMBERED.DWG



CRACKS EXTENDING FROM LUMINARIES IN NORTH PLAZA



GRANITE PAVER TYPICAL DIMENSIONS

FIGURE 29 – PAVED SECTOR CRACKS AND TYPICAL GRANITE PAVER

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

PAVED SECTOR CRACKS AND GRANITE PAVER
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED HR
DRAWN NSF
CHECKED JG
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 09:56 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30GR_PAVERS.DWG

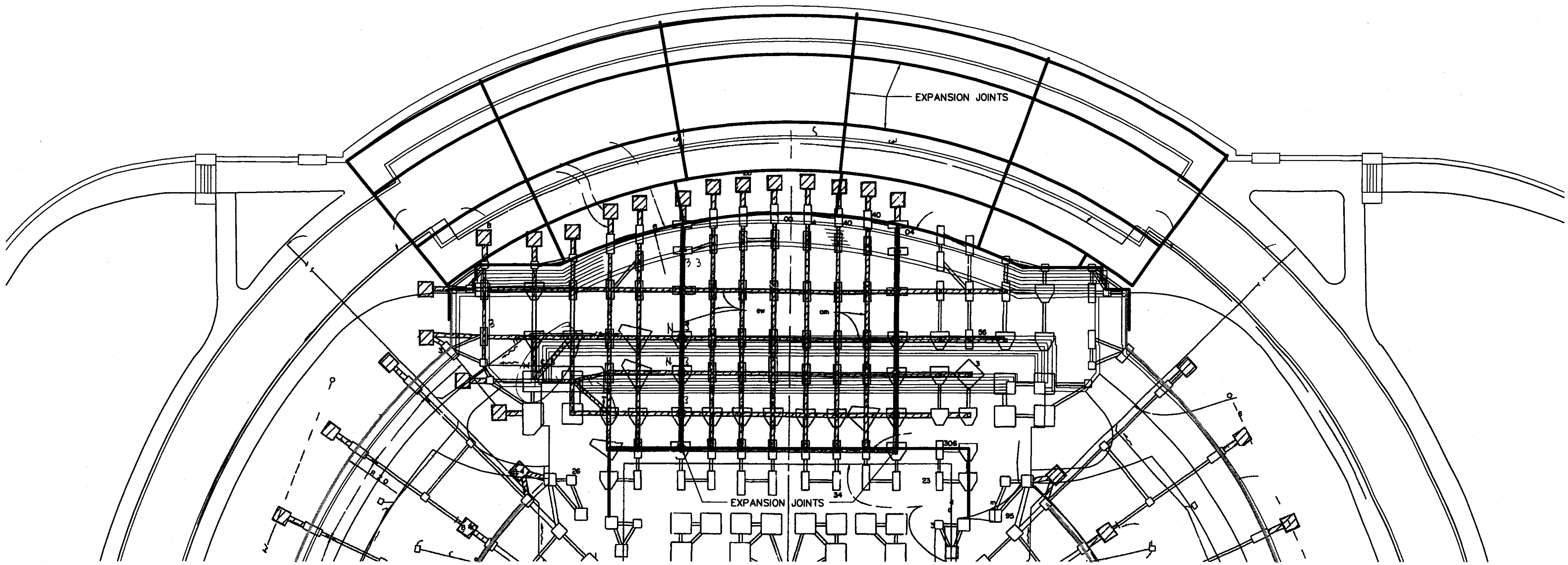
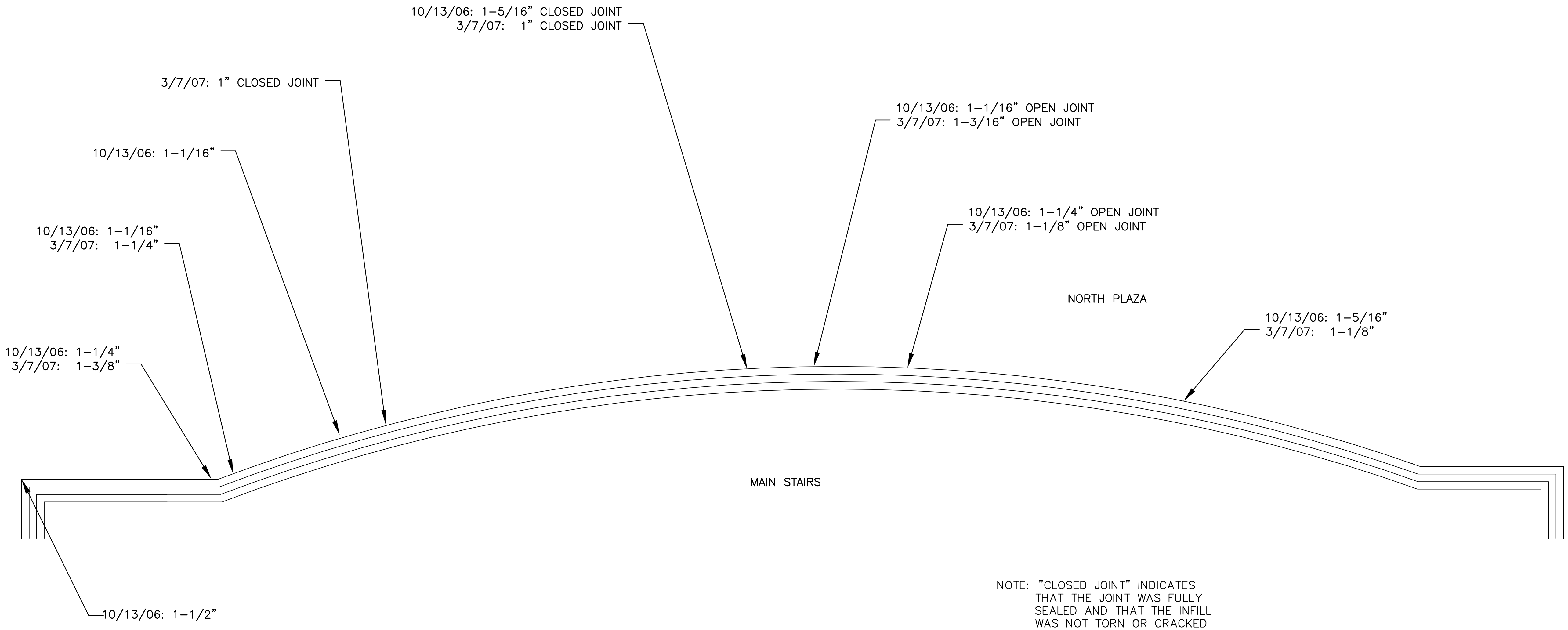


FIGURE 30 – NORTH PLAZA EXPANSION JOINTS

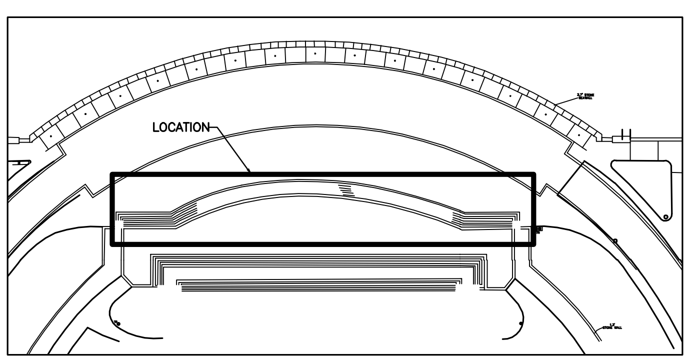
20 0 20 40
SCALE OF FEET

A/E FIRM HNTB ARCHITECTURE SCHNABEL ENGINEERING	Mark / Sheet / REVISION / Date / Initial NORTH PLAZA EXPANSION JOINTS TITLE OF DRAWING	SUB SHEET NUMBER	UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION BRANCH OF DESIGN AND CONSTRUCTION JEFFERSON MEMORIAL SETTLEMENT STUDY TITLE OF PROJECT THOMAS JEFFERSON MEMORIAL LOCATION WITHIN PARK NATIONAL MALL & MEMORIAL PARKS NAME OF PARK	HR NSF JG 128232 1/30/08 808/80284



NOTE: "CLOSED JOINT" INDICATES THAT THE JOINT WAS FULLY SEALED AND THAT THE INFILL WAS NOT TORN OR CRACKED

FIGURE 31 – JOINT BETWEEN MAIN STAIRS & NORTH PLAZA



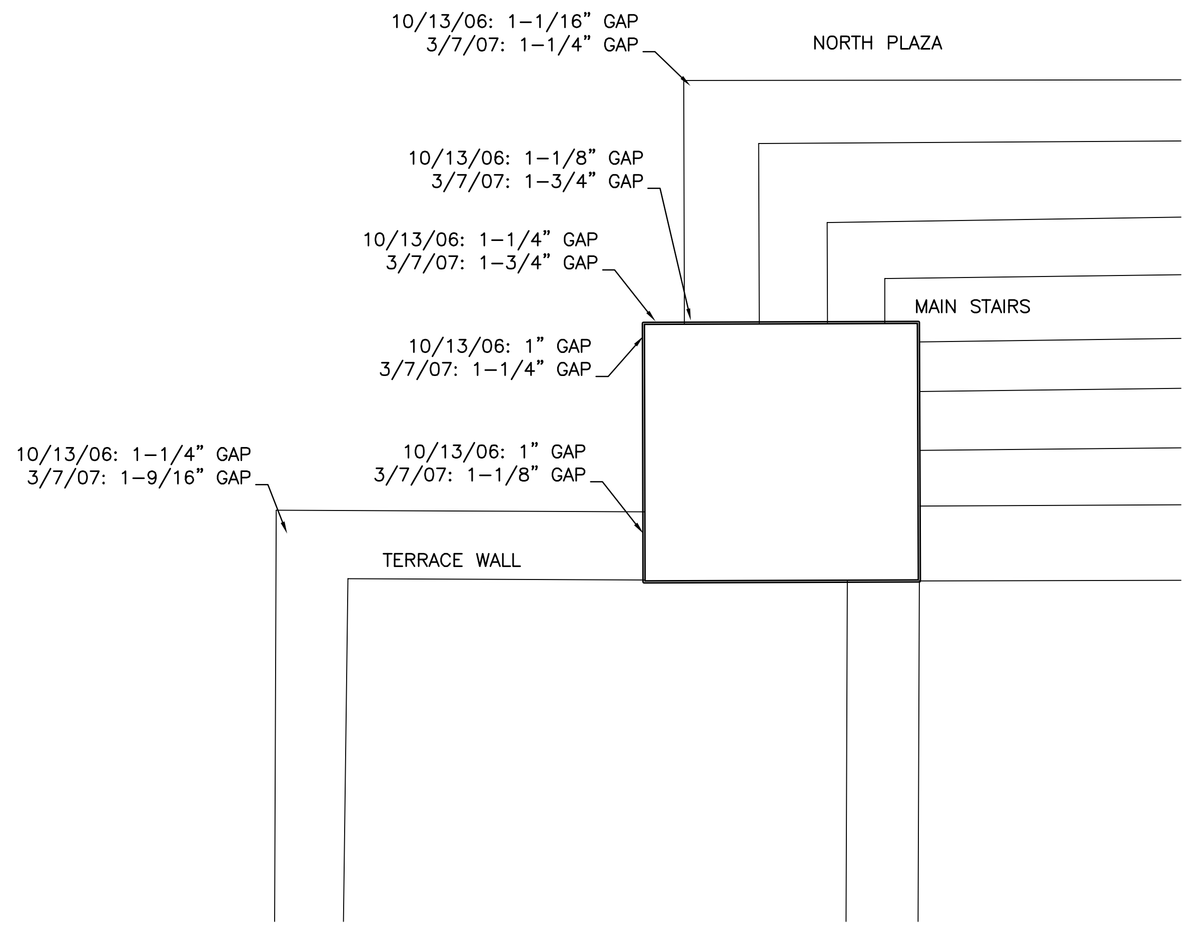
LOCATION PLAN

10 0 10 20
SCALE OF FEET

A/E FIRM	Mark	Sheet	REVISION	Date	Initial	UNITED STATES DEPARTMENT OF THE INTERIOR
HNTB ARCHITECTURE						NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION; BRANCH OF DESIGN AND CONSTRUCTION
SCHNABEL ENGINEERING						JEFFERSON MEMORIAL SETTLEMENT STUDY (TITLE OF PROJECT)
	JOINT BETWEEN MAIN STAIRS & NORTH PLAZA (TITLE OF DRAWING)				SUB SHEET NUMBER	THOMAS JEFFERSON MEMORIAL (LOCATION WITHIN PARK); NATIONAL MALL & MEMORIAL PARKS (NAME OF PARK)

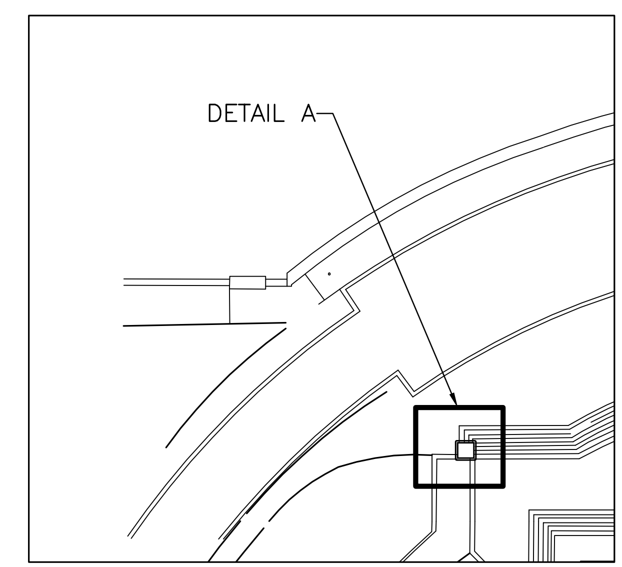
DESIGNED: HR
DRAWN: NSF
CHECKED: JG
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 12:30 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30ARC3.DWG



DETAIL A
NTS

FIGURE 32 – JOINT AT NORTHEAST CORNER OF MAIN STAIRS



PLAN VIEW OF STAIR LOCATION
NTS

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

JOINT AT NORTHEAST CORNER OF MAIN STAIRS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

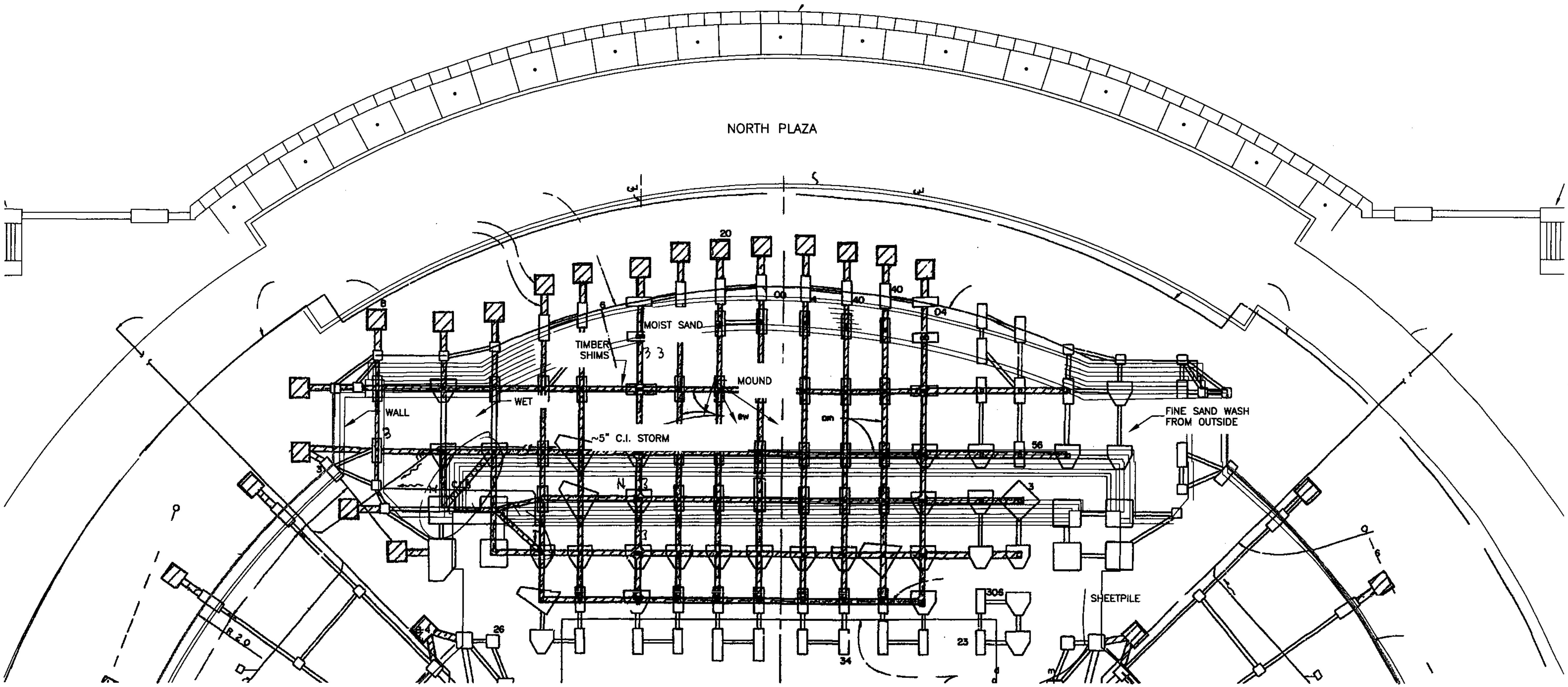


FIGURE 33 – BASEMENT UNDER MAIN STAIRS

15 0 15 30
SCALE OF FEET

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

BASEMENT UNDER MAIN STAIRS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
NSF
JG
128232
1/30/08
808/80284

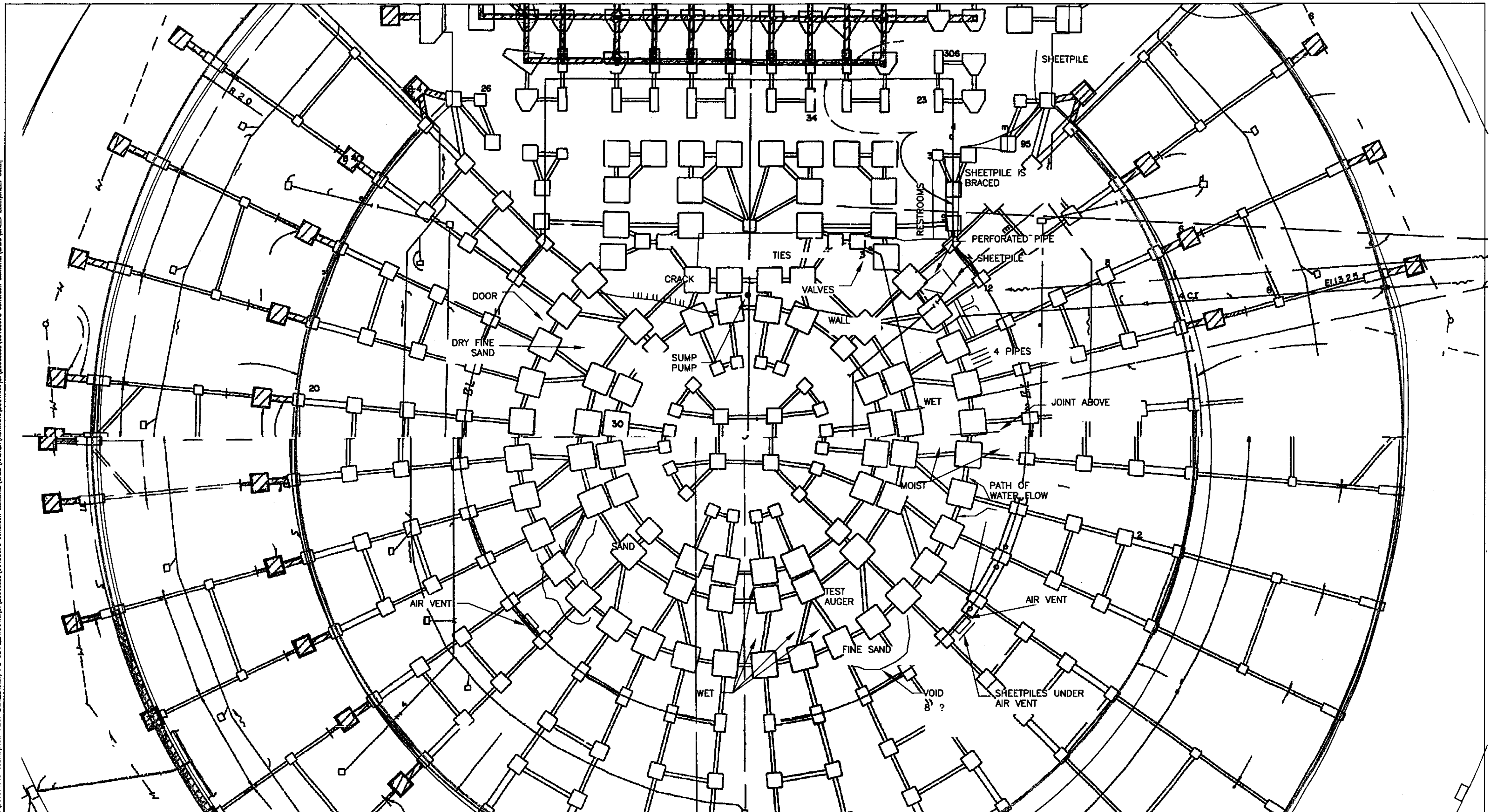


FIGURE 34 – CENTRAL BASEMENT

15 0 15 30
SCALE OF FEET

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

CENTRAL BASEMENT
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
NSF
JG
128232
1/30/08
808/80284

this area, several columns are still tied together with cables to arrest movement as described by Storch (1965). It was not clear if the cables were still performing a necessary function. There is evidence of moisture on the ground and on the underside of the stairs, and areas of wet soil likely due to infiltration of water from beneath the sheetpiles described below.

Schnabel personnel also accessed the area beneath the center of the Memorial, directly under the statue of Thomas Jefferson and outward to the Stylobate Stairs. The PVC sheetpiling along the Stylobate Stairs in this area was installed, according to the available information, with a tip elevation of roughly 10.5 ft (NAVD 29). This tip elevation is roughly 2 feet above the basement grade. A wedge of fill about 8-ft high and 12-ft wide abuts the sheetpiles. The central basement area shows considerable washout around the grade beams with sand boils and deposits of fine sand in patterns that suggest placement by water. There are significant voids, or gaps, along the grade beams and the perimeter of the pile caps as shown in Figure 35. In some cases, these voids are covered by a thin crust of carbonate impregnated soil, likely a product of leachate from the Memorial structure above. These voids represent a safety hazard and should be backfilled. The sheet piles were braced in some areas and are noticeably bulging in others. The appearance of the central area suggests that water and soil are regularly entering the basement. This is possible through the air vents which daylight at the base of the Stylobate Stairs, or beneath and through the sheetpiles which do not have a deep embedment. Although the water infiltration and soil migration are problems which should be addressed, Schnabel does not believe that they are related to the movements on the North Plaza and Ashlar Seawall. An additional study should be performed by the National Park Service to ascertain the existing condition of the sheetpiles, seepage of water, and voids around the pile caps and grade beams.

Figure 35. Pile Caps and Grade Beams in Central Basement (9-12-06)

iv. Northwest Stairs and Walkway

There is a set of stairs on the east and west sides of the North Plaza, at the concrete pathway leading up to the Plaza. On the west side, the stairs have a history of settlement and have been jacked and repaired several times. During the Storch (1969-1970) repairs, the stairs were jacked back up to grade using a steel “needle” beam. In 1998, the stairs and sidewalk were demolished and rebuilt with a reinforced slab that appears to bear on the seawall and on five H piles along their south side, parallel with the seawall. The steel piles are shown as existing in the plans for the restoration of the entrance steps and plaza in 1998, but it is not known when they were installed. Today, the stairs and adjacent walkway visibly lean toward the Tidal Basin, possibly due to settlement of the seawall.

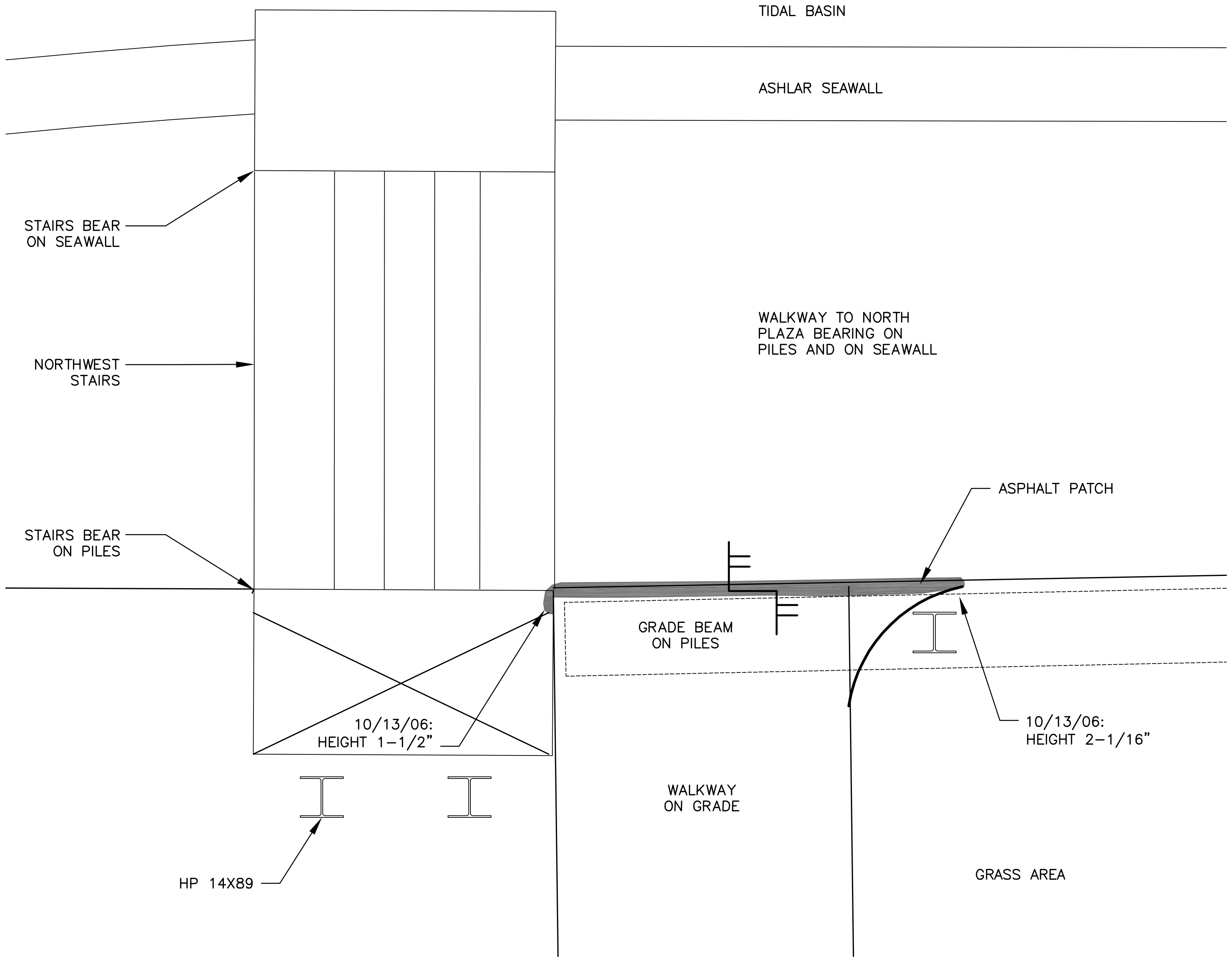
A slab-on-grade sidewalk intersects the stairs perpendicularly from the south. At this interface, there are differential elevations resulting in a tripping hazard, which has been mitigated through asphalt patching. Figures 36 and 37 show a sketch of the area and a photograph of the vicinity, respectively.

Figure 37. Asphalt Patch at Northwest Stairs (10-12-06)

The concrete walkway extends east from the Northwest Stairs to the North Plaza. This walkway is also supported on the seawall and on a grade beam on piles along its southern edge. Schnabel observed evidence of the grade beam on the adjacent grassy area. The Northwest walkway also leans toward the Tidal Basin likely due to settlement of the seawall.

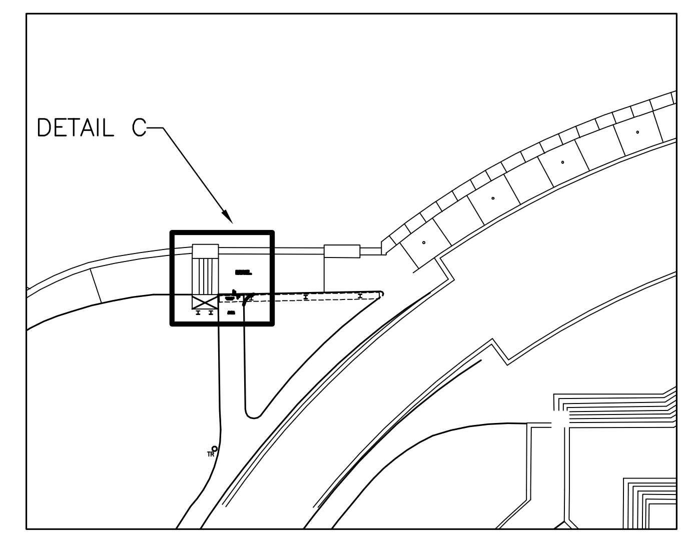
The walkway joins the North Plaza through a roughly triangular shaped segment of exposed aggregate concrete. The foundation for this triangular wedge is unknown. Schnabel personnel were able to introduce a measuring tape 12 to 20 feet under this area which suggests the existence of a significant void underneath this area. It is possible that this triangular wedge is supported on piles or that it is partially bearing on the walkway grade beam and on the North Plaza foundation. The triangular wedge is experiencing settlement, but at a lesser rate than the slab-on-grade for the Circular Roadway. Figure 38 shows the triangular wedge bounded by asphalt patches.

We recommend that this triangular wedge be demolished, backfilled and rebuilt. This will afford the opportunity to study the foundations for this portion of the North Plaza and to mitigate the potential risk for collapse.



DETAIL C
NTS

NOTE: THE ASPHALT PATCH IS AT A LOCATION WHERE THE WALKWAY ON GRADE EXTENDS OVER THE GRADE BEAM ON PILES. AS THE WALKWAY ON GRADE SETTLES, THE BEAM ACTS AS A HINGE AND THE NORTHERN EDGE OF THE WALKWAY RISES.



PLAN VIEW OF STAIR LOCATION
NTS

FIGURE 36 – NORTHWEST STAIRS

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

NORTHWEST STAIRS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 10:38 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30WEST_STAIRS.DWG

Figure 38. Standing on West Approach Walk and looking at Triangular Wedge (10-12-06)

v. West Terrace Walk

Settlement is also occurring on the exposed aggregate concrete sidewalk that leads to the exhibit area on the west side of the Terrace Walk. As shown in Figure 39, there is an asphalt patch in this area to mitigate tripping hazards. Figure 40 displays differential settlement measured at this location. At the entrance to the exhibit areas on both the east and west sides, the marble doorways are also exhibiting some movement. In past repairs to the Jefferson Memorial these doorways have been reset. Figure 41 shows measurements taken during Schnabel's visual survey in October 2006.

Figure 39. West Terrace Walkway Looking Toward Main Stairs (10-12-06)

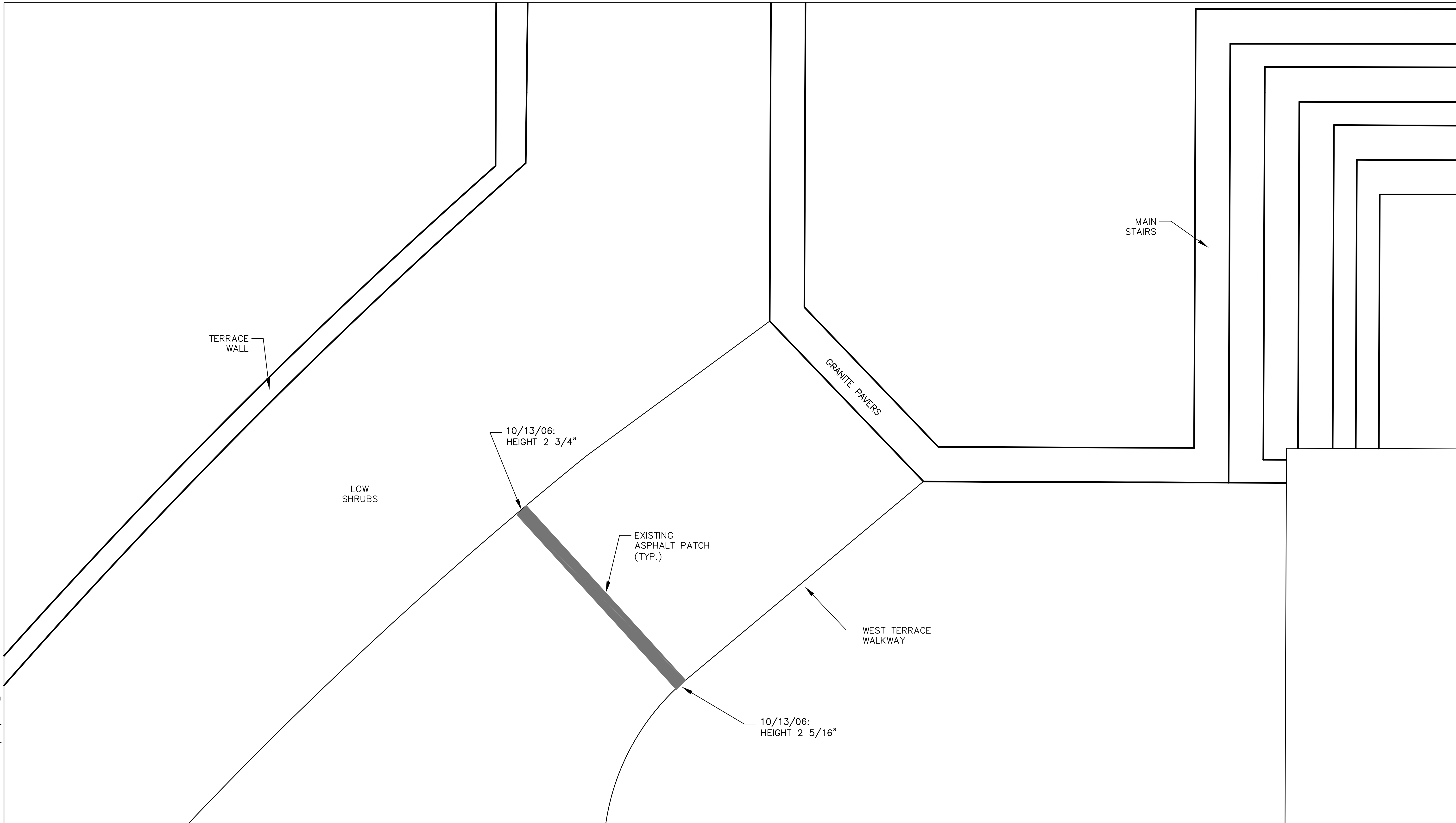


FIGURE 40 – WEST TERRACE WALKWAY

2 0 2 4
SCALE OF FEET

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

WEST TERRACE WALKWAY
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

1/29/08 09:00 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30INNER_WESTWALK.DWG

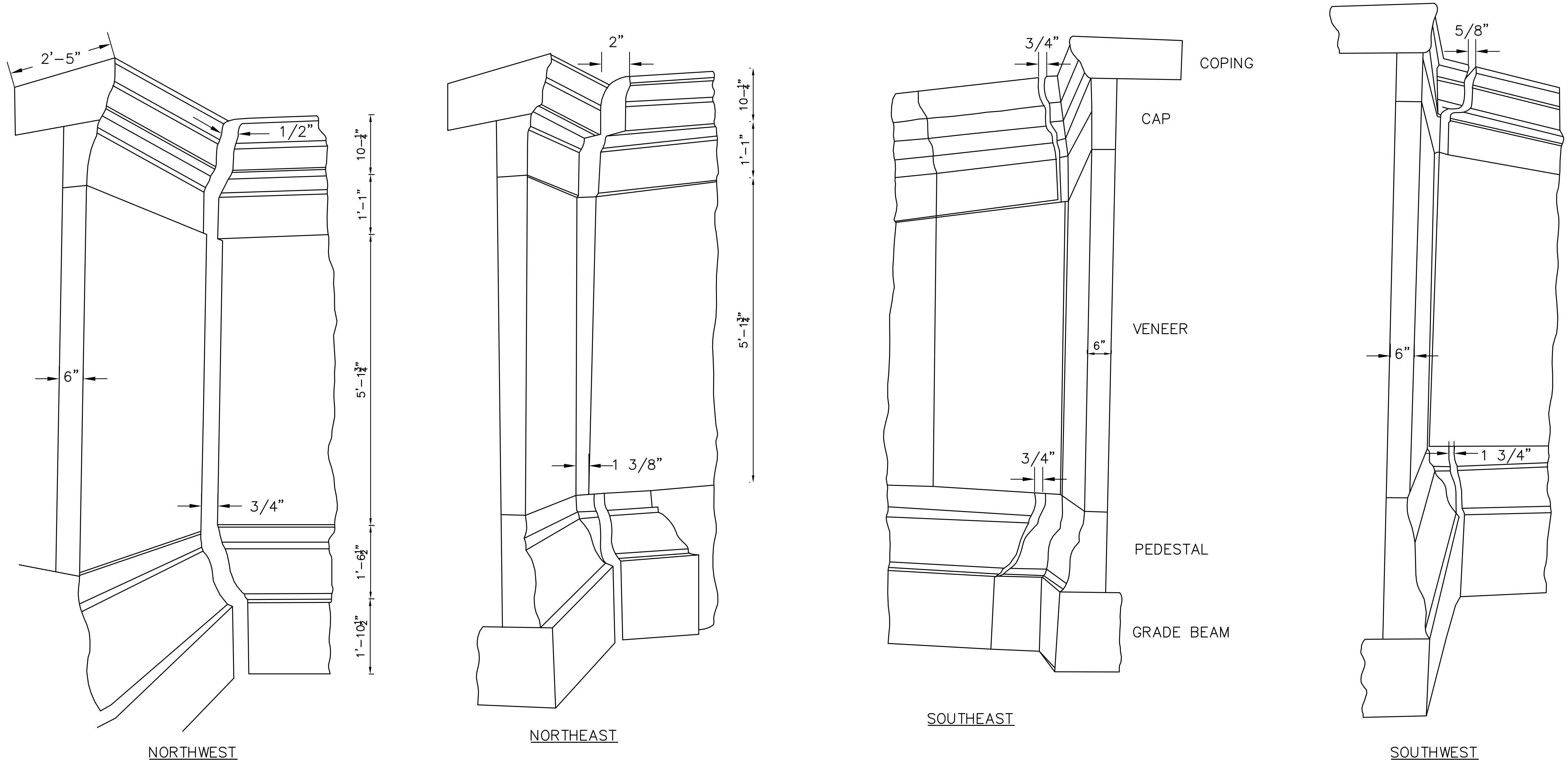


FIGURE 41 – EXISTING EXPANSION JOINTS AT STYLOBATE WALL
N.T.S.
(ISOMETRIC VIEWS TRACED FROM STORCH ENG. DWG., SHT. 23 OF 58, DATED 3/28/69)

NOTE:
MEASUREMENTS TAKEN DURING
SURVEY ON 10/13/06

5 0 5 10
SCALE OF FEET

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

EXPANSION JOINTS AT STYLOBATE WALL
TITLE OF DRAWING

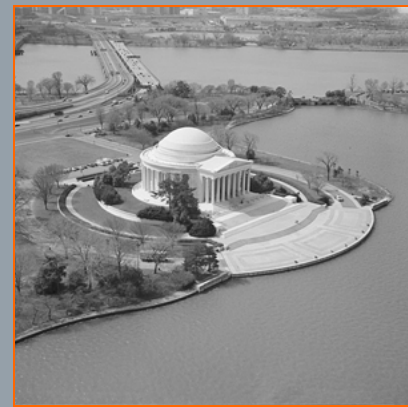
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
SMF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE 1/30/08
DWG. NO.
808/80284

This section of the report presents visual observations by Schnabel personnel during our site visits. The observations are focused on the areas immediate to the Ashlar Seawall and North Plaza and other locations as directed by NPS. There may be other areas of the site that are not documented.



4. SITE INVESTIGATION AND INSTRUMENTATION

4. SITE INVESTIGATION AND INSTRUMENTATION

I. GEOLOGY

The geologic stratigraphy of the Washington, DC, area consists of Pleistocene Age terrace deposits overlying residual materials derived from the weathering of the cretaceous rock of the Potomac Formation. The terrace deposits are alluvial soils that typically consist of a mixture of sand, clay and gravel. These soils generally exhibit moderate to high strength, and low to moderate compressibility. The underlying residual soils are derived from the chemical and physical weathering of the underlying parent material: the Patuxent arkosic sands. At the project site, Pleistocene Age terrace soils were extensively eroded by the Potomac River and were replaced with recent alluvial deposits. Significant filling of this area took place early in the 20th Century during reclamation of the West Potomac Park.

II. HISTORICAL SUBSURFACE INVESTIGATIONS

Prior to construction of the Jefferson Memorial in 1939, the Army Corps of Engineers performed 13 core borings to determine a suitable location for the Memorial in the southern portion of West Potomac Park. Once the site was selected, 14 soil borings were completed in the vicinity. Casing was driven using a 300 pound hammer falling 18 inches, and the blows per linear foot were recorded. The borings were advanced using the wash method within the 3.5-inch casing until reaching top of rock, and by diamond-bit coring through rock. From this information, the depth to bedrock was determined, and end bearing caissons were selected for the foundation type.

In 1965, Storch Engineers completed 13 soil borings around the Memorial to obtain information to design the piles for the rehabilitation of the North Plaza. The borings were advanced using a 4- or 2.5-inch I.D. casing driven with a 300 pound hammer falling 24 inches. The sampler was 1⅜-inch I.D. and was driven using a 140 pound hammer falling 30 inches. The blow counts for both the casing and the sampler are shown on the boring logs which are included in Appendix B.

Schnabel cannot attest to the veracity of the historical subsurface investigations listed above, as we were not present during the exploration. As part of the Einhorn Yaffee Prescott reports that were produced in 1990 and 1992, Schnabel Engineering Associates completed one test boring in 1992 on the west side Terrace Level near the Stylobate Wall. The boring was advanced by 3¼-inch I.D. hollow stem auger and soil samples were collected via the 1⅜-inch I.D. split-spoon sampler using a 140 pound hammer falling 30 inches. The log is included in Appendix B in the subsection “Subsurface Exploration Data, SEA 1992.” The data from these investigations were collected from historical documents and reproduced in this report.

III. CURRENT SUBSURFACE INVESTIGATIONS

i. Soil Borings

Connelly and Associates, Frederick, Maryland, drilled seven borings at this site under the observation of Schnabel. Appendix B includes specific observations, remarks, and logs for the borings; classification criteria; and sampling protocols in Appendix B. Figure 42 shows the location of these borings as well as the Storch borings from 1965 and the Schnabel Engineering Associates boring from 1992.

For this investigation, four borings were drilled through the North Plaza, two were advanced in the center basement area, and one boring was performed on the southeast Circular Roadway. They were drilled with a 4¼-inch I.D. hollow stem auger and sampled with a 1⅜-inch I.D. split spoon

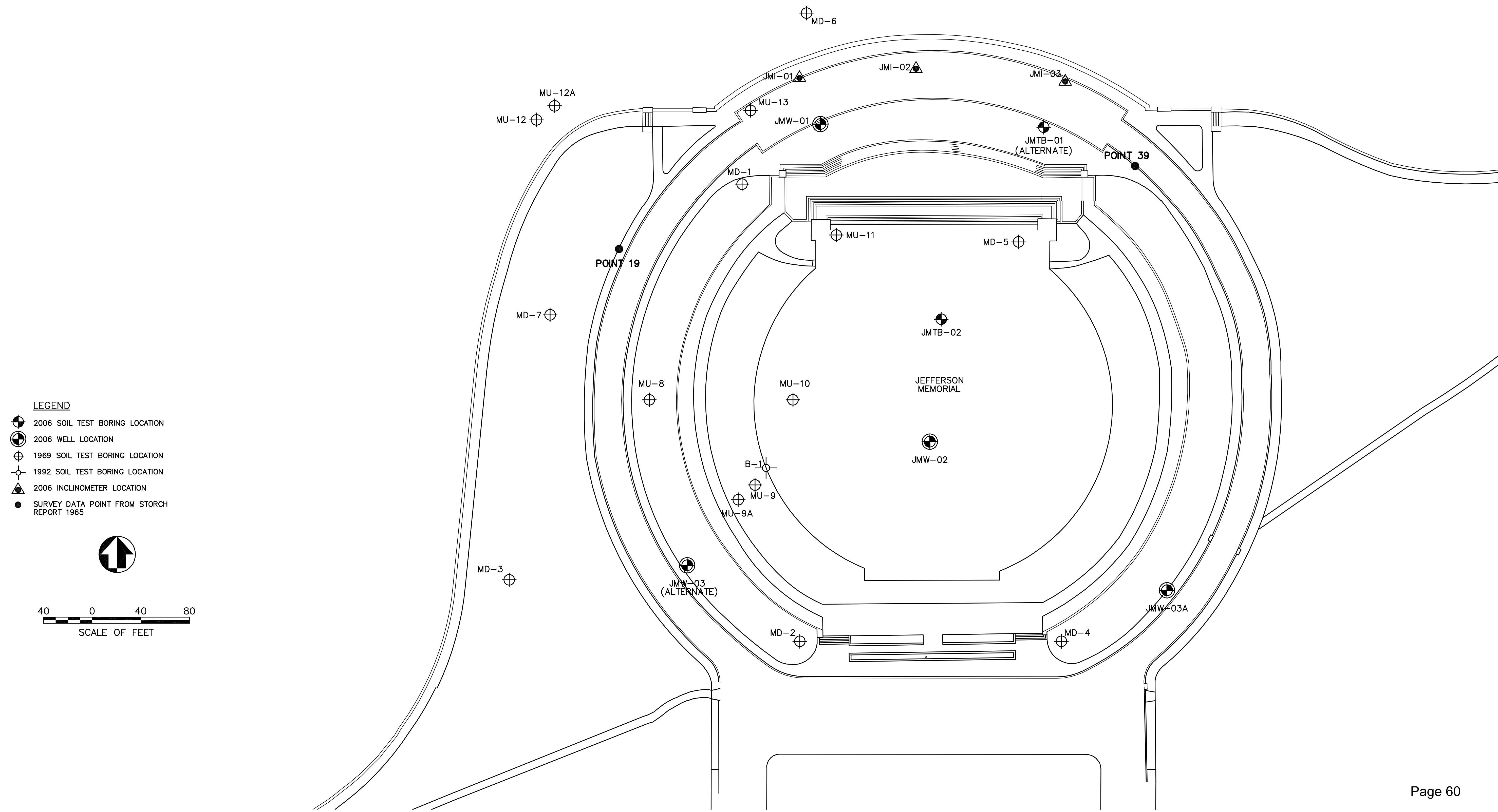


FIGURE 42 – TEST BORING LOCATION PLAN

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM

HNTB ARCHITECTURE

SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

TEST BORING LOCATION PLAN
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

1/28/08 11:57 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\51BORING.DWG XREFS: G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\30ARC3.DWG; .\30GR_PAVERS.DWG; .\30SEAWALL_JOINTS.DWG; .\30WEST_STAIRS.DWG; .\30WESTWALK.DWG;
IMAGES: G:\2006Jobs\06150078 Jefferson Memorial\CADD\Doc061010-003.TIF|PART-PLAN-EAST_END.tif|PIPE-SLAP_LAYOUT.tif|G:\2006Jobs\06150078 Jefferson Memorial\CADD\RASTER\NORTH.TIF|SOUTH.TIF|G:\2006Jobs\06150078 Jefferson Memorial\CADD\SHEET 28.tif|SHEET 30.tif|

sampler using a 140 pound hammer falling 30 inches. Due to limited basement access, the two borings inside the Memorial were advanced using a tripod rig.

Schnabel personnel cored the concrete slab of the North Plaza in order to advance the four borings (JMI-01, JMI-02, JMI-03, and JMW-01). The core obtained from the slab generally matched the rebar spacing and thickness shown on Sheet 30 of 58 in the 1969 construction plans by Storch Engineers (NPS File No. 808_40001).

During observation of the core holes, we noted a void beneath the bottom of the North Plaza slab where the soil below the slab is no longer in direct contact. This void ranged from about four inches on the east side of the Plaza to about 14 inches on the west side, near the Ashlar Seawall. It is documented in Borings JMI-01, JMI-02, JMI-03, and JMW-01, which are located in Appendix B. According to Mr. Dean Robinson, the retired NPS engineer who assisted with the design of the North Plaza in 1969, the slab was formed and poured directly on the fill soils. Therefore, it seems that this void was the product of settlement occurring after the North Plaza reconstruction. The measured thickness of the void was largest in JMI-01, which is near one of the wall joints in the Ashlar Seawall. Therefore, it is possible that washout of the wall backfill has contributed to the development of the void near the seawall.

ii. Generalized Subsurface Stratigraphy

We have characterized the following generalized subsurface soil stratigraphy based on the boring data presented in Appendix B:

Stratum A1 – **Sand Fill:** Fine- to coarse-grained, clayey or silty sand, wet, dark brown, black or gray, contains mica, gravel, rock fragments, brick fragments, and crushed shells.

Stratum A2 – **Clay or Silt Fill:** Lean clay with varying amounts of sand, and sandy or elastic silt, wet, black, gray, or green-brown, contains root fragments, gravel, and mica.

Stratum B1 – **Sand Alluvium:** Poorly graded sand, silty sand or clayey sand, wet, dark gray, brown, or black, contains organics.

Stratum B2 – **Clay or Silt Alluvium:** Sandy or elastic silt, lean or fat clay with varying amounts of sand, wet, dark gray, black or brown, trace mica, shell fragments, and some organics.

Stratum C – **Coarse Rock (Schist):** Poorly graded gravel-sized rock fragments (schist) with silt and sand, wet, green and brown.

Stratum D – **Disintegrated Rock (Schist):** Black, brown, or green-blue. Disintegrated rock is defined as residual material with N values in excess of 60 blows per foot and less than 100 blows for two inches of penetration.

Stratum E – **Rock (Schist):** Soft, slightly weathered, slightly fractured, green and black.

As described in the Historical Information section of this report, fill materials at the memorial site were placed in at least two stages. In 1908, the Potomac River was dredged to form West Potomac Park. From the report by Einhorn Yaffee Prescott (1992), "it is likely these fills were hydraulically placed over soft, highly compressible alluvial soils extending down to about EL -80 to -95 (NAVD 29), where bedrock is encountered." In 1940-1941, fill was added to modify the shoreline according to the Jefferson Memorial design plans.

The stratigraphy observed during our exploratory borings is generally consistent with the historical information. Mica schist bedrock was encountered between EL -82 and -93 (NAVD 29), and fill soils were recorded to a minimum EL -16.8 (NAVD 29). The fill is underlain by soft alluvial materials with alternating layers of fine-grained and granular soils. The alluvium contains organics, and in some cases classifies as organic silt.

Four boring cross-sections are presented in Appendix B, which shows the 1965 Storch borings and the borings completed by Schnabel in 2006. The sections are oriented in various directions across the Memorial grounds, and encompass borings located within 30 ft of the section line on either side. Information and distances along the top of the cross sections are provided to facilitate their interpretation and are only approximate.

iii. Ground Water

The boring logs completed for this study note ground water level readings measured during drilling and after completion of the borings. Connelly and Associates, the drilling subcontractor, installed ground water monitoring wells in Borings JMW-01, JMW-02 and JMW-03A. Schnabel recorded ground water levels in the wells during monthly instrumentation readings from November 2006 to January 2008. Water level elevation readings for the wells are shown in Table 3. An average ground water elevation is also listed for each monitoring well.

Table 3. Ground Water Monitoring Well Readings Between November 2006 and January 2008 (NAVD 29)

	Water Elevation (ft)		
Date	JMW-01	JMW-02	JMW-03A
11/21/2006	1.30	3.39	4.66
12/19/2006	1.27	3.90	3.72
1/5/2007	1.75	-	3.71
2/28/2007	1.76	3.75	3.52
5/7/2007	1.15	3.36	3.80
6/26/2007	-0.24	3.92	2.90
1/15/2008	1.75	3.50	5.19
Average Elevation	1.25	3.64	3.93

The data in Table 3 suggest a ground water gradient of approximately 0.6 percent toward the Tidal Basin. The average water elevation in the Tidal Basin during this period was approximately EL 1.2 according to the data from the National Oceanic and Atmospheric Administration (NOAA) for Station # 8594900 located approximately one mile downstream on the Washington Channel, adjusted to the Jefferson Memorial site. This adjustment was developed by comparing the Tidal Basin water elevation measured manually during a site visit by Schnabel, to the NOAA data for that station on the same day and at the same approximate time of day. Our estimated adjustment was approximately +2.1 ft to the NOAA data. We conclude that the ground water elevation is consistent with the Tidal Basin water elevation.

Based on our experience, the magnitude and direction of the ground water gradient is typical and not likely directly related to the observed settlement and displacements. However, piezometer readings that provide data on piezometric head with depth do show some possible correlation with observed movements as explained in subsequent sections.

IV. INSTRUMENTATION

i. Inclinometers

Inclinometers are instruments used to measure lateral soil movements and have applications in slope stability and wall monitoring. A casing with two orthogonal sets of diametrically opposed grooves is permanently installed inside a borehole. The annular space between the casing and the borehole wall is filled with grout. The inclinometer probe is fitted with two wheels that allow it to travel along one set of grooves inside the casing. The probe measures the inclination of the casing at each depth interval (typically 2 feet). This information is collected by a datalogger at the surface.

The inclinometer probe is inserted to the bottom of the casing along one set of grooves, and hoisted at two-foot intervals until the probe reaches the surface. This process is repeated along the orthogonal set of grooves. The data is then processed by computer software that develops a profile of the casing. Subsequent inclinometer readings collected over time are compared to the first, or baseline reading, to determine the direction and magnitude of the lateral movements of the soil mass.

Inclinometer casing was installed in JMI-01, JMI-02, and JMI-03 on the North Plaza. JMI-01 and JMI-02 are located along the western half of the seawall, where significant settlement has historically occurred, and where fill was placed in the tidal basin to alter the shoreline. JMI-03 is located to the east of the old seawall (see Figure 10 for location of seawall prior to 1938). These borings are protected by flush-mounted well caps that are removed to obtain inclinometer readings. The groove orientation for each inclinometer is shown in Figure 43, and data for each of the locations is shown in Figures 44 through 46.

The readings obtained from December 2006 to January 2008 show movement in the northwest direction. Inclinometer JMI-01 shows a total of about 0.73 inches movement 32 degrees west of north. Inclinometer JMI-02 shows a total of about 0.36 inches of movement 51 degrees west of north. Inclinometer JMI-03 shows a total of about 0.11 inches movement 32 degrees west of north. The data shows that lateral movement occurs to a depth of about 60 feet (EL -53.3) in JMI-01 and JMI-02. These data indicate the ground under the Memorial is undergoing significant lateral displacement at an average rate of about 0.33 inches per year within the top 10 feet of the surface of the North Plaza.

ii. Vibrating Wire Piezometers

Piezometers are instruments used to measure pore water pressure within the ground. At the Jefferson Memorial, one Vibrating Wire Piezometer was installed in each JMI-01 and JMI-03 borings. The instrument was taped to the outside of the inclinometer casing, and grouted in the borehole. Piezometer JMI-01 is at a depth of 54 ft (EL -47.5), and JMI-03 is located at a depth of 39 ft (EL -32.2). The elevations of these instruments were selected to correspond with Shelby tube sampling and lab testing performed in Borings JMI-01 and JMI-03. The instruments are each connected to a datalogger, which records the signal from the piezometers every half hour. The dataloggers can store up to 800 readings and can be connected to a laptop to download the data periodically. Dataloggers are located inside the well caps of JMI-01 and JMI-03.

Figure 47 shows the pore pressure data collected by each piezometer. The plot shows a drop in the pore pressure of about 0.6 psi in piezometer JMI-01, and of about 0.8 psi in JMI-03 from November 2006 until January 2008 (1.2 years). This apparent drop in pore water pressure corresponds to a drop in piezometric head of about 1.4 to 1.8 ft, respectively. This variation of piezometric head does not correlate well with Tidal Basin fluctuations during this period. Furthermore, it is not likely that the piezometers would react quickly to Tidal Basin fluctuations given the depth at which they are located and the low permeability of the surrounding soils. From

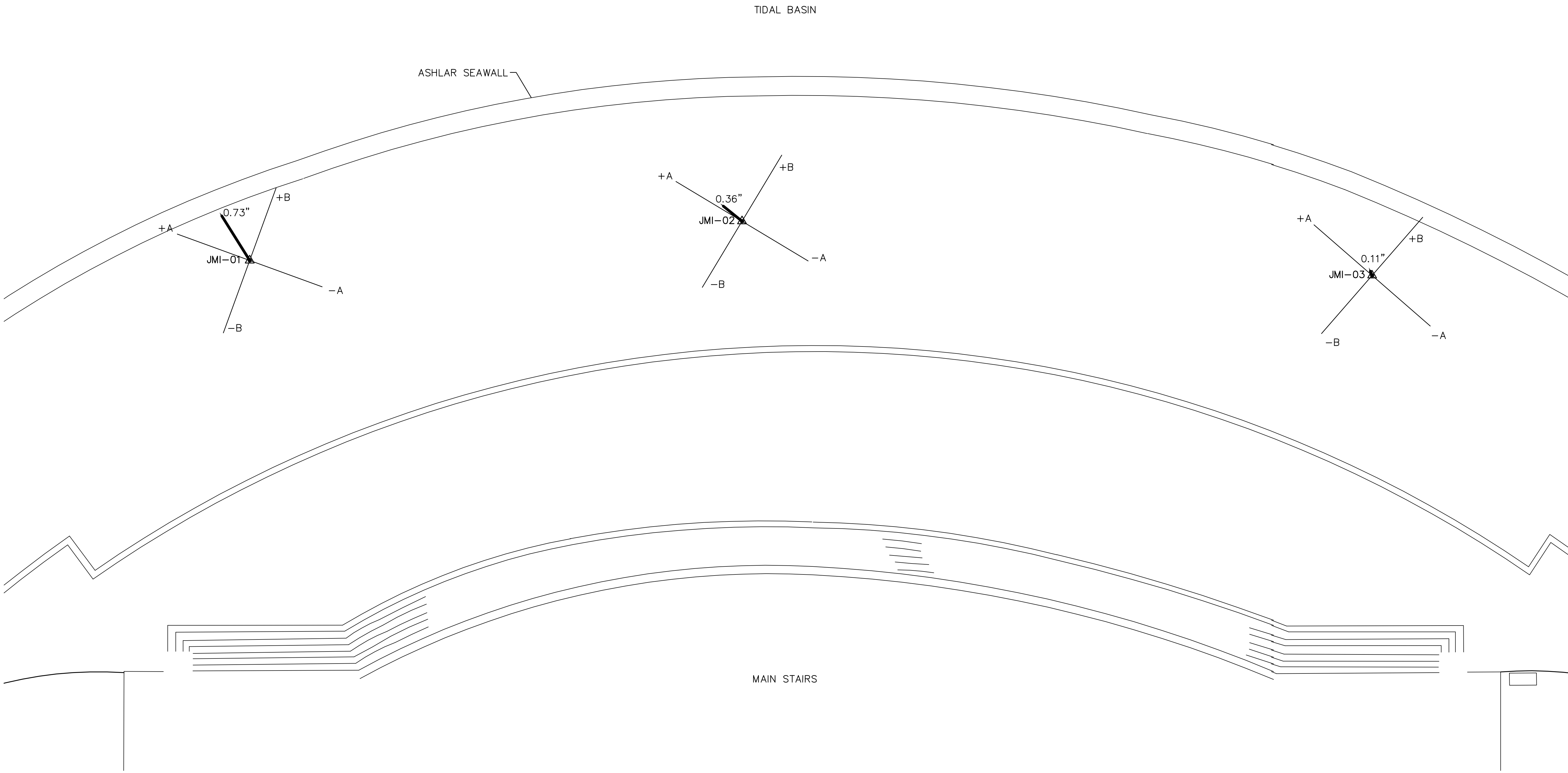
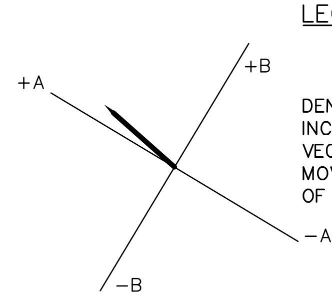
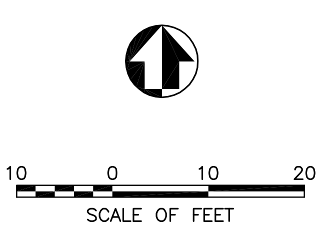


FIGURE 43 – INCLINOMETER AXIS ORIENTATION

LEGEND



DENOTES ORIENTATION OF INCLINOMETER AXES AND VECTOR OF LATERAL MOVEMENT WITHIN 10 FT. OF THE GROUND SURFACE



A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

TITLE OF DRAWING

SUB SHEET NUMBER

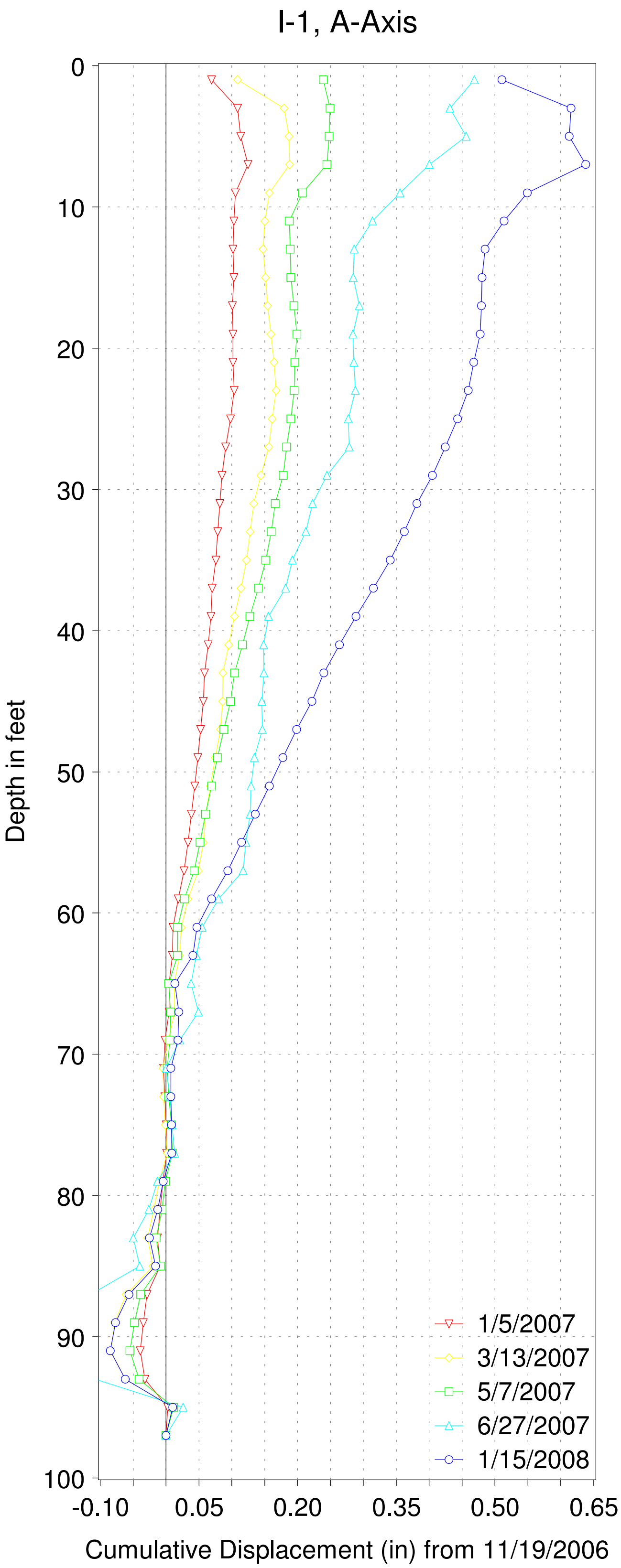
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

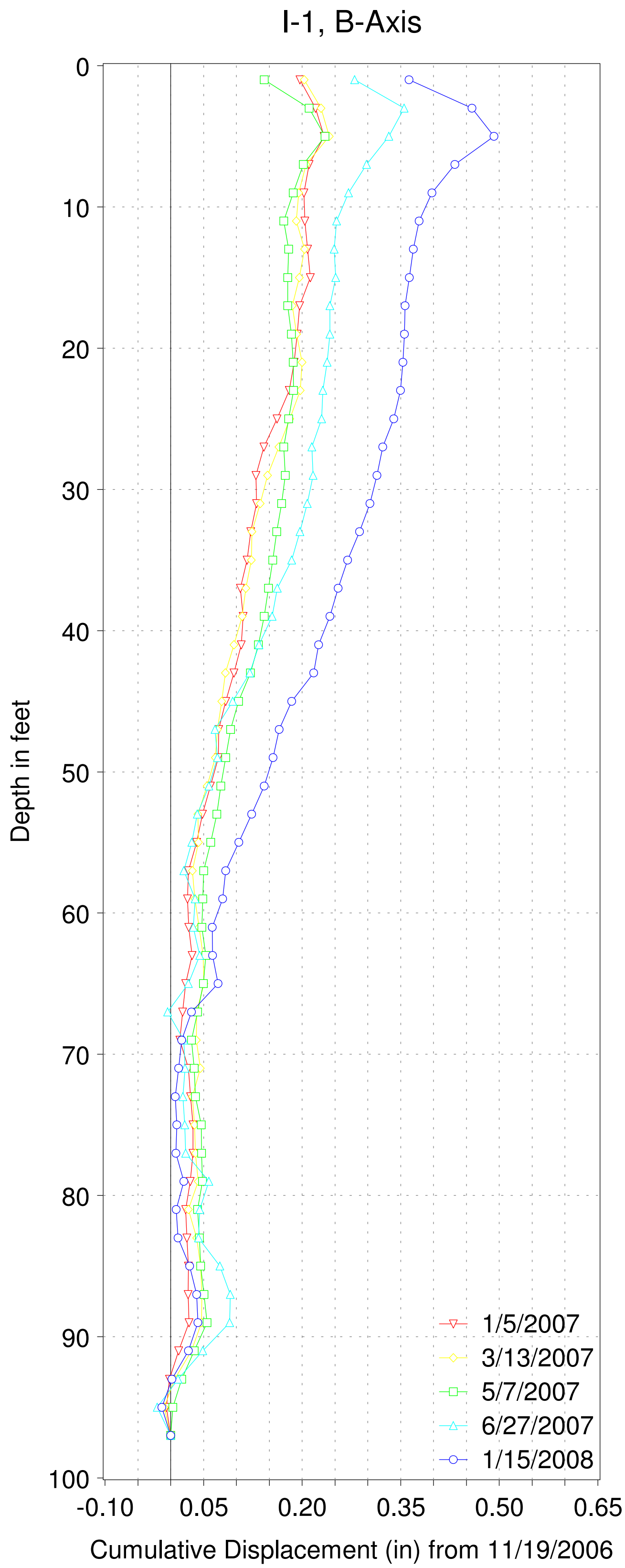
JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
JM
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

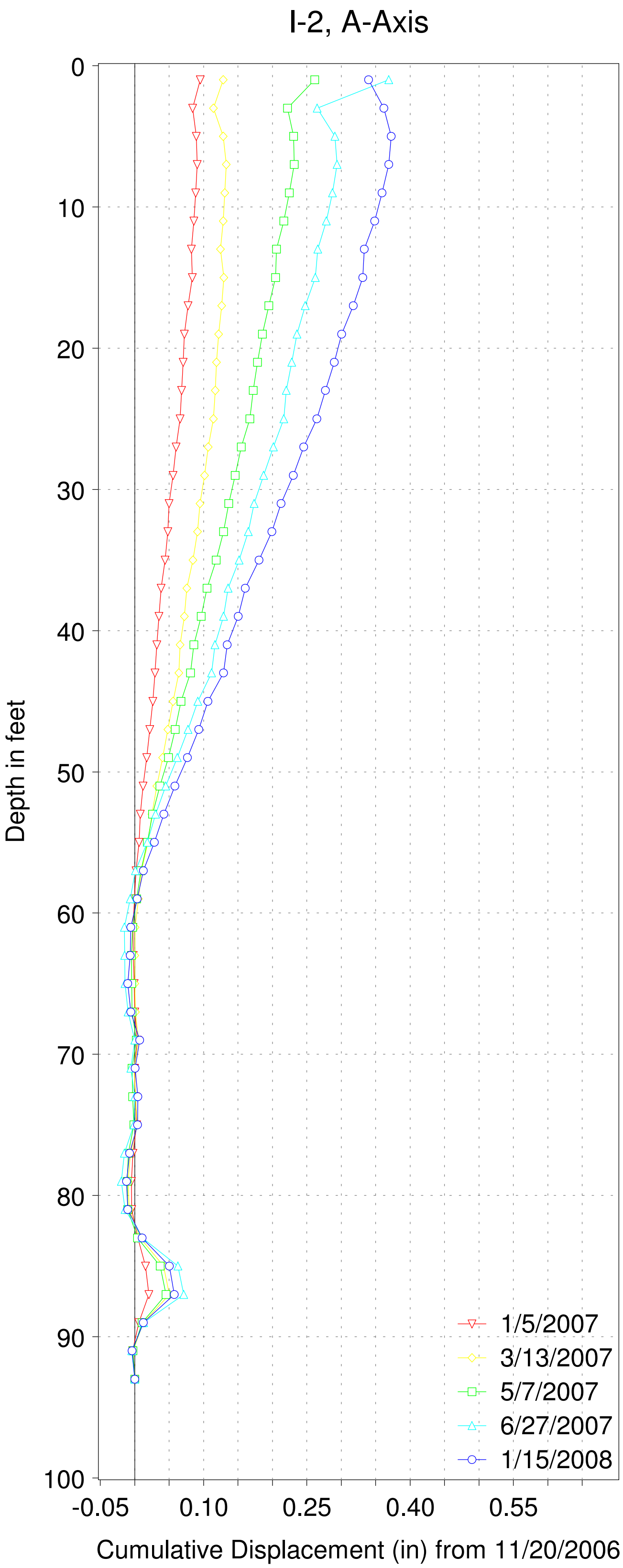
1/29/08 10:45 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\51INCLINOMETER_AXES.DWG

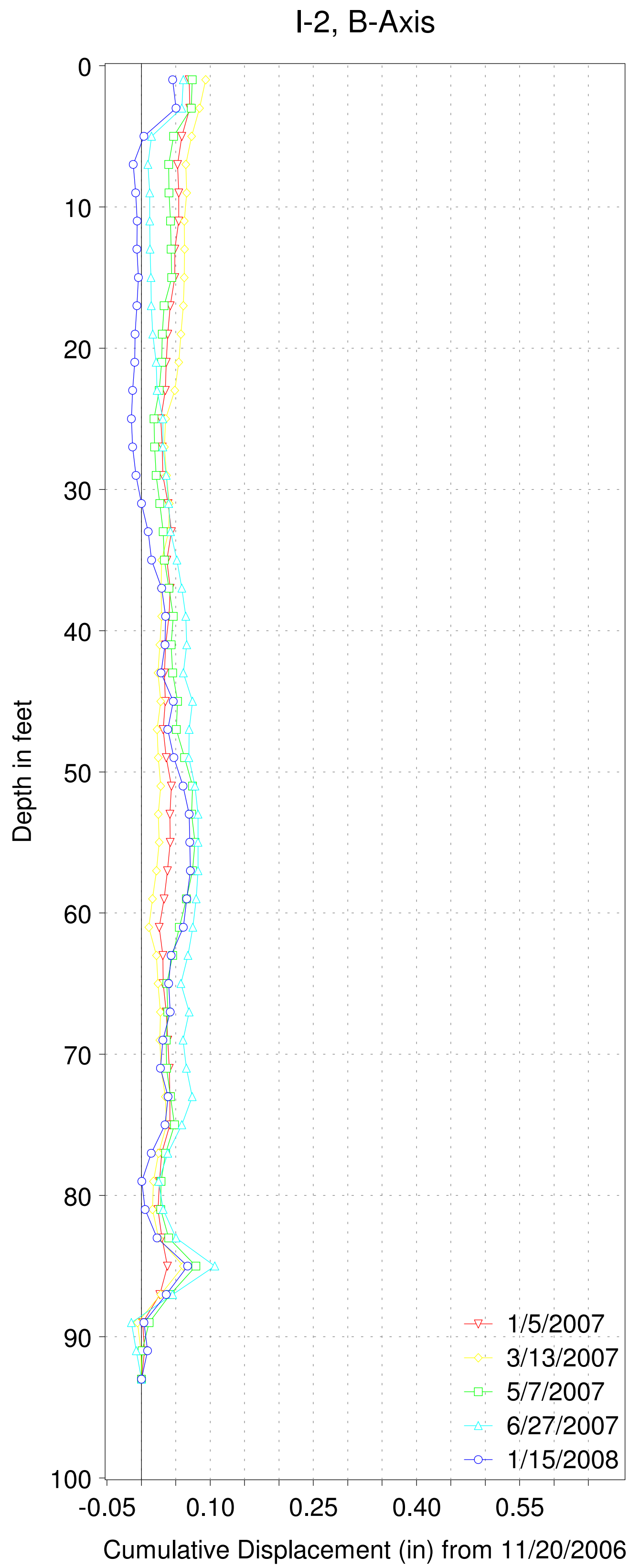




06150078 Jefferson Memorial
Baseline @ 11/19/06
Orientation Adjusted to Match I-2
Figure 44

Schnabel Engineering

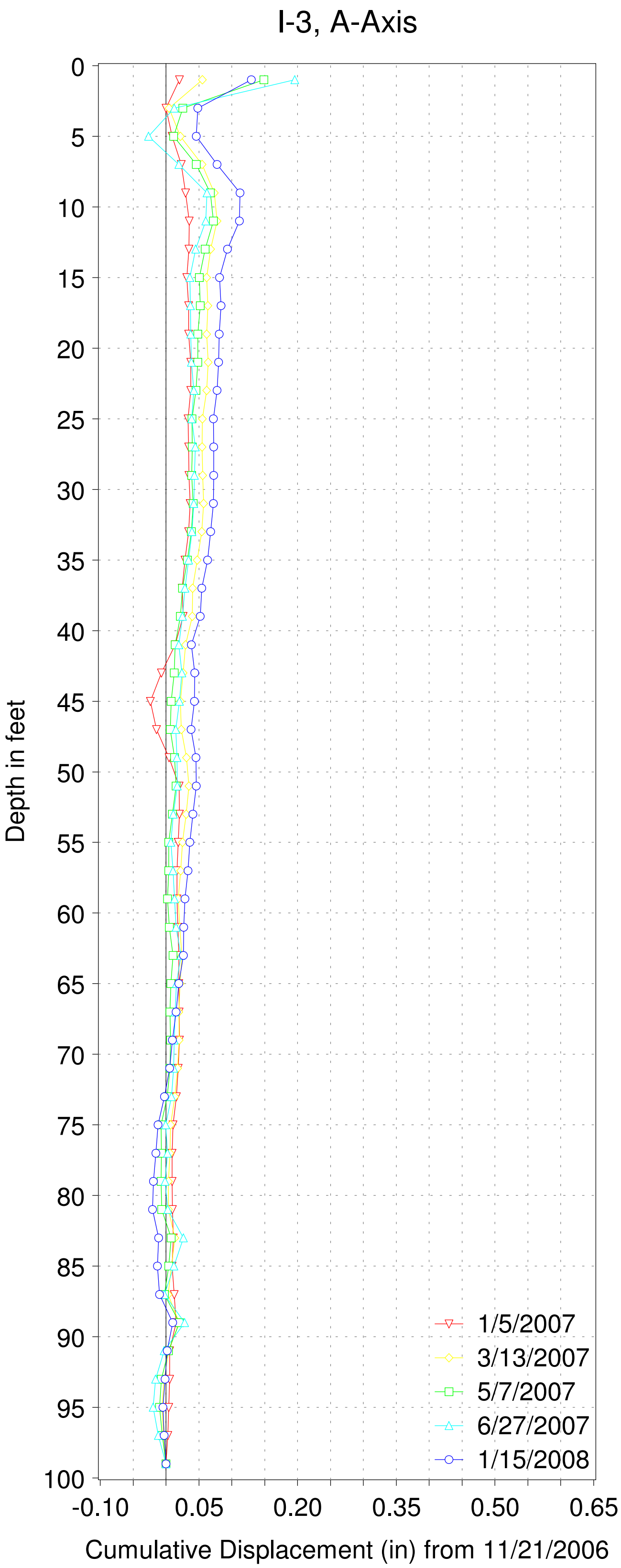


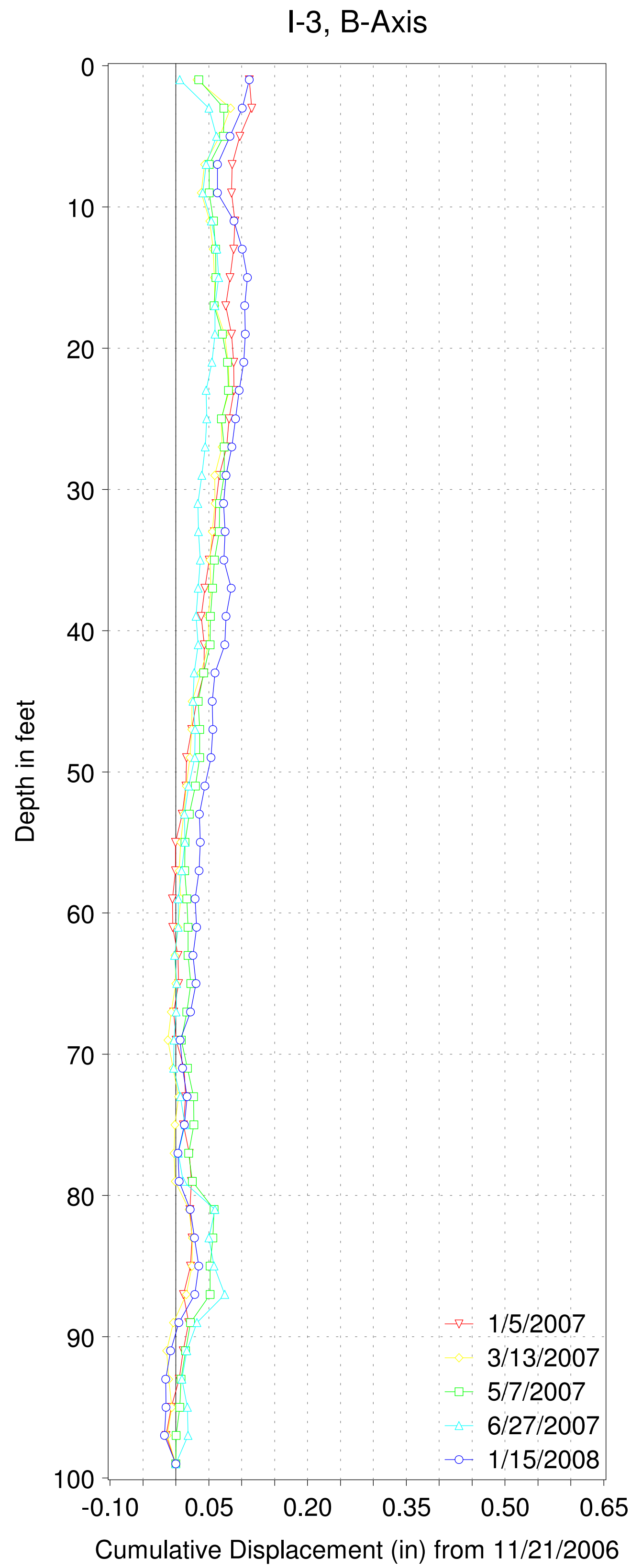


06150078 Jefferson Memorial
Baseline @ 11/20/06

Figure 45

Schnabel Engineering





06150078 Jefferson Memorial
Baseline @ 11/21/06
Orientation Adjusted to Match I-2
Figure 46

Schnabel Engineering

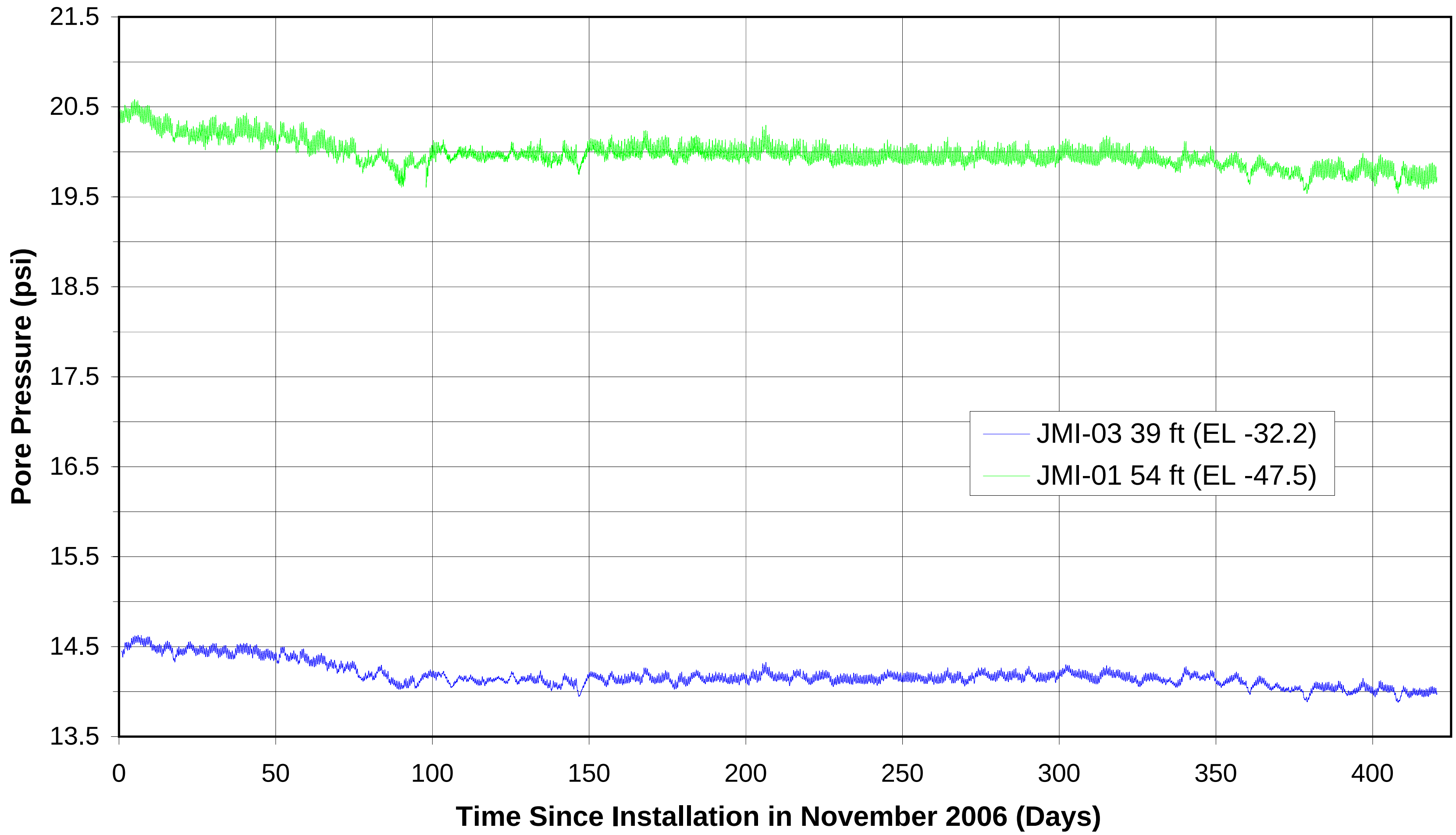


Figure 47. Vibrating Wire Piezometer Data

November 2006 to mid February 2007, the piezometers show a downward trend in pore water pressure. Generally between February 2007 and October 2007, the piezometric readings suggest a constant pore pressure. From October 2007 to January 2008, the pore water pressure again shows a downward trend. It is not likely that this trend corresponds to seasonal variation because it is continued throughout the monitoring period. It is possible that this trend is associated with consolidation of the soils at the site, which may be directly related to the observed settlements. Schnabel Engineering recommends continued monitoring of the piezometers to verify this trend.

It is important to note that the measured pore pressures are lower than the theoretical pore pressures corresponding to a hydrostatic condition. At JMI-01, the piezometric head at EL -47.5 is about 2.8 ft less than hydrostatic. At JMI-03, the piezometric head at EL -32.2 is about 0.6 ft lower than hydrostatic. The hydrostatic head was estimated based on the average tidal pool elevation. Additional monitoring is necessary to confirm these results.

iii. Tiltmeters

Tiltmeters are used to measure rotation of structures, slopes, and excavation faces. Figure 48 shows the location of two uni-directional tiltmeters that were affixed to the seawall. They were mounted on the wall with protective enclosures which hold the cables and dataloggers as shown in Figure 49. Dataloggers are used to record information from the tiltmeters at specified time intervals. The data is downloaded periodically via a laptop computer.

Figure 49. Tiltmeter Attached to the Ashlar Seawall

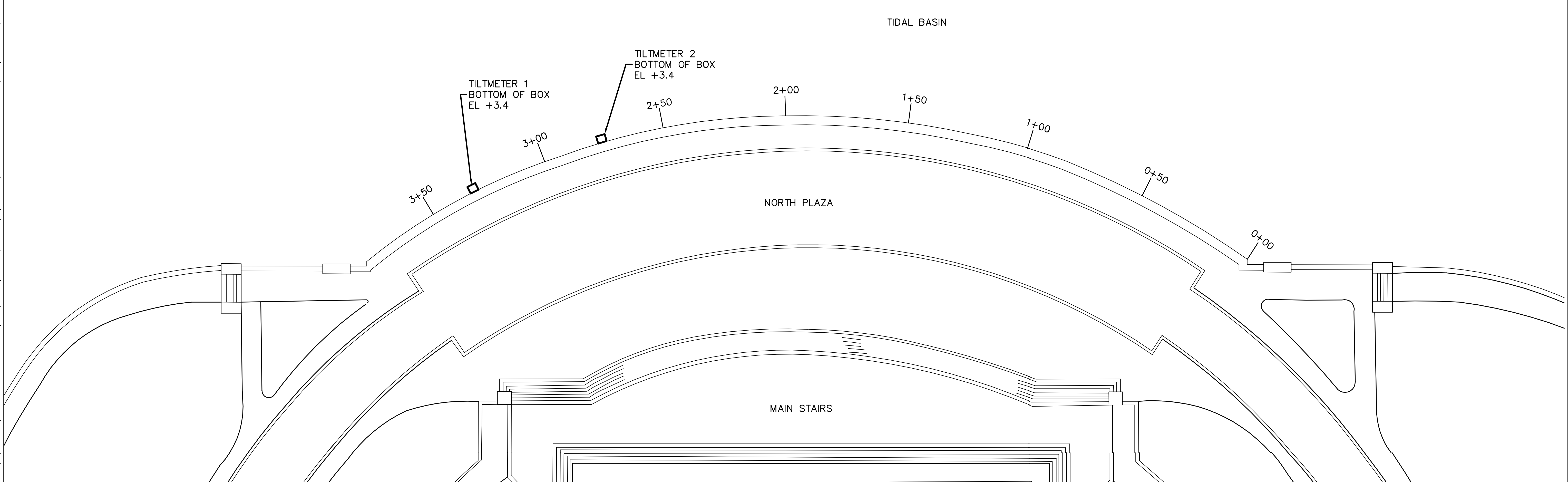
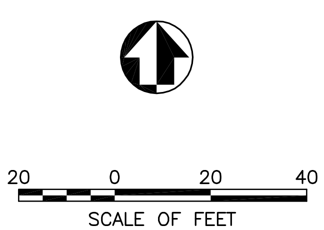


FIGURE 48 – TILTMETER LOCATION PLAN



REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

TILTMETER LOCATION PLAN
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

The tiltmeters were installed and calibrated on April 5, 2007. On May 10, 2007, Schnabel personnel accessed the site to collect the first set of readings. When the readings were obtained, there were errors in the data and evidence that the dataloggers had been submerged. The instruments were removed from the site and sent back to the manufacturer, who provided temporary replacement units that were installed on May 23, 2007. Data collected from the tiltmeters are shown in Figures 50 and 51.

Tiltmeter 1 is located at approximately Station 3+30 of the Ashlar Seawall. From June 6, 2007, to September 15, 2007, Tiltmeter 1 collected data which suggest a rate of tilt of 0.0033 degrees/month as shown in Figure 50. After September 15, 2007, the tiltmeter data show fluctuating readings. During a site visit on January 15, 2008, Schnabel Engineering personnel noted that the protective case enclosing Tiltmeter 1 had become separated from the seawall where it had been anchored. This may have been the result of vandalism. Schnabel Engineering recommends that the protective enclosure be reattached to the seawall and data continue to be collected.

Tiltmeter 2 is located at approximately Station 2+75 of the Ashlar Seawall. From May 23, 2007, to January 15, 2008, Tiltmeter 2 obtained the data shown in Figure 51. The rate of tilt was 0.008 degrees/month from May 23, 2007, to September 3, 2007, and 0.022 degrees/month following a jump in data on September 4, 2007.

The measured tilt rates are likely related with the lateral movement of the soils measured by the inclinometers. Schnabel recommends continued monitoring of the tiltmeters to confirm this trend and to assess possible ongoing damage of the existing timber piles.

V. VIDEO SURVEY OF DRAINAGE PIPES

Magnolia Plumbing, Washington, DC, performed a video survey of the drainage pipes at the Jefferson Memorial under the observation of Schnabel. The pipes on the east and west sides of the North Plaza were inspected, as shown in Figures 52 and 53. The pipes showed debris, deformation and minor damage, but do not appear to be a vehicle for sediment transportation. The video footage and our interpreted transcripts are included in Appendix C.

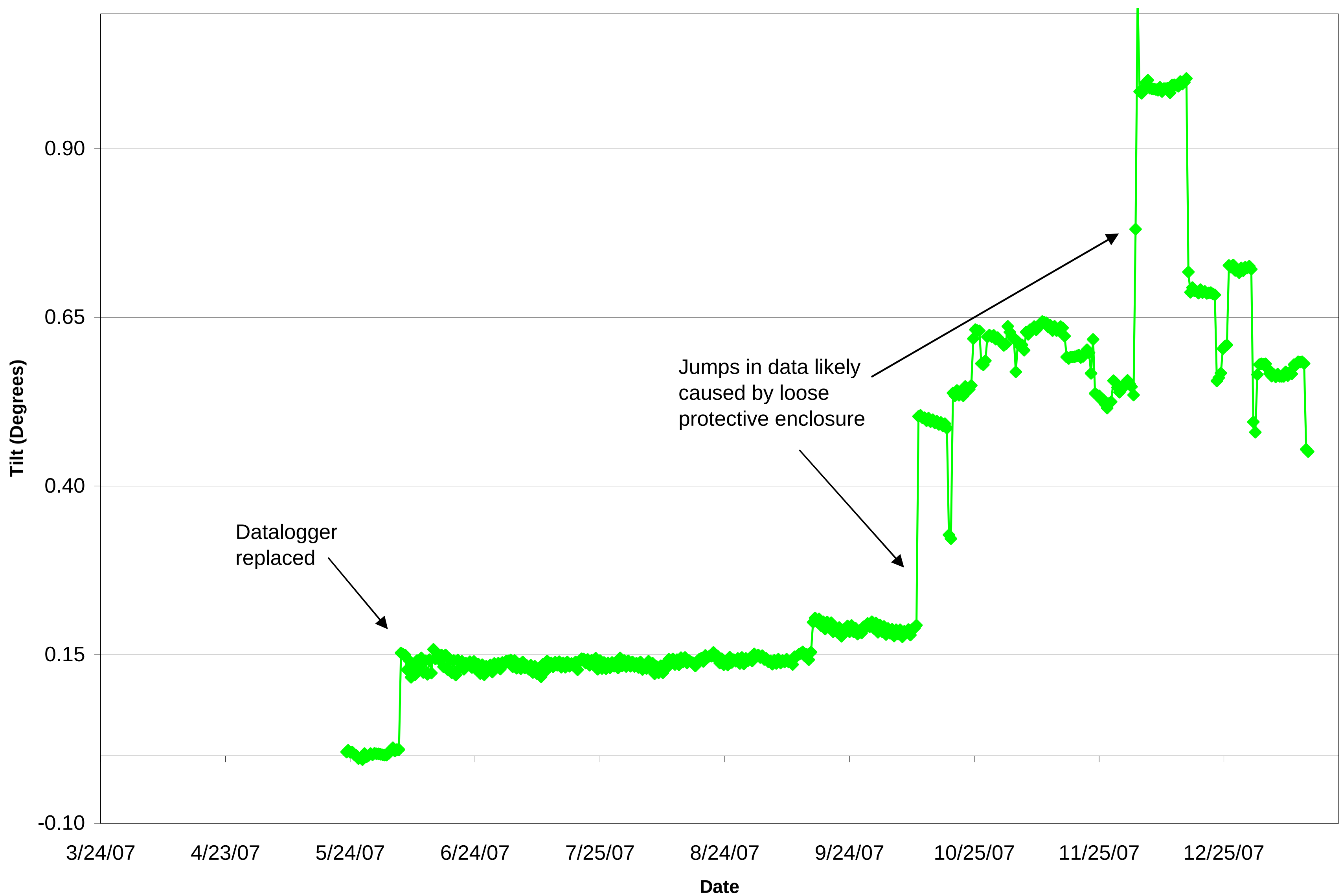


Figure 50. Tiltmeter #1 Readings

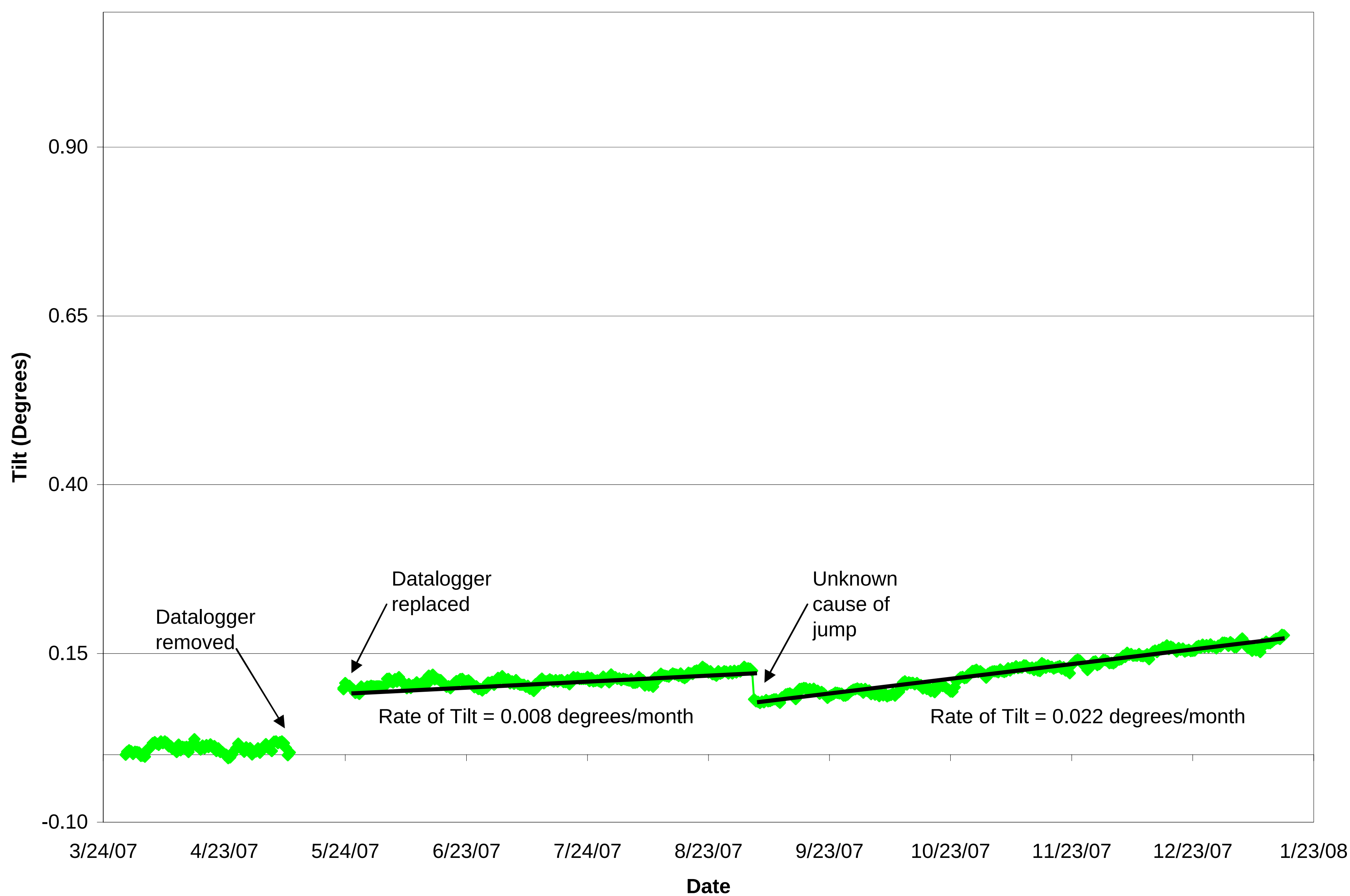


Figure 51. Tiltmeter #2 Readings

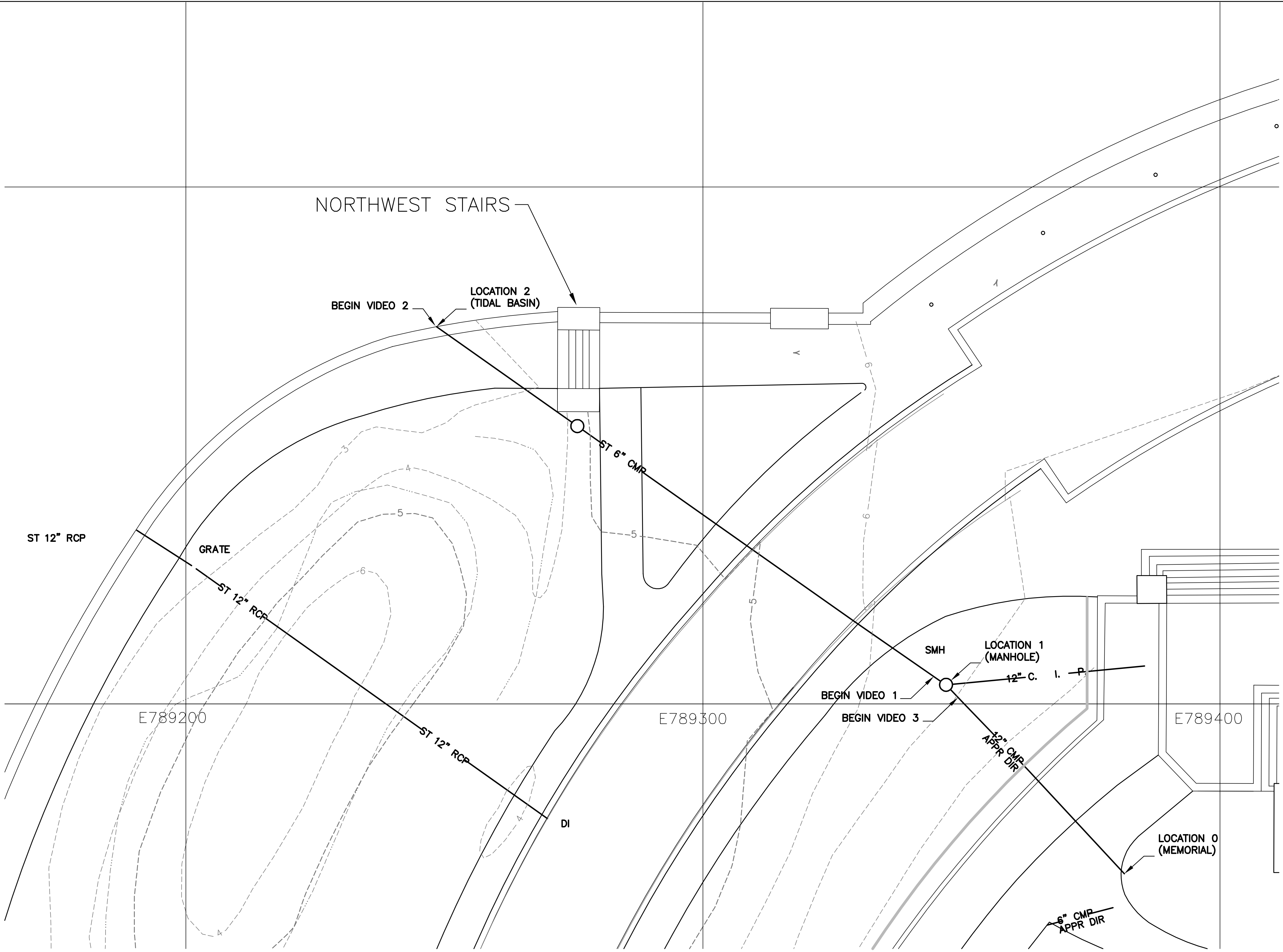


FIGURE 52 – VIDEO SURVEY OF DRAINAGE PIPES WEST SIDE

10 0 10 20
SCALE OF FEET

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

VIDEO SURVEY OF DRAINAGE PIPES WEST SIDE
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE 1/30/08
DWG. NO.
808/80284

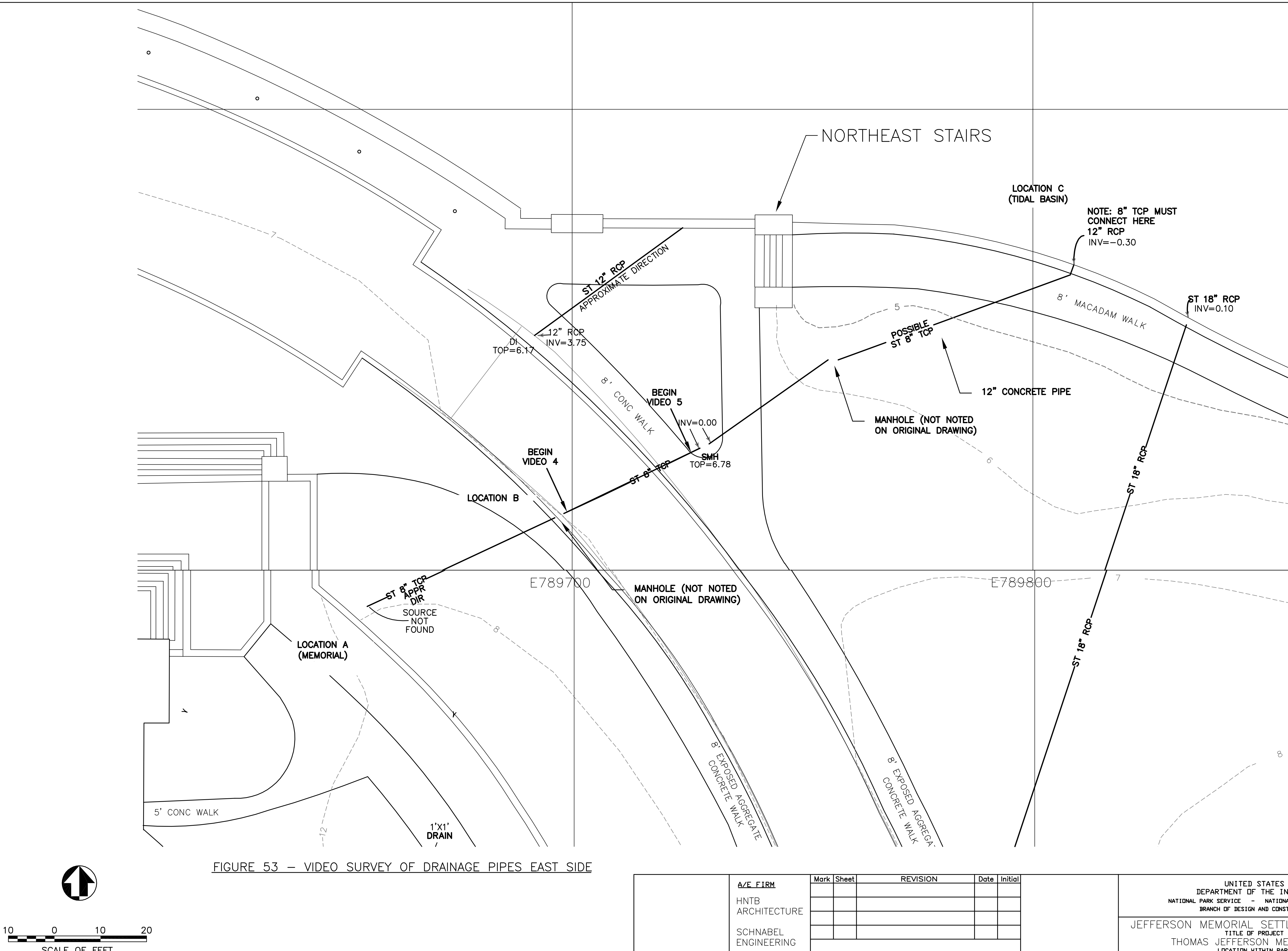


FIGURE 53 – VIDEO SURVEY OF DRAINAGE PIPES EAST SIDE

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

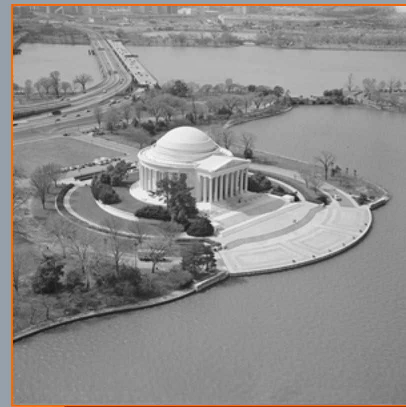
VIDEO SURVEY OF DRAINAGE PIPES EAST SIDE
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED HR
DRAWN NSF
CHECKED JG
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284



5. SURVEY MONITORING

HNTB

5. SURVEY MONITORING

I. HISTORICAL SURVEY INFORMATION

The following paragraphs discuss the survey information obtained from historical documentation provided to Schnabel. From these sources, data was obtained to compare to the current trends of movement at the Jefferson Memorial.

The Storch report from 1965 describes the extensive survey operations that took place following the construction of the Memorial in 1941. “The National Park Service immediately instituted a program of periodic survey operations in which the position of various elements of the structures and approaches were located with reference to fixed data” (Storch 1965). The Storch report contains a compilation of this data and many plots of the survey operations. Surveys include the Circular Roadway, rubble seawall, Ashlar Seawall, Terrace Walk, Terrace Wall, Stylobate Wall, Main Stairs, as well as many locations in and around the main Memorial structure. Relevant survey operations for purposes of this report include Operation D-1, Elevations on Ashlar Seawall (Plate A-3); and Operations A and B for Points 19 and 39, Settlement vs. Time (Plate A-11 1965, Plate A-10 1969). The surveys referenced the Low Water Datum – Washington Harbor (LWD) which, at the time, was used by the Washington District of the Corps of Engineers and the National Park Service, among other agencies.

Included in the historical documents provided to Schnabel are As-Constructed Drawings detailing the 1972 repairs (NPS File No. 808_41001B). These plans provide information about the grading around the North Plaza and Circular Roadway after the Plaza was demolished and reconstructed. The North Plaza and Circular Roadway were originally constructed on grade (see Figures 54 and 55). With regard to the repairs, the following comments were made: “Due to the continual settlement since the memorial’s construction, sections of the circular roadway were located at a considerably lower grade than the main plaza. In order for the plaza to meet the circular road section a transition section had to be constructed at the time of the plaza construction” (Prothero 2001). Figure 56 is an aerial view of the reconstructed plaza.

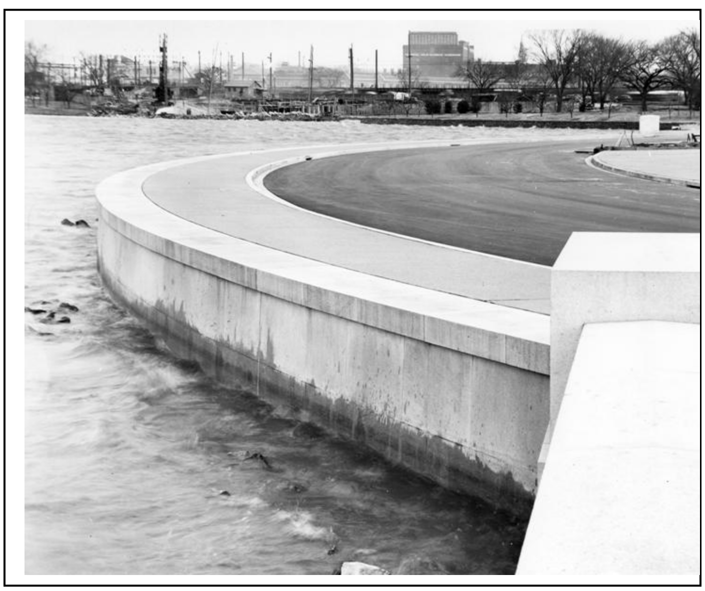


Figure 54. North Plaza during Construction (NPS Historical Photos, Dated 3-1942)

Figure 55. North Plaza before 1969-1970 Repairs (NPS Historical Photos, 8-1-1968)

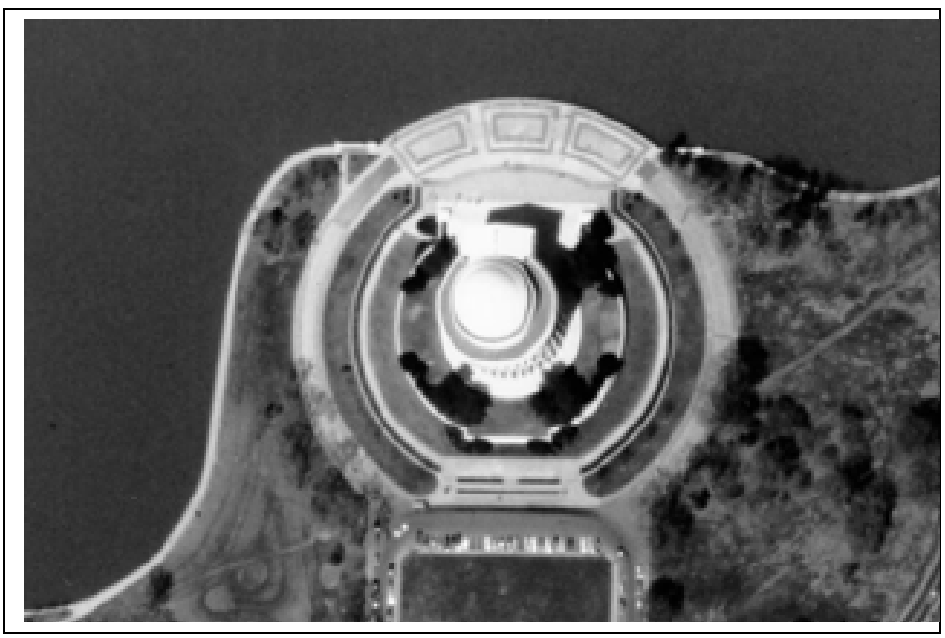


Figure 56. Aerial Photo Showing North Plaza as Reconstructed in 1970 (Prothero 2001). Note Transition Approaches at Each End of the North Plaza.

The Dewberry & Davis and Greenhorne & O'Mara survey of 1988 (NPS File No. 808_80281) was an existing conditions survey. The Memorial and surrounding areas were subdivided into 10 sectors for survey and documentation. Ten benchmarks were established with northings, eastings, and elevations which were used in subsequent surveys, including the current survey. The vertical datum used for this survey is the North American Vertical Datum 1929 (NAVD 29); therefore, a value of 1.41 feet was subtracted from the elevations in the Storch report to convert from Low Water Datum, Washington Harbor (LWD) as discussed in Section 2 of this report.

Additional survey information was obtained from the Jefferson Memorial Layout and Grading Plan, 100% Submittal - Schnabel Engineering Associates, 1996. This was part of a report on the conditions of the plaza, sidewalks and roadways around the Memorial. These plans use the 1988 Existing Conditions Survey as a base; thus their data can be compared directly.

In 1999-2000, the North Plaza and Circular Roadway were resurfaced. The following sentences discuss the grading changes that took place: "A restoration of the entrance steps and plaza, completed in 2000, focused on rehabilitating the surfaces of the memorial landscape. All marble steps were reset and repaired. The circular road was raised and resurfaced with aggregate concrete colored to mimic the original asphalt. The north plaza was redone with the same material, and raised so that it is completely flush. Where there were once curbs, granite pavers were set in the surface. The 1970s planters were removed and safety lighting was installed along the seawall. The walkways and parking lot were resurfaced, and minor landscape changes implemented" (Prothero 2001).

Unfortunately, the As-Constructed drawings for these repairs were not part of the documentation provided for this study. The Construction Drawings (NPS File No. 808_41011), were used to make comparisons between the grade elevations. However, the elevations shown are proposed, and Schnabel cannot confirm if the repairs were constructed as designed.

When differential settlements between the Ashlar Seawall and the North Plaza were noticed in February 2006, two survey operations were initiated to determine if the movement was continuing. The National Park Service conducted an in-house survey in March 2006 and used a benchmark from the 1988 Existing Conditions Survey (NPS File No. 808_80281). The United States Geological Survey (USGS) performed a survey in April 2006 to monitor settlement for several weeks. The survey used a relative datum that is unknown and therefore cannot be correlated to the current monitoring information.

II. CURRENT SURVEY INFORMATION

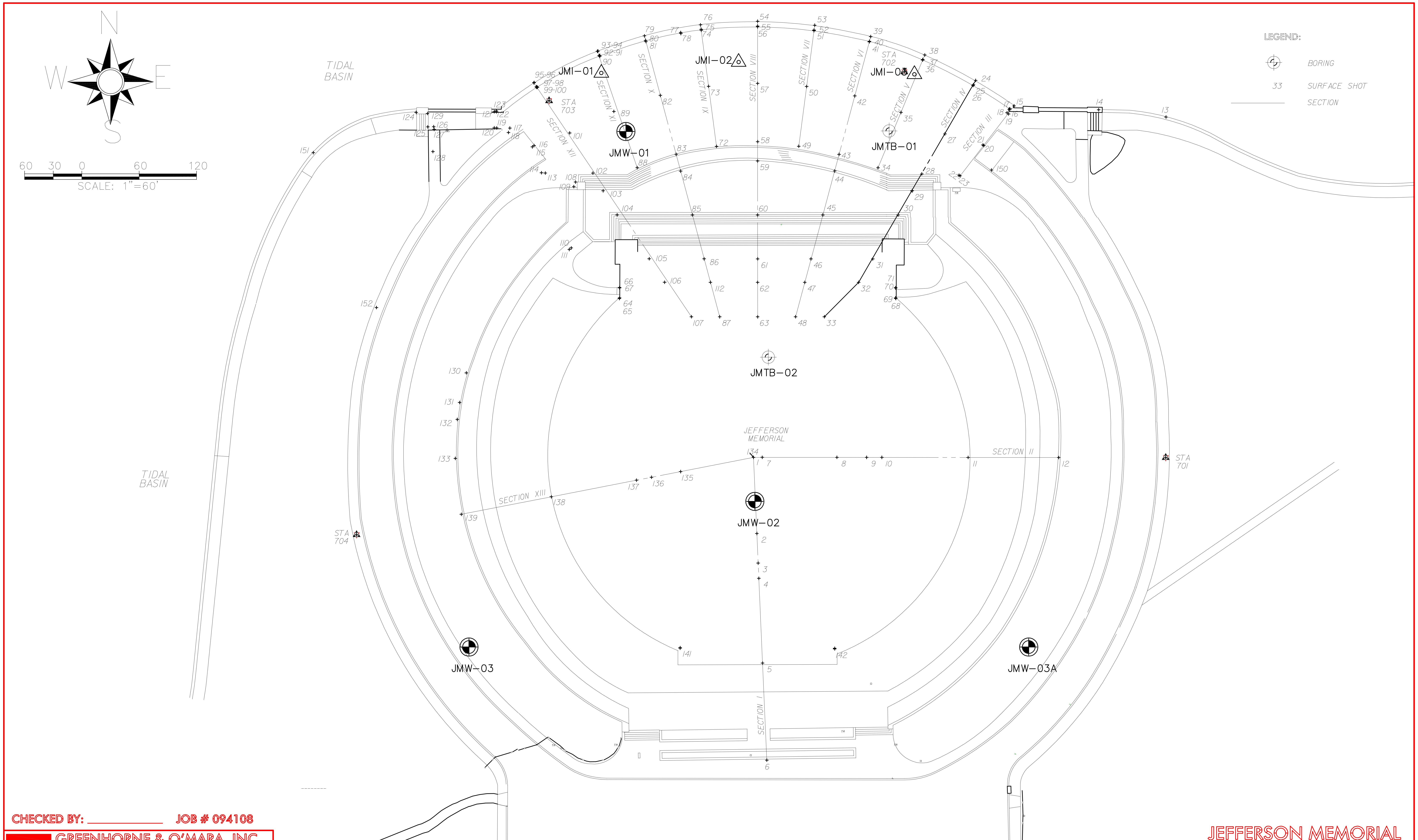
Greenhorne & O'Mara, Laurel, Maryland, was retained to provide monthly survey readings of monitoring points on the North Plaza, Main Stairs, Ashlar Seawall, and surrounding areas. Two of the benchmarks from the 1988 Existing Conditions Survey were utilized for the current survey. The benchmarks are designated as 808_HV86002 and 808_HV89003 and were established in 1986 and 1989, respectively. They are shown in Figure 57 to the south and southwest of the Memorial, respectively. The benchmarks were used to create a horizontal and vertical control loop around the Jefferson Memorial at the beginning of the monitoring process. The control loop acts as a backbone so trigonometric observations can be measured to key points and along sections established throughout the Memorial.

The horizontal and vertical control loop consists of 5 traverse stations (cross cuts) that were placed around the Memorial in the top of curbing or in the Circular Roadway. The 5 traverse stations are designated as points 700 through 704 and shown on Figure 58. The 5 traverse stations were established horizontally using conventional traverse survey procedures with a Sokkia SET 3100 Total Station survey unit and vertically utilizing conventional differential leveling procedures with a Sokkisha Automatic B1 Level.

One hundred and forty four (144) key points were established and monitored around the Memorial and along 13 cross-sections. T he monitoring points are shown on Figure 58. The monitoring began in November 2006 with the full set of 144 points and the control loop. Thereafter, a reduced number of points were surveyed on the Ashlar Seawall and the North Plaza. This survey was conducted monthly beginning in December 2006 and ending in May 2007. In June and July 2007, the full set of 144 points was surveyed as well as the control loop. During these surveys, it was discovered that points 700 through 704 forming the control loop were not stable and were experiencing movement. Without further confirmation, it was not

Provided by Greenhorne & O'Mara, 2007

FIGURE 57 - LEVEL LOOP AROUND TIDAL BASIN



CHECKED BY: ____________ JOB # 094108

GREENHORNE & O'MARA, INC.
6110 FROST PLACE
LAUREL, MARYLAND 20707
(301) 982-2800

JEFFERSON MEMORIAL MONITORING REPORT SHEET 5A

FIGURE 58 - JEFFERSON MEMORIAL MONITORING POINTS

possible to discern which of the points were moving, and at what magnitude. This discovery also cast doubt on the stability of the benchmarks 808_HV86002 and 808_HV89003.

Following these observations, several meetings and conference calls were held between Schnabel Engineering, Greenhorne & O'Mara, National Mall & Memorial Park (NAMA) personnel, and National Park Service personnel, including Mr. Bob Humphreys, Civil Engineer and National Park Service White House Liaison. The purpose of these meetings was to discuss the survey methods used to this point, as well as determine a course of action for quantifying the movements observed around the Memorial. The National Park Service (NPS) provided additional data on NPS and National Geodetic Survey (NGS) benchmarks that exist around the Tidal Basin and National Mall. Mr. Bob Humphreys provided a proposed verification control loop around the entire Tidal Basin in order to obtain the confirmation needed to assess movements in the area.

For this verification control loop and subsequent survey of monitoring points, Greenhorne & O'Mara used a Trimble DiNi Electronic Level System. This level provides an accuracy consistent with 0.01 feet.

Greenhorne & O'Mara used the points provided as well as additional NGS and NPS points to form the verification control loop in December 2007. The loop is shown in Figure 57 and the Level Report and list of benchmarks used are included in Appendix D. The verification control loop showed that many benchmarks around the Tidal Basin have undergone settlement since their installation. After examining the data, the project team along with NPS and NAMA personnel determined that the benchmark HV83001, located northeast of the Washington Monument, displayed sufficient stability to tie in the survey points on the Jefferson Memorial. Therefore, a smaller survey loop was run from HV83001 south to the Jefferson Memorial and through several benchmarks as requested by the Park Service. A temporary benchmark (TBM 27) was established south of the Memorial. Finally, the original control loop was run again using benchmarks 808_HV86002 and 808_HV89003 and points 700 through 704. Twenty-two points on the North Plaza and Ashlar Seawall were surveyed on December 28, 2007. This survey effort showed that benchmarks HV89002 and HV86003 settled an average of 0.3 ft since their installation as shown in Table 4 below.

Table 4. Settlement of Benchmarks at the Jefferson Memorial

Benchmark	**Jan. 1986**	**Jan. 1989**	**Dec. 2007**	**Difference**	**Time**
HV89003		11.371	11.078	-0.293 ft	18 years
HV86002	6.079		5.763	-0.316 ft	21 years

Points 702 and 703 from the traverse stations are located on the North Plaza. The North Plaza was demolished and rebuilt as part of the Storch repairs in 1969-1970 using piles driven to rock. Therefore, it is likely that these points have remained stable compared to the other traverse stations on grade. The elevations taken of points 702 and 703 were used to adjust the readings of the 144 monitoring points. Appendix D contains the adjusted monitoring points from the November 2006, June 2007, July 2007, and December 2007 survey efforts.

III. DATA PLOTS

Figure 59 shows a plot of selected points on the North Plaza. From this plot, it is evident that the monitoring points on the North Plaza are not moving vertically with respect to points 702 and 703, and are likely not undergoing any significant vertical movement.

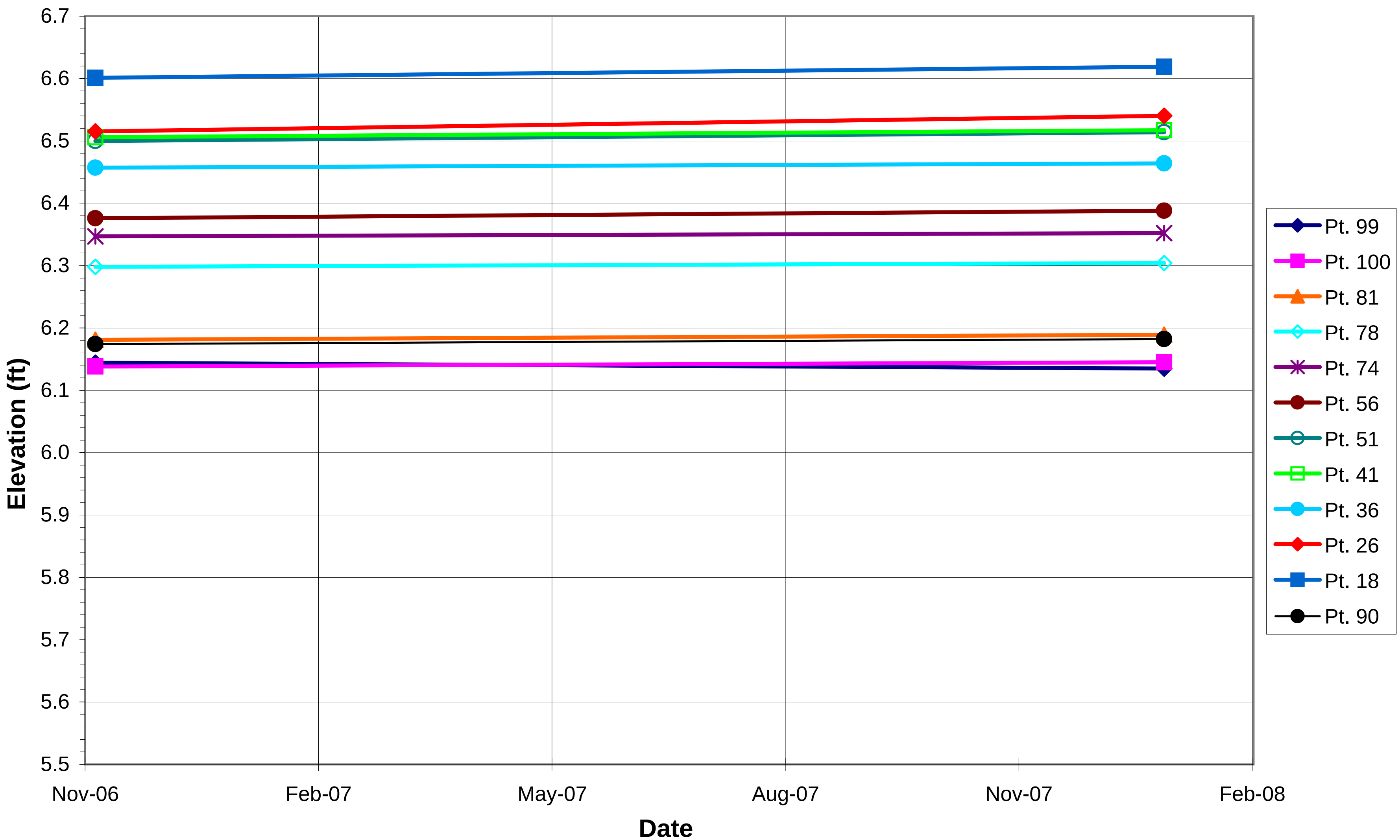


Figure 59. Plot of Selected Points Along the North Plaza

Figure 60 is a plot of selected points along the Ashlar Seawall. Point 95 is the farthest west and shows a drop in elevation of 0.1 ft from November 2006 to December 2007. Points 24, 38, 39, and 53 on the east end of the Ashlar Seawall all show a drop in elevation of 0.03 ft. Figure 61 is a profile of the top of seawall capstone elevations for the four current surveys using the established stationing along the Ashlar Seawall (refer to Figure 11). Figure 62 shows a plot of data points along the Ashlar Seawall from the historical surveys where these data points were available. The elevations from the Storch reports were adjusted to NAVD 29. Figure 63 uses the same data, but presents it as a function of time for sections at 50-foot spacings along the seawall.

Figures 64 and 65 contain plots of Settlement vs. Time from the Storch (1965) reports for points 19 and 39 (see Figure 42 for location). Point 19 corresponds with monitoring point 152 from the current survey, and is on the West Circular Roadway. Point 39 is the same as monitoring point 150, and is located on the East Circular Roadway. Where possible, additional data points were added to the plots to visualize the settlement process.

From the data presented in Figures 59 through 65, we conclude:

1) The western end of the seawall settled approximately 5 inches (0.42 ft) since the start of monitoring in November 1941, until 1996.

2) The rate of settlement of the seawall had decreased significantly by 1964, when the wall appeared to stabilize.

3) The magnitude of settlement increases from the midpoint of the seawall, roughly at the intersection with the original seawall, to the west.

4) The rate of settlement of the western half of the seawall increased considerably during 2006 and 2007.

5) The present rate of settlement of the Ashlar Seawall is not consistent with the historical trend of settlement.

6) The present rate of settlement of the seawall increases progressively toward the west. At the western end of the seawall, the rate is about 1.1 inches/year. At the midpoint of the wall, the rate is about 0.5 inches/year.

7) Settlement of the eastern end of the seawall may have started recently at a rate of about 0.3 inches/year.

8) The elevation change from the east to west end of the Ashlar Seawall is presently about 10.3 inches (0.9 ft).

9) Settlement of point 19 on the west side of the Circular Roadway was about 38.4 inches (3.2 ft) since the start of monitoring in November 1941 until 1968.

10) Settlement of point 39, located on the northeast end of the Circular Roadway, was about 3.2 inches (0.27 ft) during the same period.

11) The initial rate of settlement of point 19 in the year 1940 was significant and decreased over time. By the 1980s, the settlement had seemingly stabilized. This suggests that settlement of the northwest area of the Circular Roadway in the period 1940-1990 was due to consolidation of the soil.

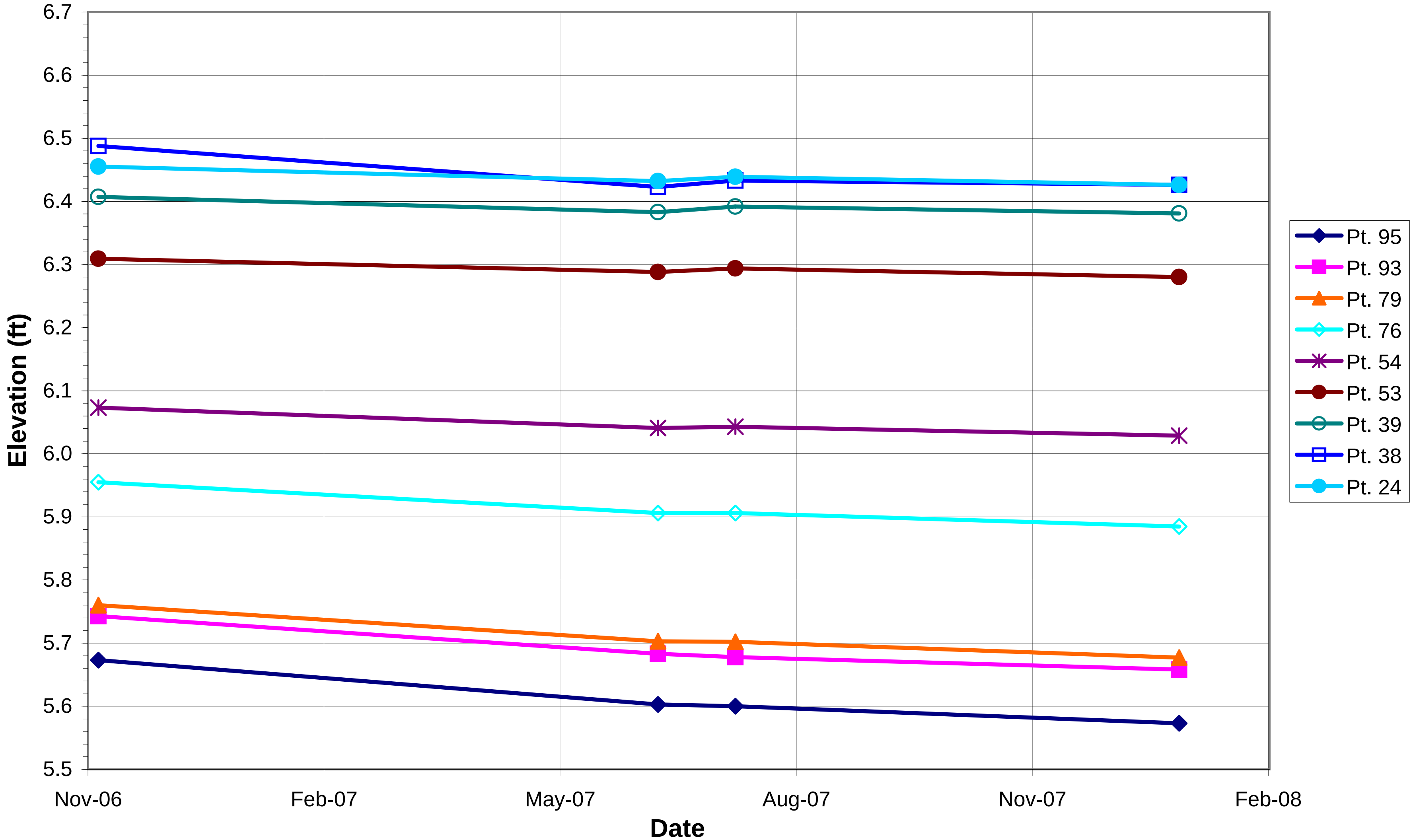


Figure 60. Plot of Selected Points Along the Ashlar Seawall

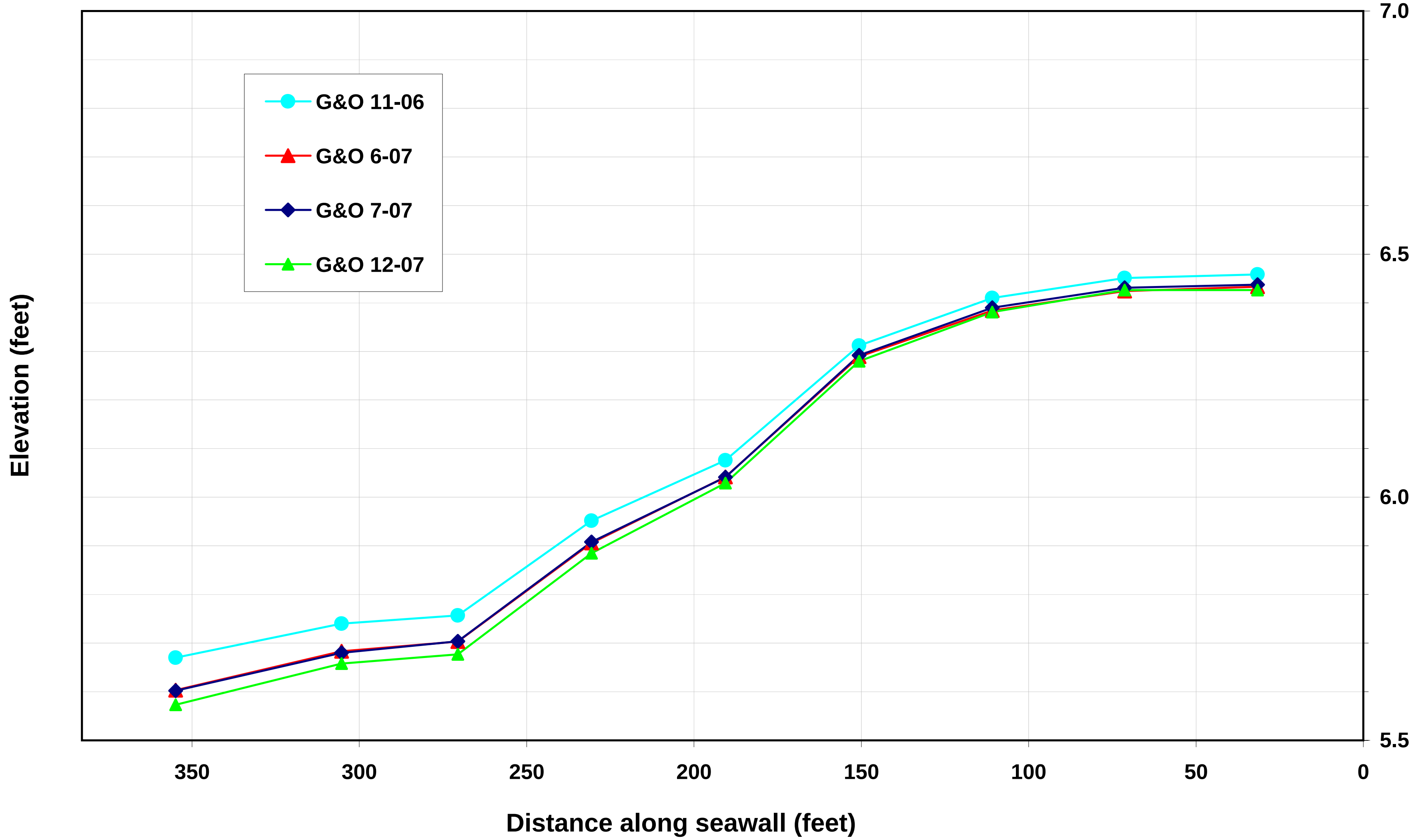


Figure 61. 2006-2007 Survey Along Capstone of Ashlar Seawall

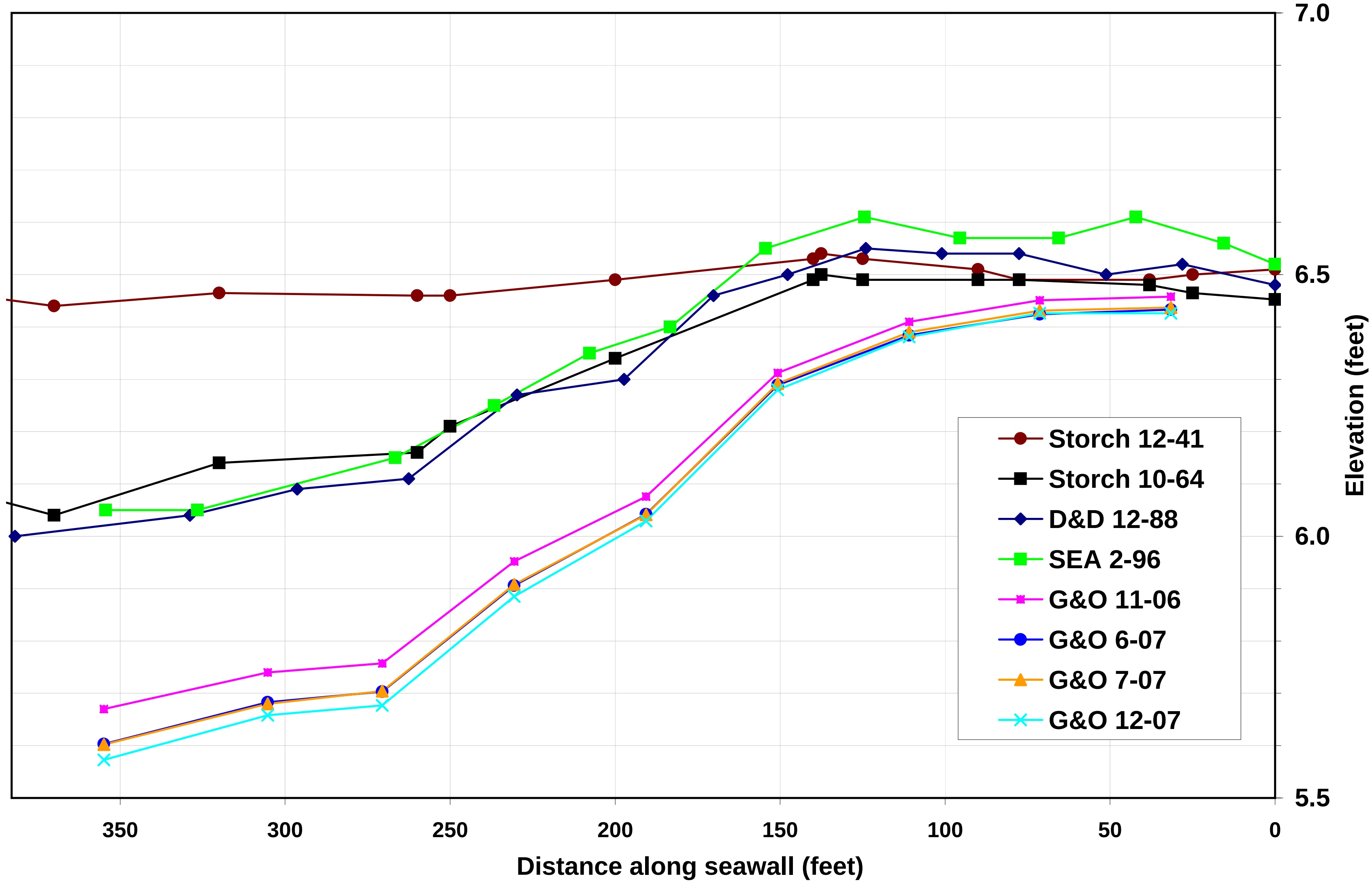


Figure 62. Historical Surveys Along Capstone of Ashlar Seawall

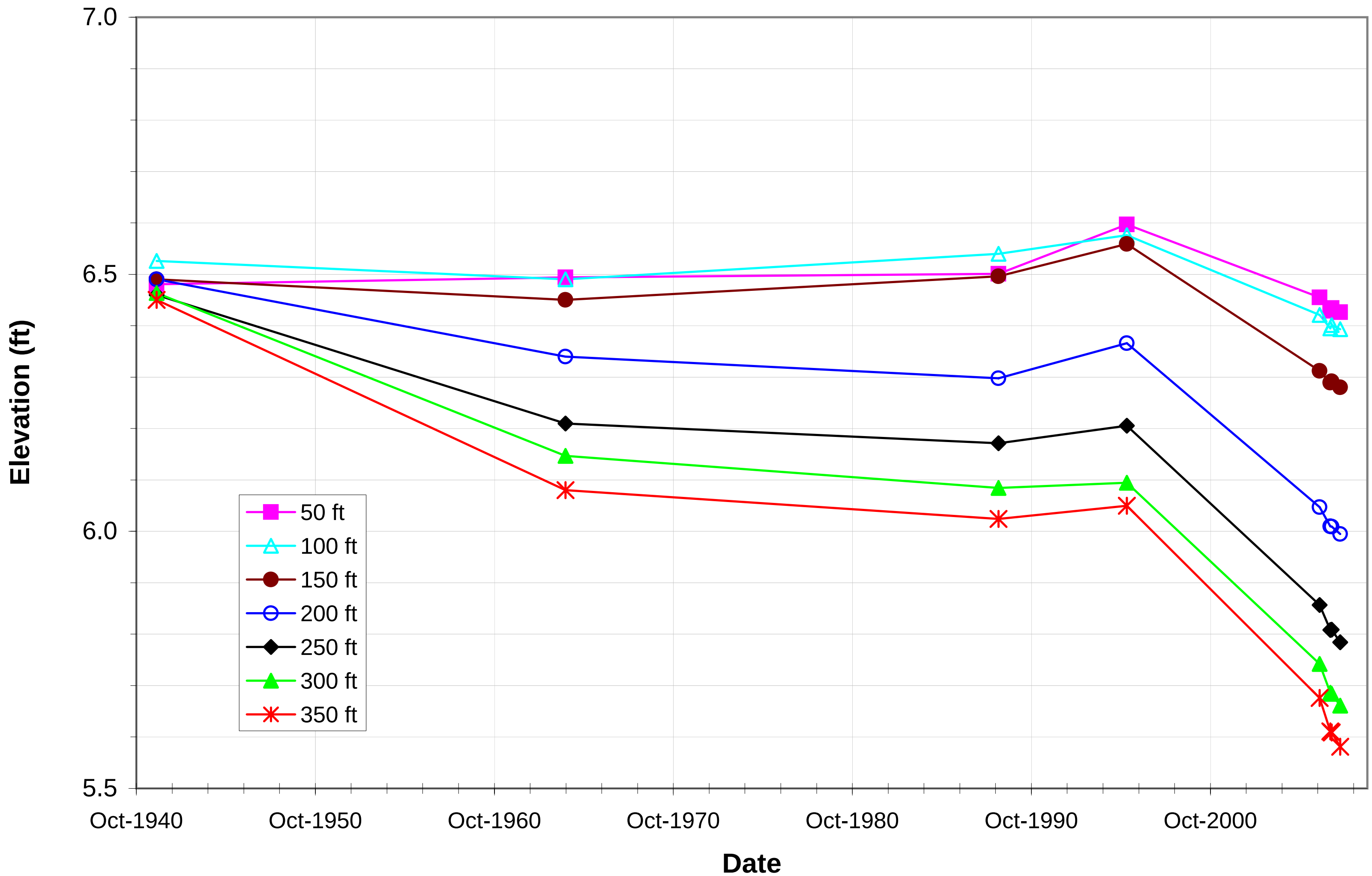


Figure 63. Monitoring Data at Various Points on the Ashlar Seawall Capstone

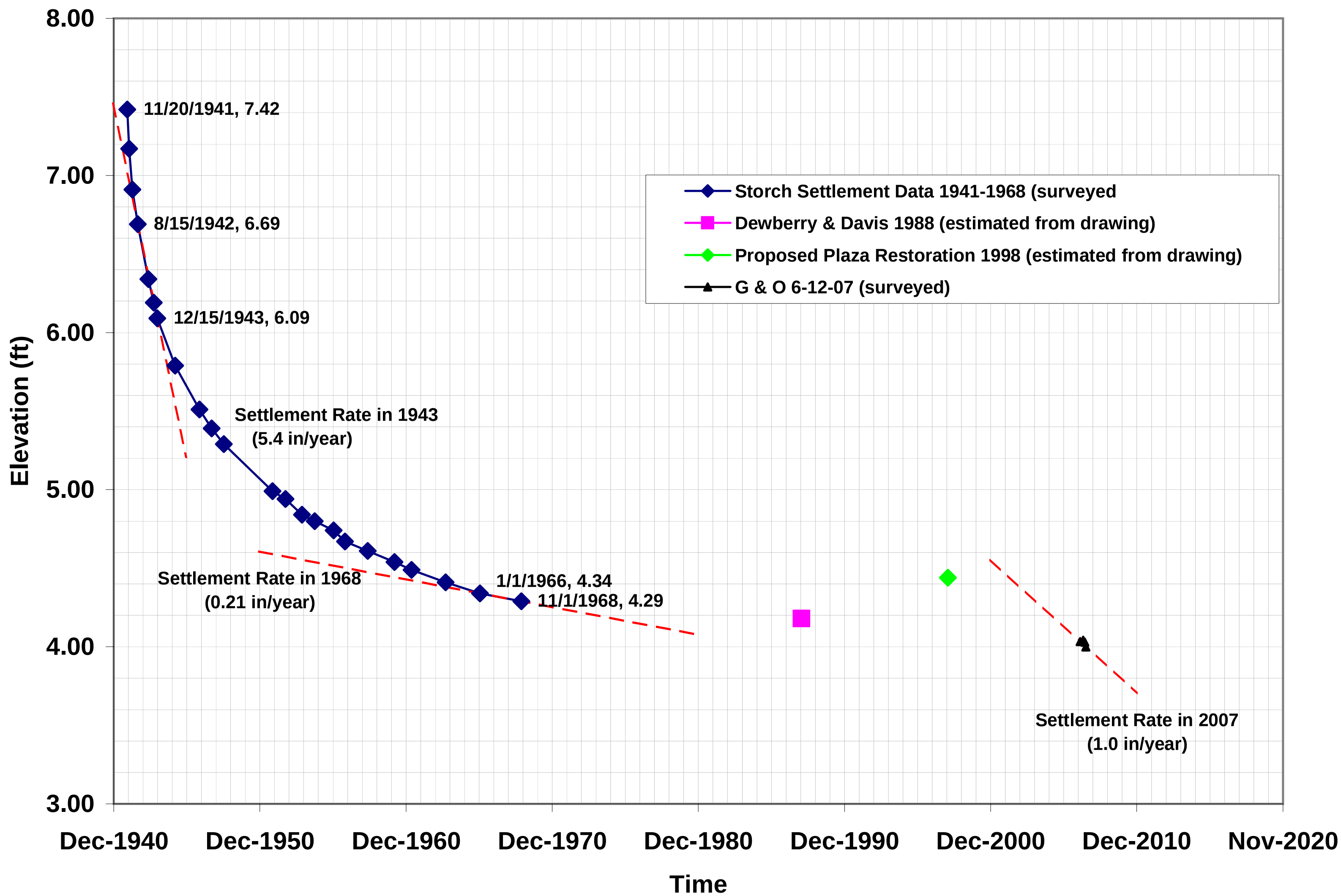


Figure 64. Settlement of Point 19 (Point 152 of current survey) on the Northwest Circular Roadway Since 1940

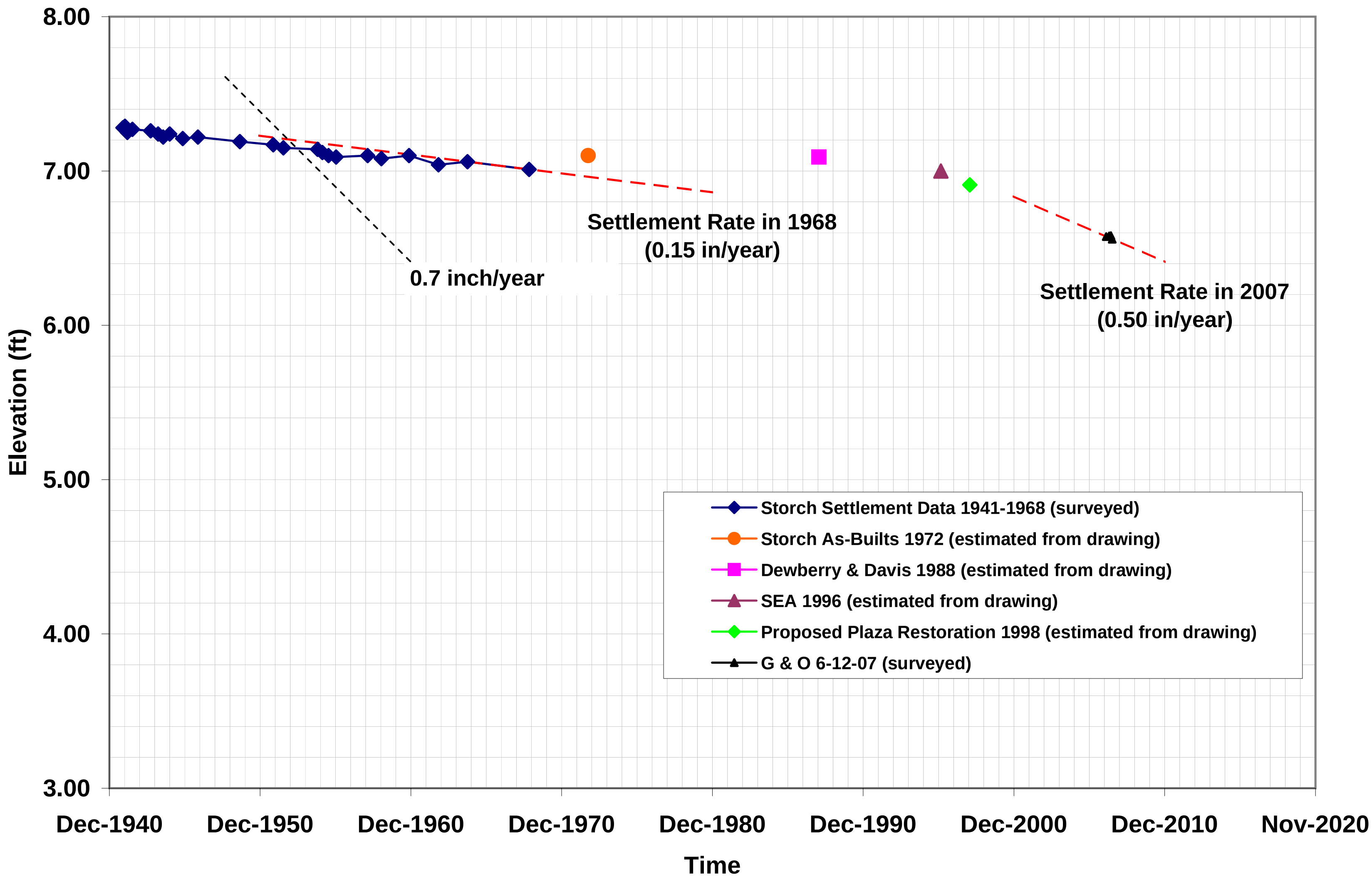


Figure 65. Settlement of Point 39 (Point 150 of current survey) on the Northeast Circular Roadway Since 1940

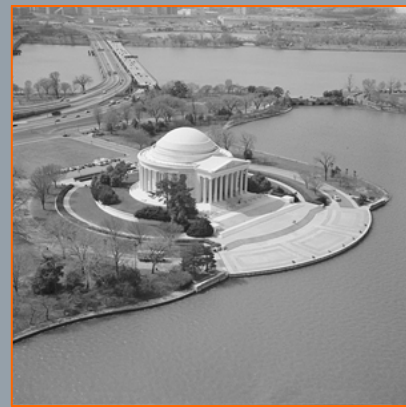
12) The rate of settlement of point 39 remained fairly uniform from 1940 until 1968, with some temporary increases which may have been caused by survey error. The magnitude of the rate of settlement suggests that the northeast area of the Circular Roadway during this period was subject to secondary compression of the soils.

13) It is not possible to directly correlate elevations of points 19 and 39 from the present survey monitoring to the 1940 survey because the Circular Roadway surface was resurfaced during the 1999-2000 repairs.

14) The rate of settlement of point 19 has increased considerably between January and June of 2007 to about 1.0 inches/year

15) The rate of settlement of point 39 has also increased between January and June of 2007 to about 0.5 inches/year.

16) Additional monitoring is necessary to confirm that this trend of increased settlement rate is maintained. It should be noted that the rate of settlement of point 39 briefly reached a maximum of about 0.7 inches/year in 1955. Although the latest monitoring data does not show evidence of a reduction in the rate of settlement, it is possible that a decrease in the rate of settlement occurred over time.



6. LABORATORY DATA

6. LABORATORY DATA

I. HISTORICAL LAB DATA

Laboratory data was available from two previous sources: the report by Storch Engineers in 1965, and the geotechnical portion of the final report by EYP in 1992. Select lab data from each source is located in Appendix E. These data were compared to the lab testing performed by Schnabel in 2006 to 2007.

Storch Engineers performed lab testing on samples obtained from soil borings including liquid and plastic limit tests, natural moisture content determinations, and sieve analyses. To measure the shear strength of the soils, unconfined compression tests and triaxial compression tests were performed on undisturbed samples. Consolidation tests were also run on fine-grained materials.

Schnabel Engineering Associates completed one test boring on site in 1992. Sieve analyses, Atterberg Limit tests, and natural moisture content determinations were performed on select samples. Two undisturbed tube samples were obtained and tested for consolidation parameters.

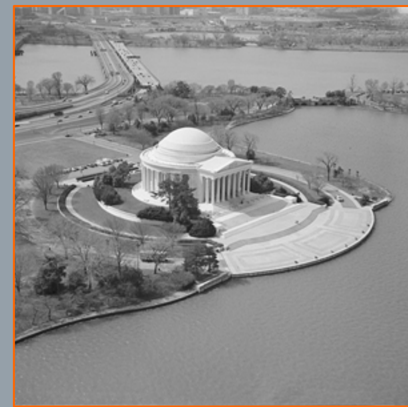
II. CURRENT LAB DATA

Schnabel performed seven test borings in and around the Memorial, and collected soil samples for testing. We performed natural moisture content determinations, Atterberg Limit tests, and grain size analyses for classification purposes. We also collected Shelby tube samples, and conducted consolidation and strength tests on some of the specimens. Table 5 is a Summary of Lab Testing Data and Appendix E includes the laboratory test results and laboratory test curves.

Material from Strata A2 and B2 is moderately compressible, with estimated compression indices (C_c) of 0.26 to 0.66, which are consistent with the range of values 0.24 to 0.55 obtained from the EYP report. Schnabel obtained recompression indices (C_r) ranging from 0.01 to 0.09, which are also consistent with the range of 0.02 to 0.03 results reported in 1992. The values of coefficient of consolidation, C_v, are an average of 9.6 ft^2/year, which is consistent with the range of 3 to 26 ft^2/year calculated from the data in the Storch report (1965). Other index properties such as Atterberg Limits and grain size distribution were generally consistent between the two sets of data. Water content measurements reported by Storch generally increase with depth, ranging from about 40 to 60 percent at the top of Strata B1 and B2 to about 58 to 63 percent at the bottom. Water content measurements performed for this study suggest the same trend; however, the measured water content is significantly lower than Storch's values below about EL -60 in the B1 and B2 Strata.

Table 5. Summary of Lab Testing Data

Boring	Top Depth of Sample	Top Elevation of Sample	N Value	Sample Type	Stratum	Soil Classification	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	% Passing 200	G_s	Wet Density (pcf)	Dry Density (pcf)	P_p Preconsol Press. (tsf)	P'_o Overburden Stress (tsf)	OCR	Void Ratio (Initial)	Void Ratio (Final)	$C\varepsilon c$	$C\varepsilon r$
JMI-01	7.5	-1.0	4	Jar	A2	CL	24.1	30	16	14	0.58											
JMI-01	18.5	-12.0	3	Jar	A2	CL	26.1	32	14	18	0.67											
JMI-01	23.5	-17.0	2	Jar	B2	MH	53.3	77	37	40	0.41											
JMI-01	33.5	-27.0	4	Jar	B1	SP-SM	26.3					5										
JMI-01	43.5	-37.0	0	Jar	B2	MH	56.7	83	50	33	0.20											
JMI-01	48.5	-42.0	3	Jar	B2	CH	65.7	91	33	58	0.56											
JMI-01	53.5	-47.0	5	Jar	B2	MH	69.5	93	43	50	0.53											
JMI-01	63.5	-57.0	5	Jar	B2	CH	75.5	98	37	61	0.63											
JMI-01	73.5	-67.0	7	Jar	B1	SM	23.5	24	21	3	0.83											
JMI-01	83.5	-77.0	10	Jar	B2	ML	32.2	42	33	9	-0.09	50										
JMI-02	28	-21.1	0	Jar	B2	CH	50.5	92	35	57	0.27											
JMI-02	33.5	-26.6	1	Jar	B2	CH	55.9	96	35	61	0.34											
JMI-02	38.5	-31.6	3	Jar	B2	CH	44.1	64	30	34	0.41											
JMI-02	43.5	-36.6	1	Jar	B1	SM	27.5					26										
JMI-02	48.5	-41.6	0	Jar	B2	CH	49.7	99	38	61	0.19											
JMI-02	53.5	-46.6	4	Jar	B2	MH	66.6	108	58	50	0.17											
JMI-02	58.5	-51.6	2	Jar	B2	CH	65.2	90	34	56	0.56											
JMI-02	61.0	-54.1		Tube	B2	OH	62.5	73	37	36	0.71	97	2.61	97.6	60.1	1.7	1.7	1	1.67	1.01	0.249	0.035
JMI-02	63.5	-56.6	2	Jar	B2	MH	60.9	95	42	53	0.36											
JMI-02	68.5	-61.6	5	Jar	B2	MH	58.6	79	36	43	0.53											
JMI-03	18.5	-11.7	2	Jar	B2	ML	40.1	41	31	10	0.91											
JMI-03	28.5	-21.7	4	Jar	B1	SM	43.7	47	38	9	0.63											
JMI-03	35.0	-28.2		Tube	B2	ML	37.3	45	30	15	0.49	76	2.65	105.5	76.9	1.5	1.1	1.36	1.02	0.63	0.128	0.006
JMI-03	38.5	-31.7	1	Jar	B2	MH	48.5	64	47	17	0.09											
JMI-03	43.5	-36.7	1	Jar	B2	MH	49.5	75	58	17	-0.50											
JMI-03	58.5	-51.7	1	Jar	B2	MH	54.5	82	42	40	0.31											
JMI-03	68.5	-61.7	5	Jar	B2	CH	45.7	80	31	49	0.30											
JMI-03	78.5	-71.7	6	Jar	B2	ML	27.4					68										
JMI-03	88.5	-81.7	44	Jar	C	GP-GM	15.2					12										
JMTB-02	13.5	-5.5	3	Jar	B2	CH	64.7	83	35	48	0.62											
JMW-01	13.5	-6.2	0	Jar	A1	SM	19.8					38										
JMW-01	20.0	-12.7		Tube	A1	CL	42.2	40	24	16	1.14	98	2.71	118.2	83.1	1.1	0.7	1.57	1.30	0.79	0.148	0.027
JMW-01	23.5	-16.2	1	Jar	B2	MH	40.2	64	32	32	0.26											
JMW-01	33.5	-26.2	2	Jar	B2	CH	48.6	70	27	43	0.50											
JMW-01	48.5	-41.2	0	Jar	B1	SP-SM	26.6					7										
JMW-01	53.5	-46.2	0	Jar	B2	MH	56.3	84	40	44	0.37											
JMW-02	8	0.0	1	Jar	B2	CH	67.9	83	36	47	0.68											
JMW-02	18	-10.0	3	Jar	B2	ML	35.1	43	32	11	0.28											
JMW-02	24	-16.0	2	Jar	B2	MH	37.1					66										
JMW-02	33.5	-25.5	5	Jar	B2	MH	71.2	101	60	41	0.27											
JMW-02	38.5	-30.5	4	Jar	B2	MH	46.5	69	41	28	0.20											
JMW-03A	8.5	0.4	8	Jar	A1	SM	18.4					42										
JMW-03A	23.5	-14.6	4	Jar	B2	CH	49.3	51	22	29	0.94											
JMW-03A	38.5	-29.6	4	Jar	B2	CH	52	76	30	46	0.48											
JMW-03A	48.5	-39.6	4	Jar	B2	MH	40.6	77	42	35	-0.04											
JMW-03A	63.5	-54.6	6	Jar	B2	MH	63.7	81	40	41	0.58											
JMW-03A	78.5	-69.6	8	Jar	B1	ML	57.7					52										



7. INTERPRETATION OF AVAILABLE INFORMATION

HNTB

7. INTERPRETATION OF AVAILABLE INFORMATION

We have considered several potential mechanisms for the current ground movements at the Jefferson Memorial. These mechanisms were selected based on interpretation of monitoring and instrumentation data and laboratory results: both collected recently and during previous investigations.

The potential causes of movement that have been evaluated are global instability, vibrations, continuation of the historical settlement process, regrading of the Circular Roadway, defects on storm drainage pipes, structural failure of timber piles under the Ashlar Seawall and reduction of boundary piezometric head. This report section contains a discussion of each of these potential mechanisms.

I. POTENTIAL CAUSES OF MOVEMENT

In the following paragraphs, several potential causes for the movements are discussed. The order in which the potential mechanisms are presented does not convey their order of relevance.

i. Global Instability

A possible cause for the movement of the Ashlar Seawall is the mobilization of a soil mass encompassing the wall. The mass of soil would slide outward following a slip plane passing below the wall footing through soils of Strata B1 and B2 (refer to Appendix B for typical soil profiles). The sliding mass would drive the North Plaza, the Ashlar Seawall, and their foundation piles in a northern direction.

The inclinometer data does not suggest the presence of a deep-seated slip surface behind the seawall. The inclinometer data suggest that the soil mass is moving horizontally to approximately 60 feet, measured from the top of the North Plaza concrete slab (refer to Figures 43 through 46). It is Schnabel's opinion that the absence of a defined slip surface behind the wall indicates that the movement of the seawall is not caused by deep-seated global instability of the soil mass surrounding the seawall.

ii. Historical Settlement Process

As discussed previously in this report, a significant amount of fill was placed during the reclamation of West Potomac Park and during construction of the Jefferson Memorial over soft, saturated alluvial soils. Over time the soft alluvial soils and the fill material settle following a process called "consolidation."

During consolidation, water is expelled from the pores of saturated soils upon application of external loading or by reduction of the pore water pressure as a consequence of dewatering. As the water is expelled, inter-granular stresses increase and the soil volume decreases with consequent settlement of the ground surface. The consolidation process may take more or less time depending on the permeability of the soils: the less permeable the soil, the slower the process of consolidation. The total magnitude of ground surface settlement at the end of the consolidation process depends on: the magnitude and geometry of the loadings applied or the intensity of dewatering, the compressibility of the soils (measured through the compressibility coefficient, C_c), and the thickness of the consolidating soil layer. The rate of ground surface settlement decreases over time and, at any given instant, depends on the time elapsed since the start of consolidation and on the coefficient of consolidation, C_v, which is dependent on the permeability of the soil.

Over time and from a practical point of view, consolidation-induced settlement ceases. Beyond this instant, called “end of primary compression,” there may still be settlement of the ground surface due to secondary compression of the soils. Secondary compression of soils is associated with creep at the inter-particle contacts under constant stress and is more noticeable in fine-grained, high-plasticity soils and especially in organic soils where organic degradation also contributed to this secondary compression effect. The rate of settlement due to secondary compression is usually low and depends on the coefficient of secondary compression, C_α, the thickness of the soil, and on the time elapsed since the end of primary compression.

The survey data collected at point 19 (point 152 of current survey) is presented in Figure 64. Point 19 is located on the ground next to the west end of the seawall (refer to Figure 42 for the location of point 19). Figure 64 shows approximately 41 inches of settlement of the ground at the location of point 19 from 1941 to 2007.

Consolidation of the soil creates down drag forces that may cause settlement of the existing piles. The North Plaza was reconstructed in 1969-1970 following the study by Storch Engineers. It was placed on reinforced steel pipe piles filled with concrete and advanced to bedrock. There are relatively good records on the size and length of these foundations. Figure 59 shows monitoring data on the North Plaza from November 2006 to December 2007. It can be inferred from this plot that the plaza has not settled significantly (the values recorded are within the accuracy of the surveying system which is consistent with a foundation on piles bearing on rock).

Based on the historical photos provided to us by NPS, it is apparent that the Ashlar Seawall is supported on timber piles. As discussed in Section 2, the tips of most of these piles may not reach hard rock and, in many cases, may be within alluvial soils above disintegrated rock. Figure 62 includes monitoring data along the Ashlar Seawall from 1941 to 2007. This plot suggests that the seawall has undergone settlement of approximately 11 inches near the west end, and approximately 0.9 inches near the east end since the first monitoring event in November 1941.

The Circular Roadway is a slab-on-grade and was subject to considerable settlement due to consolidation of the soft alluvial materials of Strata B1 and B2 during the 1940-1950 period, after which it seemed to stabilize. The Circular Roadway is now experiencing an increased rate of settlement as well.

Figure 64 also shows the varying rate of settlement with time at point 19. It can be observed that by 1943 the rate of settlement was estimated on the order of 5.4 inches per year; and by 1968 it was approximately 0.21 inch per year, consistent with typical soil behavior as it completes primary consolidation and moves into secondary consolidation. In 2007, the rate increased to about 1.0 inch per year. It is noticeable from this graph that consolidation had occurred since construction of the Memorial, and the settlement rate has been decreasing prior to the measurements performed in 2007. The settlement rate of the wall has increased recently in comparison to the historical settlement rates measured at point 19. This increase in rate of settlement suggests that either additional loads, additional excess pore water dissipation, change in effective stresses within the soil mass, or a combination of these events has triggered an increase in consolidation rates.

Figure 65 shows survey data collected at point 39 (point 150 of current survey, see Figure 42). This graph also indicates that the settlement rate at point 39 has increased from 0.15 inch per year in 1968 to 0.5 inch per year in 2007.

In order to evaluate the effect of additional loads or pore water dissipation on the soil mass, Schnabel has performed a Finite Difference analysis of the settlement process using the computer software Consol 3.0, developed at Virginia Polytechnic Institute and State University.

This software considers the effect of buoyancy of the fill as the ground surface settles below the water table.

We modeled staged placement of the fill before 1940 based on the historical information available. The fill was modeled as an area load. The top of the fill was maintained at EL 8.0 throughout fill placement and until September 1940. Settlements of the ground surface were calculated starting in November 1941, which is the date of the earliest available monitoring data for the Ashlar Seawall and the Circular Roadway.

The model also considers the application of a limited additional surcharge during reconstruction of the North Plaza in 1969-1970. At that time, fill was added on the western end of the North Plaza to raise the grade. We estimated that this fill may have been about 1 to 2 feet thick on average. The analyses show that the addition of this fill could have generated about 3 inches of additional settlement since reconstruction of the Plaza.

The soil properties were back calculated so that the estimated settlements and their progression over time matched the available monitoring data up to the year 1968. The resulting C_c and C_v values were 0.7 and 50 ft^2/year. The value of C_c is consistent with the values calculated from our laboratory data and data from previous investigations. The value of C_v is larger than the 3 to 26 ft^2/year range indicated in the Storch report (1965). This may suggest the presence of more permeable layers within Strata B1 and B2, which were not sampled or tested by Schnabel or during this exploration.

The results of this Finite Difference analysis are presented in Figure 66. The model is compared to settlement data from point 19. The model is consistent with consolidation-induced settlement measured at point 19 after construction of the Memorial and up to the period between the years 1970 and 1980. Using the model to predict settlement with time, it was observed that the rate of settlement after this period would decrease significantly if no additional loads or excess pore water pressure dissipation had influenced the soil mass.

We have proposed three potential sources for the increase in the consolidation rate: vibrations, regrading of the Circular Roadway, and a reduction of boundary in the piezometric head. The Finite Difference model was used to evaluate these possible causes of settlement rate increase.

a) Vibrations

NAMA and NPS personnel requested that Schnabel examine the potential link between vibrations and the observed movements. To our knowledge, the only nearby sources of vibration are frequent helicopter flights over the Tidal Basin and traffic along East Basin Drive, SW, and Interstate Highway 1.

Vibrations of this magnitude are common throughout the Washington, DC, area and other cities. We have dismissed this potential mechanism of movement because the depth of influence of such vibrations would be confined within a few feet of the ground surface and would not likely cause settlement of the seawall piles, which were driven to deeper elevations. Finally, vibrations of this magnitude have existed in the Washington, DC, area for many years, which is not consistent with the recent acceleration of the settlement of the Ashlar Seawall and the Circular Roadway.

b) Re-grading of the Circular Roadway

Using the soil model, Schnabel estimated the amount of backfill that would need to be added to increase the settlement rate to its present value. We modeled additional fill placement in December 2005 and estimated the rate of settlement by May 2007.

The analysis showed that placement of 2 feet of fill in December 2005 would induce rates of settlement similar to those measured during survey monitoring of point 19. This analysis would be representative of a 2-foot high embankment covering an area with plan dimensions of at least 100 ft by 100 ft, and located adjacent to the western end of the North Plaza.

Based on the information collected during this investigation, such a re-grading event has not occurred recently. Only local patching of tripping hazards and possibly minor landscaping efforts have been performed recently. Therefore, we conclude that it is not likely that regrading is the cause of the increase in settlement rate.

c) **Reduction of Boundary Piezometric Head**

Another potential cause for the observed movements would be reduction of the boundary piezometric head elevations. This phenomenon may be associated with a regional drop in the piezometric head of surface or deep aquifers, sustained reduction in the pool level of nearby lakes or rivers, nearby dewatering activities, etc.

Pore pressure data from piezometers JMI-01 and JMI-03 seem to indicate that the pore pressures within Strata B1 and B2 are decreasing, and they are not consistent with a hydrostatic condition. The interpretation of piezometric pressures with depth is presented in Section 4.

The magnitude of pore pressures measured in JMI-01 and JMI-03 and its decrease over time suggest that dewatering below EL -47.5 may be the cause for the recent accelerated settlement rate. Using our previously developed consolidation model for the site, we modeled a reduction of the boundary piezometric head of the soils at the site. We applied various magnitudes of piezometric head reduction in December 2005, until the estimated rate of ground surface settlement matched the measured rate of settlement of point 19. We estimated that a reduction in the boundary piezometric head of about 4 feet was necessary to match the observed rate of settlement as shown in Figure 67.

A reduction of boundary piezometric head elevations would be consistent with the magnitude and rate of settlement measured at point 19 (Figure 68). We did not perform specific analyses for point 39, where the rate and magnitude of settlement is significantly lower. However, it is conceivable that the soils in the area to the east of the original seawall are preconsolidated in comparison to the soils on the western end of the Ashlar Seawall and North Plaza because the original fill was excavated for construction of the seawall and plaza east of the original seawall. This would qualitatively explain the lower settlement rates in this area.

A reduction of boundary piezometric head elevations would also induce settlement of both the Ashlar Seawall and the Circular Roadway. The horizontal extent of the area undergoing settlement would depend on the extent of the piezometric head reduction. Under a regional reduction of piezometric head, the area undergoing settlement would be significant, and would likely encompass the areas to the west of the original seawall, including the existing rubble seawall. The areas to the east of the original seawall would also undergo significant settlement once the reduction of the piezometric head reaches a certain magnitude.

At this time, it is not possible to determine whether this mechanism is the principal factor contributing to the accelerated observed movements. However, we believe that an extended decrease in the boundary piezometric head would cause a settlement pattern consistent with the available data. In order to further evaluate this condition, it would be necessary to install additional piezometers and continue monitoring existing survey points.

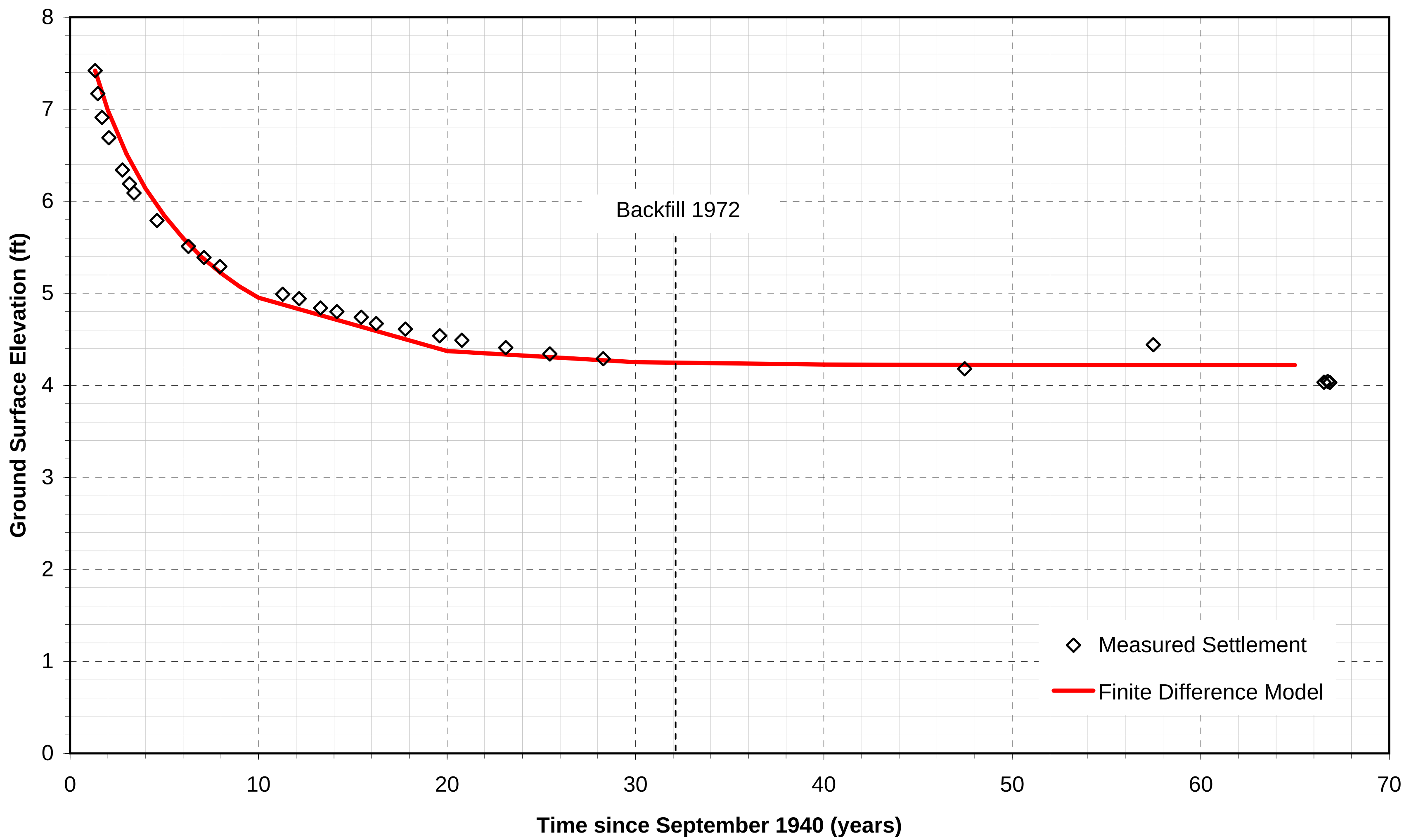


Figure 66. Comparison Between Settlement Data at Point 19 and Numerical Model

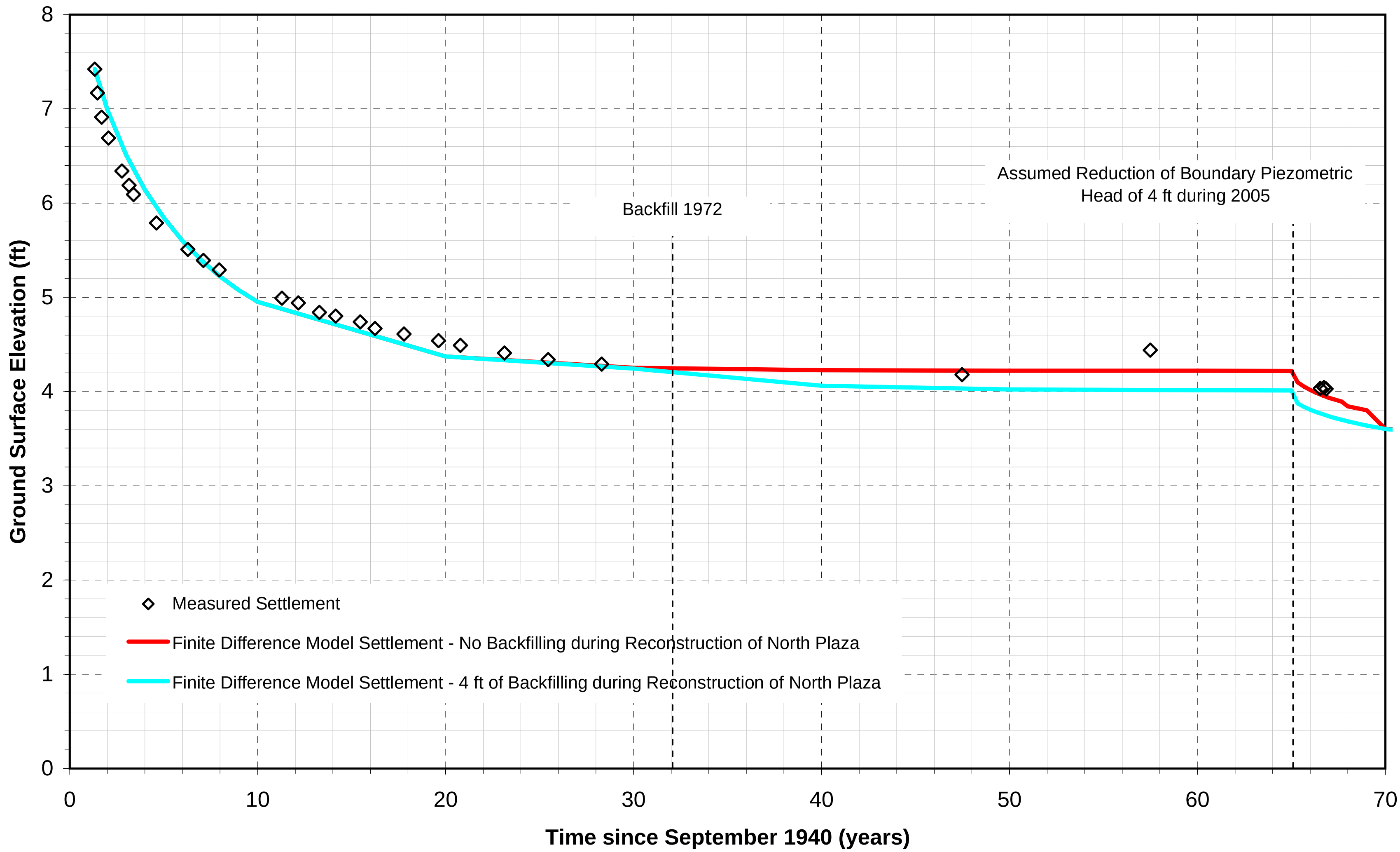


Figure 67: Comparison Between Settlement at Point 19 and Numerical Model with Reduction of Boundary Piezomatric Head

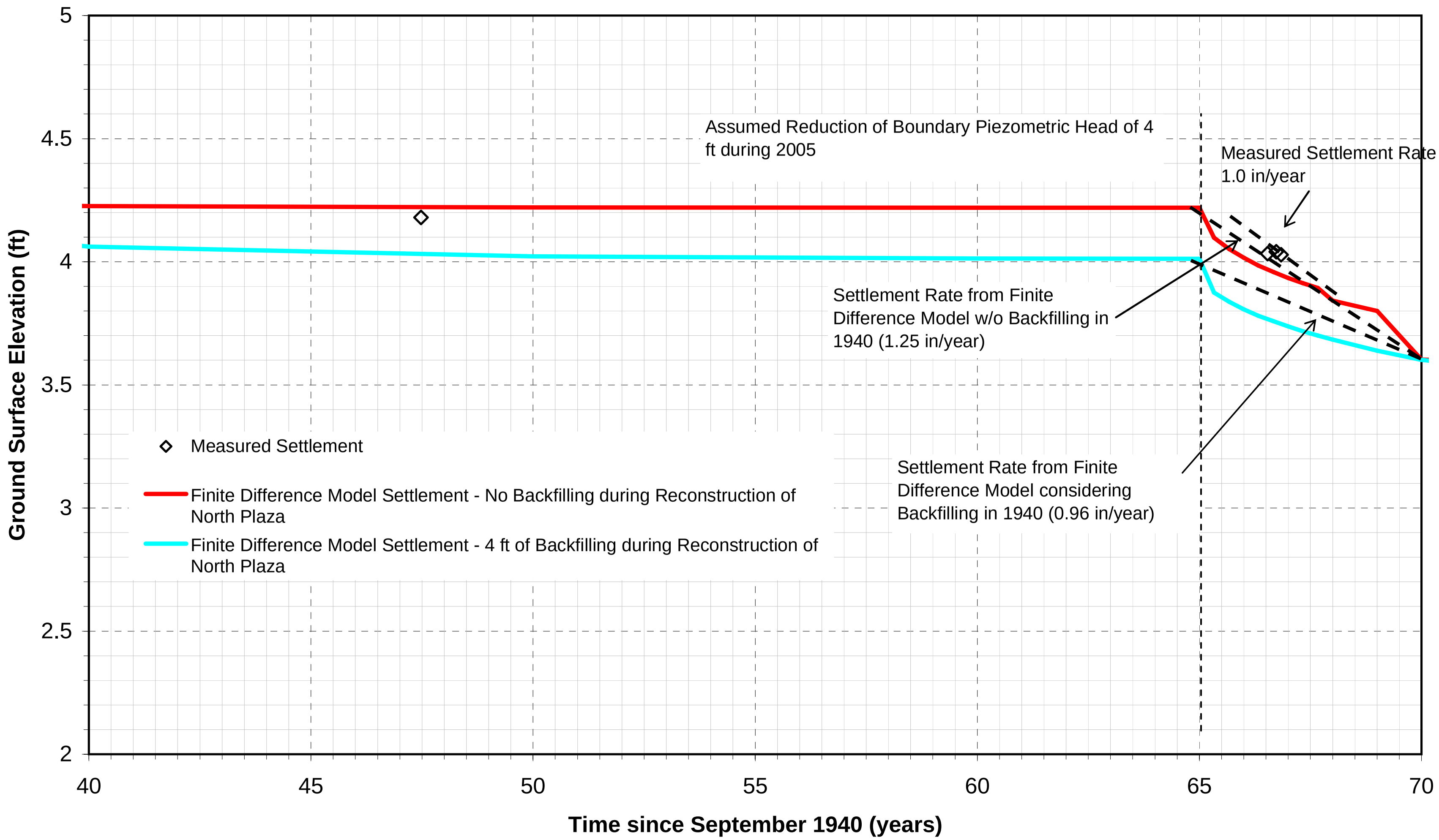


Figure 68. Detail of 2007 Settlement Data and Comparison to Numerical Model

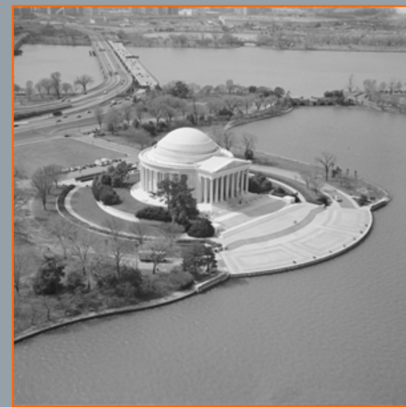
iii. Defects in Storm Drainage Pipes

Based on the results of the video inspection of the drainage pipes on the east and west sides of the Memorial, we do not believe that soil washout around or through these pipes is a likely cause for the observed movements. However, the pipes do need repair and/or replacement and may be cause for future local erosion and sinkholes. The video inspection performed on the pipes is discussed in Section 4 and Appendix C.

iv. Structural Failure of Timber Piles under the Ashlar Seawall

It is possible that the movement of the Ashlar Seawall may be associated with deterioration of its foundation on timber piles. Photos of these piles suggest that they were not treated with preservatives, and their lengths are variable. Over time, the upper portion of the piles at the interface with the wall footing, which may not be continuously submerged, could have deteriorated. It is possible that, once deterioration reached a certain level, the pile material started to yield at an accelerated rate under the weight of the wall.

This is a viable mechanism for settlement of the seawall and may be acting in conjunction with settlement induced by consolidation. This failure mechanism may contribute to the accelerated rate of settlement measured at points along the seawall (see Figure 62 for settlement along the seawall), but is independent from the consolidation induced settlement at points 19 and 39, and the continuous asphalt patching needed at the interface of the North Plaza and the Circular Roadway.



8. REMEDIATION ALTERNATIVES

8. REMEDIATION ALTERNATIVES

In this section, we provide remediation schemes for the Ashlar Seawall. Additionally, we provide recommendations for the mitigation of the tripping hazards at the interfaces between the North Plaza and the Circular Roadway, at the Northwest Stairs, and on the Terrace Level at the entrance to the exhibit areas.

I. ASHLAR SEAWALL REMEDIATION ALTERNATIVES

The recent increase on the rate of settlement along the seawall indicates that the Ashlar Seawall must be underpinned to limit further damage. We are providing three alternatives that utilize micropile technology to stabilize and underpin the seawall.

These alternatives do not consider structural re-leveling or jacking of the seawall. Consequently, approximately 378 ft of granite capstones will need to be removed, stored and reset along the arced portion of the wall to match the grade of the northern edge of the North Plaza.

Micropiles were selected for underpinning for several reasons. They can be installed with relatively small equipment, thus reducing the impact of the equipment weight on the North Plaza and adjacent areas. They can be installed at different orientations and batter, thus allowing some level of restraint against lateral movements. The micropiles are heavily reinforced, drilled and grouted elements with diameters of typically less than 12 inches. Therefore, they allow underpinning of sensitive structures without the significant potential for damage of other, larger diameter foundations. They can be drilled through the seawall, the underlying soils, and into rock as part of the same operation.

The remediation schemes presented consider battered micropiles. The purpose of the batter is to limit additional settlement of the timber piles that may be caused by micropile installation. Battered micropiles also help to support earth pressures from the wall backfill. The micropile solution is not intended to restrict the lateral movement of the North Plaza or of the Ashlar Seawall. Because of the significant depth to rock, the micropiles would deform laterally following the deformation of the soil beneath the wall. Further monitoring of the Ashlar Seawall and the North Plaza, including monitoring of lateral movements, should be performed so that adjustments to these schemes can be made if necessary.

It is noted that any remediation alternative selected will cause distress to the seawall and nearby structures during construction. Therefore, monitoring of sensitive structures must be conducted throughout construction and beyond. Other deep foundation types are also applicable to Alternative 3 including the use of H-piles and pipe piles. However, we believe the use of micropiles may reduce the possible negative impact of the construction operations on the Memorial.

i. Alternative 1

This alternative consists of installing micropiles through the existing concrete wall, the underlying fill and alluvial soils, and into bedrock as shown in Figures 69 and 70. For this alternative, segments of the North Plaza slab must be removed to excavate behind the seawall. We anticipate removing the plaza slab at the expansion joint located approximately 10 ft behind the seawall. The existing grade beams would remain in place. Battered micropiles could be installed from inside the excavation, or from scaffolding at the Plaza elevation through the stem and the base of the seawall. Holes should be cored through the wall to allow micropile installation. Following micropile installation, the plaza slab would be replaced.

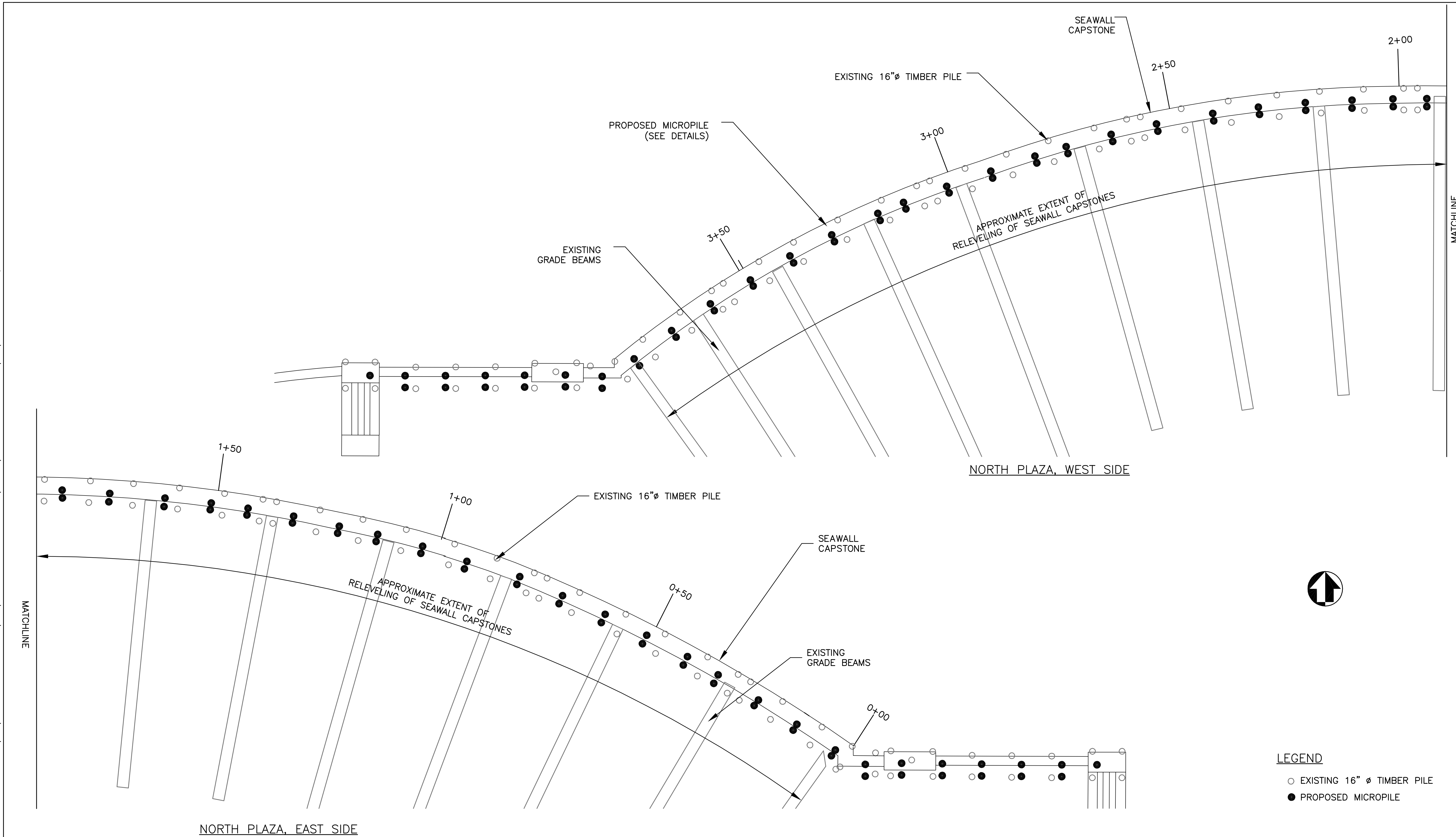


FIGURE 69 – ASHLAR SEAWALL – ALTERNATIVE 1

1/29/08 11:09 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\COST ALTERNATIVES FOR REPORT\ALT 1\S1JEFF_ALT1 – REV.DWG IMAGES: G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\PART-PLAN-EAST_END.TIF;

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

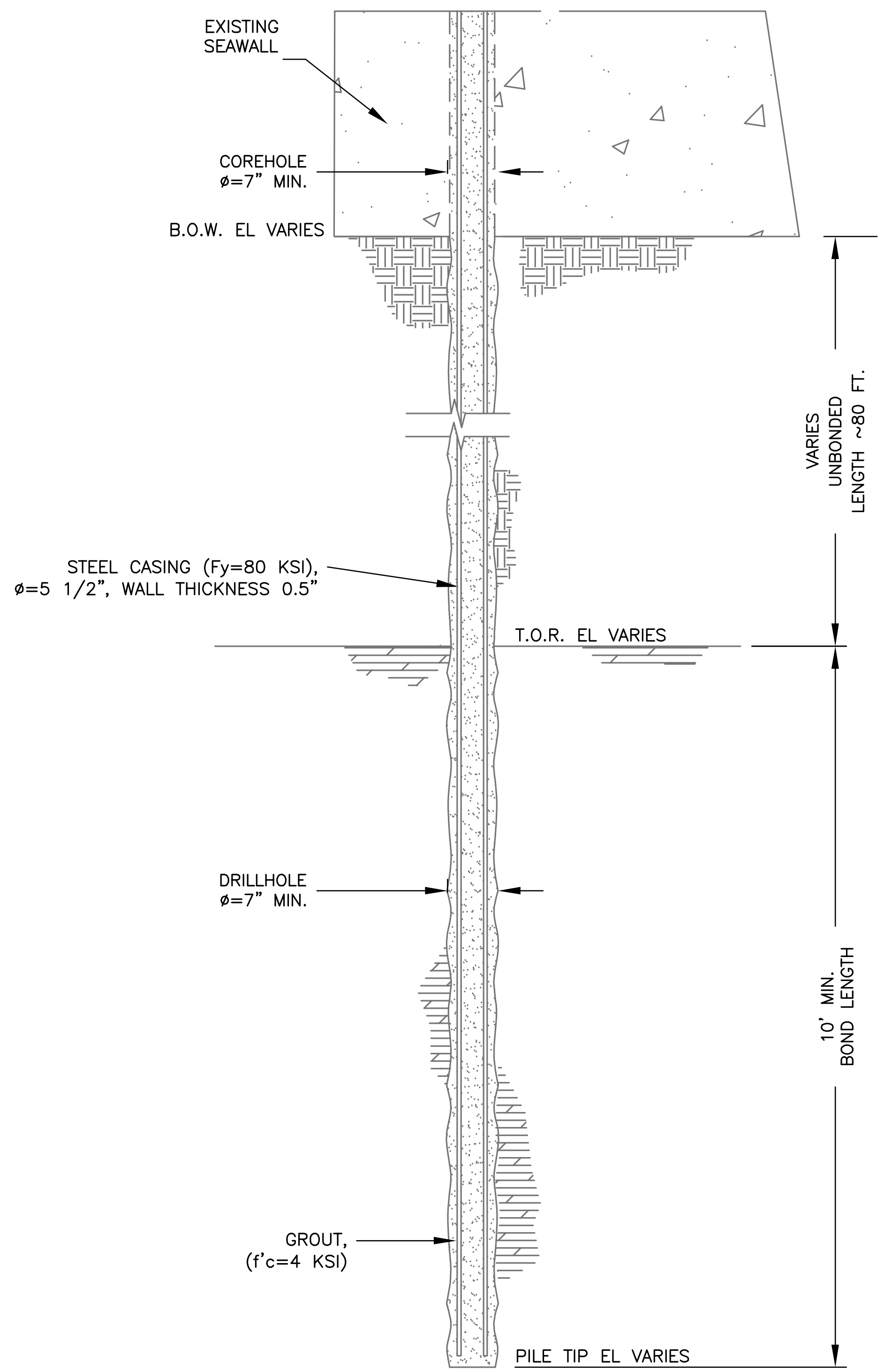
ASHLAR SEAWALL – ALTERNATIVE 1
TITLE OF DRAWING

SUB SHEET NUMBER

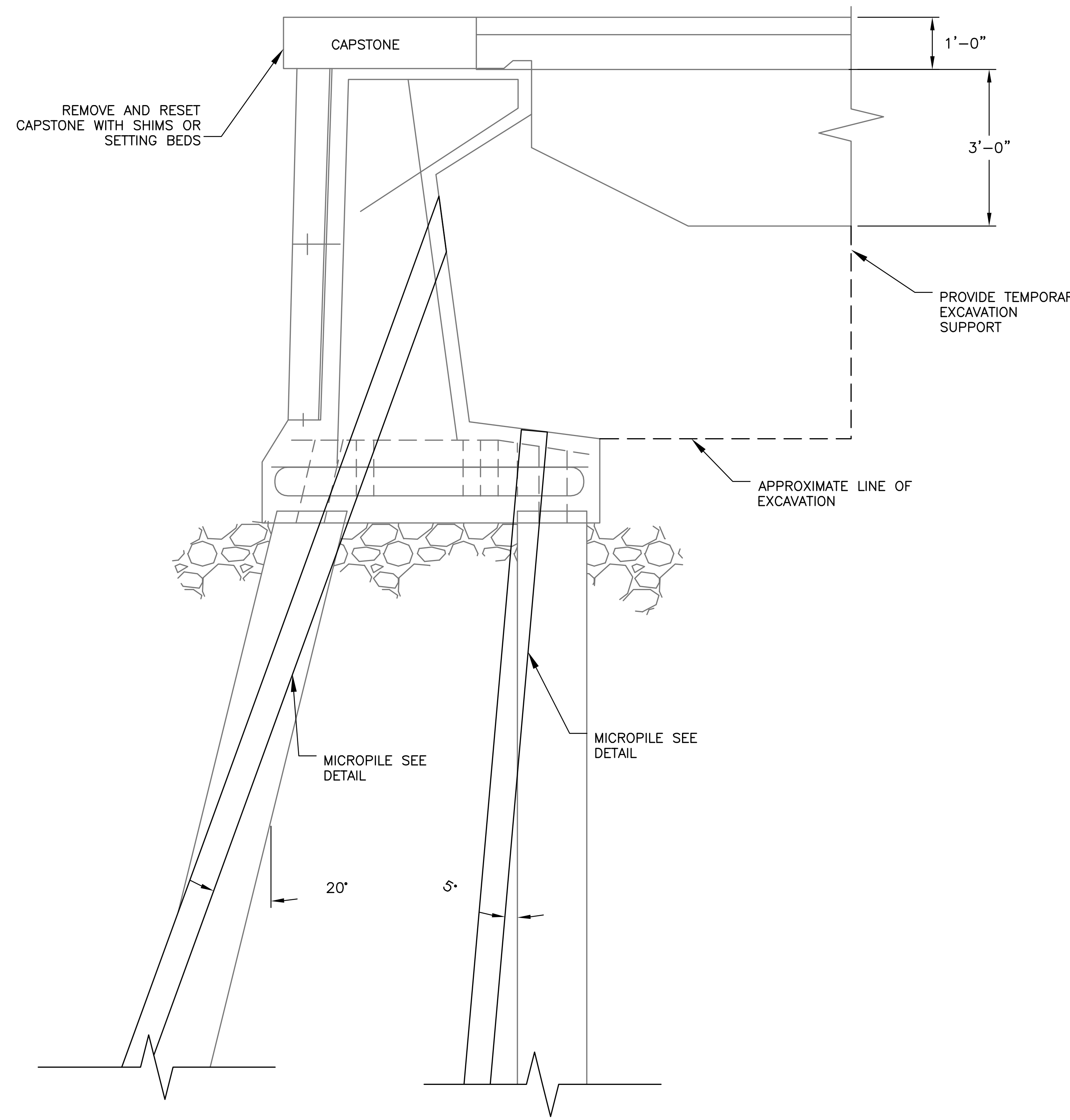
UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PKIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284



TYPICAL MICROPILE TYPE I DETAIL
NO SCALE



TYPICAL ALTERNATIVE I DETAIL
3/8" = 1'–0"

2 0 2 4 6
SCALE OF FEET

FIGURE 70 – ALTERNATIVE 1 SECTION VIEW

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

ALTERNATIVE 1 SECTION VIEW
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

This alternative allows work from land, without the need for cofferdams in the Tidal Basin. It would also provide an opportunity to determine if there is washout of the backfill behind the wall through the wall joints or the wall footings and to remedy it. Remediation for washout would require placement of backfill and geotextile behind the wall to serve as a filter for fine soils. Placement of backfill will require temporary support of the excavation, possibly with sheetpiles behind the wall and dewatering.

One disadvantage of this alternative is that it requires removal of a portion of the North Plaza slab, excavation, and possibly backfilling with select material, and the consequent disruption to Memorial operations and added cost.

This alternative would consist of approximately 52 micropiles battered at 20 degrees through the wall stem, and 52 micropiles battered at 5 degrees through the wall base as shown in Figures 61 and 62. The piles should have a minimum bond length of 10 ft into bedrock. At least one load test on a sacrificial, instrumented micropile should be performed to verify the design micropile capacity.

ii. Alternative 2

This alternative consists of installing micropiles through the existing concrete wall and underlying soils and into competent rock as shown in Figures 71 and 72. Micropiles would be installed through the top of the seawall. Granite capstones would need to be removed, stored and reset along the seawall in order to core holes through the wall.

The main advantage of this alternative is that it does not require removal of the North Plaza slab nor excavation behind the wall. It also does not require dewatering or a cofferdam within the Tidal Basin. The work area would be significantly smaller than in other alternatives.

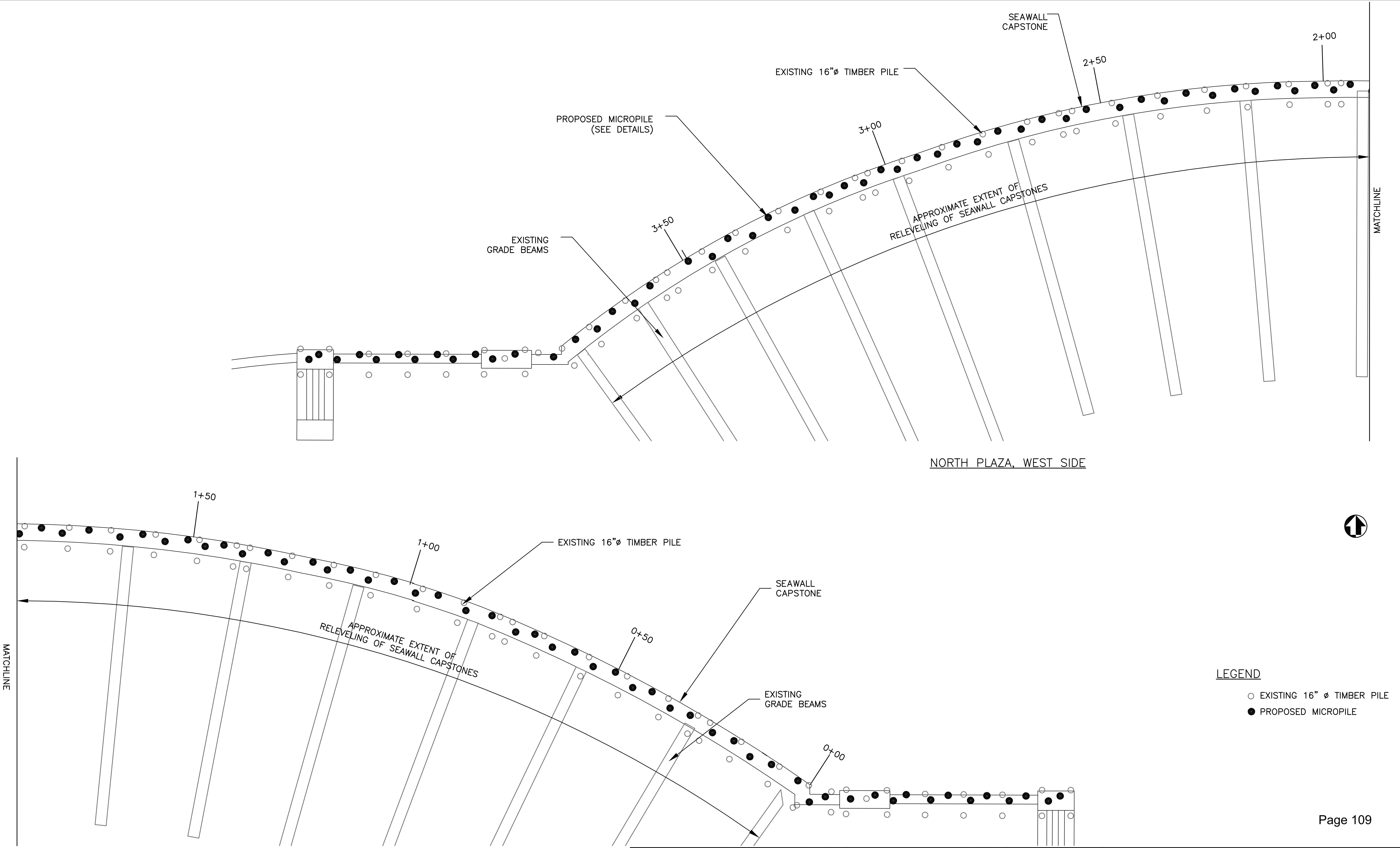
This alternative does not allow inspection of the back of the seawall. If this is deemed necessary, it would be part of a separate item.

Figures 63 and 64 illustrate this alternative which would consist of 51 micropiles battered at 7 degrees, and 51 micropiles battered at 13 degrees through the wall stem. Micropile length and load testing requirements would be similar to Alternative 1.

iii. Alternative 3

This alternative consists of installing micropiles to the north and south of the footing of the existing concrete wall as shown in Figures 73 and 74. For this alternative, segments of the North Plaza slab must be removed to excavate behind the seawall. We anticipate removing the plaza slab at the expansion joint located approximately 10 ft behind the seawall. The existing grade beams would remain in place. Battered micropiles could be installed from inside the excavation to the south of the wall footing, and pile cap extensions would be constructed. The micropiles to the north of the footing could be installed from the North Plaza elevation; however, a cofferdam would be needed around the wall to construct the pile cap extension. Following construction of the pile cap extensions, the wall would be backfilled and the plaza slab replaced.

This alternative would reduce the impact on the timber piles, as the micropiles are installed outside the wall footprint. It also allows inspection of the back and foundation of the wall. Other types of deep foundation elements could be used with this alternative. However, we anticipate that micropiles will have less impact on the seawall than most other foundation types. Coring of the existing wall would not be necessary.



10 0 10 20
SCALE OF FEET

FIGURE 71 – ASHLAR SEAWALL – ALTERNATIVE 2

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

ASHLAR SEAWALL – ALTERNATIVE 2
TITLE OF DRAWING

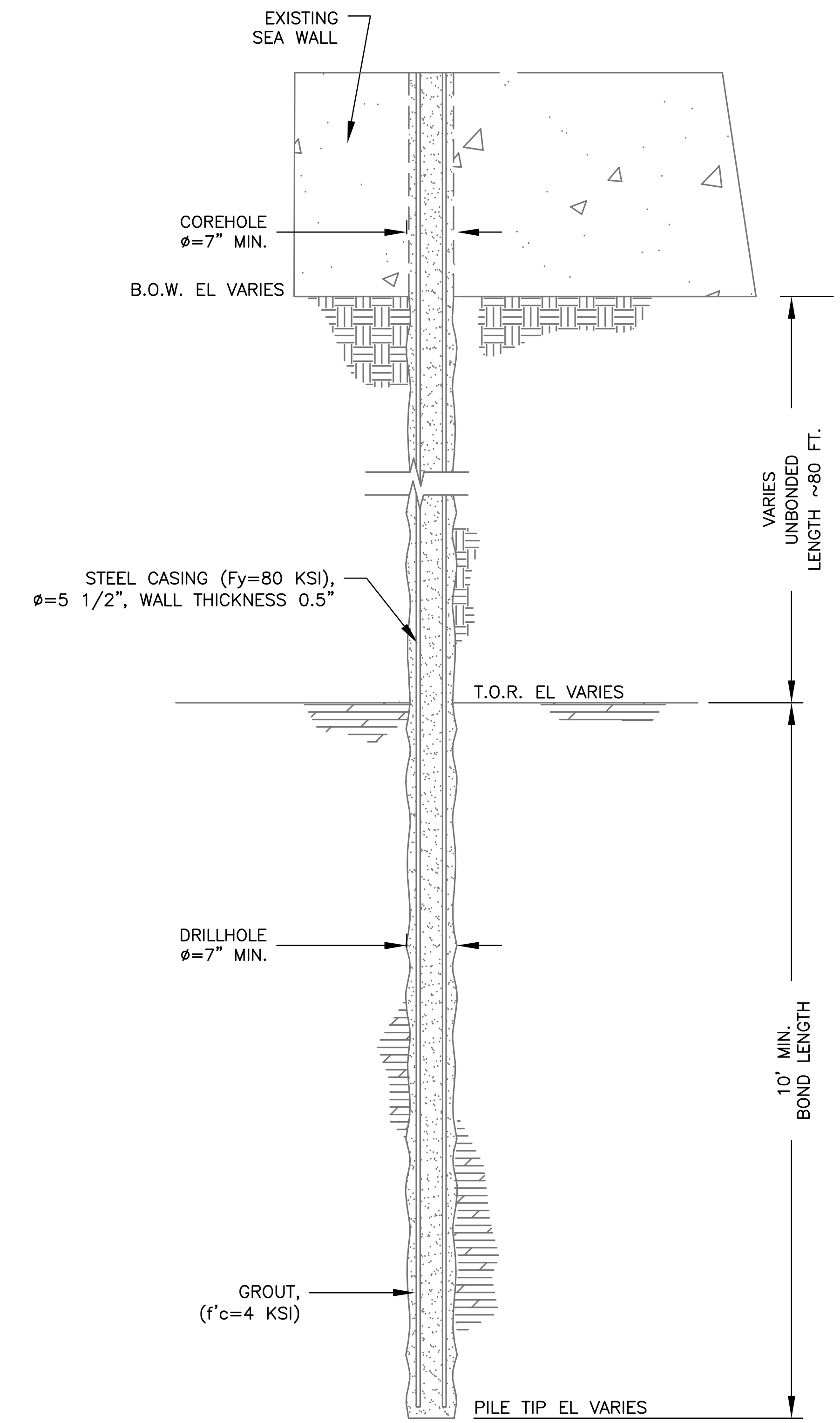
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

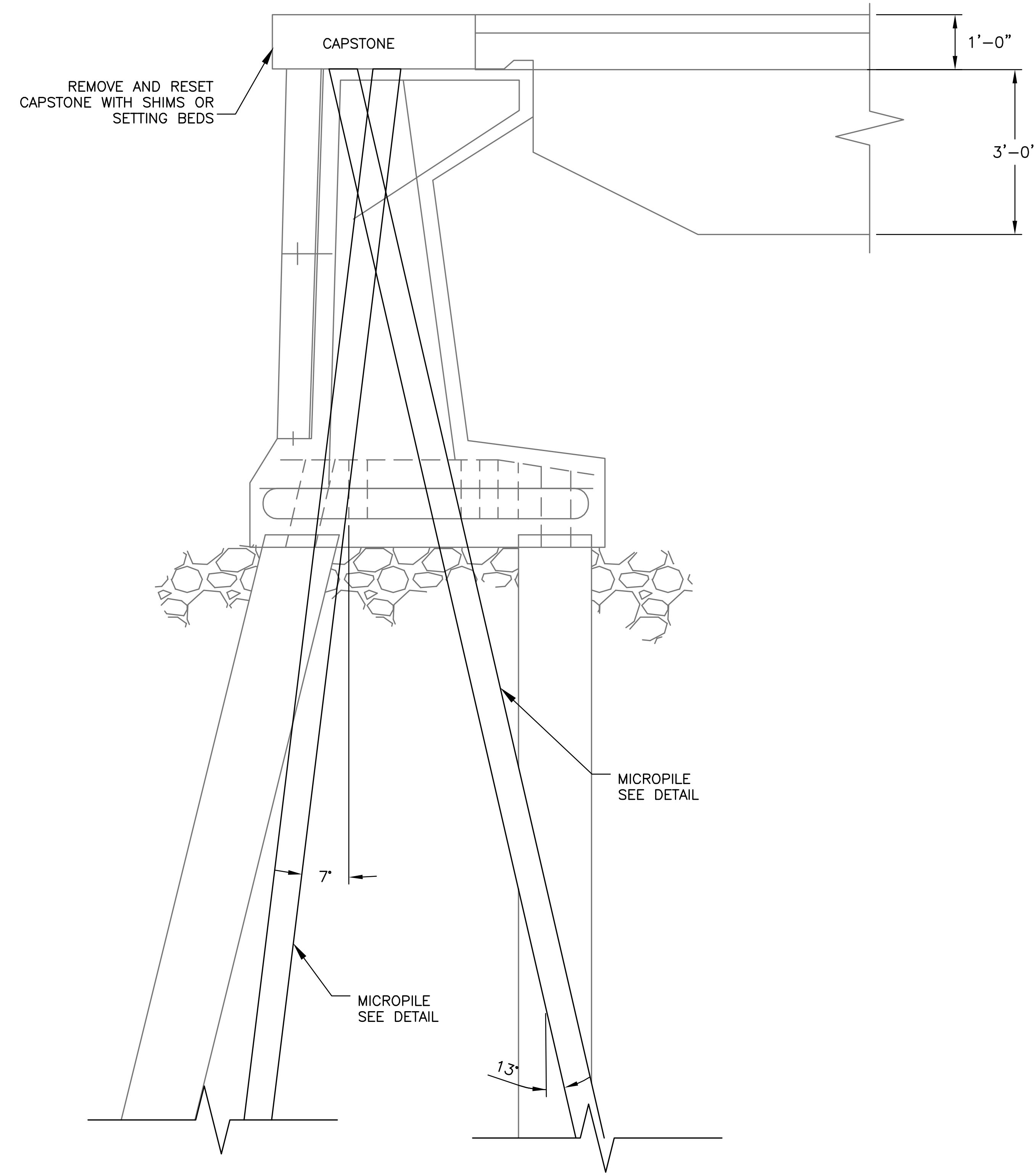
JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

1/29/08 11:09 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\COST ALTERNATIVES FOR REPORT\ALT 1\51JEFF_ALT1 – REV.DWG IMAGES: G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\PART-PLAN-EAST_END.TIF;



TYPICAL MICROPILE TYPE I DETAIL
NO SCALE



TYPICAL ALTERNATIVE 2 DETAIL
3/8" = 1'–0"

2 0 2 4 6
SCALE OF FEET

FIGURE 72 – ALTERNATIVE 2 SECTION VIEW

A/E FIRM
HNTB
ARCHITECTURE
SCHNABEL
ENGINEERING

Mark	Sheet	REVISION	Date	Initial

ALTERNATIVE 2 SECTION VIEW
TITLE OF DRAWING

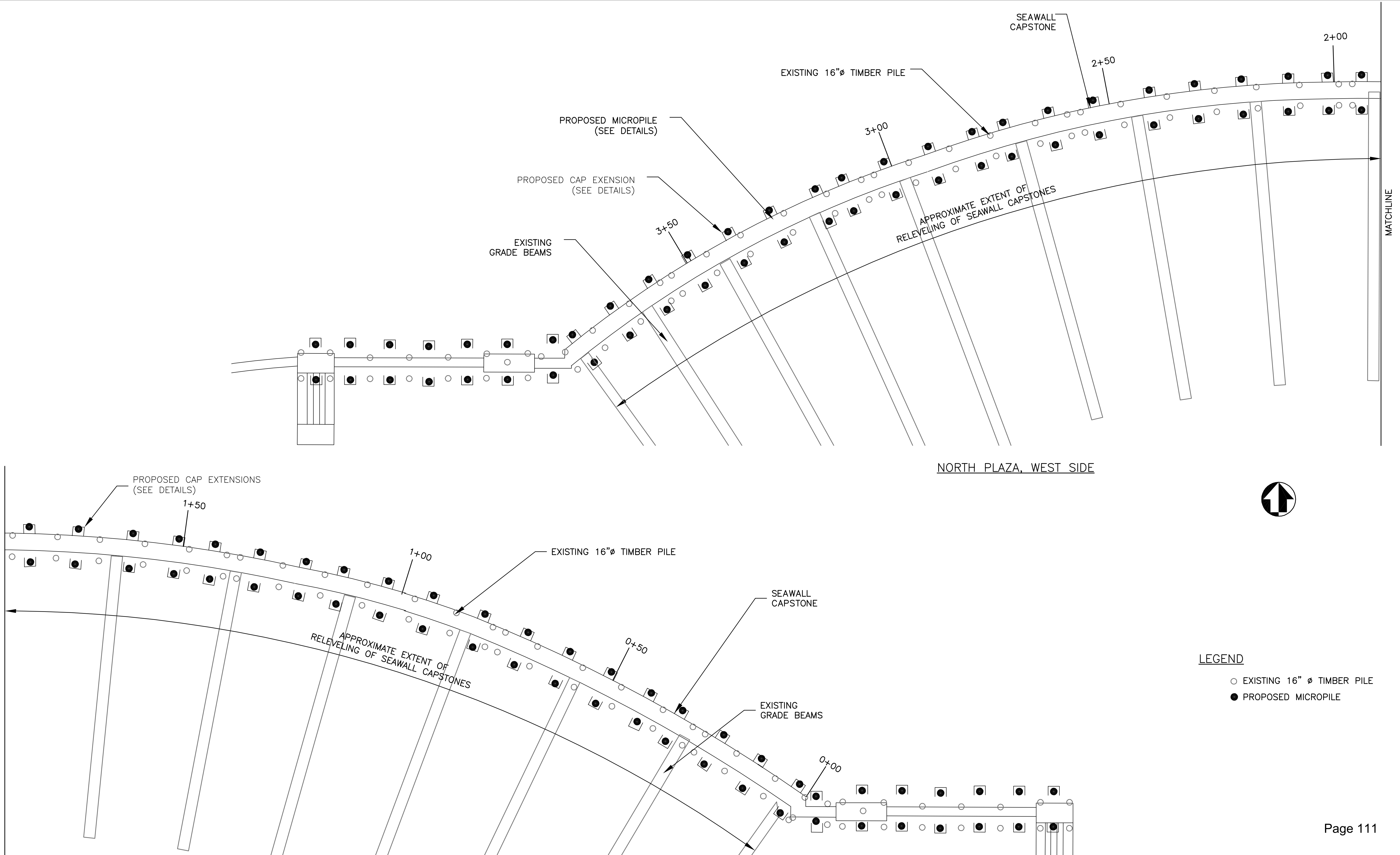
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PKIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

1/29/08 12:31 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\COST ALTERNATIVES FOR REPORT\ALT 2\54DETAIL_ALT2.DWG



NORTH PLAZA, EAST SIDE

10 0 10 20
SCALE OF FEET

FIGURE 73 – ASHLAR SEAWALL – ALTERNATIVE 3

Page 111

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

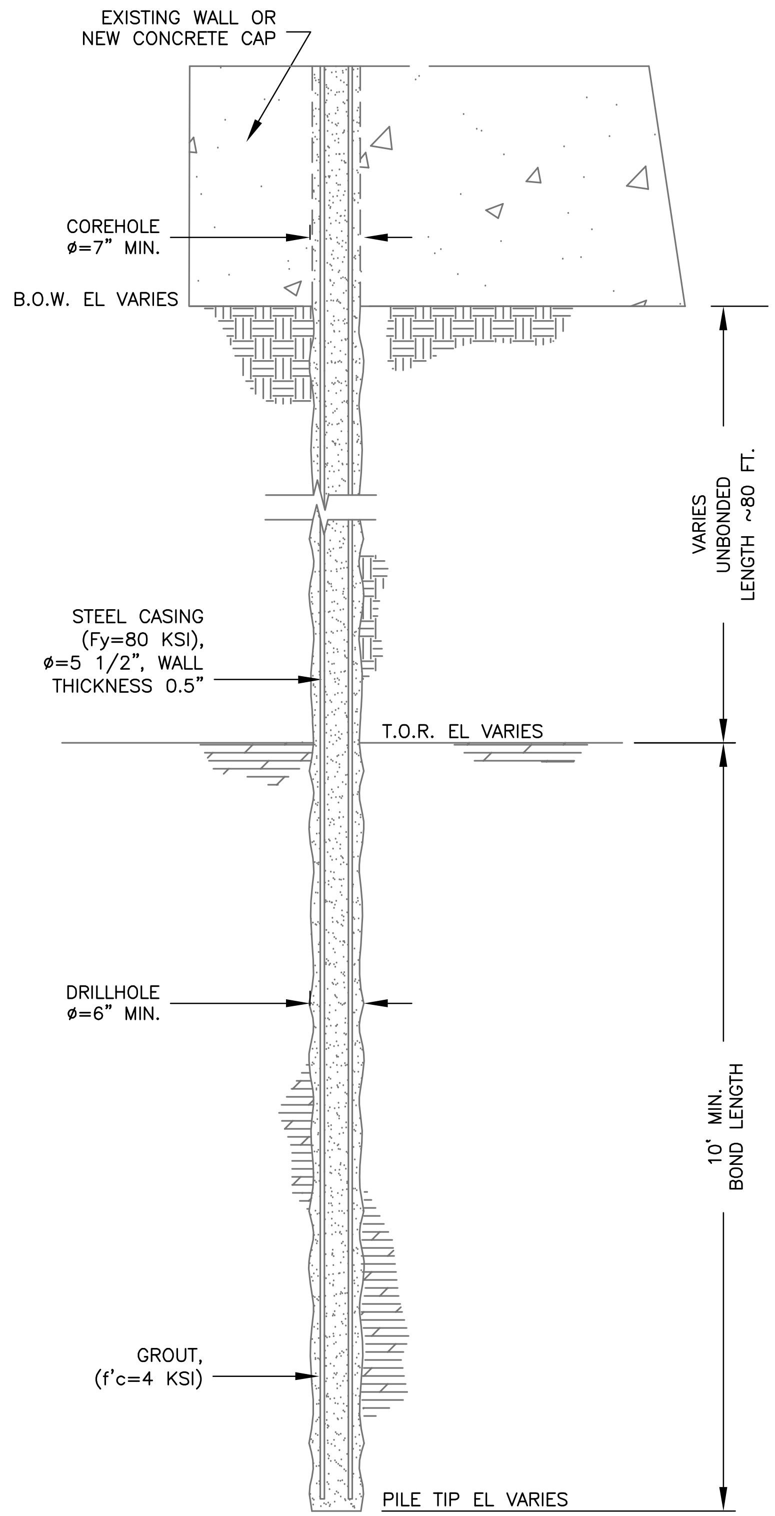
ASHLAR SEAWALL – ALTERNATIVE 3
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

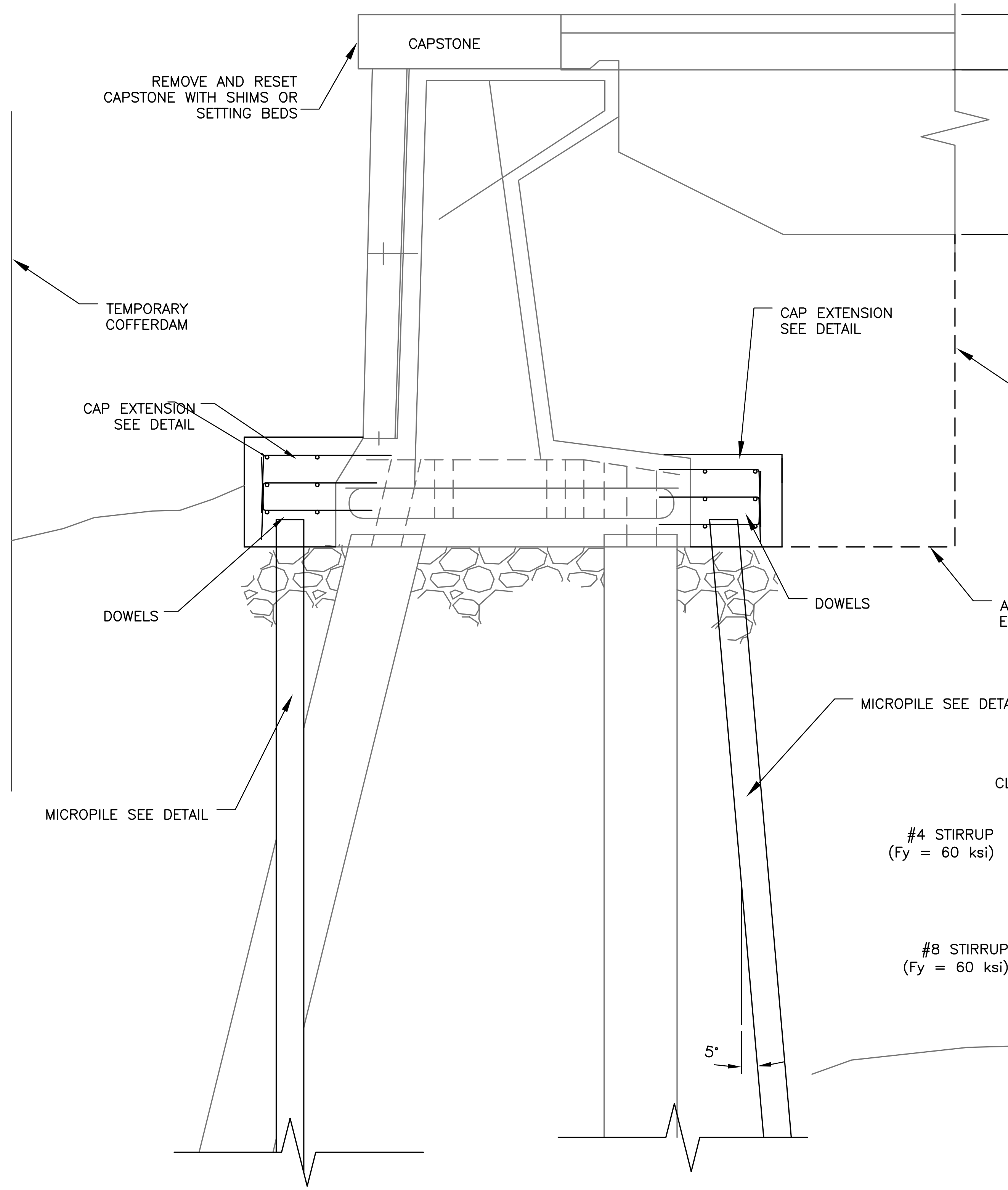
JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284



TYPICAL MICROPILE TYPE I DETAIL

NO SCALE

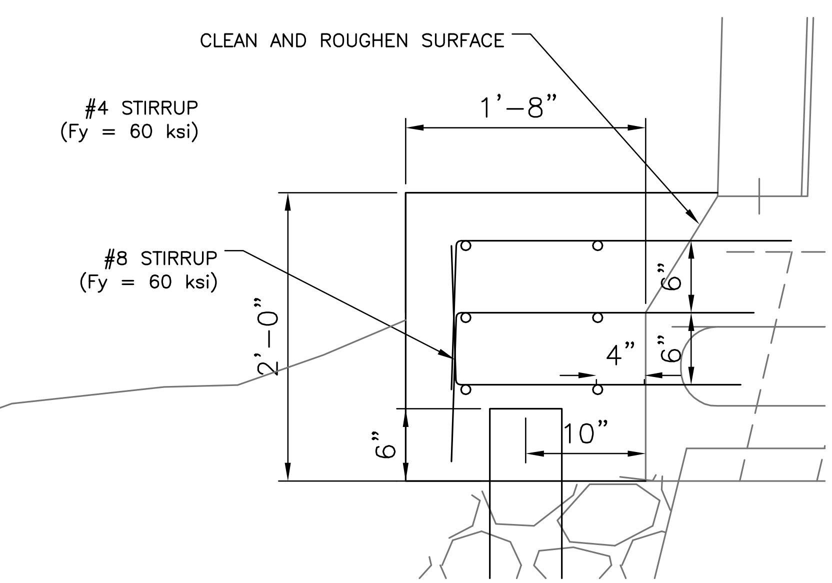


TYPICAL ALTERNATIVE 3 DETAIL

3/8" = 1'-0"

2 0 2 4 6

SCALE OF FEET



CAP EXTENSION DETAIL

3/4" = 1'-0"

1 0 1 2 3

SCALE OF FEET

FIGURE 74 – ALTERNATIVE 3 SECTION VIEW

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

ALTERNATIVE 3 SECTION VIEW
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW DESIGNED
NSF DRAWN
JG CHECKED
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

This alternative requires a significant volume of excavation and backfilling, removal of the North Plaza slab, cofferdams, and dewatering in front and behind the wall. The excavation limit would extend to the bottom of the existing riprap. Riprap will have to be removed and replaced.

This alternative would consist of about 53 vertical micropiles in front of the wall, and about 53 micropiles battered at 5 degrees behind the wall. Figures 65 and 66 show a plan and section view. Micropile length and load testing requirements would be similar to Alternative 1.

II. REMEDIATION METHOD FOR THE NORTH PLAZA

At the North Plaza, there is noticeable relative movement at the interface between the structural slab on piles and the adjacent Circular Roadway slab-on-grade. This location is depicted in Figure 67. The elevation difference, resulting from settlement of the slab-on-grade, is a tripping hazard and requires frequent asphalt patching (about 0.5 inch of patch every three months during 2006 and 2007). Our proposed remediation method consists of cutting the edge of the structural slab, removing about 10 feet of the Circular Roadway from the interface, and replacing this with a structural transition slab as shown in Figures 75 and 76. Micropiles would be installed at five feet on center adjacent to the eastern and western-most grade beams on the North Plaza, and would be capped with a grade beam. This beam would support the east and west edges of new structural slabs adjacent to each side of the North Plaza. A new footing would support the west and east edges of the slabs, and at either end a flexible joint would be used to allow the slab to undergo rotation without causing tripping hazards.

This solution is intended to address the differential settlement at the slab interfaces that occurs with time in a controlled manner. Differential settlement at the interface between the North Plaza and the Circular Roadway slab will occur as long as consolidation of the soil in the surrounding area continues. This solution is intended to limit the frequency of repairs of tripping hazards.

III. REMEDIATION METHOD FOR THE NORTHWEST STAIRS

The Northwest Stairs that approach the North Plaza along the Ashlar Seawall are supported on their north side by the seawall, and on their south side by H piles and a grade beam. A slab on grade sidewalk intersects the stairs orthogonally on the south side. At this interface between the sidewalks on piles and on grade, there are differential elevations resulting in tripping hazards. Schnabel's proposed remediation method consists of removing about 10 feet of the sidewalk slab, and creating a flexible joint near the base of the existing grade beam as shown in Figure 77. A new structural slab would be constructed and supported on the existing beam to the north, and a new footing at the south edge. The interface would be sealed with a flexible joint to allow the sidewalk to undergo anticipated settlements. This solution may also be used on the Terrace Level at the entrance to the exhibit area. A portion of the existing walkway encompassing the current tripping hazard could be removed and replaced with a slab on footings. The new slab would have a flexible joint at each end to allow differential settlement of the soils beneath the walkway.

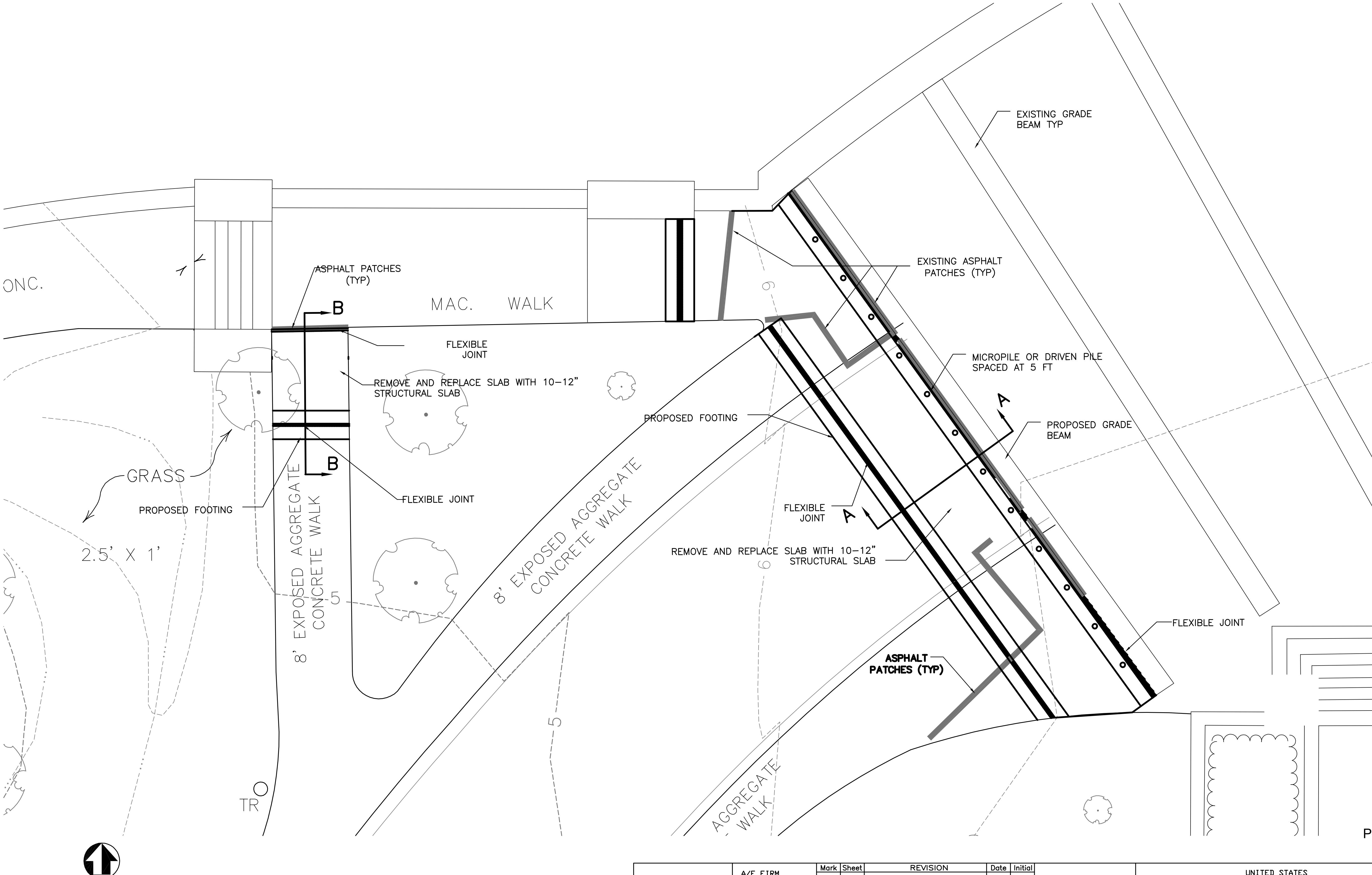


FIGURE 75 – PLAN VIEW OF NORTH PLAZA REPAIRS

5 0 5 10
SCALE OF FEET

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

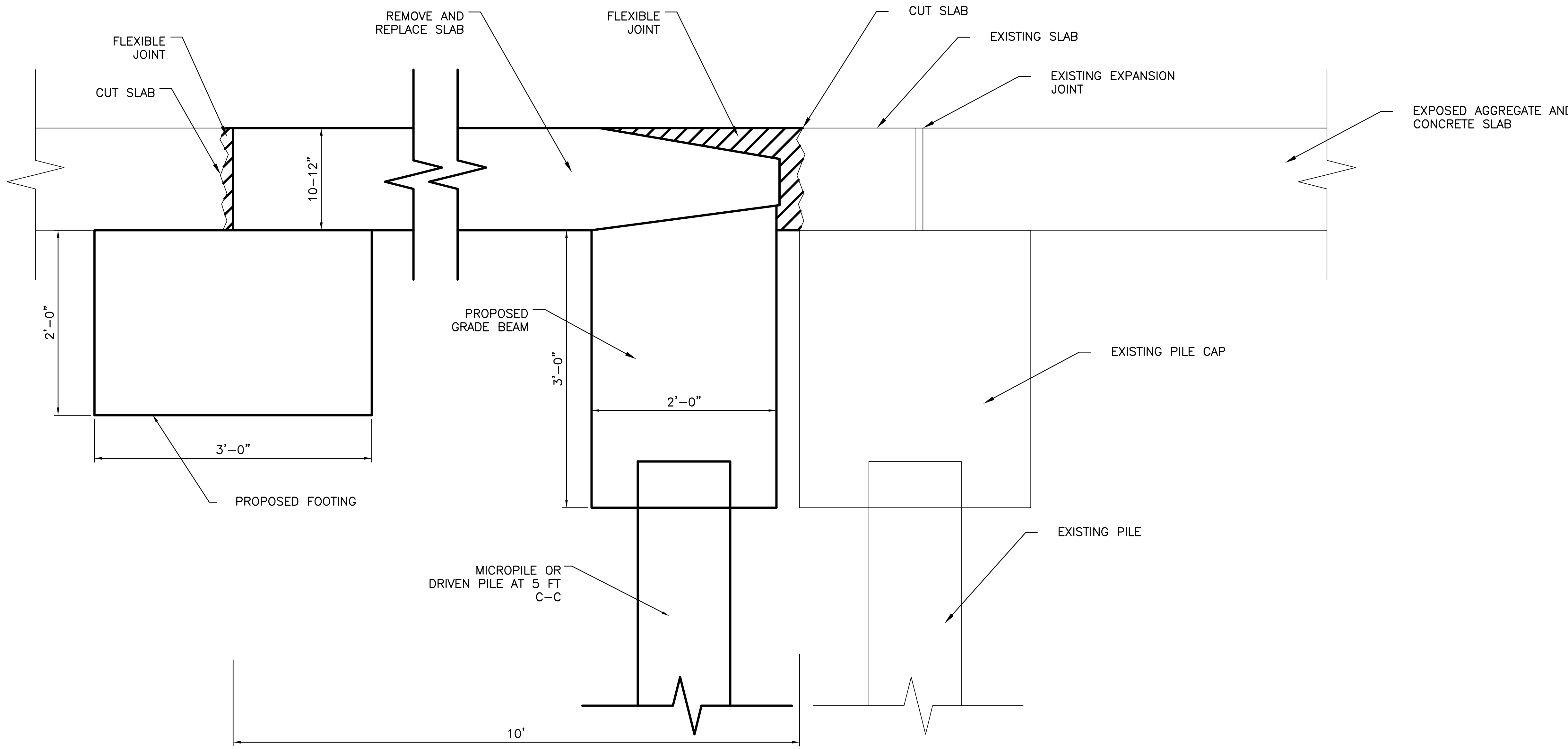
PLAN VIEW OF NORTH PLAZA REPAIRS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284



SECTION A–A
ASPHALT PATCH REPAIRS – NORTH PLAZA
3/4" = 1'–0"

FIGURE 76 – PROPOSED REMEDIATION FOR NORTH PLAZA

1 0 1 2 3
SCALE OF FEET

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

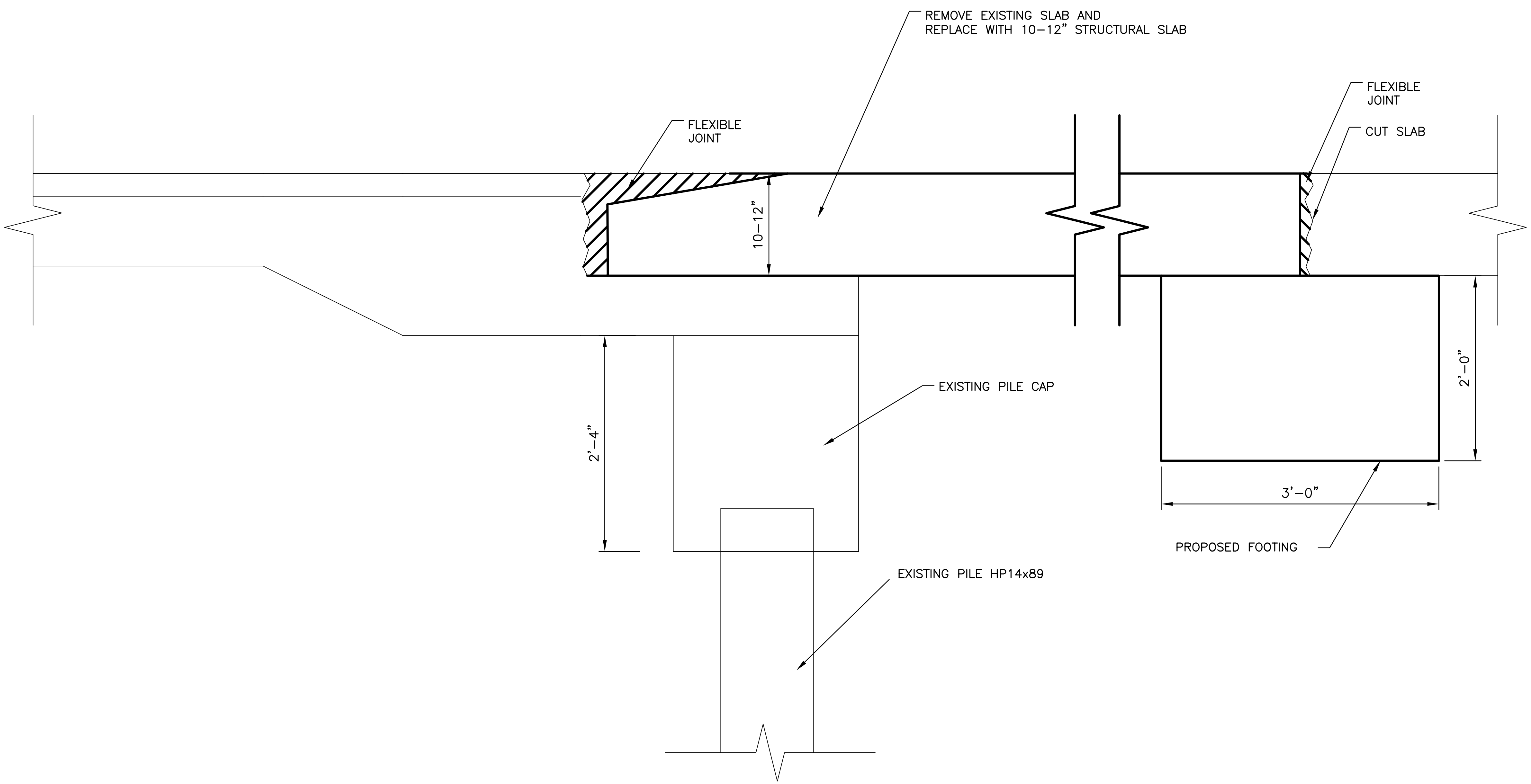
PROPOSED REMEDIATION FOR NORTH PLAZA
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
SF
DRAWN
CHECKED
PKIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284



SECTION B-B
ASPHALT PATCH REPAIRS – NORTHWEST STAIRS
3/4" = 1'-0"

FIGURE 77 – PROPOSED REMEDIATION NORTHWEST STAIRS

1 0 1 2 3
SCALE OF FEET

A/E FIRM
HNTB
ARCHITECTURE
SCHNABEL
ENGINEERING

Mark	Sheet	REVISION	Date	Initial

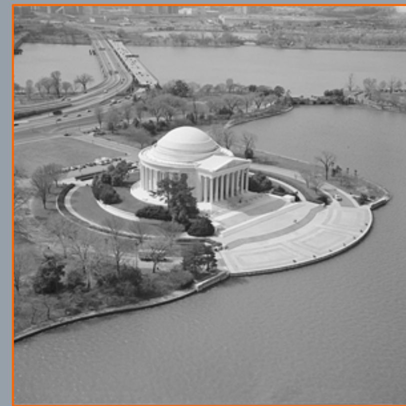
PROPOSED REMEDIATION NORTHWEST STAIRS
TITLE OF DRAWING

SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR/DW
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284



9. CONCLUSIONS AND RECOMMENDATIONS

HNTB

9. CONCLUSIONS AND RECOMMENDATIONS

I. CONCLUSIONS

Based on the data collected and the historical information available to us, we conclude the following:

1) Historical movement of the seawall and the areas surrounding the Memorial is mainly due to consolidation of the soils under the weight of the fill placed during various times in the history of West Potomac Park. This settlement was evidenced by survey data collected as early as 1941 and continued until 1964, at which time the settlement rates had decreased significantly.

2) A fraction of the settlement rate is due to secondary compression of the fine-grained and organic soils existing at the site. This secondary compression settlement will likely continue indefinitely at a decreasing rate with time.

3) The settlement rate of the Ashlar Seawall and areas surrounding the Memorial increased significantly prior to February 2006. This increased settlement rate is not consistent with the historical soil consolidation rates at the site.

4) The cause for this increased settlement rate is not known. We have examined several possible mechanisms that may contribute to this phenomenon. One likely mechanism is a decrease in the pore water pressure within the soil, which may be a result of changes in regional ground water levels. This mechanism could contribute to the settlement of the Ashlar Seawall and areas surrounding the Memorial. Structural deterioration of the timber piles supporting the Ashlar Seawall may also be a contributing factor, although we do not consider this as the primary cause for the observed movements.

5) Inspection of the drainage pipes on the east and west sides of the Memorial did not reveal evidence that the observed movements are related to washout of soils or defects in the pipes.

6) The soils under the North Plaza are also subject to lateral displacement toward the Tidal Basin. We believe that this lateral displacement may be directly related to the observed settlement. As the soils compress, they are also subject to lateral deformations, or bulging. However, additional data is needed to substantiate this mechanism.

7) It appears that the North Plaza is not undergoing vertical displacements because it is supported on piles extending to rock. The survey data collected as part of this study supports this observation. However, the North Plaza appears to be subject to lateral movement toward the Tidal Basin. These movements are evidenced by the inclinometer readings and the pattern and size of joint openings throughout the Plaza.

8) We believe that remediation of the seawall is necessary and should be undertaken as soon as practical. Remediation should include underpinning the seawall through the use of deep foundations extending to rock.

9) Lateral movement of the North Plaza should also be addressed, possibly through the use of battered piles, anchors, or soil improvement techniques.

10) Mitigation of the tripping hazards at the interfaces between the North Plaza and the areas on grade is also necessary.

II. RECOMMENDATIONS

Based on these conclusions, we offer the following recommendations:

1) We recommend that the National Park Service initiates the process for design of the remediation of the Ashlar Seawall and of areas where tripping hazards exist. It is necessary that continued monitoring of the Ashlar Seawall, the North Plaza and the Circular Roadway of the Jefferson Memorial be performed until and after construction of the selected remediation scheme. This would allow the opportunity to collect additional information to aid in the interpretation of the movements and possibly adjust the selected remediation alternative.

2) We recommend that the triangular wedge section of the North Plaza described on page 52 be demolished, backfilled, and rebuilt to mitigate the potential risk for collapse. The will also allow the opportunity to further investigate the foundations of the North Plaza.

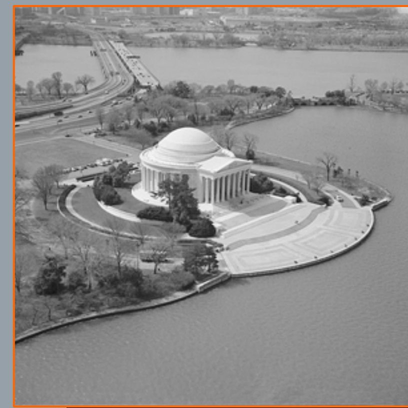
3) We recommend that additional piezometers be installed at varying depths. It is important to obtain piezometric head data from the bottom of Strata B1 and B2, near the interface with bedrock, and within the rock itself. We suggest that vibrating wire piezometers be installed at 8 different locations on the North Plaza and the northeast and northwest portion of the site. Piezometers should be installed at 5 different elevations at each location to estimate percent ground water changes and trends.

4) We recommend that the survey monitoring points continue to be read on a quarterly basis before, during and at least 5 years after construction of the repair alternative for the Ashlar Seawall. We suggest that additional points be placed along the rubble wall on the west and east sides of the Memorial, extending to the inlet and outlet bridges.

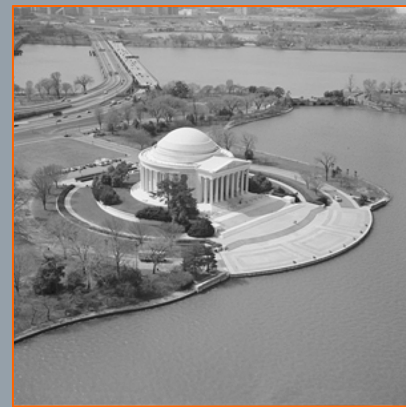
5) Inclinometers, piezometers, tiltmeters, and ground water observation wells should continue to be read on a quarterly basis before, during, and after construction.

6) Lateral movement of the North Plaza requires additional investigation. We recommended that the Park implement a structured program of monitoring joint openings throughout the Plaza that permits the measurement of relative movement along and across the joints at several locations. These measurements should continue through and after construction of any remediation measures in the Ashlar Seawall and North Plaza.

7) We recommend that the National Park Service pursue an additional effort to further investigate the lateral movement of the North Plaza. This additional effort should evaluate causes and develop remediation alternatives to control the lateral movement of the North Plaza.



10. APPENDICES



APPENDIX A

HISTORICAL PHOTOS

APPENDIX A

Historical Photos


Photo 1: View from Memorial Looking East at Material
Cut for Seawall Realignment 10/4/1940

Photo 2: View from Memorial Looking East at Material
Cut for Seawall Realignment 11/4/1940

Photo 3: View from Memorial Looking East at Material
Cut for Seawall Realignment 12/2/1940

Photo 4: View from Memorial Looking East at Material
Cut for Seawall Realignment 2/4/1941

Photo 5: View from Memorial Looking East at Material
Cut for Seawall Realignment 3/3/1941

Photo 6: View from Memorial Looking East at Material
Cut for Seawall Realignment 4/2/1941

Photo 7: View from Memorial Looking East at Material Cut for Seawall Realignment 6/6/1941

Photo 8: View from Memorial Looking East at Material
Cut for Seawall Realignment 3/1942

Photo 9: View from Memorial Looking West at Material
Placed for Seawall Realignment 2/4/1941

Photo 10: View from Memorial Looking West at Material
Placed for Seawall Realignment 3/3/1941

Photo 11: View from Memorial Looking West at Material Placed for Seawall Realignment 4/2/1941

Photo 12: View from Memorial Looking West at Material
Placed for Seawall Realignment 6/6/1941

Photo 13: View from Memorial Looking West at Material
Placed for Seawall Realignment 7/1/1941

Photo 14: View from Memorial Looking West at Material
Placed for Seawall Realignment 8/1/1941

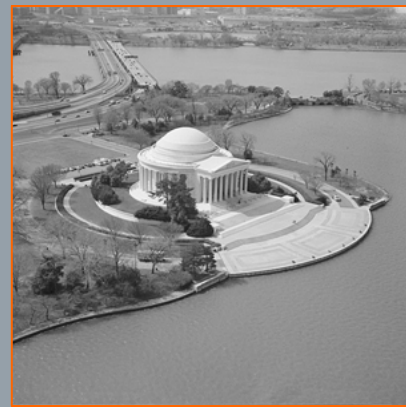
Photo 15: View from Memorial Looking West at Material
Placed for Seawall Realignment 9/5/1941

Photo 16: View from Memorial Looking West at Material Placed for Seawall Realignment 3/1942

Photo 17: Foundations for the Main Structure
of the Memorial 1939

Photo 18: Timber Pile Installation Along
the Ashlar Seawall 2/4/1941

Photo 19: Construction of the Ashlar Seawall 5/1/1941



APPENDIX B

SUBSURFACE EXPLORATION DATA

HNTB

APPENDIX B

Subsurface Exploration Data

SUBSURFACE EXPLORATION PROCEDURES

Boring Procedures

Drillers advanced the borings using hollow-stem augers. A plug device blocked off the center opening in the hollow-stem auger to prevent cuttings from entering the augers during drilling. At the designated depth, drillers removed the plug and performed the Standard Penetration Test. Water or drilling fluid was not introduced into the boring using this procedure, unless indicated on individual logs. The logs indicate water level data.

Standard Penetration Test Results

The numbers in the Sampling Data column of the boring logs represent Standard Penetration Test (SPT) results. Each number represents the blows needed to drive a two-inch O.D., 1⅜ inch I.D. split-spoon sampler six inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first six inch interval usually represents a seating interval. The total of the number of blows for the second and third six-inch intervals is the SPT "N value." When the blow count reaches 100 before the full driving distance, we determine the SPT N value based on extrapolation of the blows recorded. The SPT is conducted according to ASTM D1586.

Rock Coring

Rock was cored with NQ size core barrels. Recovery (REC) and Rock Quality Designation (RQD) are noted on the test boring logs, as applicable.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation may be expected between samples visually classified and samples classified in the laboratory.

Disintegrated rock is residual material with SPT N values between 60 blows per foot and refusal. Refusal is a penetration rate of 100 blows per two inches or less penetration.

Pocket Penetrometer Results

The values following "PP= " in the Sampling Data column of the logs represent pocket penetrometer readings. Pocket penetrometer readings provide an estimate of the unconfined compressive strength of fine-grained soils.

GENERAL NOTES FOR TEST BORING LOGS

1. Numbers in sampling data column (3+6+27) indicate blows required to drive a 2 inch O.D., 1⅜ inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches according to ASTM D1586.

2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The group classification symbols shown in the classification column are based on visual inspection and available laboratory data.

3. Ground water observations: the depth of water below grade was measured at the times indicated. The depths may vary with precipitation, porosity of the soil, site topography, etc.

4. Refusal at the surface of rock, boulder, or obstruction is defined as a resistance of 100 blows for 2 inches penetration or less.

5. The boring logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations.

6. The stratification lines represent the approximate boundary between soil and rock types as determined from the drilling and sampling operation. Some variation may also be expected vertically between samples taken. The soil profile, water level observations, and penetration resistances presented on these boring logs have been made with reasonable care and accuracy and must be considered only as an approximate representation of subsurface conditions to be encountered at the particular location.

7. Test borings drilled under the inspection of **Schnabel Engineering, LLC**.

8. Key to symbols and abbreviations:

3+6+27	Standard Penetration Test, ASTM D1586 Designation	
3" Shelby	2" or 3" Undisturbed Tube Sample, ASTM D1587 (Length Sampled Inches/Sample Recovered Inches)	
REC RQD	NQ2, NX or 2" O.D. Rock Core Run, ASTM D2113 (Recovery and RQD as Shown)	

DO = Ditto

N/E = Not Encountered

REC = Recovery (%) (Length Recovered/ Length Sampled)

w = Natural Moisture Content (%)

* = No Sample Recovery

RELATIVE CONSISTENCY

Cohesionless Soils

	N	Dr
Very Loose	0-4	<15
Loose	4-10	15-35
Medium	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	85-100

Cohesive Soils

	N	Su (tsf)
Very Soft	<2	0-0.25
Soft	2-4	0.25-0.5
Medium Stiff	4-8	0.5-1
Stiff	8-15	1-2
Very Stiff	15-30	2-4
Hard	>30	>4

Descriptive Criteria for Rock Core Logging

Rock is defined as natural subsurface material yielding SPT blow counts of N ≥ 100/2 inches (Martin, 1977). Rock descriptions may include the following descriptive elements, as applicable, generally in the order indicated. Supplemental descriptors may also be used, depending on project performance objectives and available information.

ROCK TYPE, strength, weathering, fracturing, color, recovery, RQD

Rock Type General terms are used following the NRCS (2001) rock type classification chart based on visual identification. Some of the NRCS rock types common to our geographic area of practice are listed below. Mineralogical modifiers may be added where they help define distinct units (e.g., Garnet-Muscovite Schist).

Sedimentary:	Conglomerate, Sandstone, Mudstone, Siltstone, Claystone, Shale, Limestone, Dolomite, Coal, Chert
Igneous:	Pegmatite, Granite, Diorite, Gabbro, Diabase, Rhyolite, Monzonite, Andesite, Basalt
Metamorphic:	Gneiss, Schist, Phyllite, Slate, Quartzite, Marble, Amphibolite, Hornfels

Strength (modified from Hoek, 2001) The estimated Uniaxial Compressive Strength associated with each rock strength term is based on the field strength index test for intact rock samples as follows.

Extremely Strong	>36,000 psi	Specimen can only be chipped with a geological hammer.
Very Strong	15,000 - 36,000 psi	Specimen requires many blows of a geological hammer to fracture it.
Strong	7,500 - 15,000 psi	Specimen requires more than one blow of a geological hammer to fracture it.
Medium Strong	3,500 - 7,500 psi	Specimen cannot be peeled with a pocketknife, can be fractured with one blow from a geological hammer.
Weak	700 - 3,500 psi	Specimen can be peeled with a pocketknife with difficulty, shallow indentation made by firm blow with point of a geological hammer.
Very Weak	150 - 700 psi	Material crumbles under firm blows with point of a geological hammer, can be peeled with a pocket knife.

Weathering (modified from ACOE, 1994; and USBR, 2001)

Fresh	Mineral crystals appear bright and show no discoloration. Fractures show little or no staining on their surfaces. Discoloration does not extend into intact rock.
Slightly Weathered	Rock is generally fresh except along fractures. Some fractures are stained and discoloration may extend up to 0.5 inches into rock.
Moderately Weathered	Significant portions of rock appear dull and discolored. Rock may be significantly weaker than in its fresh state near fractures. Soil zones of limited extent may occur along some fractures.
Highly Weathered	Rock appears dull and discolored throughout. Majority of rock mass is significantly weaker than in its fresh state. Isolated zones of stronger rock and/or soil may occur throughout.
Severely Weathered	Significant portions of rock mass essentially weathered to soil. Rock fabric may still be discernable (i.e., saprolite). Isolated zones of stronger rock may occur locally. Quartz may be present as hard, fractured dikes or veins.

Fracturing (from ACOE, 1994)

Very Slightly Fractured	> 6.5 ft
Slightly Fractured	2 ft - 6.5 ft
Moderately Fractured	8 in - 2 ft
Highly Fractured	2.5 in - 8 in
Intensely Fractured	< 2.5 in

Color (from Munsell Color System; and GSA, 1995) Color descriptions include a primary color and up to two shade or secondary color modifiers, and may also include a color pattern term to define the relationship between multiple colors.

Shade:	Light, Dark
Secondary:	Blackish, Brownish, Grayish, Greenish, Reddish, Yellowish, Orangeish
Primary:	Black, Brown, Gray, Green, Red, Yellow, Orange, White
Pattern:	and, to, with mottles of, with speckles of, with streaks of, with bands of

Recovery is defined as the total length of recovered core in a core run divided by the total length of the core run, times 100 percent. A core run may be any depth interval of concern. Only natural fractures are considered for determining the length of core pieces. Mechanical breaks formed during or after coring do not count against the length determination. The length of recovered core pieces is measured along the core axis, between fracture midpoints.

RQD (ASTM D-6032, Deere & Deere, 1988, 1989) is defined as the total length of core pieces at least four inches long recovered from a core run divided by the total length of the core run, times 100 percent. A core run may be any depth interval of concern. Only natural fractures are considered for determining the length of core pieces. Mechanical breaks formed during or after coring do not count against the length determination. The length of recovered core pieces should be measured along the core axis, between fracture midpoints. Core pieces that are highly to severely weathered, very weak, or contain numerous pores should not count toward RQD.

SCHNABEL ENGINEERING
IDENTIFICATION OF SOILS

I. DEFINITION OF SOIL GROUP NAMES (ASTM D-2487)

			SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾” to 3” Fine, No. 4 to ¾”	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
		Organic	OH	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color and organic odor		PT	PEAT

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D-2487)

			Examples
Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
“With”	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS .... Unified Soil Classification Symbols are shown above as group symbols. A dual symbol “-“ indicates the soil belongs to two groups. A borderline symbol “/” indicates the soil belongs to two possible groups.

FILL... Man-made deposit containing soil, rock and often foreign matter.

PROBABLE FILL .... Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

DISINTEGRATED ROCK (DR).. Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2” or less penetration.

PARTIALLY WEATHERED ROCK (PWR) .... Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2” or less penetration.

BOULDERS & COBBLES ...... Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inch size.

LENSES.................................... 0 to ½ inch seam within a material in a test pit.

LAYERS................................... ½ to 12 inch seam within a material in a test pit.

POCKET .... Discontinuous body within a material in a test pit.

MOISTURE CONDITIONS.... Wet, moist or dry to indicate visual appearance of specimen.

COLOR .... Overall color, with modifiers such as light to dark or variation in coloration.

Subsurface Exploration Data, SEI 2006

Schnabel Schnabel Engineering

TEST BORING LOG

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring Number: **JMI-01**
Contract Number: 06150078
Sheet: 1 of 3

Boring Contractor: CONNELLY AND ASSOCIATES, INC.
FREDERICK, MARYLAND

Boring Foreman: W. WOLFE

Drilling Method: 4¼" ID HOLLOW STEM AUGER

Drilling Equipment: CME-55 (TRUCK)

Schnabel Representative: K. BELL

Dates Started: 10/26/06 **Finished:** 10/27/06

Location: SEE LOCATION PLAN
ELEVATION DATUM: NAVD 29

Ground Surface Elevation: 6.5± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/26	---	14.0'	---	---

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DATA	TESTS	REMARKS
	CONCRETE SLAB, CONCRETE SLAB REBAR 5 TO 6"			A2			Void space between concrete slab and fill.
1.3	VOID BELOW SLAB		5.2				
2.5	LEAN CLAY FILL, MOIST, GREENISH BROWN, SAND, TRACE GRAVEL	FILL	4.0		6+3+5 N = 8 REC = 83%		
					3+3+2 N = 5 REC = 56%		CLAY OR SILT FILL
	DO, SANDY, DARK BROWN, TRACE MICA				1+2+2 N = 4 REC = 56%	w=24.1% LL=30 PL=16	
12.5	CLAYEY SAND FILL, FINE TO COARSE GRAINED, WET, GRAY AND BLACK, CONTAINS GRAVEL; DO, WITH GRAVEL AND ROCK FRAGMENTS	FILL	-6.0	A1	1+1+1 N = 2 REC = 56%		SAND FILL
18.5	LEAN CLAY FILL, WET, YELLOWISH BROWN AND GRAY, TRACE SAND AND GRAVEL	FILL	-12.0	A2	WOH+WOH +3 N = 3 REC = 67%	w=26.1% LL=32 PL=14	CLAY OR SILT FILL
23.5	SANDY ELASTIC SILT, WET, BLACK, TRACE ROOT FRAGMENTS	MH	-17.0	B2	WOH+WOH +2 N = 2 REC = 100%	w=53.3% LL=77 PL=37	ALLUVIAL (CLAY OR SILT)

continued on next page

Comments:
1. INCLINOMETER AND PIEZOMETER GROUTED IN PLACE. ZERO READING OF PIEZOMETER #324647= 8822.5.
2. PIEZOMETER CONNECTED BY ATTACHING TO A ¾" PVC PIPE AT A DEPTH OF 53.6 FT (EL 47.1).

Schnabel Schnabel Engineering

TEST BORING LOG

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring Number: **JMI-01**
Contract Number: 06150078
Sheet: 2 of 3

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
28.5	POORLY GRADED SAND, WITH SILT, FINE TO COARSE GRAINED, WET, GRAY AND BROWNISH GRAY, TRACE MICA AND SILT	SP-SM	-22.0	B1	30	WOH+WOH +1 N = 1 REC = 100%		ALLUVIAL (SAND)
					35	WOH+2+2 N = 4 REC = 83%	w=26.3%	
	DO, SILTY					WOR/18" N = WOR/18" REC = 67%		
39.5	SANDY ELASTIC SILT, WET, GRAY AND GREENISH GRAY, TRACE MICA AND FINE TO MEDIUM SHELL FRAGMENTS	MH	-33.0	B2	40			ALLUVIAL (CLAY OR SILT)
					45	WOH/18" N = WOH/18" REC = 100%	w=56.7% LL=83 PL=50	
49.0	FAT CLAY, WITH SAND, WET, DARK BROWN	CH	-42.5		50	WOH+WOH +3 N = 3 REC = 100%	w=65.7% LL=91 PL=33	
53.5	SANDY ELASTIC SILT, WET, DARK GRAY	MH	-47.0		55	2+3+2 N = 5 REC = 100%	w=69.5% LL=93 PL=43	
					60	2+2+2 N = 4 REC = 100%		
63.5	SANDY FAT CLAY, WET, DARK GRAY	CH	-57.0		65	2+2+3 N = 5 REC = 100%	w=75.5% LL=98 PL=37	

continued on next page

Comments:
1. INCLINOMETER AND PIEZOMETER GROUTED IN PLACE. ZERO READING OF PIEZOMETER #324647= 8822.5.
2. PIEZOMETER CONNECTED BY ATTACHING TO A ¾" PVC PIPE AT A DEPTH OF 53.6 FT (EL 47.1).

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY FAT CLAY, WET, DARK GRAY *(continued)* DO, WITH WOOD FRAGMENTS	CH		B2	70	3+4+5 N = 9 REC = 100%		ALLUVIAL (CLAY OR SILT)
73.5	SILTY SAND, WET, GRAY-BROWN	SM	-67.0	B1	75	2+4+3 N = 7 REC = 67%	w=23.5% LL=24 PL=21	ALLUVIAL (SAND)
79.0	LEAN CLAY, WITH SAND, WET, GRAY AND BLACK, TRACE MICA AND FINE TO MEDIUM SHELL FRAGMENTS.	CL	-72.5		80	2+5+4 N = 9 REC = 100%		ALLUVIAL (CLAY OR SILT)
83.5	SANDY SILT, WET, GRAY BLACK, MICA, FINE TO MEDIUM SHELL FRAGMENTS.	ML	-77.0	B2	85	2+4+6 N = 10 REC = 100%	w=32.2% LL=42 PL=33	
88.5	DISINTEGRATED ROCK (SCHIST), MOIST, BLACK AND GREENISH BLUE, TRACE MICA		-82.0	D	90	100/3" N = 100/3" REC = 100%		RESIDUAL
93.5	SCHIST, SOFT TO VERY HARD, MODERATELY WEATHERED, GREEN AND BLACK, MODERATELY FRACTURED, COARSE GRAINED, LOW INCLINATION		-87.0	E	95	100/1" N = 100/1" REC = 100% NQ REC = 92% RQD = 82%		ROCK
98.5	BOTTOM OF BORING @ 98.5 FT.		-92.0					

Comments:
1. INCLINOMETER AND PIEZOMETER GROUTED IN PLACE. ZERO READING OF PIEZOMETER #324647= 8822.5.
2. PIEZOMETER CONNECTED BY ATTACHING TO A ¾" PVC PIPE AT A DEPTH OF 53.6 FT (EL 47.1).

Schnabel Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMI-02 Contract Number: 06150078 Sheet: 1 of 3

Boring Contractor: CONNELLY AND ASSOCIATES, INC. FREDERICK, MARYLAND

Boring Foreman: D. BENDER

Drilling Method: 4¼" ID HOLLOW STEM AUGER

Drilling Equipment: CME-55

Schnabel Representative: K. BELL

Dates Started: 11/2/06 Finished: 11/3/06

Location: SEE LOCATION PLAN
ELEVATION DATUM: NAVD 29

Ground Surface Elevation: 6.9± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	11/2	8:45	8.0'	---	---

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	CONCRETE SLAB, CONCRETE SLAB WITH REBAR 14 TO 16"							
1.5	8" VOID		5.4					
2.2	SANDY LEAN CLAY FILL, SOME GRAVEL, MOIST, BLACK AND ORANGE BROWN	FILL	4.7	A2		2+1+4+8 N = 5 REC = 75%		CLAY OR SILT FILL
4.0	SANDY SILT FILL, SOME GRAVEL, MOIST, GRAY AND BROWN	FILL	2.9	A2	5	3+3+4+5 N = 7 REC = 100%	PP=1.00 tsf	CLAY OR SILT FILL
6.0	SILTY SAND FILL, FINE TO COARSE GRAINED, TRACE GRAVEL, TRACE SHELLS, MOIST, BLACK DO, TRACE MICA, CONTAINS BRICK	FILL	0.9	A1		3+4+6+7 N = 10 REC = 100% 3+3+3+3 N = 6 REC = 100%		SAND FILL
10.0	SANDY SILT FILL, WET, BLACK, TRACE MICA	FILL	-3.1	A2	10	2+1+2+3 N = 3 REC = 50%		CLAY OR SILT FILL
12.0	SILTY SAND FILL, FINE TO MEDIUM GRAINED, LITTLE ORGANICS, WET, BLACK AND GRAY, AMMONIA ODOR, TRACE SHELLS	FILL	-5.1	A1	15	2+1+1+1 N = 2 REC = 100% WOH+WOH +WOH+1 N = WOH/18" REC = 46%		SAND FILL
17.0	SANDY SILT FILL, WET, DARK BROWN	FILL	-10.1	A2		WOH+1+1+1 N = 2 REC = 100%		CLAY OR SILT FILL
18.0	SANDY ELASTIC SILT, SOME ORGANICS, WET, BLACK AND BROWNISH GRAY, TRACE MICA DO, TRACE FINE TO COARSE SHELL FRAGMENTS	MH	-11.1	B2	20 25	WOH+WOH +1+1 N = 1 REC = 100% WOH/24" N = WOH/24" REC = 75% WOH/24" N = WOH/24" REC = 100% WOH+WOH +2+2 N = 2 REC = 100% WOH+3+2+2 N = 5 REC = 75%	PP=<0.5 tsf w=50.5%	Organic layer @ 23.2 ft. ALLUVIAL (CLAY OR SILT)

continued on next page

Comments:
1. INCLINOMETER GROUTED IN PLACE.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMI-02 Contract Number: 06150078 Sheet: 2 of 3

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
28.5	SANDY FAT CLAY, WET, DARK BROWN	CH	-21.6	B2	30	WOH+WOH +WOH+1 N = WOH/18" REC = 100%	LL=92 PL=35	
					35	WOH+WOH +1+1 N = 1 REC = 100%	w=55.9% LL=96 PL=35	Wet sand lense @ 33.9 ft. ALLUVIAL (CLAY OR SILT)
					40	WOR+2+1 N = 3 REC = 100%	w=44.1% LL=64 PL=30	Sand lense @ 39.3 ft.
42.0	SILTY SAND, MEDIUM TO COARSE GRAINED, ORGANIC ODOR, WET, GRAY AND BROWN	SM	-35.1	B1	45	WOH+WOH +1 N = 1 REC = 100%	w=27.5%	ALLUVIAL (SAND)
48.0	SANDY FAT CLAY, TRACE COBBLES, LITTLE ORGANICS, TRACE FINE TO MEDIUM SHELL FRAGMENTS, WET, BLACK AND GRAY	CH	-41.1	B2	50	WOH/18" N = WOH/18" REC = 100%	w=49.7% LL=99 PL=38	
53.5	SANDY ELASTIC SILT, WET, BLACK, TRACE ROOT FRAGMENTS	MH	-46.6		55	WOH+2+2 N = 4 REC = 100%	w=66.6% LL=108 PL=58 PP=1.00 tsf	ALLUVIAL (CLAY OR SILT)
59.0	SANDY FAT CLAY, WET, DARK GRAY	CH	-52.1		60	WOH+1+1 N = 2 REC = 100%	w=65.2% LL=90 PL=34	
61.0	ORGANIC SILT, TRACE SAND, WET, GRAY-BROWN	OH	-54.1					Shelby tube @ 61 ft.
64.0	SANDY ELASTIC SILT, WET, DARK BROWN AND GRAY	MH	-57.1		65	WOH+1+1 N = 2 REC = 100%	w=60.9% LL=95 PL=42	

continued on next page

Comments:
1. INCLINOMETER GROUTED IN PLACE.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: **JMI-02** Contract Number: 06150078 Sheet: 3 of 3

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY ELASTIC SILT, WET, DARK BROWN AND GRAY *(continued)*	MH		B2	70	WOH+2+3 N = 5 REC = 100%	w=58.6% LL=79 PL=36	ALLUVIAL (CLAY OR SILT) Sand lense @ 69.9 ft.
73.5	SILTY SAND, FINE TO MEDIUM GRAINED, TRACE ORGANICS, WET, GRAY AND BROWNISH BLACK	SM	-66.6	B1		WOH+2+3 N = 5 REC = 100%		ALLUVIAL (SAND)
74.5	SILT, TRACE SAND AND MICA, MOIST, GRAY DO, SANDY, TRACE FINE TO MEDIUM SHELL FRAGMENTS, SOME ORGANICS	ML	-67.6	B2	75 80	WOH+WOH +1 N = 1 REC = 100%		ALLUVIAL (CLAY OR SILT)
83.5	SILTY SAND, FINE AND COARSE GRAINED, WET, GRAY, TRACE MICA	SM	-76.6	B1	85	2+2+3 N = 5 REC = 100%		ALLUVIAL (SAND) Harder drilling @ 86 ft.
88.5	DISINTEGRATED ROCK (SCHIST), MOIST, GREEN AND BROWN		-81.6	D		100/1" N = 100/1" REC = 100%		Rig chatter @ 88.6 ft. RESIDUAL
90.0	SCHIST, SOFT, SLIGHTLY WEATHERED, GREEN AND BLACK, SLIGHTLY FRACTURED, COARSE GRAINED, LOW INCLINATION		-83.1	E	90	NQ NQ REC = 100% RQD = 94%		ROCK
95.0	BOTTOM OF BORING @ 95.0 FT.		-88.1		95			Auger refusal @ 90.0 ft.

Comments:
1. INCLINOMETER GROUTED IN PLACE.

TEST BORING LOG 06150078 OLD AND NEW - USE THIS FILE.GPJ SCHNABEL.GDT 1/24/08

Schnabel Engineering — **TEST BORING LOG**

Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	**Boring Number:** **JMI-03**	**Contract Number:** 06150078 **Sheet:** 1 of 3

Boring Contractor: CONNELLY AND ASSOCIATES, INC.
FREDERICK, MARYLAND

Boring Foreman: D. BENDER

Drilling Method: 4¼" ID HOLLOW STEM AUGER

Drilling Equipment: CME-55

Schnabel Representative: K. BELL

Dates Started: 11/7/06 **Finished:** 11/9/06

Location: SEE LOCATION PLAN
ELEVATION DATUM: NAVD 29

Ground Surface Elevation: 6.8± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	11/7	8:45	12.0'	---	---

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	CONCRETE							
1.3	VOID		5.5					
1.6	LEAN CLAY FILL, TRACE SAND, CONTAINS BRICK, MOIST, BROWN AND BLUE GREEN	FILL	5.2	A2		2+2+4 N = 6 REC = 18%	PP=<0.5 tsf	CLAY OR SILT FILL
	DO, TRACE GRAVEL				5	1+2+2 N = 4 REC = 11%		
	DO, CONTAINS ORGANICS				10	WOH+WOH +1 N = 1 REC = 18%		
13.5	CLAYEY SAND, FINE TO COARSE GRAINED, CONTAINS ORGANICS, WET, GRAY AND BLACK	SC	-6.7	B1	15	WOH+1+1 N = 2 REC = 18%		ALLUVIAL (SAND)
18.5	SANDY SILT, TRACE ORGANICS, WET, GRAY, BROWNISH BLACK	ML	-11.7	B2	20	WOH+1+1 N = 2 REC = 18%	w=40.1% LL=41 PL=31 PP=<0.5 tsf	ALLUVIAL (CLAY OR SILT)
	DO, TRACE ROCK FRAGMENTS				25	WOH+1+2 N = 3 REC = 10%		
28.5	SILTY SAND WITH ORGANICS, WET, DARK BROWN	SM	-21.7	B1	30	1+2+2 N = 4	w=43.7% LL=47	Sand lenses @ 29.5 ft.

continued on next page

Comments:
1. INCLINOMETER AND PIEZOMETER GROUTED IN PLACE. ZERO READING OF PIEZOMETER # 324647=8882.2.
2. PIEZOMETER CONNECTED BY ATTACHING TO A ¾" PVC PIPE AT A DEPTH OF 39 FT (EL 32.2).

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMI-03 Contract Number: 06150078 Sheet: 2 of 3

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SILTY SAND WITH ORGANICS, WET, DARK BROWN *(continued)*	SM		B1		REC = 18%	PL=38	ALLUVIAL (SAND)
33.5	SANDY LEAN CLAY, CONTAINS MICA, WET, DARK BROWN	CL	-26.7		35	WOH+WOH +2 N = 2 REC = 18%		
36.0	SILT WITH SAND, WET, GRAY AND BROWN	ML	-29.2					Shelby tube @ 36 ft.
38.5	SANDY ELASTIC SILT, WITH ORGANICS, WET, GRAY	MH	-31.7	B2	40	WOH+WOH +1 N = 1 REC = 18%	w=48.5% LL=64 PL=47 PP=<0.5 tsf	
	DO, TRACE SAND AND MICA				45	WOH+WOH +1 N = 1 REC = 18%	w=49.5% LL=75 PL=58	
					50	WOH+WOH +1 N = 1 REC = 18%		ALLUVIAL (CLAY OR SILT)
					55	WOH/18" N = WOH/18" REC = 18%		
					60	WOH+WOH +1 N = 1 REC = 18%	w=54.5% LL=82 PL=42	Sand lenses @ 59.9 ft. Shelby tube @ 61 ft.
	DO, TRACE WOOD FRAGMENTS				65	WOH/18" N = WOH/18" REC = 18%		Sand lenses @ 63.7 ft.
68.0	FAT CLAY, WET, DARK GRAY	CH	-61.2			2+2+3	w=45.7% LL=80	Intermittent sand lenses from 68.5 to 70 ft.

continued on next page

Comments:
1. INCLINOMETER AND PIEZOMETER GROUTED IN PLACE. ZERO READING OF PIEZOMETER # 324647=8882.2.
2. PIEZOMETER CONNECTED BY ATTACHING TO A ¾" PVC PIPE AT A DEPTH OF 39 FT (EL 32.2).

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL, WEST POTOMAC PARK, WASHINGTON, DC	Boring Number: JMI-03
			Contract Number: 06150078
			Sheet: 3 of 3

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	FAT CLAY, WET, DARK GRAY *(continued)*	CH		B2	70	N = 5 REC = 18%	PL=31	ALLUVIAL (CLAY OR SILT)
73.5	SILTY SAND, FINE TO MEDIUM GRAINED, TRACE WOOD FRAGMENTS, WET, GRAY	SM	-66.7	B1	75	2+3+4 N = 7 REC = 18%		ALLUVIAL (SAND)
78.5	SANDY SILT, TRACE CEMENTED SAND, WET, DARK GRAY	ML	-71.7	B2	80	2+3+3 N = 6 REC = 18%	w=27.4%	ALLUVIAL (CLAY OR SILT)
					85	WOH+3+2 N = 5 REC = 18%		
88.5	POORLY GRADED GRAVEL SIZED ROCK FRAGMENTS (SCHIST) WITH SILT AND SAND, WET, GREEN AND BROWN	GP-GM	-81.7	C	90	8+20+24 N = 44 REC = 15%	w=15.2%	RESIDUAL
93.5	DISINTEGRATED ROCK (SCHIST), WITH MICA, WET, GREEN AND BLACK		-86.7	D	95	20+100/2" N = 100/2" REC = 8%		
98.6	SCHIST, SOFT, HIGHLY WEATHERED, GREEN AND BLACK, MODERATELY FRACTURED, COARSE GRAINED, LOW INCLINATION		-91.8	E	100	100/1" N = 100/1" REC = 1% NQ REC = 80% RQD = 30%		ROCK
104.5	BOTTOM OF BORING @ 104.5 FT.		-97.7					

Comments:
1. INCLINOMETER AND PIEZOMETER GROUTED IN PLACE. ZERO READING OF PIEZOMETER # 324647=8882.2.
2. PIEZOMETER CONNECTED BY ATTACHING TO A ¾" PVC PIPE AT A DEPTH OF 39 FT (EL 32.2).

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMTB-02 Contract Number: 06150078 Sheet: 1 of 2

Boring Contractor: CONNELLY AND ASSOCIATES, INC.
FREDERICK, MARYLAND

Boring Foreman: D. BENDER

Drilling Method: TRIPOD

Drilling Equipment: TRIPOD

Schnabel Representative: K. BELL

Dates Started: 10/31/06 **Finished:** 11/3/06

Location: SEE LOCATION PLAN
BORING IN BASEMENT. ELEVATION APPROXIMATE.

Ground Surface Elevation: 8.0± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
During Drilling	10/31	3:33	2.5'	---	---
Completion	11/3	12:04	9.0'	---	---
Casing Pulled	11/3	1:34	4.5'	---	26.5'
72 Hour Reading	11/6	9:12	4.0'	---	6.0'

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY SILT FILL, SOME ROCK FRAGMENTS, TRACE MICA, MOIST, BROWN AND GREEN	FILL		A2		1+13+15 N = 28 REC = 89%		CLAY OR SILT FILL
2.5	SILTY SAND FILL, FINE TO MEDIUM GRAINED, TRACE MICA, MOIST, BROWN AND ORANGE-BROWN	FILL	5.5	A1		5+3+1 N = 4 REC = 100%		SAND FILL
5.0	SANDY SILT FILL, TRACE ORGANIC MATERIAL, TRACE MICA, WET, BLACK AND GRAY	FILL	3.0	A2	5	1+1+WOH N = 1 REC = 100%		CLAY OR SILT FILL
					10	2+1+2 N = 3 REC = 100%		
12.5	FAT CLAY, CONTAINS ORGANICS, TRACE SAND, WET, GRAY AND BLACK	CH	-4.5	B2	15	2+2+1 N = 3 REC = 100%	w=64.7% LL=83 PL=35	ALLUVIAL (CLAY OR SILT)
18.5	SILTY SAND, CONTAINS ORGANIC MATERIAL, TRACE MICA, WET, GRAY AND BLACK	SM	-10.5	B1	20	3+2+2 N = 4 REC = 100%		ALLUVIAL (SAND)
	DO, TRACE FINE TO MEDIUM SHELL FRAGMENTS				25	WOH+1+2 N = 3 REC = 100%		

continued on next page

Comments:
1. THIS BORING IS LOCATED INSIDE THE MEMORIAL AND WAS NOT SURVEYED.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: **JMTB-02** Contract Number: 06150078 Sheet: 2 of 2

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
28.5	SANDY ELASTIC SILT ,CONTAINS ORGANICS, TRACE FINE TO MEDIUM SHELL FRAGMENTS, MOIST, GRAY	MH	-20.5	B2	30	WOH+2+3 N = 5 REC = 100%	PP=1.00 tsf	ALLUVIAL (CLAY OR SILT)
					35	1+2+2 N = 4 REC = 100%		
					40	WOH+1+1 N = 2 REC = 100%		
40.0	BOTTOM OF BORING @ 40.0 FT.		-32.0					

Comments:
1. THIS BORING IS LOCATED INSIDE THE MEMORIAL AND WAS NOT SURVEYED.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: **JMW-01** Contract Number: 06150078 Sheet: 1 of 2

Boring Contractor: CONNELLY AND ASSOCIATES, INC.
FREDERICK, MARYLAND

Boring Foreman: D. BENDER

Drilling Method: 4¼" ID HOLLOW STEM AUGER

Drilling Equipment: CME-55 (TRUCK)

Schnabel Representative: K. BELL

Dates Started: 10/30/06 **Finished:** 10/30/06

Location: SEE LOCATION PLAN
ELEVATION DATUM: NAVD 29

Ground Surface Elevation: 7.3± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/30	3:05	9.0'	---	---
Well Reading	11/21	9:00	6.0'	---	---
Well Reading	12/19	---	6.2'	---	---
Well Reading	1/5	---	5.6'	---	---
Well Reading	2/28	---	5.5'	---	---
Well Reading	5/7	---	6.2'	---	---

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	CONCRETE, REBAR AT 6" BELOW GRADE							
1.4	VOID		5.9					
1.8	SANDY LEAN CLAY FILL, TRACE GRAVEL, TRACE MICA, MOIST, GRAY AND BROWN	FILL	5.5	A2		2+1+3 N = 4 REC = 83%	PP=2.50 tsf	CLAY OR SILT FILL
					5	3+6+7 N = 13 REC = 89%	PP=>4.5 tsf	
						1+3+6 N = 9 REC = 100%	PP=3.50 tsf	
9.0	SILTY SAND FILL, FINE TO MEDIUM GRAINED, TRACE GRAVEL, TRACE MICA, WET, GRAY	FILL	-1.7	A1	10			SAND FILL
	DO, CONTAINS BRICK FRAGMENTS				15	WOH/18" N = WOH/18" REC = 100%	w=19.8%	
18.5	LEAN CLAY FILL, TRACE SAND, WET, GRAY	FILL	-11.2	A2	20	WOR+WOH +1 N = 1 REC = 56%	PP=0.50 tsf	Shelby tube @ 20 ft. CLAY OR SILT FILL
23.5	SANDY ELASTIC SILT, TRACE ROOT FRAGMENTS, WET, DARK BROWN	MH	-16.2	B2	25	WOH+WOH +1 N = 1 REC = 100%	w=40.2% LL=64 PL=32 PP=0.50 tsf	ALLUVIAL (CLAY OR SILT)

continued on next page

Comments:
1. WELL INSTALLED TO A DEPTH OF 40 FT.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMW-01 Contract Number: 06150078 Sheet: 2 of 2

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY ELASTIC SILT, TRACE ROOT FRAGMENTS AND FINE TO MEDIUM SHELL FRAGMENTS, WET, GRAY *(continued)*	MH			30	WOH+2+1 N = 3 REC = 100%	PP=1.00 tsf	Sand lense @ 29.5 ft.
33.5	SANDY FAT CLAY, TRACE SAND, TRACE FINE TO MEDIUM SHELL FRAGMENTS WET, GRAY	CH	-26.2	B2	35	WOH+1+1 N = 2 REC = 100%	w=48.6% LL=70 PL=27 PP=1.00 tsf	Sand lense @ 34.4 ft. ALLUVIAL (CLAY OR SILT)
					40	WOH+WOH +1 N = 1 REC = 100%	PP=1.00 tsf	
43.5	POORLY GRADED SAND, WITH SILT, FINE TO COARSE GRAINED, WET, GRAY	SP-SM	-36.2	B1	45	WOH/18" N = WOH/18" REC = 100%		
					50	WOH/18" N = WOH/18" REC = 100%	w=26.6%	ALLUVIAL (SAND)
53.5	ELASTIC SILT, TRACE FINE TO MEDIUM SHELL FRAGMENTS, TRACE SAND, MOIST, GRAY	MH	-46.2	B2	55	WOH/18" N = WOH/18" REC = 100%	w=56.3% LL=84 PL=40 PP=0.50 tsf	Shelby tube @ 55 ft. ALLUVIAL (CLAY OR SILT)
57.0	BOTTOM OF BORING @ 57.0 FT.		-49.7					

Comments:
1. WELL INSTALLED TO A DEPTH OF 40 FT.

Schnabel Engineering | **TEST BORING LOG**

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring Number: **JMW-02**
Contract Number: 06150078
Sheet: 1 of 2

Boring Contractor: CONNELLY AND ASSOCIATES, INC.
FREDERICK, MARYLAND
Boring Foreman: W. WOLFE
Drilling Method: TRIPOD
Drilling Equipment: TRIPOD
Schnabel Representative: K. BELL
Dates Started: 11/6/06 **Finished:** 11/6/06
Location: SEE LOCATION PLAN
BORING IN BASEMENT. ELEVATION APPROXIMATE.
Ground Surface Elevation: 8.0± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	11/6	8:56	5.0'	---	---
Well Reading	11/6	2:45	4.3'	---	---
Well Reading	11/21	---	4.6'	---	---
Well Reading	12/19	---	4.1'	---	---
Well Reading	2/28	---	4.3'	---	---
Well Reading	5/7	---	4.6'	---	---

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SILTY SAND FILL, FINE TO COARSE GRAINED, TRACE MICA, TRACE GRAVEL, MOIST, BROWN AND GRAY	FILL		A1		7+3+4+6 N = 7 REC = 14%		
	DO, WITH ORGANIC MATTER					10+9+7+6 N = 16 REC = 6%		Brick fragments @ 3 ft. CLAY OR SILT FILL
					5	1+WOH+1+1 N = 1		
	DO, WET					WOH+1+1+2 N = 2 REC = 8%		
8.0	FAT CLAY, TRACE SAND, TRACE ORGANIC MATTER, WET, GRAY	CH	0.0	B2	10	WOH+WOH +1+2 N = 1 REC = 10%	w=67.9% LL=83 PL=36 PP=1.00 tsf	ALLUVIAL (CLAY OR SILT)
	DO, WITH ORGANIC MATTER, GRAY AND BLACK					1+WOH+1+1 N = 1 REC = 19%		
	DO, TRACE WOOD FRAGMENTS					2+2+2+2 N = 4 REC = 24%		
					15	1+1+WOH+1 N = 1 REC = 24%		
16.0	CLAYEY SAND, FINE TO MEDIUM GRAINED, TRACE MICA, WET, GRAY	SC	-8.0	B1		3+2+2+2 N = 4 REC = 12%		ALLUVIAL (SAND)
18.0	SANDY SILT, WITH ORGANIC MATTER, TRACE SAND, WET, GRAY AND BLACK	ML	-10.0	B2		1+2+1+1 N = 3 REC = 20%	w=35.1% LL=43 PL=32	ALLUVIAL (CLAY OR SILT)
20.0	SILTY SAND, FINE TO MEDIUM GRAINED, WET, GRAY	SM	-12.0	B1	20	1+2+2+2 N = 4 REC = 15%		ALLUVIAL (SAND)
						1+1+1+1 N = 2 REC = 24%		
24.0	SANDY ELASTIC SILT, WITH ORGANICS, TRACE MICA AND SAND, MOIST, GRAY	MH	-16.0	B2	25	1+1+1+1 N = 2 REC = 19%	w=37.1%	ALLUVIAL (CLAY OR SILT)
						1+1+2+2 N = 3 REC = 20%	PP=0.50 tsf	

continued on next page

Comments:
1. WELL INSTALLED TO A DEPTH OF 40 FT.
2. THIS BORING IS LOCATED INSIDE THE MEMORIAL AND WAS NOT SURVEYED.

Schnabel Engineering	TEST BORING LOG	Project:	JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMW-02 Contract Number: 06150078 Sheet: 2 of 2

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY ELASTIC SILT, WITH ORGANICS, TRACE MICA AND SAND, MOIST, GRAY *(continued)*	MH			30	WOH+1+1+3 N = 2 REC = 18%		
				B2	35	2+2+3 N = 5 REC = 18%	w=71.2% LL=101 PL=60	ALLUVIAL (CLAY OR SILT)
40.0			-32.0		40	WOH+1+3 N = 4 REC = 18%	w=46.5% LL=69 PL=41	
	BOTTOM OF BORING @ 40.0 FT.							

Comments:

1. WELL INSTALLED TO A DEPTH OF 40 FT.
2. THIS BORING IS LOCATED INSIDE THE MEMORIAL AND WAS NOT SURVEYED.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMW-03A Contract Number: 06150078 Sheet: 1 of 4

Boring Contractor: CONNELLY AND ASSOCIATES, INC. FREDERICK, MARYLAND

Boring Foreman: W. WOLFE

Drilling Method: 4¼" ID HOLLOW STEM AUGER

Drilling Equipment: CME-55 (TRUCK)

Schnabel Representative: K. BELL

Dates Started: 10/30/06 **Finished:** 11/2/06

Location: SEE LOCATION PLAN
ELEVATION DATUM: NAVD 29

Ground Surface Elevation: 8.9± (feet)

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	10/30	6:39	5.0'	---	---
Well Reading	11/21	9:30	4.2'	---	---
Well Reading	12/19	---	5.2'	---	---
Well Reading	1/5	---	5.2'	---	---
Well Reading	2/28	---	5.4'	---	---
Well Reading	5/7	---	5.1'	---	---

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.4	ROOTMAT AND TOPSOIL	FILL	8.5					Hand augered from 0 to 5 ft
	LEAN CLAY FILL, WITH GRAVEL AND ROOT FRAGMENTS, CONTAINS BRICK FRAGMENTS, MOIST, BROWN AND ORANGE-BROWN	FILL		A2	5	4+3+3+3 N = 6 REC = 100%		CLAY OR SILT FILL
6.0	POORLY GRADED SAND FILL, WITH SILT, MEDIUM TO COARSE GRAINED, WITH ROOT FRAGMENTS, WET, BROWN	FILL	2.9					
8.5	SILTY SAND FILL, TRACE ROOT FRAGMENTS AND GRAVEL, CONTAINS BRICK FRAGMENTS, WET, ORANGE-RED AND GRAY	FILL	0.4	A1	10	3+4+4 N = 8 REC = 100%	w=18.4%	SAND FILL
13.5	SILTY SAND FILL, FINE TO COARSE GRAINED, CONTAINS GRAVEL, TRACE ROOT FRAGMENTS AND BRICK FRAGMENTS, WET, BROWN AND ORANGE-BROWN	FILL	-4.6		15	1+1+2 N = 3 REC = 56%		
17.5	SILTY SAND, FINE TO COARSE GRAINED, TRACE GRAVEL AND ROOT FRAGMENTS, WET, GRAY	SM	-8.6	B1				ALLUVIAL (SAND)
18.5	FAT CLAY, TRACE ROOT FRAGMENTS AND GRAVEL, WET, GRAY	CL	-9.6	B2	20	1+1+2 N = 3 REC = 100%		ALLUVIAL (CLAY OR SILT)
					25	1+2+2 N = 4 REC = 100%	w=49.3% LL=51 PL=22	

continued on next page

Comments:
1. WELL INSTALLED TO A DEPTH OF 54 FT.
2. BAG USED TO SEAL VOIDED AREA FROM METHANE POCKET. METHANE POCKET ENCOUNTERED AT DEPTH OF 74 FT.
3. METHANE POCKET AT 75 FT. DRILLING STOPPED TO RELEASE METHANE GAS.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL WEST POTOMAC PARK WASHINGTON, DC	Boring Number: JMW-03A Contract Number: 06150078 Sheet: 2 of 4

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	FAT CLAY, TRACE ROOT FRAGMENTS AND GRAVEL, WET, GRAY *(continued)*	CL					PP=1.00 tsf	
					30	2+2+2 N = 4 REC = 100%	PP=1.00 tsf	Sand lense @ 29.8 ft. Shelby tube @ 30 ft.
					35	2+2+3 N = 5 REC = 100%		
					40	1+1+3 N = 4 REC = 100%	w=52.0% LL=76 PL=30	Sand lense from 40.0 to 40.2 ft.
				B2				ALLUVIAL (CLAY OR SILT)
					45	1+1+3 N = 4 REC = 100%	PP=1.00 tsf	Sand lense from 44.1 to 45 ft.
48.5	SANDY ELASTIC SILT, TRACE ORGANIC MATTER, WET, BLACK	MH	-39.6		50	2+2+3 N = 5 REC = 100%	w=40.6% LL=77 PL=42	Shelby tube @ 50 ft.
					55	WOH+4+3 N = 7 REC = 100%		

continued on next page

Comments:
1. WELL INSTALLED TO A DEPTH OF 54 FT.
2. BAG USED TO SEAL VOIDED AREA FROM METHANE POCKET. METHANE POCKET ENCOUNTERED AT DEPTH OF 74 FT.
3. METHANE POCKET AT 75 FT. DRILLING STOPPED TO RELEASE METHANE GAS.

Schnabel Engineering	TEST BORING LOG	Project: JEFFERSON MEMORIAL, WEST POTOMAC PARK, WASHINGTON, DC	Boring Number: JMW-03A; Contract Number: 06150078; Sheet: 3 of 4

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	SANDY ELASTIC SILT, TRACE ORGANIC MATTER, WET, BLACK *(continued)*	MH		B2	60	WOH+3+3 N = 6 REC = 100%	PP=0.50 tsf	
					65	3+3+3 N = 6 REC = 100%	w=63.7% LL=81 PL=40	ALLUVIAL (CLAY OR SILT)
					70	WOH+2+2 N = 4 REC = 100%		Sand lense from 69 to 69.5 ft.
73.5	SILTY SAND, FINE TO MEDIUM GRAINED, CONTAINS ORGANIC MATTER, TRACE GRAVEL, WET, GRAY	SM	-64.6	B1	75	4+4+4 N = 8 REC = 100%	PP=1.00 tsf	ALLUVIAL (SAND)
								Sand lense from 78.5 to 78.8 ft.
78.8	SANDY SILT, WET, BLACK	ML	-69.9	B2	80	4+4+4 N = 8 REC = 100%	w=57.7% PP=1.00 tsf	ALLUVIAL (CLAY OR SILT)
					85	5+4+3 N = 7 REC = 100%		
88.5	POORLY GRADED GRAVEL SIZED ROCK FRAGMENTS (SCHIST), TRACE MICA, WET, BROWN	GP-GM	-79.6	C	90	2+2+4 N = 6 REC = 72%	PP=1.50 tsf	RESIDUAL

continued on next page

Comments:
1. WELL INSTALLED TO A DEPTH OF 54 FT.
2. BAG USED TO SEAL VOIDED AREA FROM METHANE POCKET. METHANE POCKET ENCOUNTERED AT DEPTH OF 74 FT.
3. METHANE POCKET AT 75 FT. DRILLING STOPPED TO RELEASE METHANE GAS.

Schnabel Engineering — **TEST BORING LOG**

Project: JEFFERSON MEMORIAL, WEST POTOMAC PARK, WASHINGTON, DC

Boring Number: JMW-03A
Contract Number: 06150078

DEPTH (FT)	STRATA DESCRIPTION	CLASS.	ELEV. (FT)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
	POORLY GRADED GRAVEL SIZED ROCK FRAGMENTS (SCHIST), TRACE MICA, WET, BROWN *(continued)*	GP-GM		C				
93.5	DISINTEGRATED ROCK (SCHIST), MOIST, GREEN BLACK, MICA		-84.6	D	95	10+13+23 N = 36 REC = 100%		RESIDUAL
						44+70+32/2" N = 32/2" REC = 100%		
	TRAP USED AND BROKEN UPON SPOON RETURN				100	12+24+32 N = 56 * REC = 0%		
						34+100/3" N = 100/3" * REC = 0%		
104.5	SCHIST, SOFT, MODERATELY WEATHERED, GREEN AND BLACK, MODERATELY FRACTURED, COARSE GRAINED, LOW INCLINATION		-95.6	E	105	NQ REC = 90% RQD = 25%		ROCK
109.5	BOTTOM OF BORING @ 109.5 FT.		-100.6					

Comments:
1. WELL INSTALLED TO A DEPTH OF 54 FT.
2. BAG USED TO SEAL VOIDED AREA FROM METHANE POCKET. METHANE POCKET ENCOUNTERED AT DEPTH OF 74 FT.
3. METHANE POCKET AT 75 FT. DRILLING STOPPED TO RELEASE METHANE GAS.

Subsurface Exploration Data, SEA 1992

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: JEFFERSON MEMORIAL	Contract Number: V920238 Boring Number: 1 Sheet: 1 Of 2

Boring Contractor: FTS DRILLING, INC.

Boring Foreman: S. WINGET
Drilling Method: 3¼" HOLLOW STEM AUGER
Drilling Equipment: CME-750

SEA Representative: PAUL BURKART

Dates Started: 07/01/92 Completed: 07/02/92

Location: EAST POTOMAC PARK
WASHINGTON, D.C

Ground Surface Elevation: 11.7 ±

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	7-1	1:27	13.5	16.5	
Completion	7-2	9:29	32.7	58.5	
Casing Pulled	7-2	9:54	8.3	NONE	12.0

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
0.4	topsoil and roots		11.3			5+7+9		
2.0	sandy silt FILL, trace gravel, dry, brown		9.7			4+2+2		
	silty sand, trace gravel, FILL, moist, brown				5	2+1+1		
						1+1+1		
8.0	with cinders from 7.0' to 8.0'		3.7		10	1+1/12"		
11.0	silt with sand, FILL, moist, brown		0.7			11+17+10		
14.0	well graded sand with silt and gravel, FILL, moist, brown		-2.3		15	1+2+2		
16.5	sandy silt, FILL, wet, gray		-4.8			2+2+3		
19.4	sandy lean clay, trace gravel, FILL with brick and cinders, moist, brown		-7.7		20	4+8+9		
	well graded sand with silt and gravel, FILL, with lignite, moist, brown and black					4+17+54		Running sand @ 22.0'
	with clayey sand layers from 19.4' to 22.0'				25	10+4+12		
						9+13+12		
29.0	ELASTIC SILT with silty sand lenses, trace organic matter, moist, gray	MH	-17.3		30	4+2+2		
						1+2+2		
34.0	sandy SILT with silty sand layers, wet, gray	ML	-22.3		35	2+3+3		
	trace gravel from 41.5' to 44.0'					1+2+3		
					40	3T 24/22		Running sand @ 41.5' and 44.0'
						2+2+1		
					45	1+1+2		
						3T 24/22		
					50	1+2+2		

SCHNABEL ENGINEERING ASSOCIATES CONSULTING GEOTECHNICAL ENGINEERS TEST BORING LOG	Project: JEFFERSON MEMORIAL	Contract Number: V920238 Boring Number: 1 Sheet: 2 Of 2

DEPTH (FT.)	STRATA DESCRIPTION	CLASS.	ELEV. (FT.)	STRA-TUM	SAMPLING DEPTH	SAMPLING DATA	W (%)	REMARKS
54.0	ELASTIC SILT, with sand, moist, gray with silty sand and sandy silt layers and lenses from 56.0' to 60.0'	MH	-42.3		55	1+1+1 3T 24/24 1+3+2		
60.0	BOTTOM OF BORING @ 60.0 FT.		-48.3		60			

Comments:
Backfilled upon completion.

Subsurface Exploration Data,
Storch Engineers, 1965

Note: The survey datum used for these boring logs is the historical low water datum for Washington Harbor, Subtract 1.41 ft from these elevations to obtain elevations in the North American Vertical Datum of 1929 (NAVD 29).

STORCH ENGINEERS
Boring Report

Drilling Contractor: Froehling & Robertson

Client	U. S. Dept. of Interior
Project	National Park Service Jefferson Memorial
Location	Washington, D. C.
Number	NCR 65.52 - 249

Sheet 1 of 3
Hole No. MD-1
Line See Plan of
Station Subsurface
Offset Investigations

GROUND WATER OBSERVATIONS
At 10.1 Ft. after 0 Hours
At 3.0 Ft. after 95 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	18"	24"	AX

SURFACE ELEV. 6.8
DATE FINISH 2-4-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
0	5	0.0-	D	2	3	2			1	18	8
	10	1.5						Loose brown fine sandy			
	15						3.0	SILT with roots			
	6	3.0-	D	6	16	7		Stiff gray and brown	2	18	14
	14	4.5					5.3	sandy clayey SILT			
	58										
	27	6.0-	D	7	5	4			3	18	10
	39	7.5						Loose brown fine silty			
	35										
10	21							SAND, trace coarse to			
	32										
	14	11.0-	D	1	1	1		fine sand	4	18	8
	7	12.5									
	7										
	7										
	7										
	11	16.0-	D	1	1	1			5	18	3
	11	17.5									
	12						19.0				
20	14										
	15							Soft brown sandy c[illegible]			
	15	21.0-	D	2	2	2		clayey SILT with occa-	6	18	10
	15	22.5									
	16							sional thin layers of fine			
	17						25.5	sand			
	18										
	16	26.0-	D	1	2	3			7	18	15
	20	27.5						Soft black organic clayey			
	24										
30	24							SILT, with occasional			
	22										
	50	31.0-	D	2	2	2			8	18	14
	40	32.5						shells, fine gravel and			
	34										
	32							fine sand			
	39										
	30	36.0-	D	2	2	2			9	18	8
	31	37.5									
	33						39.0				
40	34							Loose gray medium			

GROUND SURFACE TO ______ FT., USED ______" CASING: THEN ______" CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-1

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client	U. S. Dept. of Interior	Sheet 2 of 3	
Project	National Park Service	Hole No.	MD-1
	Jefferson Memorial	Line	See Plan of
Location	Washington, D. C.	Station	Subsurface
Number	NCR 65.52 - 249	Offset	Investigations

GROUND WATER OBSERVATIONS

At 10.1 ft. after 0 Hours

At 3.0 ft. after 95 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 6.8
DATE FINISH 2-4-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	29										
	32	41.0-	D	1	1	1	41.5	to fine SAND	10	18	12
	36	42.5									
	36							Soft gray organic clayey			
	35										
	34										
	47	46.0-	D	2	2	2		SILT with occasional	11	18	10
	41	47.5									
	40							thin layers of brown			
50	42										
	38							silty clay, and trace			
	60	51.0-	D	2	2	2			12	18	9
	57	52.5						of fine sand			
	54										
	58										
	60										
	65	56.0-	D	2	3	4		- becoming firm, with	13	18	8
	68	57.5									
	57							frequent thin layers or			
60	62										
	68										
	78	61.0-	D	3	4	4		pockets of fine sand	14	18	12
	66	62.5									
	71										
	74										
	100										
	107	66.0-	D	3	3	3			15	18	9
	102	67.5									
	97										
70	81										
	85										
	87	71.0-	D	3	5	5			16	18	10
	81	72.5									
	82										
	81										
	78						76.0				
	89	76.0-	D	5	7	8			17	18	12
	83	77.5						Medium dense gray silty			
	67							fine SAND			
80	75										

GROUND SURFACE TO ______ FT., USED ______" CASING THEN ______" CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-1

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 3 of 3 Hole No. MD-1 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS

At 10.1 ft. after 0 Hours

At 3.0 ft. after 95 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 6.8
DATE FINISH 2-4-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil, Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
80	75										
	102	81.0-	D	5	2	8		- becoming coarser with	18	18	13
	87	82.5						depth			
	68										
	75										
	75										
	100	86.0-	D	6	6	12			19	18	15
	82	87.5									
	75						89.0				
90	282							Dense weathered MICA-SCHIST			
	5M	90.0-	D	100/2"			91.2		20	2	2
	15M	91.5									
	20M	90.2-	C					Gray-green MICA-SCHIST	C	12	5
	10M	91.2-	C						C	48	40
	10M	95.2-	C						C	12	11
		96.2									
		96.2-	C						C	48	30
100		100.2					100.2				
								Bottom of Boring			
110											

GROUND SURFACE TO 90 FT., USED 2-1/2" CASING: THEN Cored" ~~CASING TO~~ 100.2 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-1

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client U. S. Dept. of Interior Project National Park Service Jefferson Memorial Location Washington, D. C. Number NCR 65.52 - 249	Sheet 1 of 3 Hole No. MD-2 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 11 ft. after 0 Hours	Type		SS	D.T.	SURFACE ELEV. 10.3
	Size I.D.	2-1/2"	1-1/2"	1-3/16"	DATE FINISH 2-3-65
At 4.6 ft. after 120 Hours	Hammer wt.	300#	140#	BIT.	BORING FOREMAN E. Ayers
	Hammer Fall	24"	30"	AX	INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
0	3	0.0-	D	1	2	2		Loose brown fine sandy	1	18	6
	6	1.5						SILT with roots			
	20						3.0				
	7	3.0-	D	16	6	5		Medium dense GRAVEL (Fill)	2	18	6
	5	4.5									
	5						5.5				
	6	6.0-	D	1	1	1			3	18	12
	11	7.5						Soft brown sandy clayey			
	8						9.0	SILT			
	5										
10	12	10.0-	D		2/18"			Very soft gray-brown	4	18	18
	7	11.5									
	7						13.0	organic clayey SILT			
	8										
	5							Very soft brown sandy			
	12	15.0-	D		2/18"				5	18	8
	7	16.5						clayey SILT			
	6										
	8										
20	11										
	17	20.0-	D	1	1	2			6	18	12
	15	21.5						- becoming soft with			
	14										
	11							occasional layers of			
	11										
	15	25.0-	D	2	1	2			7	18	14
	12	26.5						fine sand below 20'			
	12										
	11										
30	11										
	24	30.0-	D	1	1	1			8	18	18
	17	31.5									
	17										
	15										
	15										
	24	35.0-	D	2	4	6	36.0		9	18	16
	21	36.5						Medium dense gray			
	16							gravelly coarse to			
	14							fine SAND			
40	14										

GROUND SURFACE TO _____ FT., USED _____ " CASING, THEN _____ " CASING TO _____ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used; trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-2

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR-65.52 - 249

Hole No. MD-2
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS
At 11 ft. after 0 Hours
At 4.6 ft. after 120 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 10.3
DATE FINISH 2-3-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	24	40.0-	D	1	2	2	41.0		10	18	14
	23	41.5									
	22										
	24							Soft gray organic clayey			
	23										
	38	45.0-	D	1	2	2		SILT with occasional	11	18	14
	28	46.5									
	22							thin layers of sand,			
	22										
50	24										
	44	50.0-	D	1	3	3		pockets of decomposed	12	18	10
	37	51.5									
	32							vegetation, and trace			
	33										
	32							of shells			
	50	55.0-	D	1	2	3			13	18	12
	45	56.5									
	40										
	40							- becoming firm and more			
60	50										
	50	60.0-	D	2	2	2		plastic	14	18	12
	52	61.5									
	52										
	52										
	57										
	70	65.0-	D	1	2	3			15	18	14
	60	66.5									
	60										
	55										
70	58										
	75	70.0-	D	2	2	2			16	18	16
	75	71.5									
	75										
	75										
	80										
	-	75.0-	D	4	4	5		- sand layers more	17	18	15
	-	76.5						frequent			
	81										
	88										
80	90										

GROUND SURFACE TO ____ FT., USED ____" CASING: THEN ____" CASING TO ____ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-2

STORCH ENGINEERS Boring Report	Client	U. S. Dept. of Interior	Sheet 3 of 3
	Project	National Park Service Jefferson Memorial	Hole No. MD-2
Drilling Contractor	Location	Washington, D. C.	Line See Plan of
Froehling & Robertson	Number	NCR 65.52 - 249	Station Subsurface
			Offset Investigations

GROUND WATER OBSERVATIONS

At 11 ft. after 0 Hours

At 4.6 ft. after 120 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 10.3
DATE FINISH 2-3-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil, remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
80	105	80.0-	D	3	3	3			18	18	14
	85	81.5									
	75										
	85										
	90										
	92	85.0-	D	3	3	5		- becoming stiff	19	18	12
	95	86.5-									
	87										
	100										
90	105										
	150	90.0-	D	3	3	8			20	18	12
	146	91.5									
	90										
	150										
	142						95.0				
	135	95.0-	D	27	50	55			21	18	8
	200	96.5						Very dense weathered			
	200/6"										
	W							MICA-SCHIST			
100	W										
		100.0-	D	56	100/3"		100.8		22	8	6
	6M	100.8									
	6M	100.8	C	p=	120	psi		Gray-green MICA-SCHIST	C	36	35
	6M	103.8									
	6M										
	6M										
	6M										
	8M	103.8	C	p=	120	psi			C	60	53
	6M	108.8					108.8				
110								Bottom of Boring			
								Note: Methane gas encountered at a depth of 75'			
120											

GROUND SURFACE TO 98.5 FT., USED 2-1/2 " CASING: THEN Cored " ~~casing to~~ 108.8 FT.

D = DRY   W = WASHED   C = CORED   P = PIT   A = AUGER   UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-2

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 1 of 3 Hole No. MD-3 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS

At 11.0 ft. after 0 Hours

At 1.0 ft. after 160 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 3.9
DATE FINISH 2-5-65
BORING FOREMAN L. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
0	4	0.0-	D	5	4	4		Loose brown silty medium	1	18	2
	6	1.5									
	8							to fine SAND with roots			
	6	3.0-	D	2	2	3			2	18	5
	7	4.5						in upper 2'			
	10						6.0				
	10	6.0	D	2	2	4			3	18	10
	10	7.5									
	9							Soft brown fine sandy			
	8										
10	9	10.0-	D	1	2	2		clayey SILT, slightly	4	18	3
	10	11.5									
	6							organic, with occasional			
	7										
	7										
	12	15.0-	D	1	1	1		thin layers of silty	5	18	12
	10	16.5									
	7							fine sand			
	6										
	6										
20	10	20.0-	D	1	1	1			6	18	12
	11	21.5					22.0				
	14										
	14							Soft gray organic clayey			
	14										
	18	25.0-	D	1	1	1		SILT, with occasional	7	18	12
	17	26.5									
	15							thin layers of sand,			
	14										
	12										
30	18	30.0-	D	1	1	1		pockets of decomposed	8	18	12
	17	31.5									
	15							vegetation, and trace of			
	16										
	14										
	26	35.0-	D	1	1	2		shells	9	18	12
	23	36.5									
	21										
	24										
40	20										

GROUND SURFACE TO ______ FT., USED ______ " CASING THEN ______ " CASING TO ______ FT.

D = DRY   W = WASHED   C = CORED   P = PIT   A = AUGER   UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-3

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR 65.52 - 249

Hole No. MD-3
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS
At 1.0 ft. after 0 Hours
At 1.0 ft. after 160 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 3.9
DATE FINISH 2-5-65
BORING FOREMAN L. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	26	40.0-	D	1	1	1			10	18	16
	23	41.5									
	22										
	22										
	21										
	20	45.0-	D	1	1	1			11	18	14
	24	46.5									
	26										
	25										
	25										
50	30	50.0-	D	1	1	2			12	18	14
	29	51.5									
	30										
	30										
	32										
	33	55.0-	D	1	1	2			13	18	13
	36	56.5									
	36										
	36										
	34										
60	40	60.0-	D	1	2	2		- with thin layers of light brown clay	14	18	12
	46	61.5									
	46										
	50										
	57										
	57	65.0-	D	1	2	3			15	18	10
	60	66.5									
	59										
	56										
	56						69.5				
70	60	70.0-	D	2	2	2	71.0	Loose green coarse to fine SAND	16	18	18
	63	71.5									
	67							Firm gray organic clayey SILT with occasional layers of medium to fine sand			
	78										
	80										
	70	75.0-	D	2	3	4			17	18	8
	71	76.5									
	74										
	85										
80	80										

GROUND SURFACE TO ______ FT., USED ______ " CASING; THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-3

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 3 of 3 Hole No. MD-3 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS

At 11.0 ft. after 0 Hours

At 1.0 ft. after 160 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 3.9
DATE FINISH 2-5-65
BORING FOREMAN L. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soils, Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
80	76	80.0-	D	2	3	3			18	18	10
	76	81.5									
	85										
	94										
	98										
	100	85.0-	D	2	6	25	86.0		19	18	8
	162	86.5									
	205/6"							Very dense weathered MICA-SCHIST			
90		90.0-	D	63	100/3		90.8		20	9	7
	8M	91.5									
	8M	90.8-	C					Gray-green MICA-SCHIST	C	30	30
	7M	93.3									
	6M	93.3-	C						C	30	27
	6M	95.8					95.8				
								Bottom of Boring			
100											
								Note: Methane gas encountered at a depth of 65'			
110											

GROUND SURFACE TO 87.5 FT., USED 2-1/2" CASING: THEN Cored " ~~CASING~~ TO 95.8 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-3

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 1 of 3 Hole No. MD-4 Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.		
At 10.2 ft. after 0 Hours	Type		SS	D.T.	SURFACE ELEV.	10.8
	Size I.D.	2-1/2"	1-1/2"	1-3/16"	DATE FINISH	2-10-65
At 5.3 ft. after 24 Hours	Hammer Wt.	300#	140#	BIT.	BORING FOREMAN	H. Watts
	Hammer Fall	24"	30"	AX	INSPECTOR	M. D'Altilio
					SOILS ENGR.	V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler 0-6	6-12	12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	3	0.0-	D	2	4	4		Medium dense brown silty fine SAND with roots in upper 2 feet becoming coarser with depth	1	18	12
	5	1.5									
	10										
	17	3.0-	D	11	6	9			2	18	8
	13	4.5									
	9						6.0				
	21	6.0-	D	1/18"				Very loose gray clayey silty fine SAND	3	18	2
	18	7.5									
	15						9.5				
10	9										
	9										
	10	11.0-	D	1	2	2		Soft gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation, and trace of shells	4	18	10
	9	12.5									
	9										
	9										
	9										
	12	16.0-	D	1	1	2			5	18	15
	10	17.5									
	9										
20	10										
	9										
	13	21.0-	D	1	1	1			6	18	10
	10	22.5									
	10										
	10										
	10										
	13	26.0-	D	2	2	2			7	18	8
	10	27.5									
	10										
30	10										
	12										
	18	31.0-	D	2	2	2			8	18	14
	17	32.5									
	17										
	17										
	18							- becoming firm			
	21	36.0-	D	3	4	4			9	18	16
	21	37.5									
	20										
40	18										

GROUND SURFACE TO ______ FT., USED ______ " CASING: THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-4

STORCH ENGINEERS Boring Report	Client	U. S. Dept. of Interior	Sheet 2 of 3
	Project	National Park Service	Hole No. MD-4
		Jefferson Memorial	Line See Plan of
Drilling Contractor	Location	Washington, D. C.	Station Subsurface
Froehling & Robertson	Number	NCR 65.52 - 249	Offset Investigations

GROUND WATER OBSERVATIONS

At 10.2 ft. after 0 hours

At 5.3 ft. after 24 hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 10.8
DATE FINISH 2-10-65
BORING FOREMAN H. Watts
INSPECTOR N. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
40	18										
	32	41.0-	D	1	2	3			10	18	14
	31	42.5									
	31										
	28						45.5				
	26										
	55	46.0-	D	7	5	5		Medium dense gray medium to fine ~~SAND~~, with thin layers of clayey silt	11	18	12
	34	47.5					48.0				
	34										
50	30							Firm gray organic clayey SILT, with occasional layers of sand, decayed vegetation and light brown silty clay			
	28										
	37	51.0-	D	2	2	2			12	18	16
	32	52.5									
	31										
	30										
	28										
	38	56.0-	D	2	3	3			13	18	15
	35	57.5									
	30										
60	30										
	28										
	37	61.0-	D	2	2	2			14	18	15
	31	62.5									
	36										
	35										
	35										
	38	66.0-	D	2	2	2			15	18	15
	35	67.5									
	39										
70	34										
	35										
	51	71.0-	D	3	3	3		- becoming stiff	16	18	12
	47	72.5									
	46										
	48										
	46										
	80	76.0-	D	4	4	5			17	18	8
	68	77.5									
	66										
80	64										

GROUND SURFACE TO ______ FT., USED ______ " CASING; THEN ______ " CASING TO ______ FT.

D = DRY   W = WASHED   C = CORED   P = PIT   A = AUGER   UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-4

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client	U. S. Dept. of Interior
Project	National Park Service
	Jefferson Memorial
Location	Washington, D. C.
Number	NCR 65.52 - 249

Hole No. MD-4
Line See Plan of
Station Subsurface
Offset Investigations

GROUND WATER OBSERVATIONS

At 10.2 ft. after 0 Hours

At 5.3 ft. after 24 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 10.8
DATE FINISH 2-10-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
80	65										
	75	81.0-	D	4	4	5			18	18	8
	72	82.5									
	68										
	62										
	58										
	84	86.0-	D	4	5	5			19	18	12
	80	87.5									
	75										
90	70										
	74										
	88	91.0-	D	3	3	4			20	18	18
	84	92.5									
	86										
	84										
	85										
	84	96.0-	D	4	4	12	97.4		21	18	16
	92	97.5									
	99							Gray-green weathered			
100	130						100.2	MICA-SCHIST			
	10M	100.0-	D	99/2"					--	18	-
	8M	101.5						Gray-green MICA-SCHIST			
	8M										
	8M	100.2	C						C	60	10
	10M	105.2									
		105.2	C						C	61	1
110		110.2					110.2				
								Bottom of Boring			
120											

GROUND SURFACE TO 100 FT., USED 2-1/2" CASING: THEN Cored " ~~CASING~~ TO 110.2 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-4

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: MCR 65.52 - 249

Sheet 1 of 3
Hole No. MD-5
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS
At 6.3 ft. after 0 Hours
At 2.4 ft. after 50 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. 9.5
DATE FINISH 2-9-65
BORING FOREMAN L. Dowdy
INSPECTOR M. B'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	3	0.0-	D	1	2	3		Loose brown silty medium to fine SAND	1	18	12
	6	1.5									
	9						3.0				
	6	3.0-	D	2	2	1		Loose gray gravelly silty coarse to fine SAND	2	18	12
	3	4.5									
	3										
	2	6.0-	D	4	1	2			3	18	4
	3	7.5									
	8						8.5				
	5										
10	10	10.0-	D	2	1	2		Soft gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation, and trace of shells	-	18	—
	10	11.5-	D	2	1	2			4	18	14
	8	13.0									
	8										
	6										
	15	15.0-	D	1	1	4			5	18	5
	12	16.5									
	14										
	12										
	12										
20	13	20.0-	D	3	1	1			6	18	6
	11	21.5									
	10										
	8										
	8										
	16	25.0-	D	2	2	3			7	18	12
	12	26.5									
	10										
	14										
	9										
30	16	30.0-	D	2	2	2			8	18	16
	13	31.5									
	17										
	12										
	10										
	16	35.0-	D	2	2	2			9	18	9
	15	36.5									
	14										
	20										
40	17										

GROUND SURFACE TO ____ FT., USED ____ " CASING THEN ____ " CASING TO ____ FT.

D = DRY   W = WASHED   C = CORED   P = PIT   A = AUGER   UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-5

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 2 of 3 Hole No. MD-5 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 6.3 ft. after 0 Hours	Type		SS	D.T.	SURFACE ELEV. 9.5
	Size I.D.	2-1/2"	1-1/2"	1-3/16"	DATE FINISH 2-9-65
At 2.4 ft. after 50 Hours	Hammer wt.	300#	140#	BIT-	BORING FOREMAN L. Dowdy
	Hammer Fall	24"	30"	AX	INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
40	27	40.0-	D	4	6	4			10	18	10
	22	41.5									
	28										
	24										
	22										
	48	45.0-	D	3	2	2			11	18	13
	42	46.5									
	40										
	38										
50	41										
	50	50.0-	D	2	2	2			12	18	15
	51	51.5									
	47										
	50										
	55										
	58	55.0-	D	2	3	2			13	18	12
	56	56.5									
	51										
	50										
60	52										
	116	60.0-	D	2	2	2			14	18	18
	101	61.5									
	100										
	99										
	92										
	78	65.0-	D	2	3	3		- becoming firm	15	18	8
	58	66.5									
	49										
	45										
70	46										
	68	70.0-	D	3	3	3			16	18	10
	60	71.5									
	57										
	53										
	51										
	73	75.0-	D	3	4	5		- becoming stiff	17	18	8
	64	76.5									
	63										
	67										
80	70										

GROUND SURFACE TO ______ FT., USED ______ " CASING; THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-5

STORCH ENGINEERS Boring Report	Client	U. S. Dept. of Interior	Sheet 3 of 3
	Project	National Park Service	Hole No. MD-5
		Jefferson Memorial '	Line See Plan of
Drilling Contractor	Location	Washington, D. C.	Station Subsurface
Froehling & Robertson	Number	NCR 65.52 - 249	Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 6.3 ft. after 0 Hours	Type		SS	D.T.	SURFACE ELEV. 9.5
	Size I.D.	2-1/2"	1-1/2"	1-3/16"	DATE FINISH 2-9-65
At 2.4 ft. after 50 Hours	Hammer wt.	300#	140#	BIT.	BORING FOREMAN L. Dowdy
	Hammer Fall	24"	30"	AX	INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
80	73	80.0-	D	5	6	6			18	18	10
	68	81.5									
	75										
	77										
	82						84.8				
	62	85.0-	D	11	14	11		Dense gray medium to fine SAND, trace silt	19	18	10
	58	86.5									
	58										
	69										
90	76										
	113/9"	90.0-	D	14	15	17	91.5		20	18	17
	4M	91.5-	D	100/1"			92.3	Dense weathered MICA-SCHIST	-	18	-
	5M	93.0									
	4M	91.5	C					Gray-green MICA-SCHIST	C	12	4
	4M	92.5-	C						C	48	27
	4M	96.5					96.5				
								Bottom of Boring			
100											
								Note: Methane gas encountered at depth of 84'			
110											
120											

GROUND SURFACE TO 91.5 FT., USED 2-1/2" CASING: THEN Cored" ~~CASING~~ TO 96.5 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-5

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client U. S. Dept. of Interior Project National Park Service Jefferson Memorial Location Washington, D. C. Number NCR 65.52 - 249	Sheet 1 of 2 Hole No. MD-6 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At ____ ft. after ____ Hours	Type		SS	D.T.	SURFACE ELEV. -3.1
Water Boring	Size I.D.	2-1/2"	1-1/2"	1-3/16"	DATE FINISH 2-12-65
At ____ ft. after ____ Hours	Hammer Wt.	300#	140#	BIT.	BORING FOREMAN E. Ayers
	Hammer Fall	24"	30"	AX	INSPECTOR M. D'Altilio SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
0	WOC	0.0-	D	WOR	WOR	WOR			1	18	2
	WOC	1.5						Very loose brown-gray silty			
	WOC	·					3.0	coarse to fine SAND			
	WOC	3.0-	D	1	1	1			2	18	6
	4	4.5						Soft brown sandy clayey			
	4							SILT, trace of gravel			
	1	6.0	D	1	1	1			3	18	6
	1	7.5									
	2						9.5				
10	4										
	6										
	4	11.0-	D	1	1	1		Soft gray organic clayey	4	18	12
	4	12.5									
	4							SILT, with occasional			
	8										
	9										
	9	16.0-	D	1	1	1		thin layers of fine sand,	5	18	8
	9	17.5									
	8										
20	8							pockets of decomposed			
	7										
	25	21.0-	D	1	1	1		vegetation, and trace of	6	18	10
	22	22.5									
	20							shells			
	15										
	12										
	25	26.0-	D	2	1	12			7	18	10
	14	27.5									
	12										
30	12										
	12										
	18	31.0-	D	1	1	1			8	18	10
	14	32.5									
	14										
	14										
	14										
	25	36.0-	D	1	2	1			9	18	9
	23	37.5									
	27										
40	25										

GROUND SURFACE TO ____ FT., USED ____ " CASING: THEN ____ " CASING TO ____ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-6

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client U. S. Dept. of Interior Project National Park Service Jefferson Memorial Location Washington, D. C. Number NCR 65.52 - 249	Sheet 2 of 2 Hole No. MD-6 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS

At ____ ft. after ____ Hours

Water Boring

At ____ ft. after ____ Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	D.T.
Size I.D.	2-1/2"	1-1/2"	1-3/16"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	AX

SURFACE ELEV. -3.1
DATE FINISH 2-12-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
40	25										
	23	41.0-	D	1	1	1			10	18	8
	23	42.5									
	18										
	20										
	20										
	25	46.0-	D	2	4	4	47.0		11	18	12
	28	47.5					48.0	Loose gray silty medium to fine SAND			
	27										
50	31							Firm gray organic clayey			
	32										
	26	51.0-	D	3	3	4		SILT, with 1/4" sand	12	18	10
	29	52.5						layers every 2" inches,			
	20										
	34							and occasional pockets			
	36										
	40	56.0-	D	2	4	3		of decayed vegetation	13	18	11
	42	57.5									
	42										
60	44						60.0				
	42										
	44	61.0-	D	2	2	2			14	18	12
	44	62.5						Soft brown sandy clayey			
	40										
	40							SILT with occasional			
	40										
	42	66.0-	D	1	1	2		pockets of organic clayey	15	18	10
	41	67.5									
	38										
70	38						70.0	silt			
	39						71.5	Loose gray fine sandy SILT			
	300/8"	71.0-	D	2	100/3"				16	18	4
	4M	72.5					71.8	Gray-green weathered MICA-SCHIST			
	6M										
	5M							Gray-green MICA-SCHIST			
	6M	71.8-	C						C	60	32
	6M	76.8					76.8				
								Bottom of Boring			
								Note: Methane gas encountered			
80								at depth of 47'			

GROUND SURFACE TO 71.5 FT., USED 2-1/2" CASING: THEN Cored" CASING TO 76.8 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-6

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR 65.52 - 249

Hole No. MD-7
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS
At 9.5 ft. after 0 Hours
At 1.0 ft. after 90 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	
Size I.D.	2-1/2"	1-1/2"	
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 4.8
DATE FINISH 2-8-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	3	0.0-1.5	D	3	4	4		Firm brown fine sandy SILT, trace gravel; with roots in upper few feet	1	18	8
	5										
	7										
	5	3.0-4.5	D	2	3	7			2	18	6
	15										
	34										
	23	6.0-7.5	D	6	5	7			3	18	8
	19										
	20										
10	22						10.0				
	21							Firm brown clayey SILT, trace fine sand, slightly organic			
	19	11.0-12.5	D	2	2	3			4	18	12
	18										
	15										
	15										
	12										
	17	16.0-17.5	D	2	2	2			5	18	10
	15										
	15										
20	12										
	13										
	15	21.0-22.5	D	2	2	2			6	18	14
	19						23.0				
	14							Soft gray organic clayey SILT, with occasional thin layers of fine sand			
	15										
	13										
	37	26.0-27.5	D	2	2	2			7	18	10
	25										
	25						29.5				
30	23										
	23							Medium dense gray gravelly coarse to fine SAND			
	28	31.0-32.5	D	6	8	8			8	18	10
	27										
	32										
	35						35.0				
	31							Soft gray organic clayey SILT, with occasional thin layers			
	28	36.0-37.5	D	2	2	2			8	18	12
	27										
	32										
40	35										

GROUND SURFACE TO ______ FT., USED ______ " CASING: THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-7

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client U. S. Dept. of Interior Project National Park Service Jefferson Memorial Location Washington, D. C. Number NCR 65.52 - 249	Sheet 2 of 3 Hole No. MD-7 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 9.5 ft. after 0 Hours	Type		SS		SURFACE ELEV. 4.8
	Size I.D.	2-1/2"	1-1/2"		DATE FINISH 2-8-65
At 1.0 ft. after 90 Hours	Hammer wt.	300#	140#	BIT.	BORING FOREMAN H. Watts
	Hammer Fall	24"	30"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	30										
	28	41.0-	D	1	2	2		of fine sand, pockets	10	18	12
	29	42.5									
	22										
	26							of decomposed vegetation,			
	30										
	37	46.0-	D	2	2	2		and trace of shells	11	18	12
	24	47.5									
	29										
50	29										
	29										
	28	51.0-	D	2	2	2			12	18	10
	35	52.5									
	37										
	41										
	42										
	60	56.0-	D	2	2	2			13	18	6
	51	57.5									
	48										
60	48										
	42										
	52	61.0-	D	2	2	2			14	18	7
	50	62.5									
	46										
	44							- becoming stiffer			
	48										
	62	66.0-	D	1	2	2			15	18	18
	45	67.5									
	42										
70	48										
	47										
	75	71.0-	D	2	2	2			16	18	16
	77	72.5									
	67										
	62										
	60						76.0				
	66	76.0-	D	3	4	5		Loose gray silty fine	17	18	6
	61	77.5						SAND			
	61										
80	63										

GROUND SURFACE TO ____ FT., USED ____" CASING THEN ____" CASING TO ____ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-7

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 3 of 3 Hole No. MD-7 Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS

At 9.5 ft. after 0 Hours

At 1.0 ft. after 90 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	
Size I.D.	2-1/2"	1-1/2"	
Hammer wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 4.8
DATE FINISH 2-8-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
80	68										
		81.0-82.5	D	3	3	5			18	18	10
							85.0				
		85.0-85.3	D	100/3"			85.3	Gray-green weathered MICA-SCHIST	19	3	3
								Bottom of Boring			
90								Note: Methane gas encountered at depth of 76'			
100											
110											
120											

GROUND SURFACE TO 80 FT., USED 2-1/2" CASING: THEN "Washed" ~~CASING TO~~ 85.0 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MD-7

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 1 of 3 Hole No. MU-8 Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS

At 12.0 ft. after 0 Hours

At 7.6 ft. after 12 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	UP
Size I.D.	4"	1-1/2"	3"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 6.8
DATE FINISH 2-23-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	[illegible]	Sample No.	Pen	Rec.
0	10	0.0-	D	3	4	6		Stiff brown sandy clayey SILT	1	18	6
	18	1.5									
	27										
	30	3.0-	D	8	5	13			2	18	10
	28	4.5					4.6				
	80	5.0-	D	4	3	3		Firm gray organic clayey SILT	3	18	8
	200	6.5									
	310						7.3				
	214							Medium dense brown silty coarse to fine SAND, trace gravel - finer with depth			
10	200										
	60	10.0-	D	10	8	8			4	18	12
	48	11.5									
	39										
	62										
	63										
	60	15.0-	D	3	3	3			5	18	12
	42	16.5									
	38										
	51										
20	62										
	40	20.0-	D	4	4	4			6	18	12
	22	21.5									
	35										
	51						24.0				
	42							Firm gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation, and trace of shells			
	61	25.0-	D	3	4	5			7	18	10
	31	26.5									
	30										
	39										
30	25										
	25										
	30	31.5-	VS						VS #1		
	31	33.0-	VS								
	51										
	80										
	73	35.0-	UP	P=	270	psi			UP1	24	17
	44	37.0									
	49										
	62										
40	65										

GROUND SURFACE TO ______ FT., USED ______ " CASING THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-8

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client	U. S. Dept. of Interior
Project	National Park Service
	Jefferson Memorial
Location	Washington, D. C.
Number	NCR 65.52 - 249

Sheet 2 of 3
Hole No. MU-8
Line See Plan of
Station Subsurface
Offset Investigations

GROUND WATER OBSERVATIONS
At 12.0 ft. after 0 Hours
At 7.0 ft. after 12 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS UP	
Size I.D.	4"	1-1/2" 3"	
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 6.8
DATE FINISH 2-23-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
40	178										
	150										
	52	42.0-	D	2	2	3			8	18	14
	46	43.5									
	77										
	80										
	75										
	103										
	81	48.5	VS						VS	#2	
50	81	50.0									
	89										
	69										
	78										
	65										
	180										
	104	55.0-	D	2	3	3			9	18	16
	82	56.5									
	65										
	66										
60	64										
	71										
	56	61.5	Dummy Test								
	52	63.0									
	63										
	94										
	70										
	56										
	52										
	76	68.0-	D	3	3	4			10	18	16
70		69.5									
	WASHED	74.5-	VS					- becoming stiffer	VS	#3	
		76.0									
80											

GROUND SURFACE TO ____ FT., USED ____ " CASING; THEN ____ " CASING TO ____ FT.

D = DRY   W = WASHED   C = CORED   P = PIT   A = AUGER   UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-8

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 3 of 3 Hole No. MU-8 Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 12.0 ft. after 0 Hours	Type		SS UP		SURFACE ELEV. 6.8
At 7.0 ft. after 12 Hours	Size I.D.	4"	1-1/2" 3"		DATE FINISH 2-23-65
	Hammer Wt.	300#	140#	BIT.	BORING FOREMAN H. Watts
	Hammer Fall	24"	30"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
80		80.0-81.5	VS						VS	#4	
	WASHED	82.0-84.0	UP	p=440 psi					UP2	24	21
							87.6				
		87.6-87.9	D	100/3"			87.9	Dense gray green weathered MICA-SCHIST	11	3	3
90								Bottom of Boring			
100											
110											
120											

GROUND SURFACE TO 69 FT., USED 4" CASING: THEN Washed TO 87.6 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-8

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 1 of 1 Hole No. MU-9 Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS

At – ft. after – Hours

At – ft. after – Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	
Size I.D.	4"	1-1/2"	
Hammer wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 10.8
DATE FINISH 2-12-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	12	0.0-	D	2	3	3			1	18	9
	28	1.5						Loose brown silty fine			
	28										
	28	3.0-	D	3	5	8		SAND, trace coarse sand	2	18	10
	20	4.5									
	18	5.0-	D	2	2	2			3	18	6
	20	6.5						- becoming clayey with			
	20						8.0	depth			
	42							Medium dense brown coarse			
	46										
10	8	10.0-	D	6	8	8		to fine SAND, trace silt	4	18	3
	12	11.5									
	12							and gravel			
	40										
	26						14.5				
	18	15.0-	D	3	3	3		Firm brown clayey SILT	5	18	3
	18	16.5									
	22						18.0	trace fine sand			
	55										
	37										
20	35	20.0-	D	4	5	8		Medium dense brown	6	18	4
	40	21.5									
	48							gravelly coarse to fine			
	102										
	140						25.0	SAND			
								Refusal on underground			
								obstruction believed to			
30								be pile cap or pile			
40											

GROUND SURFACE TO 25 FT., USED 4 " CASING; THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-9

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 1 of 3 Hole No. MU-9A Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 10.1 ft. after 0 Hours	Type		SS	UP	SURFACE ELEV. 10.8
	Size I.D.	4"	1-1/2"	3"	DATE FINISH 2-17-65
At 8.7 ft. after 24 Hours	Hammer wt.	300#	140#	BIT.	BORING FOREMAN H. Watts
	Hammer Fall	24"	30"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0								Loose brown silty fine SAND, trace coarse sand - becoming clayey with depth			
							8.0				
10								Medium dense brown coarse to fine SAND, trace silt and gravel			
							14.5				
								Firm brown clayey SILT, trace fine sand			
							18.0				
20								Medium dense brown gravelly coarse to fine SAND			
							25.0				
	28	25.0-	D	2	3	3		Firm gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation, and trace of shells	1	18	4
	30	26.5									
	42										
	50										
30	48										
	50	30.0-	D	3	3	3			12	18	12
	50	31.5									
	48										
	48										
	47										
	105	35.0-	UP	p=120 psi					UP1	24	19
	86	37.0									
	85										
	120										
40	95										

GROUND SURFACE TO ____ FT., USED ______ " CASING; THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-9A

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 2 of 3 Hole No. MU-9A Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 10.1 ft. after 0 Hours	Type		SS	UP	SURFACE ELEV. 10.8
	Size I.D.	4"	1-1/2"	3"	DATE FINISH 2-17-65
At 8.7 ft. after 24 Hours	Hammer Wt.	300#	140#	BIT.	BORING FOREMAN H. Watts
	Hammer Fall	24"	30"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	118										
	72										
	62	42.0-	D	3	3	3		Firm gray organic	3	18	10
	56	43.5									
	130										
	130							clayey SILT, with			
	80										
	89										
	70	48.0-	VS					occasional thin layers	No sample		
50	55	49.5									
	80										
	78							of fine sand, pockets			
	78										
	80										
	200	54.5	D	3	4	5		of decomposed vegetation	4	18	10
	235	56.0									
	200										
	60							and trace of shells			
	45										
60	32										
	35										
	47	61.0	Dummy Test								
	80	62.5									
	65										
	64										
	54										
	66										
	230	67.0	UP	200	psi				UP2	24	15
	150	69.0									
70	85										
	90										
	81										
		74.0-	D	2	3	3			5	18	18
	WASHED	75.5									
80											

GROUND SURFACE TO ______ FT., USED ______ " CASING; THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-9A

STORCH ENGINEERS Boring Report	Client	U. S. Dept. of Interior	Sheet 3 of 3
	Project	National Park Service	Hole No. MU-9A
		Jefferson Memorial	Line See Plan of
Drilling Contractor	Location	Washington, D. C.	Station Subsurface
Froehling & Robertson	Number	NCR 65.52 - 249	Offset Investigations

GROUND WATER OBSERVATIONS

At 10.0 ft. after 0 Hours

At 8.7 ft. after 24 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	UP
Size I.D.	4"	1-1/2"	3"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 10.8
DATE FINISH 2-17-65
BORING FOREMAN H. Watts
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
80		80.0-81.5	D	3	3	3			6	18	18
	WASHED	85.0-86.5	D	5	6	6		- becoming stiff	7	18	12
90		90.0-91.5	D	3	4	5			8	18	14
							93.1	Refusal on spoon			
		93.0-93.1	D	100/1"				Bottom of Boring	-	18	-
100											
110											
120											

GROUND SURFACE TO 72 FT., USED 4" CASING: THEN Washed ~~CASING~~ TO 93.0 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-9A

STORCH ENGINEERS Boring Report			
Drilling Contractor: Froehling & Robertson	Client / Project: U. S. Dept. of Interior, National Park Service, Jefferson Memorial	Sheet 1 of 3	Hole No. MU-10
	Location: Washington, D. C.	Line: See Plan of	Station: Subsurface
	Number: NCR 65.52 - 249	Offset: Investigations	

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 23.0. after 0 Hours	Type		SS	UP	SURFACE ELEV. 21.2
	Size I.D.	4"	1-1/2"	3"	DATE FINISH 2-23-65
At 16.0 ft. after 24 Hours	Hammer wt.	300#	140"	BIT.	BORING FOREMAN J. Bryant
	Hammer Fall	24"	30"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	6	0.0-	D	2	2	6		Firm brown clayey SILT, trace fine sand	1	18	10
	22	1.5					2.0				
	53										
	30	3.0-	D	8	6	4		Medium dense brown silty fine SAND, with occasional layers of brown clayey silt	2	18	8
	22	4.5									
	48										
	70	6.0-	D	4	3	4			3	18	10
	170	7.5									
	85										
10	59										
	53	10.0-	D	3	9	16			4	18	12
	80	11.5									
	140										
	93										
	46										
	48	15.0-	D	2	3	5			5	18	12
	72	16.5									
	155										
	92										
20	42										
	60	20.0-	D	4	11	25			6	18	8
	96	21.5									
	120										
	90										
	48						25.0				
	40	25.0-	D	2	2	2		Soft gray organic clayey SILT	-	18	-
	58	26.5-	D	1	1	2			-	18	-
	40	28.0									
	64	28.0-	D	3	3	9	29.0		7	18	10
30	90	29.5						Dense gray organic clayey silty fine SAND, trace gravel			
	96										
	70										
	120										
	117										
	84	34.5-	D	23	26	10			8	18	6
	100	36.0									
	95										
	95						38.0				
	75										
40	70	39.5-	D	2	2	3			9	18	15

GROUND SURFACE TO ______ FT., USED ______ " CASING: THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-10

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR 65.52 - 249

Hole No. MU-10
Line See Plan of
Station Subsurface
Offset Investigations

GROUND WATER OBSERVATIONS
At 23.0 ft. after 0 hours
At 16.0 ft. after 24 hours

	CASING	SAMPLER	CORE BAR.
Type		SS	UP
Size I.D.	4"	1-1/2"	3"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 21.2
DATE FINISH 2-23-65
BORING FOREMAN J. Bryant
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	113	41.0									
	120							Soft gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation, and trace of shells			
	108										
	118										
	113										
	116										
	100										
	120	46.5	UP	p=	190	psi			UP1	24	18
	130	48.5									
50	123										
	70										
	140										
	147										
	70	53.5	D	1	2	3			10	18	15
	58	55.0									
	24										
	90										
	75										
	65										
60	62										
	70	60.0-	UP	p=	175	psi			UP2	24	22
	90	62.0									
	100										
	87										
	80										
	86										
	73										
	105	67.0-	D	3	3	4		- becoming firm	11	18	11
	119	68.5									
70	124										
	118										
	150										
	128										
	110										
	100	73.5	UP	p=	225	psi			UP3	24	20
	191	75.5									
	220										
	197										
	158										
80	140										

GROUND SURFACE TO ______ FT., USED ______ " CASING: THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-10

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR 65.52 - 249

Sheet 3 of 3
Hole No. MU-10
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS
At 23.0 ft. after 0 Hours
At 16.0 ft. after 24 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	UP
Size I.D.	4"	1-1/2"	3"
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 21.2
DATE FINISH 2-23-65
BORING FOREMAN J. Bryant
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
80	362	80.5-	D	3	4	5			12	18	12
	280	82.0									
	274										
	290										
	208										
	241										
	266										
	240	87.0-	UP	p=	275	psi			UP4	24	17
	231	89.0									
90	219										
	280										
	271										
	284										
	270										
	250										
	190	95.0-	D	3	4	6		- becoming stiff	13	18	12
	197	96.5									
	168										
	177										
100	165										
		101.5-	UP	0-	18"	WOR					
		103.4		18-	24	700psi	104.4				
		104.0-		No pen.		18-24					
		105.5		85	64	100/5"	105.5	Dense gray-green weathered MICA-SCHIST			
								Bottom of Boring			
110											
120											

GROUND SURFACE TO 100 FT., USED 4 " CASING: THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-10

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client	U. S. Dept. of Interior
Project	National Park Service
	Jefferson Memorial
Location	Washington, D. C.
Number	NCR 65.52 - 249

Hole No. MU-11
Line See Plan of
Station Subsurface
Offset Investigations

GROUND WATER OBSERVATIONS
At 8.8 ft. after 12 Hours
At 6.7 ft. after 15 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	
Size I.D.	4"	1-1/2"	
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 8.3
DATE FINISH 2-16-65
BORING FOREMAN L. Dowdy
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	15	0.0-	D	4	4	4		Medium dense brown medium to fine SAND, with pockets of brown clayey silt	1	18	6
	15	1.5									
	15										
	13	3.0-	D	4	5	5			-	18	-
	10	4.5-	D	3	2	1			-	18	-
	5	6.0					5.5				
	6	6.0-	D	4	2	3		Firm gray organic sandy clayey SILT	2	18	7
	7	7.5									
	6										
10	10										
	28	10.0-	D	1	1	2	11.0		-	18	-
	29	11.5-	D	3	2	2		Soft layered gray organic clayey SILT and loose gray medium to fine SAND	3	18	2
	24	13.0									
	30										
	29										
	34	15.0-	D	2	4	4			4	18	4
	35	16.5									
	35										
	34						18.5				
20	36										
	42	20.0-	D	1	2	2		Soft gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation and trace of shells	-	18	-
	36	21.5-	D	1	1	1			5	18	8
	33	23.0									
	30										
	30										
	55	25.0-	D	2	1	2			6	18	6
	53	26.5									
	49										
	43	28.5	VS	(2-1/2")					VS#1		
30	44	30.0									
	60										
	60										
	62										
	64										
	66										
	158	35.0-	D	2	2	4			7	18	12
	123	36.5									
	111										
	86										
40	71										

GROUND SURFACE TO ______ FT., USED ______ " CASING: THEN ______ " CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-11

STORCH ENGINEERS Boring Report	Client: U. S. Dept. of Interior	Sheet 2 of 3
Drilling Contractor: Froehling & Robertson	Project: National Park Service Jefferson Memorial	Hole No. MU-11
	Location: Washington, D. C.	Line: See Plan of
	Number: NCR 65.52 - 249	Station: Subsurface
		Offset: Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 8.8 ft. after 12 Hours	Type		SS		SURFACE ELEV. 8.7
	Size I.D.	4"	1-1/2"		DATE FINISH 2-16-65
At 6.7 ft. after 15 Hours	Hammer Wt.	300#	140#	BIT.	BORING FOREMAN L. Dowdy
	Hammer Fall	24"	30"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	69	39.0-	VS						VS	#2	
	51	40.5									
	54										
	51										
	52	44.5	Dummy V.S.								
	66	46.0									
	64	46.0-	D	2	2	2			8	18	15
	60	47.5									
	55										
50	58										
	103										
	89										
	86	52.5	VS	(2-1/2")					VS	#3	
	83	54.0									
	81										
	97										
	121										
	148										
	157							- becoming stiff			
60	163	59.0-	D	3	5	7			9	18	12
	181	60.5									
	153										
	162										
	152										
	141	64.5-	VS	(2-1/2")					VS	#4	
	124	66.0									
	100										
	97										
	88										
70	92										
		71.0-	D	2	3	4			10	18	14
		72.5									
	D										
	E										
	H										
	S										
	A	77.5-	VS	(3-1/2")					No Sample		
	W	79.0					79.0				
80											

GROUND SURFACE TO ______ FT., USED ______" CASING; THEN ______" CASING TO ______ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-11

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR 65.52 - 249

Sheet 3 of 3
Hole No. MU-11
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS

At 8.8 ft. after 12 Hours

At 6.7 ft. after 15 Hours

	CASING	SAMPLER	CORE BAR.
Type		SS	
Size I.D.	4"	1-1/2"	
Hammer Wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. 8.7
DATE FINISH 2-16-65
BORING FOREMAN L. Dowdy
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
80	WASHED	79.0-80.5	D	14	27	36		Dense gray silty fine SAND	11	18	14
		85.5-87.0	D	5	4	10			12	18	12
90		88.1-88.4	D	100/3"			88.1	Dense gray-green weathered MICA-SCHIST	13	3	2
							88.4	Bottom of Boring			
100											
110											
120											

GROUND SURFACE TO 70 FT., USED 4" CASING: THEN Washed CASING TO 88.1 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-11

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client: U. S. Dept. of Interior
Project: National Park Service
Jefferson Memorial
Location: Washington, D. C.
Number: NCR 65.52 - 249

Sheet 1 of 2
Hole No. MU-12
Line: See Plan of
Station: Subsurface
Offset: Investigations

GROUND WATER OBSERVATIONS
At ____ ft. after ____ Hours
Water Boring
At ____ ft. after ____ Hours

	CASING	SAMPLER	CORE BAR.
Type		UP SS	
Size I.D.	4"	3" 1-1/2"	
Hammer wt.	300#	140#	BIT.
Hammer Fall	24"	30"	

SURFACE ELEV. -8.5
DATE FINISH 2-17-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
0	WOC	0.0-	D	WOR				Very soft gray organic clayey SILT, trace fine sand and shells	1	18	10
	WOC	1.5									
	WOC										
	WOC	3.0-	D	1/18"					2	18	8
	5	4.5									
	4										
	6	6.0-	D	1/18"					3	18	8
	3	7.5									
	3										
10	15										
	16										
	11	11.0-	D	1/18"					4	18	10
	14	12.5									
	14										
	12										
	14										
	25	16.0-	D	1	1	1			5	18	8
	24	17.5									
	19										
20	17										
	15						21.5				
	31	21.0-	D	1	2	2		Loose gray medium to fine SAND	6	18	10
	31	22.5					23.0				
	31										
	25										
	25										
	33	26.0-	D	1	1	1		Very soft gray organic clayey SILT, with occasional thin layers of fine sand, pockets of decomposed vegetation, and trace of shells	7	18	14
	32	27.5									
	25										
30	20										
	16	30.0-	UP	p= 300 psi					UP1	24	24
	16	32.0									
	22										
	29										
	18										
	15										
	17										
	18	37.0-	D	1	1	1			8	18	16
	20	38.5									
40	60										

GROUND SURFACE TO ____ FT., USED ____ " CASING; THEN ____ " CASING TO ____ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-12

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client U. S. Dept. of Interior Project National Park Service Jefferson Memorial Location Washington, D. C. Number NCR 65.52 - 249	Sheet 2 of 2 Hole No. MU-12 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS At ___ ft. after ___ Hours Water Boring At ___ ft. after ___ Hours		CASING	SAMPLER	CORE BAR.
	Type		UP SS	
	Size I.D.	4"	3" 1-1/2"	
	Hammer wt.	300#	140#	BIT.
	Hammer Fall	24"	30"	

SURFACE ELEV. -8.5
DATE FINISH 2-17-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field Identification of Soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40	105										
	71										
	65										
	49	43.5-	D	1	1	1			9	18	16
	48	45.0									
	126										
	70										
	35										
	33										
50	33	49.0	VS	(3-1/2")					VS #1		
	89	50.5									
	70										
	48										
	43										
	44	54.5	VS	(3-1/2")					No Sample		
	51	56.0									
	48										
	43										
	44										
60	57						60.5				
	58										
	60	61.0-	D	1	3	2		Firm gray sandy organic clayey SILT	10	18	18
	61	62.5									
	60										
	60										
	W						67.0				
	A	67.0	UP	450 psi				Medium dense gray silty medium to fine SAND	UP2	24	14
	S	69.0									
70	H										
	E										
	D										
		72.5	D	100/3"			72.5	Dense gray-green weathered MICA-SCHIST	11	18	3
		72.8					72.8				
								Bottom of Boring			
80											

GROUND SURFACE TO 65 FT., USED 4 " CASING: THEN Washed " ~~CASING~~ TO 72.5 FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-12

STORCH ENGINEERS
Boring Report

Drilling Contractor
Froehling & Robertson

Client	U. S. Dept. of Interior
Project	National Park Service Jefferson Memorial
Location	Washington, D. C.
Number	NCR 65.52 - 249

Sheet 1 of 1
Hole No. MU-12A
Line See Plan of
Station Subsurface
Offset Investigations

GROUND WATER OBSERVATIONS
At ___ ft. after ___ Hours
WATER BORING
At ___ ft. after ___ Hours

	CASING	SAMPLER	CORE BAR.
Type		UP	
Size I.D.	4"	3"	
Hammer Wt.	300#		BIT.
Hammer Fall	24"		

SURFACE ELEV. 8.7
DATE FINISH 2-18-65
BORING FOREMAN L. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
0								Very soft gray organic clayey SILT, trace fine sand and shells			
		3.0-5.0	UP	p= 100 psi					UP1	24	23
10		10.0-12.0	UP	p= 150 psi			12.0		UP2	24	23
								Bottom of Boring			
20											
30											
40											

GROUND SURFACE TO 10.0 FT., USED 4 " CASING; THEN ___ " CASING TO ___ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-12A

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client U. S. Dept. of Interior Project National Park Service Jefferson Memorial Location Washington, D. C. Number NCR 65.52 - 249	Sheet 1 of 3 Hole No. MU-13 Line See Plan of Station Subsurface Offset Investigations

GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	
At 7.2 ft. after 0 Hours	Type	SS	UP		SURFACE ELEV. 5.6
At 1.3 ft. after 35 Hours	Size I.D.	4"	1-1/2"	3"	DATE FINISH. 2-9-65
	Hammer Wt.	300#	140#	BIT:	BORING FOREMAN E. Ayers
	Hammer Fall	18"	24"		INSPECTOR M. D'Altilio
					SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	SAMPLE No.	Pen	Rec.
0	C	0.2-	C				1.0	Asphalt & concrete pavement	1	8	6
	75	1.0-	D	2	4	5			-	18	-
	84	2.5-	D	6	11	9		Very stiff brown sandy	-	18	-
	71	4.0									
	37	4.0-	D	4	8	8		clayey SILT	2	18	18
	18	5.5									
	22						7.0				
	23	7.0-	D	3	3	3		Loose brown gravelly silty	3	18	2
	23	8.5						coarse to fine SAND			
10	23						10.0				
	23	10.0-	D	1	1	2			4	18	6
	18	11.5						Soft gray sandy organic			
	18							clayey SILT			
	18						14.0				
	14							Soft brown sandy clayey			
	12	15.0-	D	6	2	2			-	18	-
	35	16.5-	D	2	2	2		SILT	-	18	-
	27	18.0									
	27	18.0-	D	4	3	2			5	18	16
20	19	19.5									
	25										
	26										
	26										
	24										
	19						25.0				
	60	25.0-	D	2	3	3			6	18	6
	45	26.5						Soft gray organic clayey			
	35										
	38										
30	39	28.5-	P	450 P.S.I.				SILT, with occasional	UP1	24	18
	38	30.5									
	39							thin layers of fine SAND,			
	37										
	40							pockets of decomposed			
	44										
	160	35.5-	D	1	1	1			7	18	16
	90	37.0						vegetation, and trace of			
	67										
	40							shells			
40	35										

GROUND SURFACE TO ____ FT., USED ____ " CASING: THEN ____ " CASING TO ____ FT.

D = DRY   W = WASHED   C = CORED   P = PIT   A = AUGER   UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-13

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 2 of 3 Hole No. MU-13 Line: See Plan of Station: Subsurface Offset: Investigations

GROUND WATER OBSERVATIONS

At 7.2 ft. after 0 hours

At 1.3 ft. after 35 hours

	CASING	SAMPLER	CORE BAR.
Type		SS UP	
Size I.D.	4"	1-1/2" 3"	
Hammer Wt.	300#	140#	BIT.
Hammer Fall	18"	24"	

SURFACE ELEV. 5.6
DATE FINISH 2-9-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler 0-6	6-12	12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
40											
		42.0-44.0	UP	500 psi					-	24	-
		44.0-46.0	UP	450 psi					UP2	24	24
50											
		51.0-52.5	D	1	1	1			8	18	10
		57.5-59.5	UP	550 psi					UP3	24	24
60								- becoming stiff			
		64.5-66.0	D	9	8	4			9	18	18
70								- with alternating layers of sandy silt			
		71.0-72.5	D	2	4	4	72.0		10	18	18
								Loose gray silty fine SAND			
		76.0-77.5	D	1	1	1			11	18	18
80											

GROUND SURFACE TO ____ FT., USED ____ " CASING: THEN ____ " CASING TO ____ FT.

D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-13

STORCH ENGINEERS Boring Report Drilling Contractor Froehling & Robertson	Client: U. S. Dept. of Interior Project: National Park Service Jefferson Memorial Location: Washington, D. C. Number: NCR 65.52 - 249	Sheet 3 of 3 Hole No. MU-13 Line: See Plan of Station: Subsurface Offset: Investigations	

GROUND WATER OBSERVATIONS

At 7.2 ft. after 0 Hours

At 1.3 ft. after 35 Hours

	CASING	SAMPLER	CORE BAR.
Type	SS	UP	
Size I.D.	4"	1-1/2" 3"	
Hammer Wt.	300#	140#	BIT.
Hammer Fall	18"	24"	

SURFACE ELEV. 5.6
DATE FINISH 2-9-65
BORING FOREMAN E. Ayers
INSPECTOR M. D'Altilio
SOILS ENGR. V. Elias

LOCATION OF BORING:

Depth Below Surface	Casing Blows per foot	Sample Depths From-To	Type of Sample	Blows per 6" on Sampler From 0-6	6-12	To 12-18	Strata Change Depth Elev.	Field identification of soil. Remarks (incl. color, loss of wash water, seams in rock, etc.)	Sample No.	Pen	Rec.
80											
		81.0-82.5	D	1	1	1			12	18	18
							85.0				
		85.0-85.3	D	100/4			85.3	Dense gray-green weathered MICA-SCHIST	13	4	4
90								Bottom of Boring			
100											
110											
120											

GROUND SURFACE TO 40 FT., USED 4 " CASING: THEN Washed " ~~CASING~~ TO 85.0 FT.

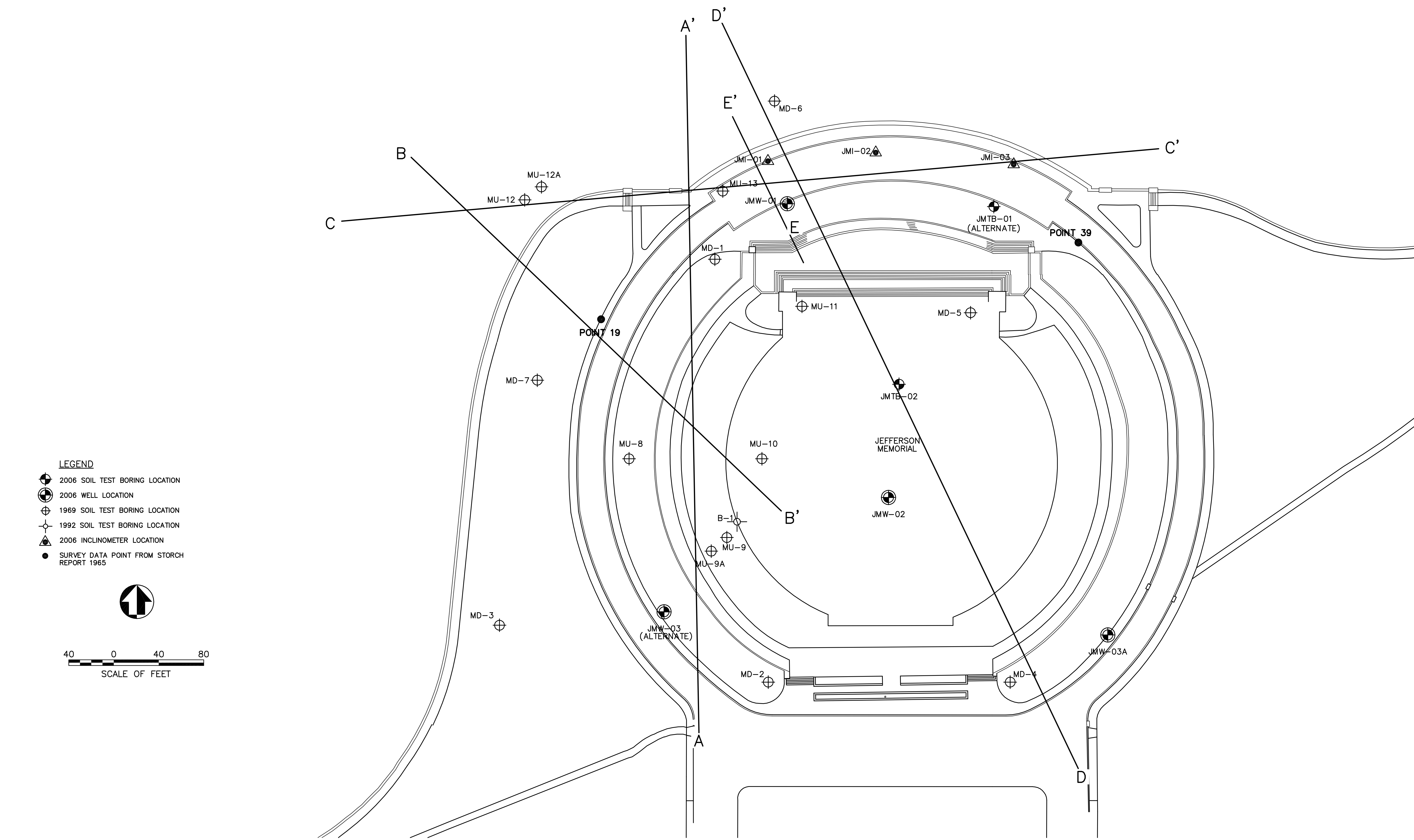
D = DRY W = WASHED C = CORED P = PIT A = AUGER UP = UNDISTURBED, PISTON
UB = UNDISTURBED, BALL CHECK

Proportions used: trace = 0-10%, little = 10-20%, some = 20-35%, and = 35-50%

HOLE NO. MU-13

Boring Cross-Sections

Note: The elevations shown in these cross-sections are based on survey datum NAVD 29.



SHEET 1 OF 5

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

BORING CROSS-SECTION PLAN
TITLE OF DRAWING

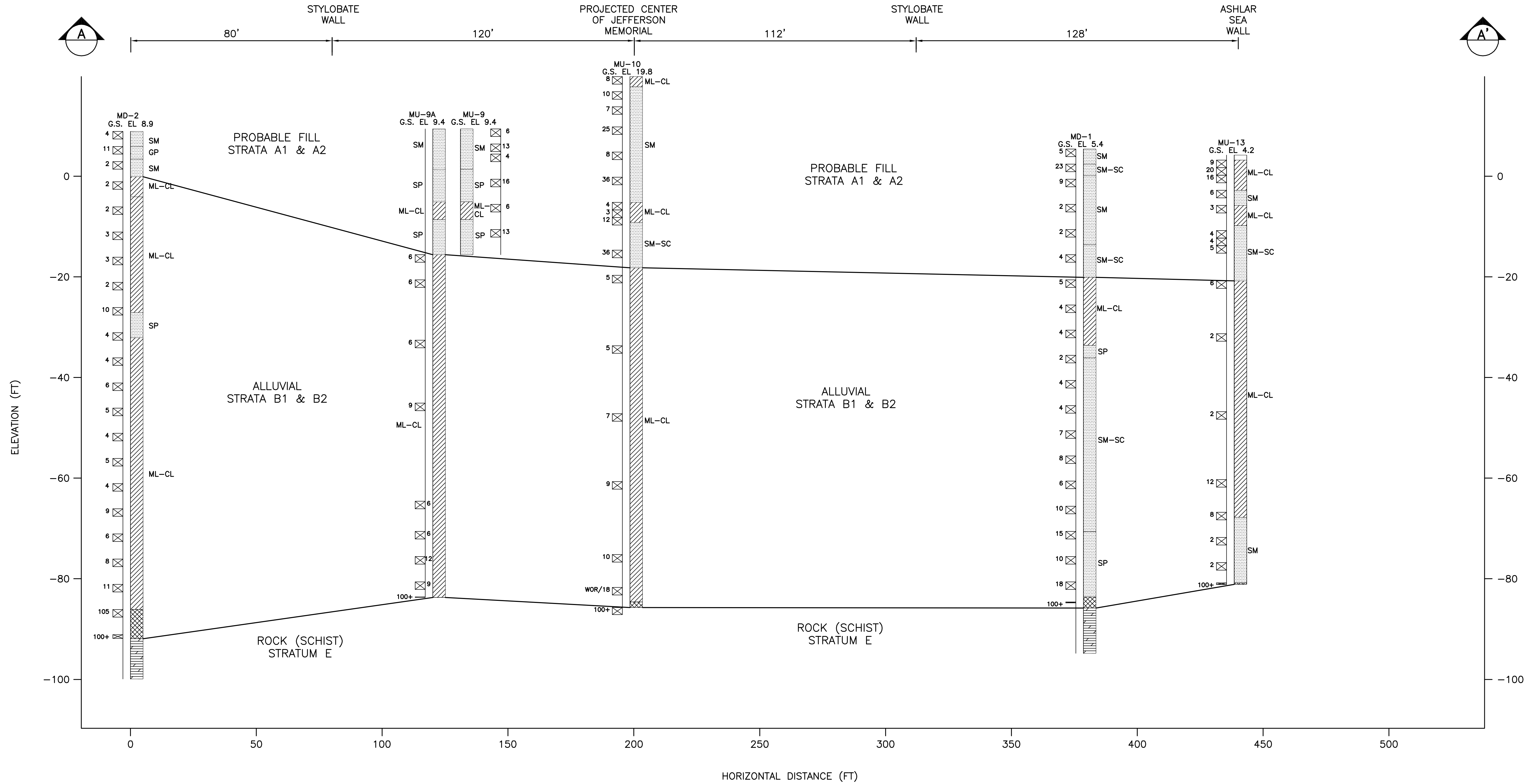
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE 1/30/08
DWG. NO.
808/80284

REFERENCE: BASE PLAN FOR THIS DRAWING WAS PROVIDED BY DEWBERRY & DAVIS AND GREENHORNE & O'MARA



LEGEND

- STRATUM A1 & A2 – CLAY OR SILT FILL
- STRATUM B1 – ALLUVIAL (SAND)
- STRATUM B2 – ALLUVIAL (CLAY OR SILT)
- STRATUM C – RESIDUAL ROCK FRAGMENTS & GRAVEL (SCHIST)
- STRATUM D – RESIDUAL DISINTEGRATED ROCK (SCHIST)
- STRATUM E – ROCK (SCHIST)

SCALE OF FEET: 20 0 20 40 HORIZ.; 10 0 10 20 VERT.

1"= 20' HORIZ. 10' VERT.

SHEET 2 OF 5

A/E FIRM	Mark	Sheet	REVISION	Date	Initial
HNTB ARCHITECTURE					
SCHNABEL ENGINEERING					

BORING CROSS-SECTION A-A'
TITLE OF DRAWING

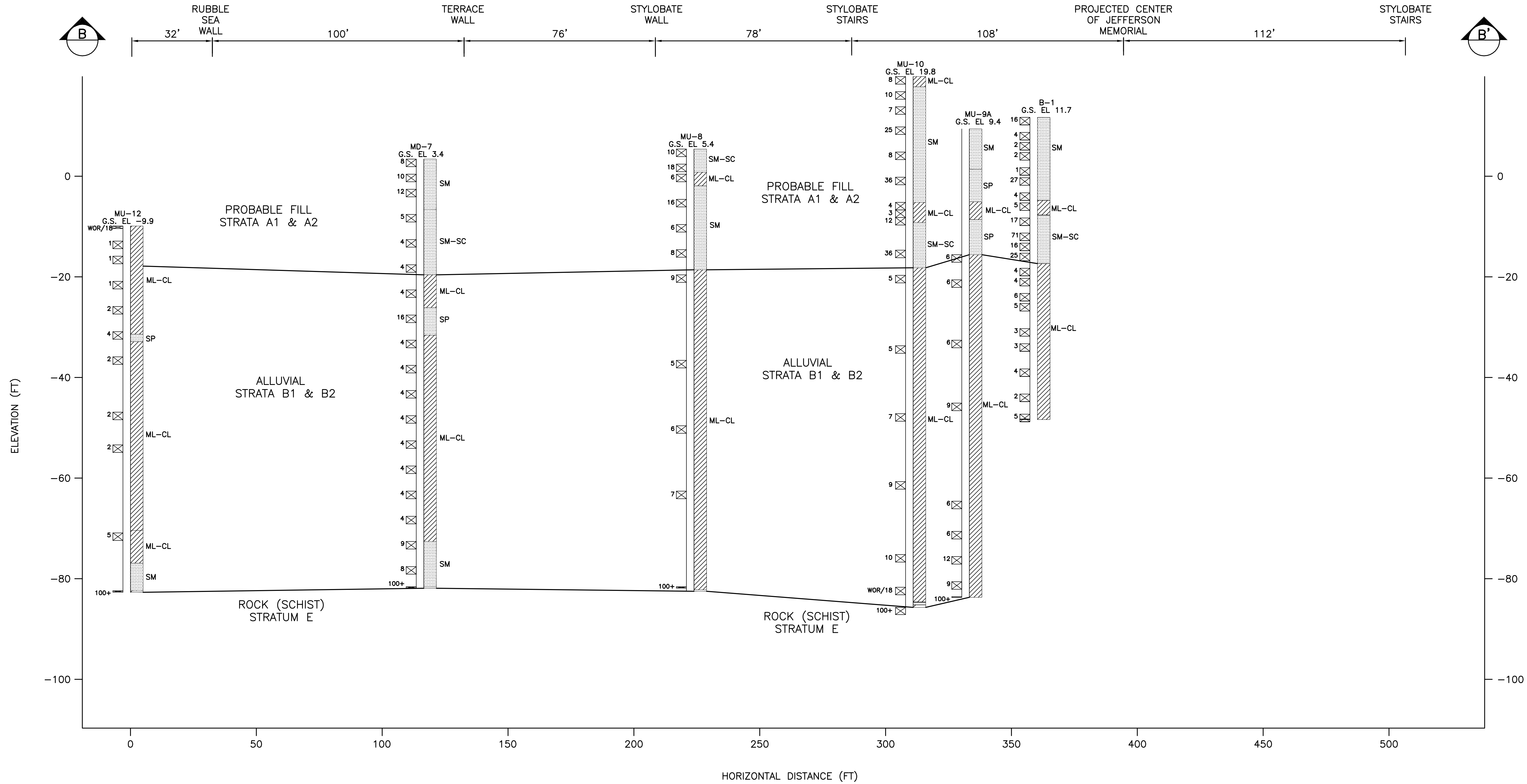
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED HR
DRAWN NSF
CHECKED JG
PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

2/7/07 09:15 SFERGESEN R2007 G:\2006Jobs\06150078 Jefferson Memorial\CADD\aa.dwg



LEGEND

- STRATUM A1 & A2 – CLAY OR SILT FILL
- STRATUM B1 – ALLUVIAL (SAND)
- STRATUM B2 – ALLUVIAL (CLAY OR SILT)
- STRATUM C – RESIDUAL ROCK FRAGMENTS & GRAVEL (SCHIST)
- STRATUM D – RESIDUAL DISINTEGRATED ROCK (SCHIST)
- STRATUM E – ROCK (SCHIST)

20 0 20 40 HORIZ.
10 0 10 20 VERT.
SCALE OF FEET

1"= 20' HORIZ.
10' VERT.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

BORING CROSS-SECTION B-B'
TITLE OF DRAWING

SUB SHEET NUMBER

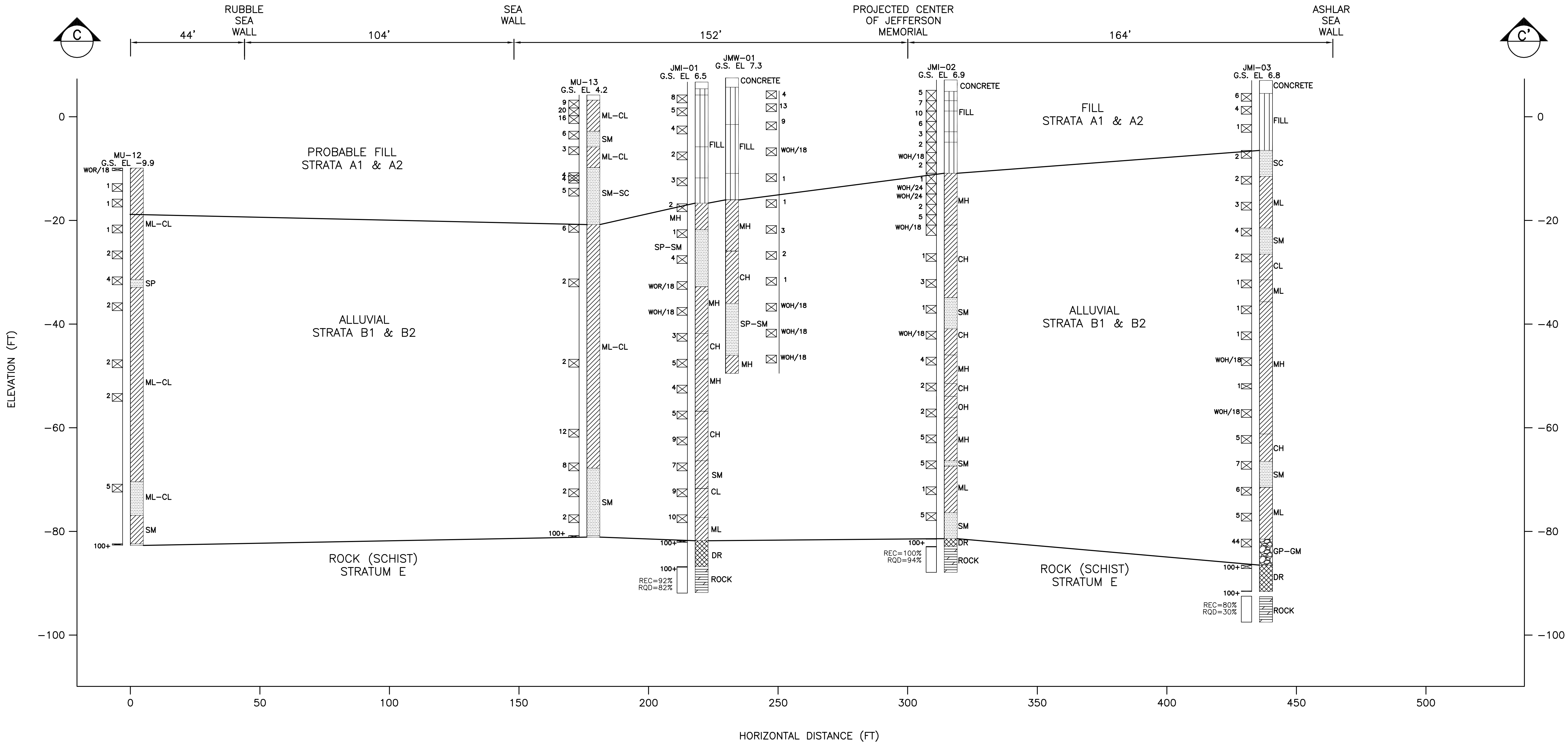
SHEET 3 OF 5

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED HR
DRAWN NSF
CHECKED JG
PKIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 15:06 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\BB.DWG



LEGEND

- STRATUM A1 & A2 – CLAY OR SILT FILL
- STRATUM B1 – ALLUVIAL (SAND)
- STRATUM B2 – ALLUVIAL (CLAY OR SILT)
- STRATUM C – RESIDUAL ROCK FRAGMENTS & GRAVEL (SCHIST)
- STRATUM D – RESIDUAL DISINTEGRATED ROCK (SCHIST)
- STRATUM E – ROCK (SCHIST)

SCALE OF FEET: 20 0 20 40 HORIZ. / 10 0 10 20 VERT.

1" = 20' HORIZ. 10' VERT.

A/E FIRM: HNTB ARCHITECTURE; SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

BORING CROSS-SECTION C-C'
TITLE OF DRAWING

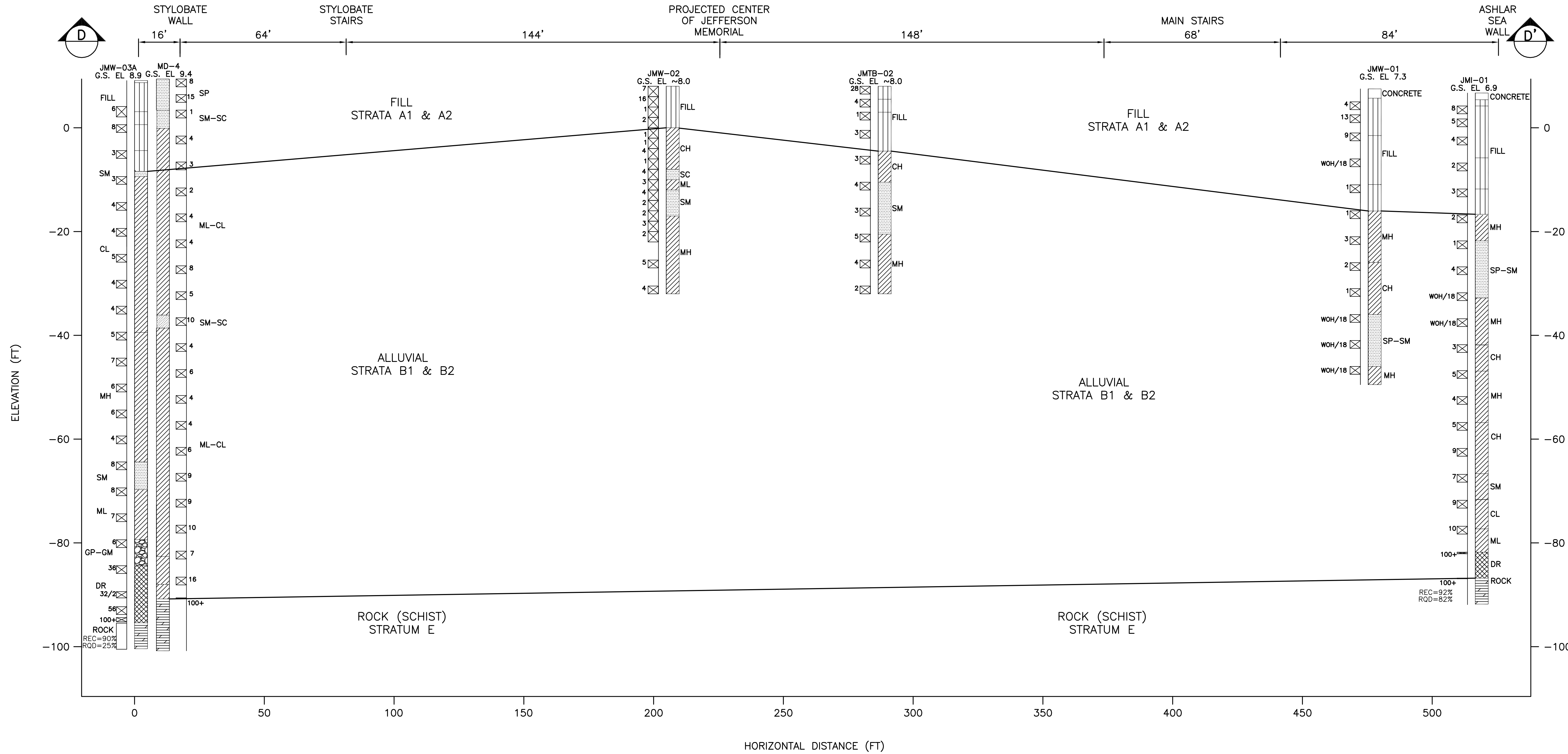
SUB SHEET NUMBER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

DESIGNED: HR
DRAWN: NSF
CHECKED: JG
PMIS/PKG NO. 128232
DATE 1/30/08
DWG. NO. 808/80284

1/28/08 15:23 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\CC.DWG



LEGEND

- STRATUM A1 & A2 – CLAY OR SILT FILL
- STRATUM B1 – ALLUVIAL (SAND)
- STRATUM B2 – ALLUVIAL (CLAY OR SILT)
- STRATUM C – RESIDUAL ROCK FRAGMENTS & GRAVEL (SCHIST)
- STRATUM D – RESIDUAL DISINTEGRATED ROCK (SCHIST)
- STRATUM E – ROCK (SCHIST)

20 0 20 40 HORIZ.
10 0 10 20 VERT.
SCALE OF FEET

1"= 20' HORIZ.
10' VERT.

A/E FIRM
HNTB ARCHITECTURE
SCHNABEL ENGINEERING

Mark	Sheet	REVISION	Date	Initial

BORING CROSS-SECTION D-D'
TITLE OF DRAWING

SUB SHEET NUMBER

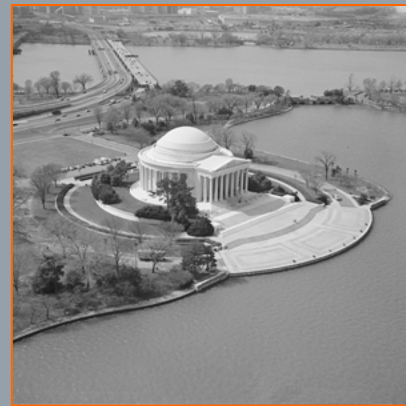
SHEET 5 OF 5

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE – NATIONAL CAPITAL REGION
BRANCH OF DESIGN AND CONSTRUCTION

JEFFERSON MEMORIAL SETTLEMENT STUDY
TITLE OF PROJECT
THOMAS JEFFERSON MEMORIAL
LOCATION WITHIN PARK
NATIONAL MALL & MEMORIAL PARKS
NAME OF PARK

HR
DESIGNED
NSF
DRAWN
JG
CHECKED
PMIS/PKG NO.
128232
DATE
1/30/08
DWG. NO.
808/80284

1/28/08 15:32 NFAHEY R17 G:\2006JOBS\06150078 JEFFERSON MEMORIAL\CADD\DD.DWG



APPENDIX C

VIDEO SURVEY INFORMATION

APPENDIX C

Video Survey Information

Transcript of Magnolia Plumbing Drainage Pipe Survey at the Jefferson Memorial by Schnabel Engineering

West Side of North Plaza

1. Location 1 to Location 2- Manhole to Tidal Basin
    a. 12-inch corrugated pipe
    b. Starting at 3 ft
    c. Considerable debris in manhole 1
    d. 16.8 ft. – deformed pipe at 11:00 (11 o'clock) position
    e. 20.4 – 22.9 ft. – broken corrugated pipe; pipe flaking at break
    f. 25.7 ft. – deformed pipe at 1:00 position
    g. 30 ft. – some erosion at bottom of pipe 6:00 position
    h. 39.8 ft. – erosion at 9:00 position
    i. 50.9 ft. – 9:00 connection
    j. 62.9 ft. – deformed pipe at 1:00 position
    k. 71.1 ft. – hole in pipe; separation of pipe; void visible
    l. 78.2 ft. – new section of pipe
    m. 80.5 ft. – 2x4 stuck in pipe – camera will not navigate around

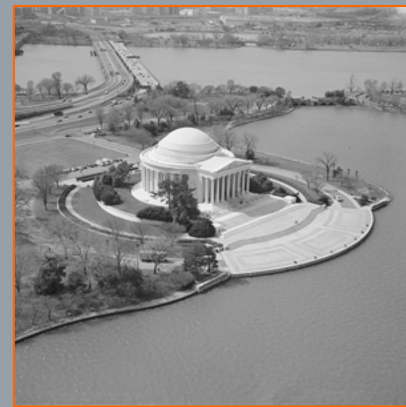
2. Location 2 to Location 1 – Tidal Basin to Manhole
    a. 12" corrugated pipe
    b. starting at 3'
    c. 8.7 ft. – separation of pipe; some type of point repair
    d. 23.8 ft. – deformed pipe at 9:00 position
    e. 28 ft. – reached bend
    f. Total footage 30'
    g. Pipe makes several turns

3. Location 1 to Location 0 – Manhole to Memorial
    a. 12" corrugated pipe
    b. Starting at 3'
    c. 7.1-9.2 ft. – some debris at bottom of pipe (old mud)
    d. 22.2 ft. – void in pipe at joint between two sections of pipe
    e. 26.4 ft. – connection from 3:00 side and 9:00 side
        i. 9:00 service full of debris
        ii. Hold inspection – camera cannot navigate further
    f. The diameter changes to 10" ahead of stopping point, can see 10-15'

East Side of North Plaza

4. Location B to Location C – Manhole to Tidal Basin
    a. First attempt
        i. 12" concrete pipe
        ii. Starting at 3'
        iii. Debris noted in line
        iv. 14.8 ft. – stopped at a joint per request
        v. Quite a bit of debris in line
        vi. 25.6 ft. – still noting debris in line
        vii. 34.2 ft. – manhole noted; two lines coming into manhole facing against the flow
        viii. 34 ft. – sheets of concrete noted in line
        ix. 40 ft. – camera stuck on debris

2. Location B to Location C – Manhole to Tidal Basin
    a. Second attempt
        i. 34.9 ft. – manhole identified earlier
        ii. 36.8 ft. – noting presence of limestone grout on bottom of pipe
        iii. 56.8 ft. – grout buildup tapers off
        iv. 70.8 ft. – lots of grout in pipe (large pieces); holding inspection (reached second manhole)



APPENDIX D

SURVEY INFORMATION

HNTB

APPENDIX D

Survey Monitoring Data

Jefferson Memorial Plaza Monitoring

DESCRIPTION	POINT NUMBER	11/06/06 INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	06/12/07 MONTHLY READING ELEV. LOOP ONLY	07/11/07 MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	12/28/07 MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP
Section I	1	38.124			
	2	32.308	32.318	32.304	
	3	30.476	30.481	30.471	
	4	26.466	26.468	26.460	
	5	22.056	22.063	22.058	
	6	11.395		11.365	
Section II	7	38.356	38.371	38.353	
	8	32.309	32.317	32.306	
	9	30.46	30.464	30.454	
	10	26.459	26.46		
	11	22.093	22.094		
	12	11.819			
Section III	15	6.404	6.383	6.403	
	16	6.456	6.433	6.439	
	17	6.54	6.549	6.573	
	18	6.601	6.61	6.628	6.619
	19	6.517	6.508	6.526	6.509
	20	7.008	6.988	7.009	
	21	7.12	7.118	7.143	
	22	7.561	7.56	7.579	
	23	7.492	7.488	7.510	
Section IV	24	6.455	6.432	6.439	6.426
	25	6.458	6.443	6.453	
	26	6.515	6.518	6.541	6.540
	27	7.309	7.303	7.325	
	28	7.788	7.799	7.805	
	29	11.57	11.591	11.592	
	30	12.513	12.519	12.512	
	31	21.605	21.629	21.614	
	32	22.823	22.849	22.836	
	33	30.468	30.496	30.481	
Section V	34	7.768	7.773		
	35	7.209	7.193		
	36	6.457	6.449	6.470	6.464
	37	6.467	6.443	6.453	
	38	6.448	6.423	6.433	6.426

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07
DESCRIPTION	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP
Section VI	39	6.407	6.383	6.392	6.381
	40	6.428	6.404	6.414	
	41	6.506	6.495	6.520	6.517
	42	7.229	7.217	7.242	
	43	7.796	7.793	7.804	
	44	11.576	11.582	11.589	
	45	12.528	12.539	12.534	
	46	21.63	21.649	21.633	
	47	22.821	22.839	22.824	
	48	30.464	30.483	30.468	
Section VII	49	7.816	7.813		
	50	7.221	7.216		
	51	6.500	6.495	6.514	6.514
	52	6.353	6.331	6.333	
	53	6.309	6.288	6.294	6.280
Section VIII	54	6.073	6.041	6.043	6.029
	55	6.131	6.093	6.094	
	56	6.376	6.373	6.389	6.388
	57	7.151	7.151	7.160	
	58	7.771	7.778	7.781	
	59	11.576	11.582	11.590	
	60	12.526	12.529	12.530	
	61	21.638	21.653	21.638	
	62	22.886	22.899	22.886	
	63	30.451	30.47	30.458	
Section IX	72	7.826	7.824		
	73	7.082	7.074		
	74	6.347	6.344	6.352	6.352
	75	6.001	5.953	5.950	
	76	5.955	5.906	5.906	5.885
Section X	79	5.760	5.703	5.702	5.677
	80	5.836	5.783	5.785	
	81	6.181	6.183	6.190	6.189
	82	7.005	7.001	7.010	
	83	7.809	7.814	7.812	
	84	11.571	11.588	11.593	
	85	12.528	12.53	12.525	
	86	21.632	21.64	21.625	
	87	30.479	30.496	30.479	
	112			22.892	

Jefferson Memorial Plaza Monitoring

DESCRIPTION	POINT NUMBER	11/06/06 INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	06/12/07 MONTHLY READING ELEV. LOOP ONLY	07/11/07 MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	12/28/07 MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP
Section XI	88	7.814	7.819		
	89	7.018	7.019		
	90	6.174	6.175	6.185	6.182
	91	5.821	5.762	5.760	
	92	5.842	5.782	5.780	
	93	5.743	5.683	5.678	5.658
	94	5.753	5.688	5.685	
Section XII	95	5.673	5.603	5.600	5.573
	96	5.68	5.611	5.608	
	97	5.735	5.67	5.668	
	98	5.779	5.713	5.710	
	99	6.144	6.138	6.147	6.135
	100	6.138	6.133	6.138	6.145
	101		7.024	7.035	
	102	7.821	7.824	7.829	
	103	11.602	11.616	11.620	
	104	12.538	12.54	12.538	
	105	21.66	21.671	21.659	
	106	22.904	22.917	22.905	
	107	30.475	30.496	30.479	
Section XIII	134	38.333	38.367	38.344	
	135	32.296	32.323	32.304	
	136	30.479	30.498	30.479	
	137	26.456	26.481		
	138		22.113		
	139		11.884		
Ground Shots	13	4.413	4.396		
	14	9.448	9.426		
	64	22.073	22.09		
	65	22.086	22.102		
	66	22.173	22.1		
	67	22.176	22.105		
	68	22.044	22.066		
	69		22.087		
	70	22	22.02		
	71	21.997	22.02		
	77	5.92	5.868	5.868	
	78	6.298	6.295	6.302	6.304
	108	12.442	12.45		
	109	7.807	7.812		
	110	11.783	11.785		

Jefferson Memorial Plaza Monitoring

		11/06/06	06/12/07	07/11/07	12/28/07
DESCRIPTION	POINT NUMBER	INITIAL READING ELEV. NOV.6 LOOP+NOV. 17 TRIG.	MONTHLY READING ELEV. LOOP ONLY	MONTHLY READING ELEV. LOOP ONLY (SUMMARY/ GREEN SECTIONS)	MONTHLY READING ELEV. FOLLOWING VERIFICATION LOOP
	111	11.535	11.51		
	112		22.907	22.892	
	113	7.108	7.089		
	114	6.798			
	115	6.694			
Ground Shots	116	6.842	6.842		
	117	6.301	6.294		
	118	5.951			
	119	5.99	5.994	6.001	
	120	5.892			
	121	5.697	5.647	5.650	
	122	5.992	5.999	6.000	
	123	5.689	5.637	5.631	
	124	8.462	8.429		
	125	5.37	5.375	5.370	
	126	5.4			
	127	5.637			
	128	4.998	4.959		
	129		5.119	5.112	
	130	11.788	11.801		
	131	11.685	11.679		
	132	11.657	11.633		
	133	11.953	11.963		
	140		22.085		
	141	22.099	22.095		
	142	22.079	22.079		
	143	22.079	22.075		
	150		6.559		
	151		1.897		
	152		3.999		

Benchmarks (NGVD 29)	December 2007 Level Run	Park Service Benchmarks	NGS Benchmarks	Date Set PS	Date Set or Recovered NGS	PS DIFF	NGS DIFF
PS 80 IV / NGS HV 1860 / ERICSON TOE	17.841	17.841	17.97		1941	0	-0.129
NGS AI 4421 (converted from 88 to 29)	7.783		7.77		1999		0.013
PS HV 83022	12.382	12.43		July 1983		-0.048	
PS HV M 17 / NGS HV 1845	13.623	13.54	13.56		1971	0.083	0.063
NGS HV 1844	16.706		16.63		1941		0.076
PS HV 83001	10.555	10.57		July 1983		-0.015	
PS HV 86023	6.294	6.596		January 1986		-0.302	
NGS AI 4422 (converted from 88 to 29)	5.928		6.184		1999		-0.256
PS HV 86024	5.939	6.177		January 1986		-0.238	
PS HV 86025	7.875	7.896		January 1986		-0.021	
PS HV 86026	5.964	5.993		January 1986		-0.029	
PS HV 86007	5.078	5.225		January 1986		-0.147	
NGS HV 2009	12.086		12.03		1956		0.056
PS HV 89002	10.169	10.415		January 1986		-0.246	
PS HV 89003	11.078	11.371		January 1986		-0.293	
PS HV 86002	5.763	6.079		January 1986		-0.316	
NGS HV 2004 / GATE 2	16.528		16.7		1970		-0.172
PS 801 HV 86006	7.931	8.081		January 1986		-0.15	
NGS HV 2008 / SPEED RM 1	3.754		4.11		1935		-0.356
PS 80 IV / NGS HV 1860 / ERICSON TOE	17.843	17.841	17.97		1941	0.002	-0.127
PS 801 HV 86006	7.93	8.081		January 1986	1971	-0.151	
NGS AI 4421 (88 TO 29)	7.778		7.77		1999		0.008

	A	B
1	**Benchmarks (NGVD 29)**	**December 2007 Level Run**
2		
3	83001	10.57
4	86025	7.885
5	86026	5.973
6	2009	12.097
7	TBM 27	10.951
8	89003	11.092
9	89002	5.776
10	83001	10.574 TIE
11		
12	TBM 27	10.951
13	700	8.861
14	701	7.728
15	86005	6.372
16	19	6.509
17	18	6.619
18	24	6.426
19	26	6.54
20	36	6.464
21	38	6.426
22	702	6.846
23	39	6.381
24	41	6.517
25	51	6.514
26	53	6.28
27	54	6.029
28	56	6.388
29	74	6.352
30	76	5.885
31	78	6.304
32	81	6.189
33	79	5.677
34	93	5.658
35	91	6.182
36	100	6.145
37	99	6.135
38	95	5.573
39	703	6.469
40	704	4.55
41	86003	3.018
42	700	8.864
43	TBM 27	10.954 TIE
44		
45	TBM 27	10.951
46	89003	11.091
47	86002	5.774
48	TBM 27	10.949 TIE

Level Report *(121707Edit.DAT)*

TIDAL BASIN LOOP
12-07-07 TO 12-17-07 LEVEL LOOPS

Contents

Back to top

Leveling Data

Station Points	BS	IS	FS	Elevation	Distance	Description	Stakeout Deltas
✓ 1860	1.620sft			17.841sft	26.450sft	PS NG 10:50:463	
✓ 1			6.931sft	12.530sft	26.440sft	PK 10:56:173	
	5.611sft				128.170sft	PK 10:59:103	
✓ 2			5.225sft	12.916sft	129.750sft	TP 11:06:313	
	5.682sft				132.070sft	TP 11:09:443	
✓ 3			3.848sft	14.750sft	132.300sft	PK 11:14:483	
	4.423sft				126.900sft	PK 11:33:493	
✓ 4			5.489sft	13.684sft	134.200sft	PK 11:38:143	
	4.793sft				133.980sft	PK 11:40:563	
✓ 5			5.471sft	13.007sft	130.350sft	PK 11:44:283	
	4.845sft				125.560sft	PK 12:36:293	
✓ 6			4.908sft	12.943sft	126.730sft	TP 12:39:053	
	5.788sft				122.300sft	TP 12:42:063	
✓ 7			5.646sft	13.084sft	120.890sft	TP 12:44:043	
	4.604sft				120.800sft	TP 12:46:253	

✓ 8			6.784sft	10.905sft	121.640sft	PK 12:53:073	
	5.498sft				129.440sft	PK 13:00:313	
✓ 9			5.544sft	10.858sft	128.590sft	TP 13:03:103	
	4.848sft				131.250sft	TP 13:05:343	
✓ 10			5.601sft	10.105sft	132.090sft	TP 13:07:403	
	4.889sft				132.170sft	TP 13:10:303	
✓ 11* = 111*			5.612sft	9.382sft	132.110sft	TP 13:14:423	
	5.746sft				142.440sft	TP 13:21:253	
✓ 12			5.174sft	9.954sft	144.260sft	PT 13:24:073	
	5.019sft				132.780sft	PT 13:27:123	
✓ 13			6.639sft	8.334sft	132.600sft	PT 13:31:463	
	5.125sft				90.560sft	PT 13:36:363	
NGS AI 4421 ✓ WW2			5.676sft	7.783sft	97.690sft	NGS 13:42:263	
	4.988sft				133.550sft	NGS 10:53:543	
✓ 10			5.027sft	7.744sft	133.390sft	TP 10:59:143	
	5.396sft				119.060sft	TP 11:06:593	
✓ 11			4.294sft	8.845sft	118.500sft	TP 11:08:523	
	6.761sft				86.220sft	TP 11:12:163	
✓ B3022			3.224sft	12.382sft	93.450sft	NPS 11:18:153	
	5.677sft				80.650sft	NPS 11:21:433	
✓ 1845			4.436sft	13.623sft	84.900sft	NGS 11:29:163	
	6.755sft				119.840sft	NGS 11:34:183	
✓ 14			4.851sft	15.527sft	116.330sft	TP 11:36:483	
	5.122sft				37.380sft	TP 11:39:433	
✓ 1844			3.943sft	16.706sft	38.700sft	NGS 11:41:413	
	3.817sft				98.490sft	NGS 11:45:233	
			3.853sft	16.670sft	96.070sft	TP 11:48:063	

✓ 16	6.639sft				121.530sft	TP 11:50:153	
✓ 17			4.665sft	18.644sft	119.790sft	TP 11:52:543	
	5.175sft				124.410sft	TP 11:56:203	
✓ 18			4.364sft	19.455sft	121.750sft	TP 11:58:513	
	2.971sft				130.010sft	TP 12:00:593	
✓ 19*= 33*			2.461sft	19.966sft	130.590sft	PKS 12:10:583	
	5.740sft				127.530sft	PKS 12:14:223	
✓ 20			5.095sft	20.611sft	125.240sft	PKS 12:16:503	
	5.191sft				131.110sft	PKS 12:19:023	
✓ 21			4.629sft	21.173sft	130.550sft	TP 12:21:543	
	4.260sft				126.320sft	TP 12:23:593	
✓ 22			6.092sft	19.340sft	124.780sft	TP 12:25:583	
	5.004sft				137.990sft	TP 12:28:363	
✓ 23			5.602sft	18.742sft	134.800sft	TP 12:38:573	
	2.990sft				123.770sft	TP 12:41:213	
✓ 24			8.390sft	13.342sft	122.080sft	TP 12:43:493	
	3.915sft				123.880sft	TP 12:48:463	
✓ 25			6.411sft	10.846sft	122.930sft	TP 12:52:093	
	5.482sft				43.000sft	TP 12:55:163	
✓ 83001			5.773sft	10.555sft	41.040sft	NPS 12:58:123	
	7.453sft				126.260sft	NPS 13:01:483	
✓ 27			3.063sft	14.945sft	129.260sft	TP 13:03:513	
	8.078sft				130.510sft	TP 13:07:123	
✓ 28			3.021sft	20.002sft	129.600sft	PKS 13:11:283	
	4.509sft				135.630sft	PKS 08:17:153	
✓ 29			5.667sft	18.844sft	137.880sft	TP 08:20:103	
	6.305sft				124.560sft	TP 08:23:183	

✓ 30			4.337sft	20.813sft	124.140sft	TP 08:27:363	
	5.134sft				120.430sft	TP 08:29:563	
✓ 31			5.256sft	20.690sft	120.260sft	TP 08:31:483	
	5.319sft				115.260sft	TP 08:35:573	
✓ 32			5.324sft	20.685sft	115.930sft	TP 08:37:553	
	4.805sft				38.900sft	TP 08:40:203	
✓ 33*= 19*			5.525sft	19.965sft	40.720sft	PKF 08:43:033	
	2.415sft				137.730sft	PKF 08:47:453	
✓ 34			3.408sft	18.972sft	137.370sft	TP 08:51:263	
	5.453sft				130.880sft	TP 08:55:213	
✓ 35			6.396sft	18.029sft	133.470sft	PKS 08:59:533	
	2.086sft				136.480sft	PKS 10:32:443	
✓ 36			5.026sft	15.089sft	136.290sft	PKS 10:41:303	
	1.953sft				116.360sft	PKS 10:50:113	
✓ 37			10.209sft	6.832sft	115.690sft	PKS 10:53:153	
	3.856sft				134.040sft	PKS 10:56:393	
38			4.409sft	6.279sft	134.810sft	TP 10:58:453	
	4.632sft				51.160sft	TP 11:01:213	
86023			4.618sft	6.294sft	58.180sft	NPS 11:03:243	
	4.573sft				81.230sft	NPS 11:06:413	
A14422			4.939sft	5.928sft	84.680sft	NGS 11:08:353	
	4.735sft				111.020sft	NGS 11:11:573	
✓ 86024			4.724sft	5.939sft	108.960sft	NPS 11:14:023	
	4.237sft				125.170sft	NPS 11:16:113	
✓ 39			4.002sft	6.174sft	126.030sft	TP 11:20:563	
	5.074sft				134.820sft	TP 11:24:363	
			4.334sft	6.914sft	131.300sft	PKS 11:27:513	

✓ 40	5.286sft				35.670sft	PKS 11:31:143	
✓ 86025			4.325sft	7.875sft	40.200sft	NPS 11:33:443	
	3.949sft				120.960sft	NPS 11:38:023	
✓ 41			5.293sft	6.531sft	121.230sft	TP 11:42:473	
	4.739sft				98.920sft	TP 11:46:133	
✓ 86026			5.305sft	5.964sft	100.930sft	NPS 11:47:473	
	5.662sft				46.680sft	NPS 08:30:183	
✓ 41			1.695sft	9.932sft	46.320sft	TP 08:33:113	
	7.768sft				48.280sft	TP 08:35:523	
✓ 42			3.684sft	14.015sft	48.240sft	TP 08:37:353	
	5.054sft				137.480sft	TP 08:39:343	
✓ 43			7.810sft	11.259sft	134.990sft	TP 08:44:253	
	3.283sft				42.570sft	TP 08:55:473	
✓ 86007			9.465sft	5.078sft	44.640sft	NPS 08:58:173	
	11.621sft				50.920sft	NPS 09:42:103	
✓ 44			3.515sft	13.184sft	52.040sft	TP 09:44:363	
	3.675sft				55.030sft	TP 09:45:483	
✓ 2009			4.773sft	12.086sft	53.560sft	NGS 09:50:583	
	4.628sft				138.100sft	NGS 09:52:443	
✓ 45			5.832sft	10.882sft	138.220sft	TP 09:57:313	
	3.760sft				128.650sft	TP 10:00:253	
✓ 46			4.726sft	9.917sft	128.580sft	TP 10:02:233	
	3.136sft				132.890sft	TP 10:04:213	
✓ 47			3.397sft	9.656sft	132.880sft	TP 10:06:563	
	4.826sft				127.500sft	TP 10:09:123	
✓ 48			4.811sft	9.671sft	127.750sft	TP 10:11:093	
	3.776sft				127.310sft	TP 10:13:293	

✓ 49			3.557sft	9.891sft	122.130sft	TP 10:15:383	
	4.464sft				70.720sft	TP 10:18:103	
✓ 89002			4.186sft	10.169sft	71.210sft	NPS 10:20:313	
	5.853sft				129.410sft	NPS 10:23:163	
✓ 50			3.720sft	12.302sft	128.760sft	TP 10:26:573	
	6.291sft				123.960sft	TP 10:30:233	
✓ 51			6.724sft	11.869sft	122.880sft	TP 10:35:273	
	4.892sft				10.330sft	TP 10:38:043	
✓ 89003			5.682sft	11.078sft	10.440sft	NPS 10:39:013	
	3.261sft				125.380sft	NPS 10:40:593	
✓ 52			7.417sft	6.922sft	126.310sft	TP 10:49:553	
	3.531sft				85.800sft	TP 10:52:583	
✓ 86002			4.690sft	5.763sft	84.730sft	NPS 10:58:223	
	8.017sft				101.600sft	NPS 11:02:503	
✓ 53			3.365sft	10.415sft	101.580sft	TP 11:04:423	
	8.871sft				82.170sft	TP 11:09:573	
✓ 54			2.509sft	16.777sft	82.350sft	TP 11:11:593	
	2.207sft				133.340sft	TP 11:14:173	
✓ 2004			2.456sft	16.528sft	133.330sft	NGS 11:15:113	
	2.398sft				133.430sft	NGS 11:16:323	
✓ 55			8.995sft	9.932sft	133.000sft	TP 11:18:433	
	5.132sft				132.430sft	TP 11:21:423	
✓ 56			6.256sft	8.808sft	132.290sft	PKR 11:27:223	
	4.965sft				126.880sft	PKR 11:30:433	
✓ 57			4.976sft	8.798sft	125.930sft	TP 11:34:083	
	5.360sft				127.970sft	TP 11:40:283	
			5.150sft	9.008sft	128.640sft	TP 11:42:283	

✓ 58	5.198sft				130.780sft	TP 11:45:133	
✓ 59			4.850sft	9.357sft	129.940sft	TP 11:47:043	
	5.192sft				127.010sft	TP 11:49:143	
✓ 60			5.048sft	9.501sft	126.460sft	PKS 11:52:313	
	4.271sft				89.590sft	PKS 12:45:113	
✓ 86006			5.842sft	7.931sft	88.350sft	NPS 12:49:293	
	5.835sft				88.350sft	NPS 12:51:133	
✓ 61			4.315sft	9.450sft	88.920sft	TP 12:52:083	
	4.017sft				125.690sft	TP 12:54:133	
✓ 62			3.871sft	9.595sft	125.010sft	TP 12:56:213	
	4.718sft				128.770sft	TP 12:58:473	
✓ 63			4.615sft	9.698sft	126.950sft	TP 13:00:343	
	4.809sft				136.120sft	TP 13:02:403	
✓ 64			4.406sft	10.101sft	136.330sft	TP 13:04:323	
	4.437sft				130.430sft	TP 13:06:483	
✓ 65			5.878sft	8.661sft	130.680sft	TP 13:09:373	
	3.112sft				83.030sft	TP 13:13:163	
HV 2008 ✓ NO1			8.018sft	3.754sft	82.610sft	USCGS 13:15:423	
	6.499sft				88.930sft	USCGS 08:20:503	
✓ 61			4.867sft	5.387sft	88.920sft	TP 08:26:403	
	6.009sft				117.270sft	TP 08:29:363	
✓ 62			3.836sft	7.560sft	116.760sft	TP 08:32:123	
	9.083sft				110.430sft	TP 08:37:053	
✓ 63			4.719sft	11.924sft	111.120sft	TP 08:39:293	
	6.177sft				127.600sft	TP 08:42:043	
✓ 64			5.685sft	12.416sft	126.890sft	TP 08:48:143	
	4.870sft				47.890sft	TP 08:51:233	

✓ 65			4.241sft	13.045sft	47.680sft	TP 08:52:483	
	6.587sft				17.450sft	TP 08:55:213	
✓ 66 = 1860			1.788sft	17.843sft	18.350sft	TP 08:56:273	
✓ 86006	7.151sft			7.930sft	130.020sft	NPS 10:09:223	
✓ 1			2.883sft	12.198sft	129.520sft	TP 10:12:073	
	3.288sft				133.740sft	TP 10:16:283	
✓ 2			5.691sft	9.795sft	134.640sft	TP 10:19:273	
	5.246sft				135.910sft	TP 10:25:303	
✓ FDR1			5.075sft	9.966sft	135.790sft	PKS 10:36:473	
	4.263sft				127.720sft	PKS 10:39:053	
✓ 3			5.213sft	9.016sft	127.480sft	TP 10:41:283	
	5.446sft				126.540sft	TP 10:44:053	
✓ 4			4.593sft	9.870sft	126.220sft	TP 10:47:053	
	5.213sft				141.130sft	TP 10:50:263	
✓ WM1			5.076sft	10.006sft	140.470sft	PKS 10:55:143	
	5.528sft				131.710sft	PKS 10:57:563	
✓ 5			4.877sft	10.657sft	133.060sft	TP 11:00:103	
	5.002sft				131.800sft	TP 11:07:563	
✓ 6			5.391sft	10.268sft	131.320sft	TP 11:11:003	
	4.755sft				132.880sft	TP 11:13:303	
✓ 7			5.625sft	9.399sft	132.620sft	TP 11:16:433	
	5.100sft				18.230sft	TP 11:18:433	
✓ 111* = 11*			5.120sft	9.379sft	19.230sft	PKF 11:19:283	
	5.132sft				127.960sft	PKF 11:26:233	
✓ 12			5.618sft	8.893sft	127.250sft	TP 11:28:403	
	4.849sft				125.030sft	TP 11:31:213	

✓ 13			5.335sft	8.407sft	125.510sft	TP 11:33:523	
	4.971sft				114.490sft	TP 11:37:453	
✓ 14			5.338sft	8.041sft	115.110sft	TP 11:42:393	
	5.565sft				65.060sft	TP 11:46:553	
✓ WW2A			5.827sft	7.778sft	65.290sft	NGS 11:49:233	

Back to top

Leveling Observations

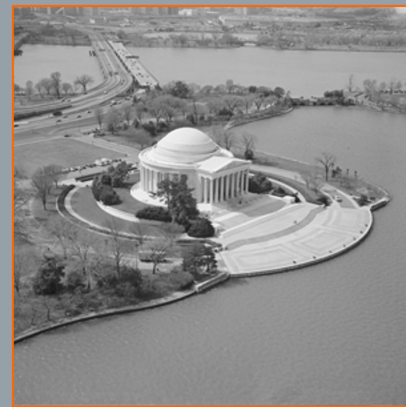
ID	From Pt	To Point	Quality	Δ Elevation
LR1	1860	1		-5.311sft
LR2	1	2		0.386sft
LR3	2	3		1.834sft
LR4	3	4		-1.066sft
LR5	4	5		-0.677sft
LR6	5	6		-0.063sft
LR7	6	7		0.141sft
LR8	7	8		-2.180sft
LR9	8	9		-0.046sft
LR10	9	10		-0.753sft
LR11	10	11		-0.723sft
LR12	11	12		0.572sft
LR13	12	13		-1.620sft
LR14	13	WW2		-0.551sft
LR15	WW2	10		-0.039sft
LR16	10	11		1.101sft
LR17	11	83022		3.537sft

LR18	83022	1845		1.240sft
LR19	1845	14		1.905sft
LR20	14	1844		1.179sft
LR21	1844	16		-0.036sft
LR22	16	17		1.974sft
LR23	17	18		0.811sft
LR24	18	19		0.511sft
LR25	19	20		0.644sft
LR26	20	21		0.562sft
LR27	21	22		-1.832sft
LR28	22	23		-0.598sft
LR29	23	24		-5.400sft
LR30	24	25		-2.496sft
LR31	25	83001		-0.291sft
LR32	83001	27		4.390sft
LR33	27	28		5.057sft
LR34	28	29		-1.158sft
LR35	29	30		1.969sft
LR36	30	31		-0.122sft
LR37	31	32		-0.005sft
LR38	32	33		-0.720sft
LR39	33	34		-0.993sft
LR40	34	35		-0.943sft
LR41	35	36		-2.940sft
LR42	36	37		-8.256sft
LR43	37	38		-0.553sft
LR44	38	86023		0.014sft
LR45	86023	14422		-0.366sft
LR46	14422	86024		0.011sft

LR47	86024	39		0.236sft
LR48	39	40		0.740sft
LR49	40	86025		0.961sft
LR50	86025	41		-1.344sft
LR51	41	86026		-0.566sft
LR52	86026	41		3.967sft
LR53	41	42		4.084sft
LR54	42	43		-2.756sft
LR55	43	86007		-6.182sft
LR56	86007	44		8.106sft
LR57	44	2009		-1.097sft
LR58	2009	45		-1.204sft
LR59	45	46		-0.966sft
LR60	46	47		-0.261sft
LR61	47	48		0.015sft
LR62	48	49		0.219sft
LR63	49	89002		0.278sft
LR64	89002	50		2.133sft
LR65	50	51		-0.433sft
LR66	51	89003		-0.790sft
LR67	89003	52		-4.156sft
LR68	52	86002		-1.159sft
LR69	86002	53		4.652sft
LR70	53	54		6.361sft
LR71	54	2004		-0.249sft
LR72	2004	55		-6.596sft
LR73	55	56		-1.124sft
LR74	56	57		-0.010sft
LR75	57	58		0.210sft

LR76	58	59		0.348sft
LR77	59	60		0.144sft
LR78	60	86006		-1.570sft
LR79	86006	61		1.519sft
LR80	61	62		0.146sft
LR81	62	63		0.103sft
LR82	63	64		0.403sft
LR83	64	65		-1.441sft
LR84	65	NO1		-4.906sft
LR85	NO1	61		1.632sft
LR86	61	62		2.174sft
LR87	62	63		4.364sft
LR88	63	64		0.492sft
LR89	64	65		0.629sft
LR90	65	66		4.798sft
LR91	86006	1		4.268sft
LR92	1	2		-2.404sft
LR93	2	FDR1		0.171sft
LR94	FDR1	3		-0.950sft
LR95	3	4		0.854sft
LR96	4	WM1		0.137sft
LR97	WM1	5		0.651sft
LR98	5	6		-0.389sft
LR99	6	7		-0.869sft
LR100	7	111		-0.020sft
LR101	111	12		-0.486sft
LR102	12	13		-0.486sft
LR103	13	14		-0.367sft
LR104	14	WW2A		-0.263sft

Back to top



APPENDIX E

LABORATORY TEST DATA

APPENDIX E

Laboratory Test Data

Laboratory Test Data, SEI 2006-2007
Laboratory Test Data, SEA 1992
Laboratory Test Data, Storch Engineers, 1965

Laboratory Test Data, SEI 2006-2007

Boring No.	Sample Depth (ft) / Elevation	Sample Type	Description of Soil Specimen	Stratum	Atterberg Limits LL	PL	PI	Natural Moisture (%)	% Passing No. 200 Sieve	Remarks
JMI-01	7.5-9.0 -1.0--2.5	Jar	SANDY LEAN CLAY, dark brown (CL)	A2	30	16	14	24.1		
JMI-01	18.5-20.0 -12.0--13.5	Jar	LEAN CLAY, brown (CL)	A2	32	14	18	26.1		
JMI-01	23.5-25.0 -17.0--18.5	Jar	SANDY ELASTIC SILT, black (MH)	B2	77	37	40	53.3		
JMI-01	33.5-35.0 -27.0--28.5	Jar	Poorly graded SAND WITH SILT, dark brown (SP-SM)	B1				26.3	5	
JMI-01	43.5-45.0 -37.0--38.5	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	83	50	33	56.7		
JMI-01	48.5-50.0 -42.0--43.5	Jar	FAT CLAY WITH SAND, dark brown (CH)	B2	91	33	58	65.7		
JMI-01	53.5-55.0 -47.0--48.5	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	93	43	50	69.5		
JMI-01	63.5-65.0 -57.0--58.5	Jar	SANDY FAT CLAY, dark gray (CH)	B2	98	37	61	75.5		

Notes:
1. Soil tests were performed in accordance with applicable ASTM Standards.
2. Soil classifications are in accordance with ASTM D2487, based on testing indicated and visual identification.
3. Key to abbreviations: LL=Liquid Limit; PL=Plastic Limit; PI=Plasticity Index; NP=Non-Plastic.
4. Soil tests were conducted by: KA.

Schnabel
Schnabel Engineering

SUMMARY OF SOIL LABORATORY TESTS

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring No.	Sample Depth (ft) / Elevation	Sample Type	Description of Soil Specimen	Stratum	Atterberg Limits LL	PL	PI	Natural Moisture (%)	% Passing No. 200 Sieve	Remarks
JMI-01	73.5-75.0 / -67.0--68.5	Jar	SILTY SAND, gray-brown (SM)	B1	24	21	3	23.5		
JMI-01	83.5-85.0 / -77.0--78.5	Jar	SANDY SILT, dark brown (ML)	B2	42	33	9	32.2	50	
JMI-02	28.0-30.0 / -21.1--23.1	Jar	SANDY FAT CLAY, dark brown (CH)	B2	92	35	57	50.5		
JMI-02	33.5-35.5 / -26.6--28.6	Jar	SANDY FAT CLAY, dark brown (CH)	B2	96	35	61	55.9		
JMI-02	38.5-40.0 / -31.6--33.1	Jar	SANDY FAT CLAY, dark gray (CH)	B2	64	30	34	44.1		
JMI-02	43.5-45.0 / -36.6--38.1	Jar	SILTY SAND, dark brown (SM)	B1				27.5	26	
JMI-02	48.5-50.0 / -41.6--43.1	Jar	SANDY FAT CLAY, dark gray (CH)	B2	99	38	61	49.7		
JMI-02	53.5-55.0 / -46.6--48.1	Jar	SANDY ELASTIC SILT, black (MH)	B2	108	58	50	66.6		

Notes:
1. Soil tests were performed in accordance with applicable ASTM Standards.
2. Soil classifications are in accordance with ASTM D2487, based on testing indicated and visual identification.
3. Key to abbreviations: LL=Liquid Limit; PL=Plastic Limit; PI=Plasticity Index; NP=Non-Plastic.
4. Soil tests were conducted by: KA.

Schnabel
Schnabel Engineering

SUMMARY OF SOIL LABORATORY TESTS

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring No.	Sample Depth (ft) / Elevation	Sample Type	Description of Soil Specimen	Stratum	Atterberg Limits LL	PL	PI	Natural Moisture (%)	% Passing No. 200 Sieve	Remarks
JMI-02	58.5-60.0 / -51.6--53.1	Jar	SANDY FAT CLAY, dark gray (CH)	B2	90	34	56	65.2		
JMI-02	63.5-65.0 / -56.6--58.1	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	95	42	53	60.9		
JMI-02	68.5-70.0 / -61.6--63.1	Jar	SANDY ELASTIC SILT, dark brown (MH)	B2	79	36	43	58.6		
JMI-03	18.5-20.0 / -11.7--13.2	Jar	SANDY SILT, dark brown (ML)	B2	41	31	10	40.1		
JMI-03	28.5-30.0 / -21.7--23.2	Jar	SILTY SAND, dark brown (SM)	B1	47	38	9	43.7		
JMI-03	38.5-40.0 / -31.7--33.2	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	64	47	17	48.5		
JMI-03	43.5-45.0 / -36.7--38.2	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	75	58	17	49.5		
JMI-03	58.5-60.0 / -51.7--53.2	Jar	ELASTIC SILT, dark gray (MH)	B2	82	42	40	54.5		

Notes:
1. Soil tests were performed in accordance with applicable ASTM Standards.
2. Soil classifications are in accordance with ASTM D2487, based on testing indicated and visual identification.
3. Key to abbreviations: LL=Liquid Limit; PL=Plastic Limit; PI=Plasticity Index; NP=Non-Plastic.
4. Soil tests were conducted by: KA.

Schnabel Engineering

SUMMARY OF SOIL LABORATORY TESTS

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring No.	Sample Depth (ft) / Elevation	Sample Type	Description of Soil Specimen	Stratum	Atterberg Limits LL	PL	PI	Natural Moisture (%)	% Passing No. 200 Sieve	Remarks
JMI-03	68.5-70.0 -61.7--63.2	Jar	FAT CLAY, dark gray (CH)	B2	80	31	49	45.7		
JMI-03	78.5-80.0 -71.7--73.2	Jar	SANDY SILT, trace cemented sand, dark gray (ML)	B2				27.4	68	
JMI-03	88.5-90.0 -81.7--83.2	Jar	Poorly graded gravel sized ROCK FRAGMENTS WITH SILT AND SAND (schist), dark green (GP-GM)	C				15.2	12	
JMTB-02	13.5-15.0 -5.5--7.0	Jar	FAT CLAY, dark brown (CH)	B2	83	35	48	64.7		
JMW-01	13.5-15.0 -6.2--7.7	Jar	SILTY SAND, trace gravel, rock fragments and brick, brown (SM)	A1				19.8	38	
JMW-01	23.5-25.0 -16.2--17.7	Jar	SANDY ELASTIC SILT, dark brown (MH)	B2	64	32	32	40.2		
JMW-01	33.5-35.0 -26.2--27.7	Jar	SANDY FAT CLAY with shells, dark gray (CH)	B2	70	27	43	48.6		
JMW-01	48.5-50.0 -41.2--42.7	Jar	Poorly graded SAND WITH SILT, dark brown (SP-SM)	B1				26.6	7	

Notes:
1. Soil tests were performed in accordance with applicable ASTM Standards.
2. Soil classifications are in accordance with ASTM D2487, based on testing indicated and visual identification.
3. Key to abbreviations: LL=Liquid Limit; PL=Plastic Limit; PI=Plasticity Index; NP=Non-Plastic.
4. Soil tests were conducted by: KA.

Schnabel Engineering

SUMMARY OF SOIL LABORATORY TESTS

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring No.	Sample Depth (ft) / Elevation	Sample Type	Description of Soil Specimen	Stratum	Atterberg Limits LL	PL	PI	Natural Moisture (%)	% Passing No. 200 Sieve	Remarks
JMW-01	53.5-55.0 / -46.2--47.7	Jar	ELASTIC SILT, dark gray (MH)	B2	84	40	44	56.3		
JMW-02	8.0-10.0 / 0.0--2.0	Jar	FAT CLAY, trace sand, dark brown (CH)	B2	83	36	47	67.9		
JMW-02	18.0-20.0 / -10.0--12.0	Jar	SANDY SILT, trace sand, dark brown (ML)	B2	43	32	11	35.1		
JMW-02	24.0-26.0 / -16.0--18.0	Jar	SANDY ELASTIC SILT, dark brown (MH)	B2				37.1	66	
JMW-02	33.5-35.0 / -25.5--27.0	Jar	SANDY ELASTIC SILT, dark brown (MH)	B2	101	60	41	71.2		
JMW-02	38.5-40.0 / -30.5--32.0	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	69	41	28	46.5		
JMW-03A	8.5-10.0 / 0.4--1.1	Jar	SILTY SAND, trace gravel and root fragments, contains brick fragments, dark brown (SM)	A1				18.4	42	
JMW-03A	23.5-25.0 / -14.6--16.1	Jar	FAT CLAY, trace gravel and root fragments, gray-brown (CH)	B2	51	22	29	49.3		

Notes:
1. Soil tests were performed in accordance with applicable ASTM Standards.
2. Soil classifications are in accordance with ASTM D2487, based on testing indicated and visual identification.
3. Key to abbreviations: LL=Liquid Limit; PL=Plastic Limit; PI=Plasticity Index; NP=Non-Plastic.
4. Soil tests were conducted by: KA.

Schnabel
Schnabel Engineering

SUMMARY OF SOIL LABORATORY TESTS

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

Boring No.	Sample Depth (ft) / Elevation	Sample Type	Description of Soil Specimen	Stratum	Atterberg Limits LL	PL	PI	Natural Moisture (%)	% Passing No. 200 Sieve	Remarks
JMW-03A	38.5-40.0 -29.6--31.1	Jar	SANDY FAT CLAY, black (CH)	B2	76	30	46	52.0		
JMW-03A	48.5-50.0 -39.6--41.1	Jar	SANDY ELASTIC SILT, black (MH)	B2	77	42	35	40.6		
JMW-03A	63.5-65.0 -54.6--56.1	Jar	SANDY ELASTIC SILT, dark gray (MH)	B2	81	40	41	63.7		
JMW-03A	78.5-80.0 -69.6--71.1	Jar	SANDY SILT, black (ML)	B1				57.7	52	

Notes:
1. Soil tests were performed in accordance with applicable ASTM Standards.
2. Soil classifications are in accordance with ASTM D2487, based on testing indicated and visual identification.
3. Key to abbreviations: LL=Liquid Limit; PL=Plastic Limit; PI=Plasticity Index; NP=Non-Plastic.
4. Soil tests were conducted by: KA.

Schnabel Engineering

SUMMARY OF SOIL LABORATORY TESTS

Project: JEFFERSON MEMORIAL
WEST POTOMAC PARK
WASHINGTON, DC

LAB TESTING RESULTS

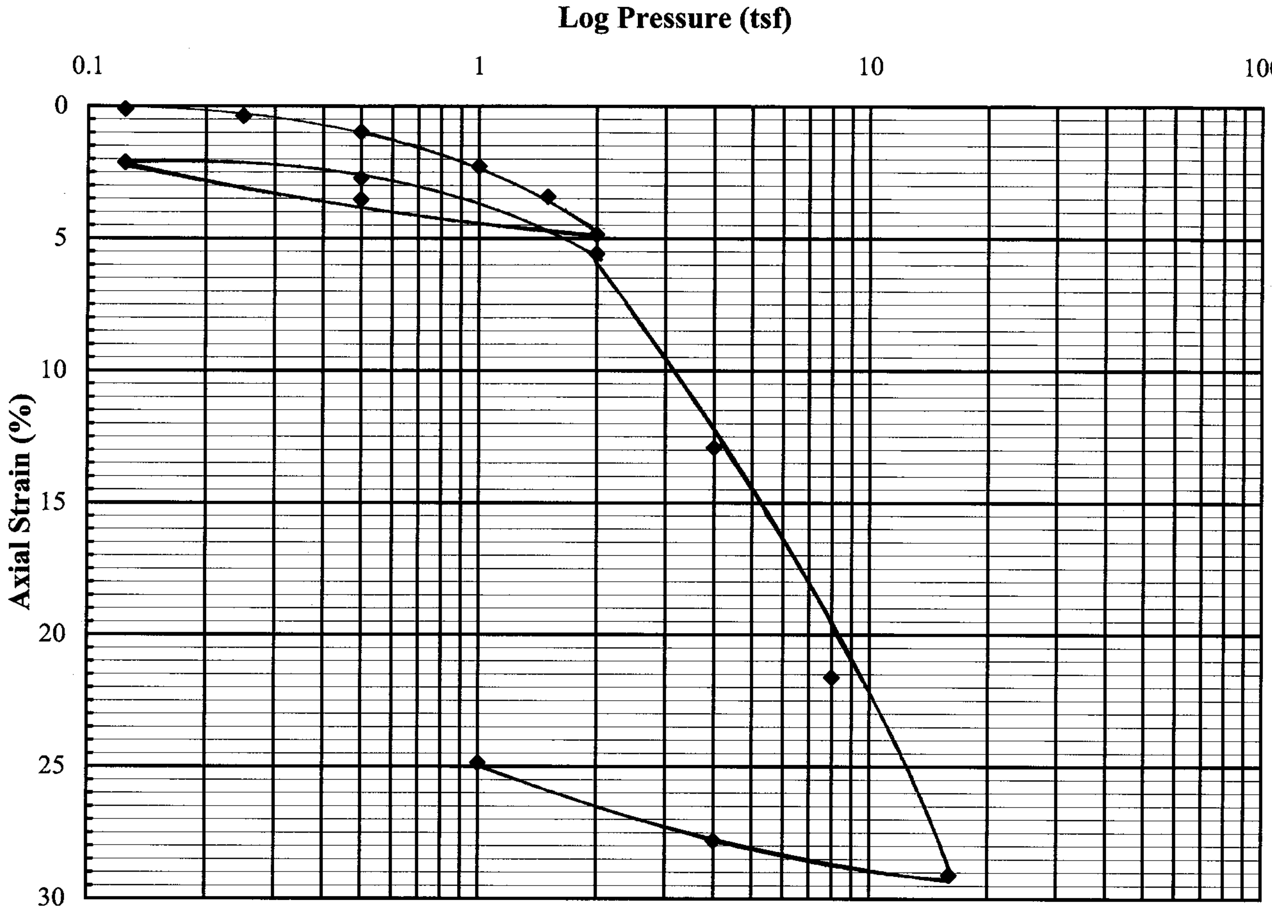
SEI Project: 06150078

Jefferson Memorial Settlement Study
Washington, D.C.

TUBE SAMPLES

BORING NO.	SAMPLE DEPTH (ft)	SAMPLE TYPE	WET NAT DEN (pcf)	W (%)	DESCRIPTION OF SOIL SPECIMEN (USCS)	ATTERBERG LIMITS			SIEVES		STRENGTH TESTS					REMARKS
						LL	PL	PI	% PASS. No. 200	% RET. No. 4	q_u	UU	CU	CD	DS	
JMI-02	61-63	Tube	97.6	62.5	ORGANIC SILT (OH), trace sand - gray brown	73	37	36	96.7	0.0		X				See consolidation report. Gs = 2.61 LL_{oven} = 50
JMI-03	35-37	Tube	105.5	37.3	SILT with sand (ML) - gray brown	45	30	15	76.3	0.0		X				See consolidation report. Gs = 2.65 LL_{oven} = 38
JMW-01	20-22	Tube	118.2	42.2	LEAN CLAY (CL), trace sand - gray brown	40	24	16	97.7	0.0		X				See consolidation report. Gs = 2.71 LL_{oven} = 43

NOTES:
1. Soil tests are in general accordance with applicable ASTM standards.
2. Soil classification symbols are in general accordance with Unified Soil Classification System, based on testing indicated and visual identification
3. Key to abbreviation: LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; NP = Nonplastic; NA = Not Assigned



Probable Preconsolidation Pressure (Pp), tsf:	*1.7*
Type of Specimen:	*Tube Sample*
Description:	*ORGANIC SILT (OH), trace sand - gray brown*

LL:	*73*	**PI:**	*36*	**Gs:**	*2.61*	**P_o' (tsf):**	*1.70*
% < No. 200:	*96.7*	**Test Method:**	*ASTM D2435 Method A*				
Test Condition:	*Inundated @ 0.05 tsf*						

Remarks: *Oven-dried Liquid Limit = 50*

Recompression Ratio (Cεr):	*0.035*
Compression Ratio (Cεc):	*0.249*

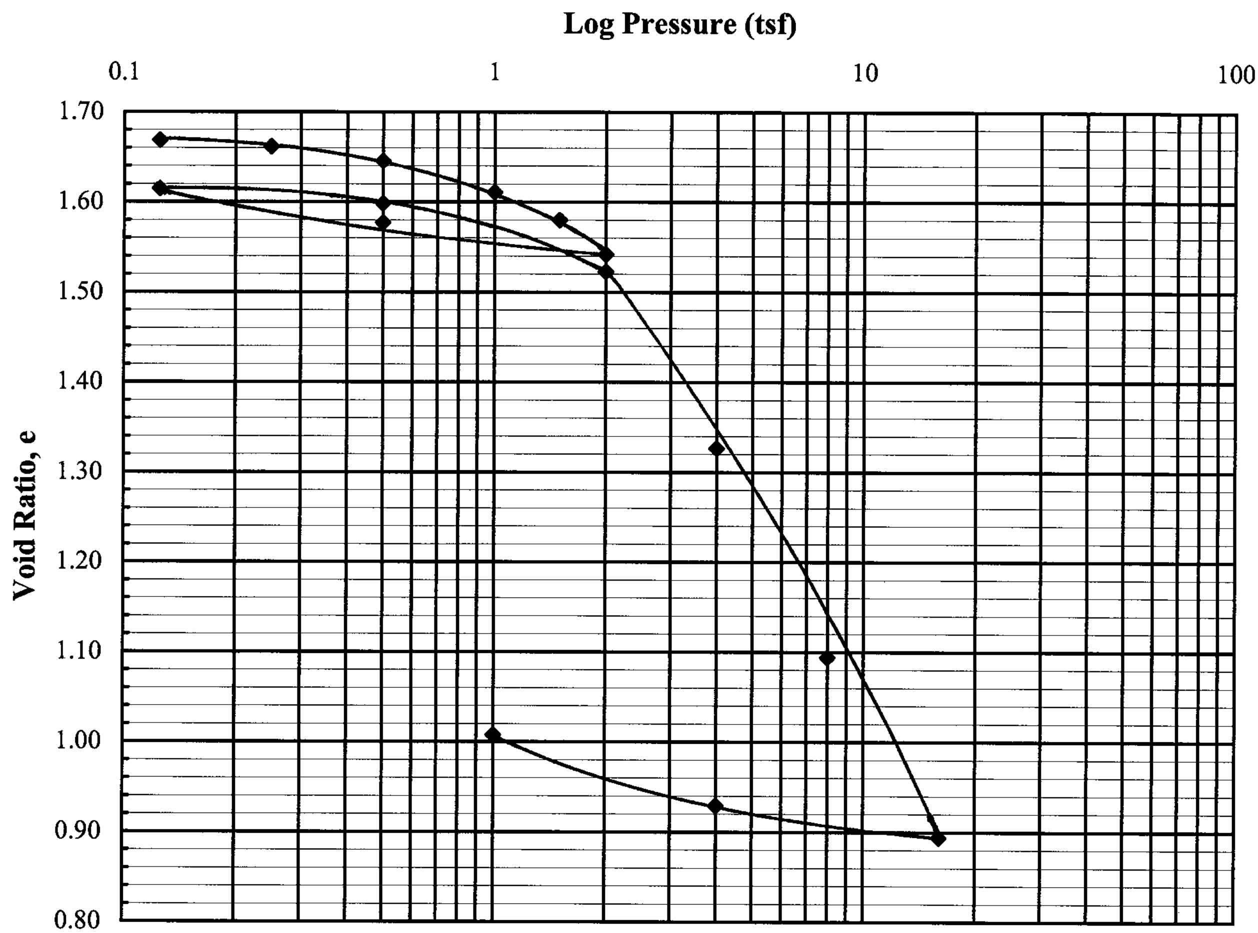
	Initial	Final
Water Content, %	*61.8*	*42.3*
Void Ratio	*1.67*	*1.01*
Saturation, %	*97*	*100*
Dry Unit Weight, pcf	*60.9*	*81.1*

Project: Jefferson Memorial Settlement Study

Location:	*Washington, D.C.*		
Boring:	*JMI-02*	**Schnabel No.:**	*06150078*
Depth:	*61-63 ft.*	**Elevation:**	*-54.1 to -55.7*
Date:	*2/7/2007*	**Reviewed by:**	*CJS*

Schnabel
Schnabel Engineering

Consolidation Test Report



Probable Preconsolidation Pressure (Pp'), tsf:	*1.7*	**Recompression Index (Cr):**	*0.094*
Type of Specimen:	*Tube Sample*	**Compression Index (Cc):**	*0.664*

Description: *ORGANIC SILT (OH), trace sand - gray brown*

LL:	*73*	**PI:**	*36*	**Gs:**	*2.61*	**P_o' (tsf):**	*1.70*
% < No. 200:	*96.7*	**Test Method:**	*ASTM D2435 Method A*				
Test Condition:	*Inundated @ 0.05 tsf*						

	Initial	Final
Water Content, %	*61.8*	*42.3*
Void Ratio	*1.67*	*1.01*
Saturation, %	*97*	*100*
Dry Unit Weight, pcf	*60.9*	*81.1*

Remarks: *Oven-dried Liquid Limit = 50*

Project: Jefferson Memorial Settlement Study

Location:	*Washington, D.C.*		
Boring:	*JMI-02*	**Schnabel No.:**	*06150078*
Depth:	*61-63 ft.*	**Elevation:**	*-54.1 to -55.7*
Date:	*2/7/2007*	**Reviewed by:**	*CJS*

Schnabel Engineering

Consolidation Test Report

Consolidation Test Data Sheet

Consolidometer ID: 3 2/7/07

Schnabel Contract: *06150078*

Test Method: *ASTM D2435 Method A*

Project: *Jefferson Memorial Settlement Study*

Test Condition: *Inundated @ 0.05 tsf*

Initial Height of Specimen (H_o), in.: 0.7478

Boring No.: *JMI-02*

Height of Solids (H_s), in.: 0.2799

Depth: *61-63 ft.*

Seating Press. (tsf): 0.05

Initial Dial Gauge Reading (D_o), in.: -0.0001

Reviewed by: CJS

Pressure, P (tsf)	TimeReadings Required	Date Load Applied	Time Load Applied	Load Applied By	A: Final[1] Dial Reading, D_{fi} x 10^{-4} in.	B: Apparatus Correction[2], D_{ci} x 10^{-4} in.	C: Cumulative Change in Height[3], ΔH_i in.	D: Height of Voids[4], H_{vi} in.	Vertical Strain[5], ε_i (%)	Void Ratio[6], e_i
0.125		12/28/2006	9:10	DWC	1	-6	0.0008	0.4671	0.11	1.669
0.25		12/29/2006	9:10	DWC	25	-2	0.0028	0.4651	0.37	1.661
0.5		12/30/2006	9:10	DWC	78	6	0.0073	0.4606	0.98	1.645
1		1/2/2007	9:10	DWC	182	13	0.0170	0.4509	2.27	1.611
1.5		1/3/2007	9:10	DWC	272	17	0.0256	0.4423	3.42	1.580
2		1/4/2007	9:10	DWC	382	20	0.0363	0.4316	4.85	1.542
0.5		1/5/2007	9:10	DWC	269	6	0.0264	0.4415	3.53	1.577
0.125		1/6/2007	9:10	CJS	152	-6	0.0159	0.4520	2.13	1.615
0.5		1/8/2007	9:10	DWC	209	6	0.0204	0.4475	2.73	1.599
2		1/9/2007	9:10	DWC	436	20	0.0417	0.4262	5.58	1.522
4		1/10/2007	9:10	DWC	992	27	0.0966	0.3713	12.92	1.326
8		1/11/2007	9:10	DWC	1652	36	0.1617	0.3062	21.62	1.094
16		1/12/2007	9:10	DWC	2220	44	0.2177	0.2502	29.11	0.894
4		1/15/2007	9:10	DWC	2105	27	0.2079	0.2600	27.80	0.929
1		1/16/2007	9:10	DWC	1871	13	0.1859	0.2820	24.86	1.007

Notes:
1 "Final" based on test method; 24 hrs for Method A, end of primary for Method B.
2 Correction value, for the current pressure, from the consolidometer's calibration curve.
3 $\Delta H = D_{fi} - D_o - D_{ci}$ = Col. A - D_o - Col. B
4 $H_{vi} = (H_o - H_s) - \Delta H$
5 $\varepsilon_i = (\Delta H / H_o) \times 100$ = (Col. C / H_o) x 100
6 $e_i = H_{vi} / Hs$ = Col. D / Hs

Load Time Readings

2/7/07

Schnabel Engineering

Project: Jefferson Memorial Settlement Study
Schnabel Contract: 06150078
Boring No.: JMI-02 Depth: 61-63 ft.
Reviewed by: CJS

Consol. ID: 3

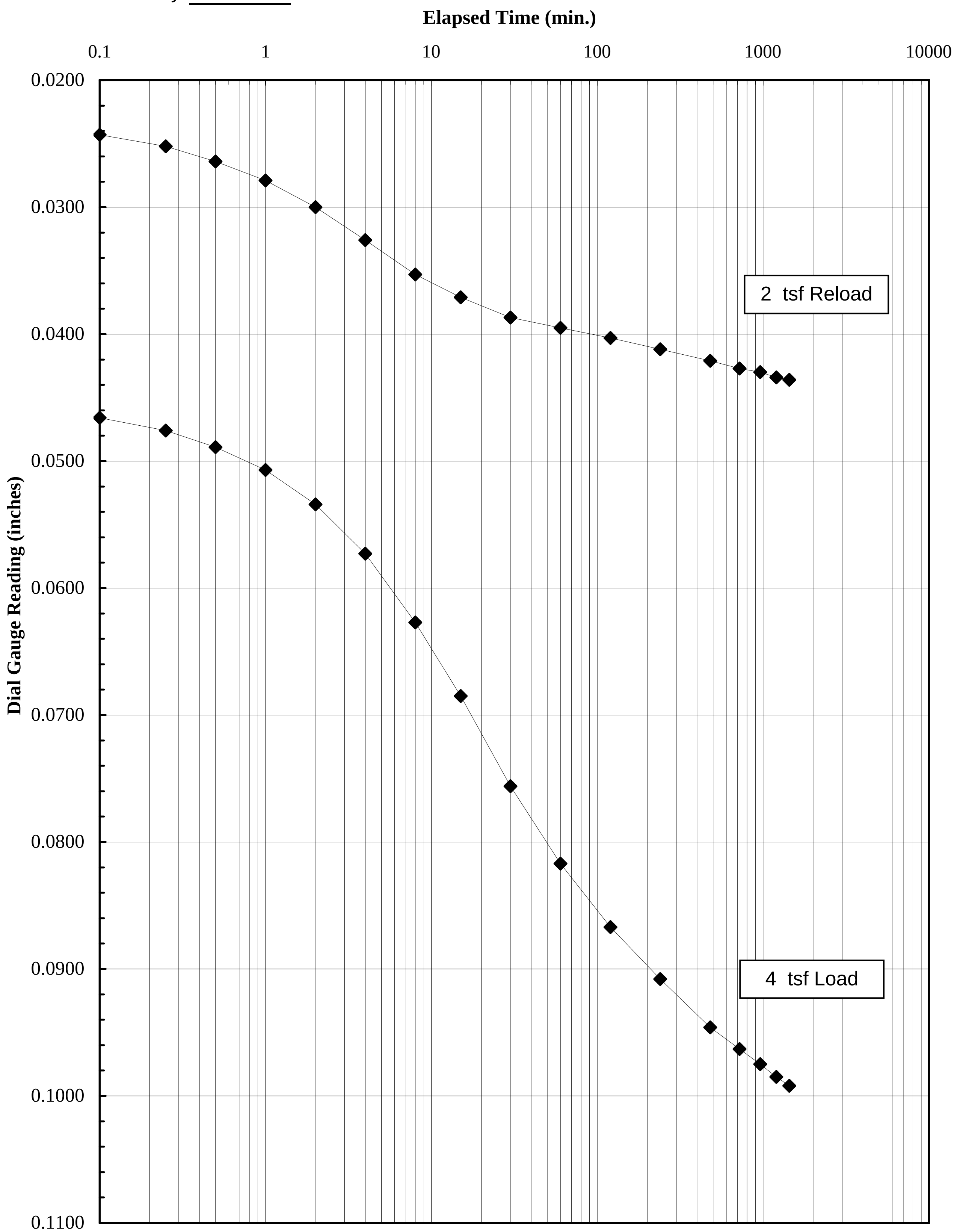
Elapsed Time (min.)	Dial Guage Readings (inches)					
	2 tsf Reload 1/9/2007	4 tsf Load 1/10/2007	X tsf Load Date	X tsf Load Date	X tsf Load Date	X tsf Load Date
0.1	0.0243	0.0466				
0.25	0.0252	0.0476				
0.5	0.0264	0.0489				
1	0.0279	0.0507				
2	0.0300	0.0534				
4	0.0326	0.0573				
8	0.0353	0.0627				
15	0.0371	0.0685				
30	0.0387	0.0756				
60	0.0395	0.0817				
120	0.0403	0.0867				
240	0.0412	0.0908				
480	0.0421	0.0946				
720	0.0427	0.0963				
960	0.0430	0.0975				
1200	0.0434	0.0985				
1440	0.0436	0.0992				
1680						
1920						
2160						
2400						
2640						
2880						

Consolidation Time Curves

2/7/07

Project: Jefferson Memorial Settlement Study
Schnabel Contract: 06150078
Boring No.: JMI-02 Depth: 61-63 ft.

Reviewed by: CJS



Schnabel Engineering

Unconsolidated Undrained Triaxial Compression Test   ASTM D2850

Schnabel Contract: *06150078*   Date: *2/7/2007*

Project: *Jefferson Memorial Settlement Study*   Boring No.: *JMI-02*

Depth: *61-63 ft*   Reviewed by: *CJS*

Location: *Washington, D.C.*   Elevation: *-54.1 to -55.7*

Confining Stress (psi) *56.6*

Specimen Conditions	
Diameter (in)	2.876
Height (in)	5.844
Area (in^2)	6.50
Moisture (%):	62.5
Weight (lbs)	2.14
ρ_{wet} (pcf)	97.6
ρ_{dry} (pcf)	60.1
Void Ratio	1.71
Saturation, %	95

Shear Testing Conditions	
Cell Pressure (psi):	56.6
Rate of Strain (%/min):	1.0

Specimen Type: *Tube Sample*

Axial Strain at Failure (%): *10.00*

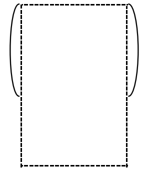
Compressive Strength (psi): *7.2*

Major Principal Stress (psi): *63.8*

Minor Principal Stress (psi): *56.6*

Soil Description: *ORGANIC SILT (OH), trace sand - gray brown*

Failure Sketch



Liquid Limit: *73*

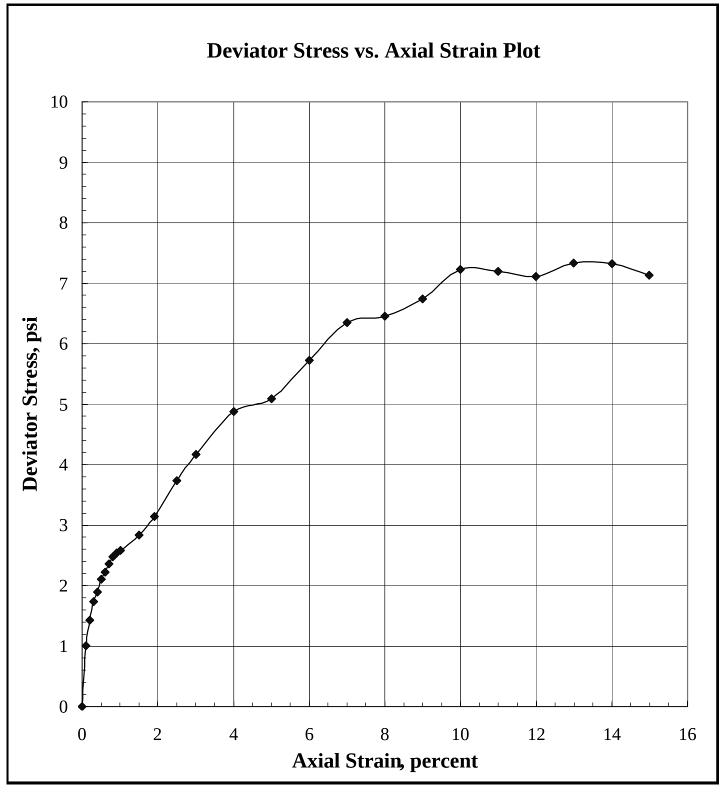
Plasticity Index: *36*

% finer that No. 200: *96.7*

Specific Gravity: *2.61*

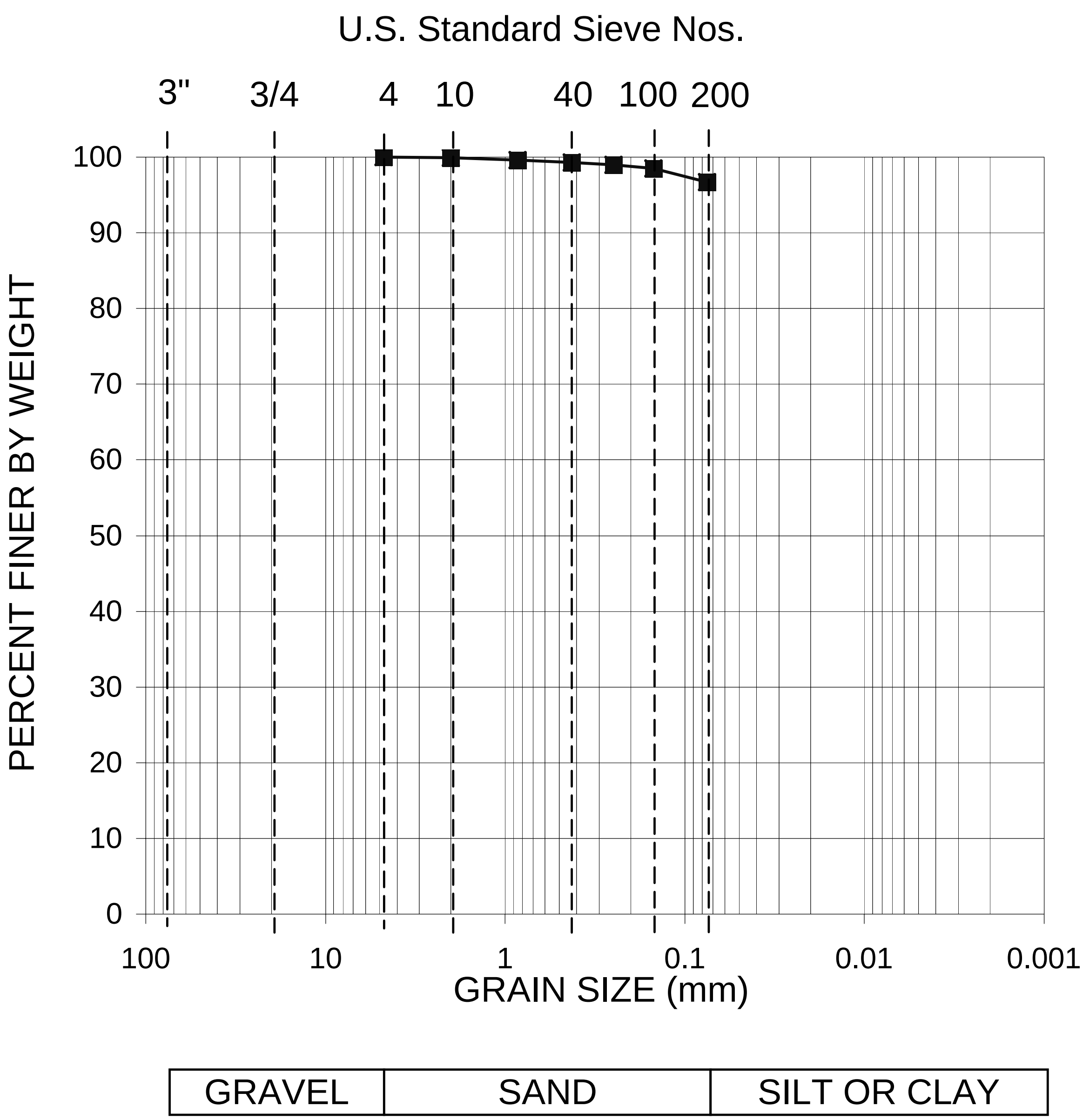
Remarks: *Oven-dried Liquid Limit = 50*

Reading No.	Deviator Load (lbs)	Corrected Dev. Load[1] (lbs.)	Axial Displacement (in.)	Axial Strain (%)	Corrected Area[2] (in^2)	σ_1 (psi)	σ_3 (psi)	Deviator Stress (psi)
Initial	0.0	0.0	0.000	0.00	6.50	56.6	56.6	0.0
1	6.5	6.5	0.006	0.11	6.50	57.6	56.6	1.0
2	9.4	9.3	0.012	0.21	6.51	58.0	56.6	1.4
3	11.4	11.3	0.018	0.31	6.52	58.3	56.6	1.7
4	12.5	12.4	0.024	0.41	6.52	58.5	56.6	1.9
5	13.9	13.8	0.030	0.51	6.53	58.7	56.6	2.1
6	14.7	14.5	0.036	0.61	6.54	58.8	56.6	2.2
7	15.6	15.4	0.041	0.71	6.54	59.0	56.6	2.4
8	16.4	16.2	0.047	0.81	6.55	59.1	56.6	2.5
9	16.8	16.6	0.053	0.91	6.56	59.1	56.6	2.5
10	17.2	16.9	0.059	1.01	6.56	59.2	56.6	2.6
11	19.0	18.7	0.088	1.51	6.60	59.4	56.6	2.8
12	21.2	20.8	0.111	1.91	6.62	59.7	56.6	3.1
13	25.4	24.9	0.146	2.51	6.66	60.3	56.6	3.7
14	28.6	27.9	0.176	3.01	6.70	60.8	56.6	4.2
15	33.9	33.0	0.234	4.00	6.77	61.5	56.6	4.9
16	35.9	34.8	0.292	5.00	6.84	61.7	56.6	5.1
17	40.9	39.6	0.351	6.00	6.91	62.3	56.6	5.7
18	45.9	44.4	0.409	7.00	6.99	63.0	56.6	6.4
19	47.3	45.5	0.468	8.00	7.06	63.1	56.6	6.5
20	50.1	48.1	0.526	9.00	7.14	63.3	56.6	6.7
21	54.3	52.1	0.584	10.00	7.22	63.8	56.6	7.2
22	54.9	52.5	0.643	11.00	7.30	63.8	56.6	7.2
23	55.1	52.5	0.701	11.99	7.38	63.7	56.6	7.1
24	57.6	54.8	0.759	12.99	7.47	63.9	56.6	7.3
25	58.4	55.3	0.819	14.01	7.56	63.9	56.6	7.3
26	57.7	54.5	0.876	14.99	7.64	63.7	56.6	7.1



Notes: 1. Deviator load corrected for membrane effects.

2. Right Cylinder Correction Method



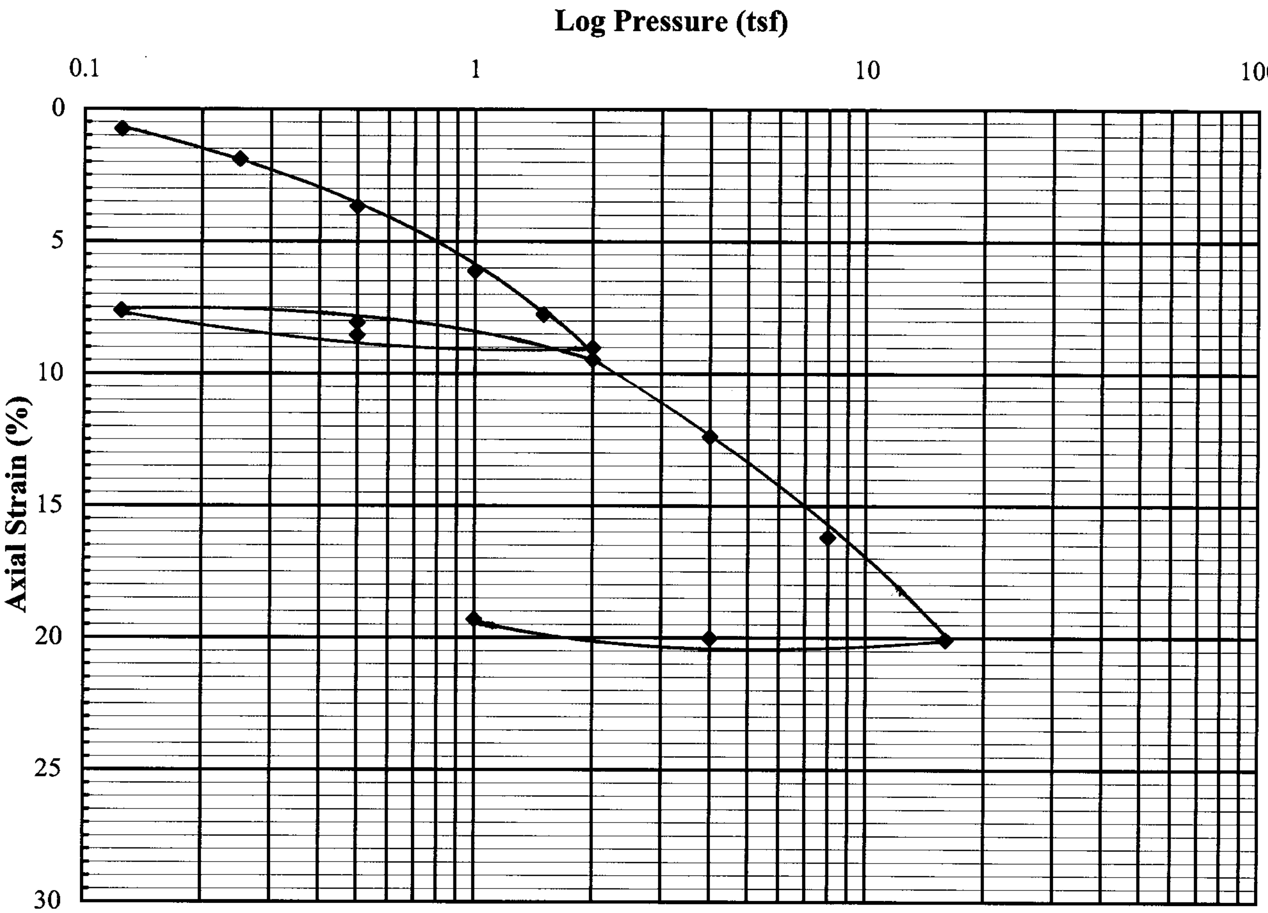
Key	Sample	Depth(ft.)	Sample Description	Class.	LL	PI
■	JMI-02	61-63	ORGANIC SILT, trace sand - gray brown	OH	73	36
			$LL_{oven\text{-}dried} = 50$			

Schnabel
Schnabel Engineering

GRADATION CURVES

Project:
Jefferson Memorial
Settlement Study

Contract No. 06150078



Probable Preconsolidation Pressure (Pp), tsf:			*1.5*	**Recompression Ratio (Cεr):**		*0.006*	
Type of Specimen:	*Tube Sample*			**Compression Ratio (Cεc):**		*0.128*	
Description:	*SILT with sand (ML) - gray brown*				**Initial**	**Final**	
				Water Content, %	*36.1*	*24.9*	
LL: *45*	**PI:** *15*	**Gs:** *2.65*	**P$_o$' (tsf):** *1.10*	**Void Ratio**	*1.02*	*0.63*	
% < No. 200: *76.3*		**Test Method:** *ASTM D2435 Method A*		**Saturation, %**	*94*	*100*	
Test Condition: *Inundated @ 0.05tsf*				**Dry Unit Weight, pcf**	*81.9*	*101.5*	

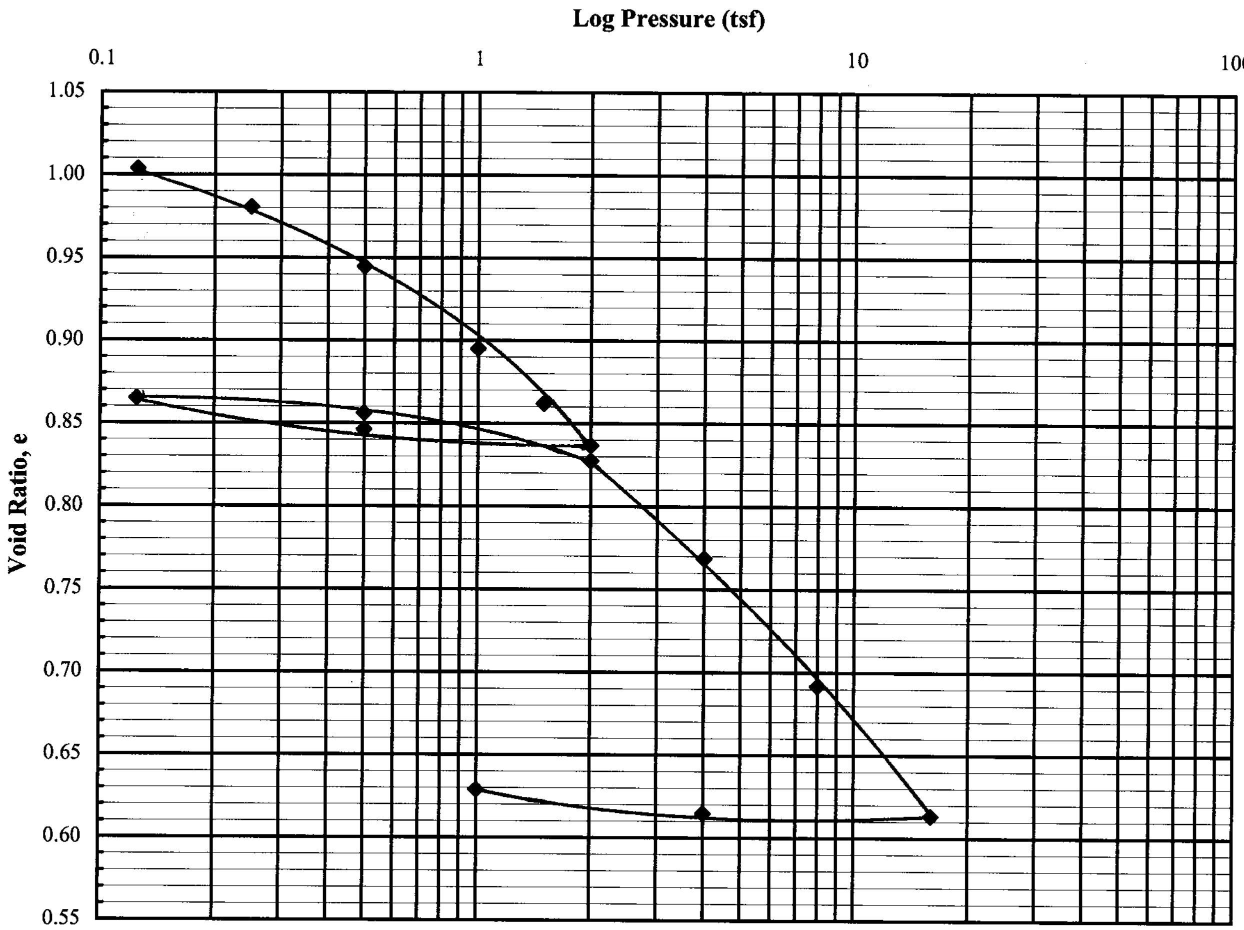
Remarks: *Oven-dried Liquid Limit = 38*

Project: Jeffferson Memorial Settlement Study

Location:	*Washington, D.C.*		
Boring:	*JMI-03*	**Schnabel No.:**	*06150078*
Depth:	*35-37 ft.*	**Elevation:**	*-28.2 to -30.2*
Date:	*2/7/2007*	**Reviewed by:**	*CJS*

Schnabel
Schnabel Engineering

Consolidation Test Report



Probable Preconsolidation Pressure (Pp'), tsf:			*1.5*	**Recompression Index (Cr):**	*0.013*			
Type of Specimen:	*Tube Sample*			**Compression Index (Cc):**	*0.259*			
Description:	*SILT with sand (ML) - gray brown*				**Initial**	**Final**		
LL: *45*	**PI:** *15*	**Gs:** *2.65*	**P_o' (tsf):** *1.10*	**Water Content, %**	*36.1*	*24.9*		
% < No. 200: *76.3*	**Test Method:** *ASTM D2435 Method A*			**Void Ratio**	*1.02*	*0.63*		
				Saturation, %	*94*	*100*		
Test Condition:	*Inundated @ 0.05tsf*			**Dry Unit Weight, pcf**	*81.9*	*101.5*		

Remarks: *Oven-dried Liquid Limit = 38*

Project:	Jeffferson Memorial Settlement Study		
Location:	*Washington, D.C.*		
Boring:	*JMI-03*	**Schnabel No.:**	*06150078*
Depth:	*35-37 ft.*	**Elevation:**	*-28.2 to -30.2*
Date:	*2/7/2007*	**Reviewed by:**	*CJS*

Schnabel
Schnabel Engineering

Consolidation Test Report

Consolidation Test Data Sheet

Consolidometer ID: 2 2/7/07

Schnabel Contract: *06150078*

Test Method: *ASTM D2435 Method A*

Project: *Jeffferson Memorial Settlement Study*

Test Condition: *Inundated @ 0.05tsf*

Initial Height of Specimen (H_o), in.: 0.7459

Boring No.: *JMI-03*

Height of Solids (H_s), in.: 0.3695

Depth: *35-37 ft.*

Seating Press. (tsf): 0.05

Initial Dial Gauge Reading (D_o), in.: 0.0019

Reviewed by: CJS

Pressure, P (tsf)	TimeReadings Required	Date Load Applied	Time Load Applied	Load Applied By	A Final[1] Dial Reading, D_{fi} x 10^{-4} in.	B Apparatus Correction[2], D_{ci} x 10^{-4} in.	C Cumulative Change in Height[3], ΔH_i in.	D Height of Voids[4], H_{vi} in.	Vertical Strain[5], ε_i (%)	Void Ratio[6], e_i
0.125		12/28/2006	9:05	DWC	77	2	0.0056	0.3708	0.75	1.004
0.25		12/29/2006	9:05	DWC	166	6	0.0141	0.3623	1.89	0.981
0.5		12/30/2006	9:05	DWC	304	11	0.0274	0.3490	3.67	0.945
1		1/2/2007	9:05	DWC	491	15	0.0457	0.3307	6.13	0.895
1.5		1/3/2007	9:05	DWC	616	18	0.0579	0.3185	7.76	0.862
2		1/4/2007	9:05	DWC	713	21	0.0673	0.3091	9.02	0.837
0.5		1/5/2007	9:05	DWC	667	11	0.0637	0.3127	8.54	0.846
0.125		1/6/2007	9:05	CJS	589	2	0.0568	0.3196	7.62	0.865
0.5		1/8/2007	9:05	DWC	631	11	0.0601	0.3163	8.06	0.856
2		1/9/2007	9:05	DWC	747	21	0.0707	0.3057	9.48	0.827
4		1/10/2007	9:05	DWC	971	28	0.0924	0.2840	12.39	0.769
8		1/11/2007	9:05	DWC	1263	36	0.1208	0.2556	16.20	0.692
16		1/12/2007	9:05	DWC	1562	45	0.1498	0.2266	20.08	0.613
4		1/15/2007	9:05	DWC	1540	28	0.1493	0.2271	20.02	0.615
1		1/16/2007	9:05	DWC	1474	15	0.1440	0.2324	19.31	0.629

Notes:
1. "Final" based on test method; 24 hrs for Method A, end of primary for Method B.
2. Correction value, for the current pressure, from the consolidometer's calibration curve.
3. $\Delta H = D_{fi} - D_o - D_{ci}$ = Col. A - D_o - Col. B
4. $H_{vi} = (H_o - H_s) - \Delta H$
5. $\varepsilon_i = (\Delta H / H_o) \times 100$ = (Col. C / H_o) x 100
6. $e_i = H_{vi} / Hs$ = Col. D / Hs

Schnabel Engineering

Load Time Readings

2/7/07

Project: Jeffferson Memorial Settlement Study
Schnabel Contract: 06150078
Boring No.: JMI-03   Depth: 35-37 ft.
Consol. ID: 2   Reviewed by: CJS

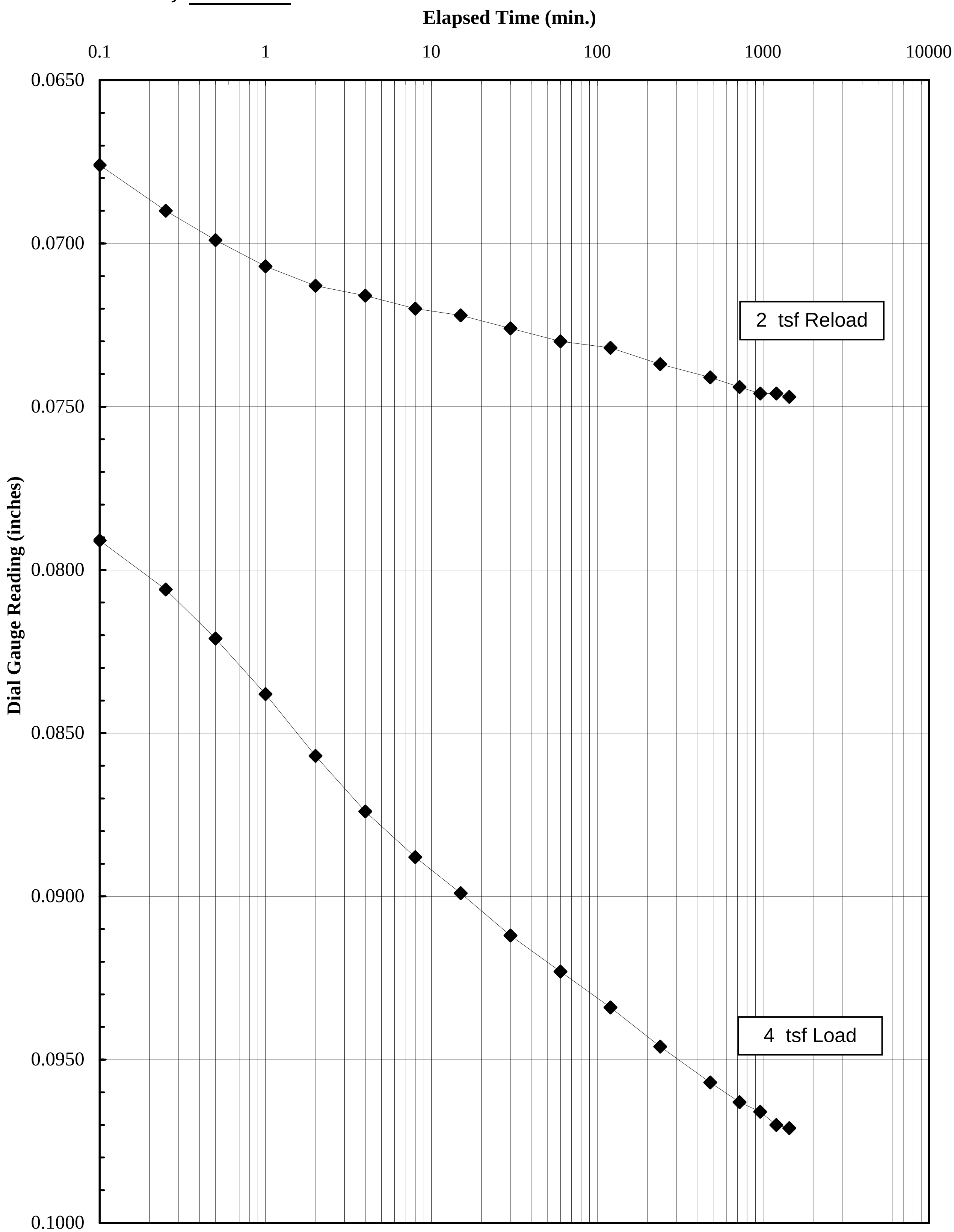
Elapsed Time (min.)	Dial Guage Readings (inches)					
	2 tsf Reload 1/9/2007	4 tsf Load 1/10/2007	X tsf Load Date	X tsf Load Date	X tsf Load Date	X tsf Load Date
0.1	0.0676	0.0791				
0.25	0.0690	0.0806				
0.5	0.0699	0.0821				
1	0.0707	0.0838				
2	0.0713	0.0857				
4	0.0716	0.0874				
8	0.0720	0.0888				
15	0.0722	0.0899				
30	0.0726	0.0912				
60	0.0730	0.0923				
120	0.0732	0.0934				
240	0.0737	0.0946				
480	0.0741	0.0957				
720	0.0744	0.0963				
960	0.0746	0.0966				
1200	0.0746	0.0970				
1440	0.0747	0.0971				
1680						
1920						
2160						
2400						
2640						
2880						

Consolidation Time Curves

2/7/07

Project: Jeffferson Memorial Settlement Study
Schnabel Contract: 06150078
Boring No.: JMI-03 Depth: 35-37 ft.

Reviewed by: CJS



Schnabel Engineering

Unconsolidated Undrained Triaxial Compression Test

ASTM D2850

Project: *Jefferson Memorial Settlement Study*

Location: *Washington, D.C.*

Schnabel Contract: *06150078* Date: *2/7/2007*

Boring No.: *JMI-03*

Depth: *35-37 ft.* Reviewed by: *CJS*

Elevation: *-28.2 to -30.2*

Confining Stress (psi) *32.6*

Specimen Conditions	
Diameter (in)	2.886
Height (in)	5.893
Area (in^2)	6.55
Moisture (%):	37.3
Weight (lbs)	2.36
ρ_{wet} (pcf)	105.5
ρ_{dry} (pcf)	76.9
Void Ratio	1.15
Saturation, %	86

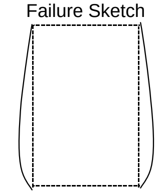
Shear Testing Conditions	
Cell Pressure (psi):	32.6
Rate of Strain (%/min):	1.0

Specimen Type: *Tube Sample*

Axial Strain at Failure (%): *10.00*
Compressive Strength (psi): *3.5*
Major Principal Stress (psi): *36.1*
Minor Principal Stress (psi): *32.6*

Soil Description: *SILT with sand (ML) - gray brown*

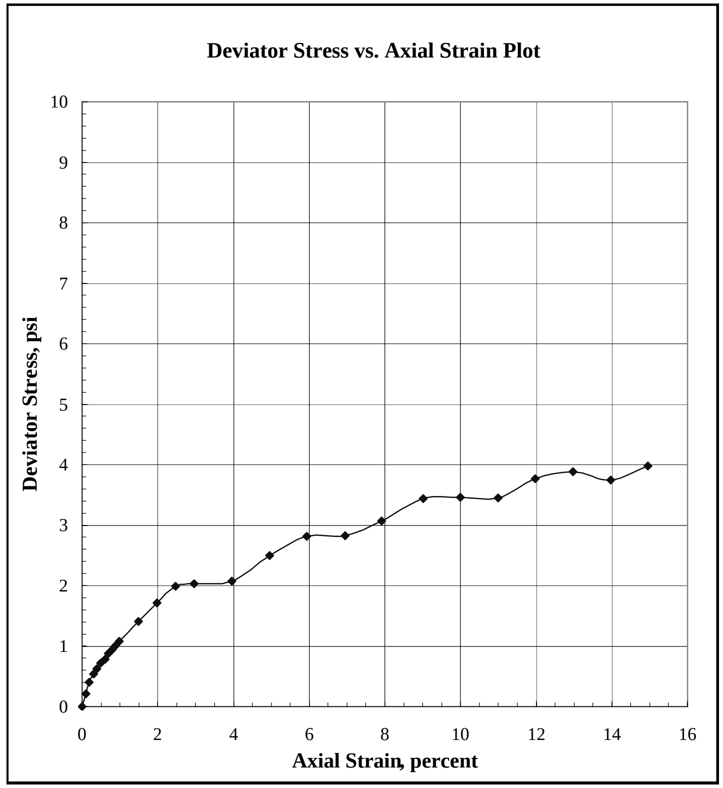
Failure Sketch



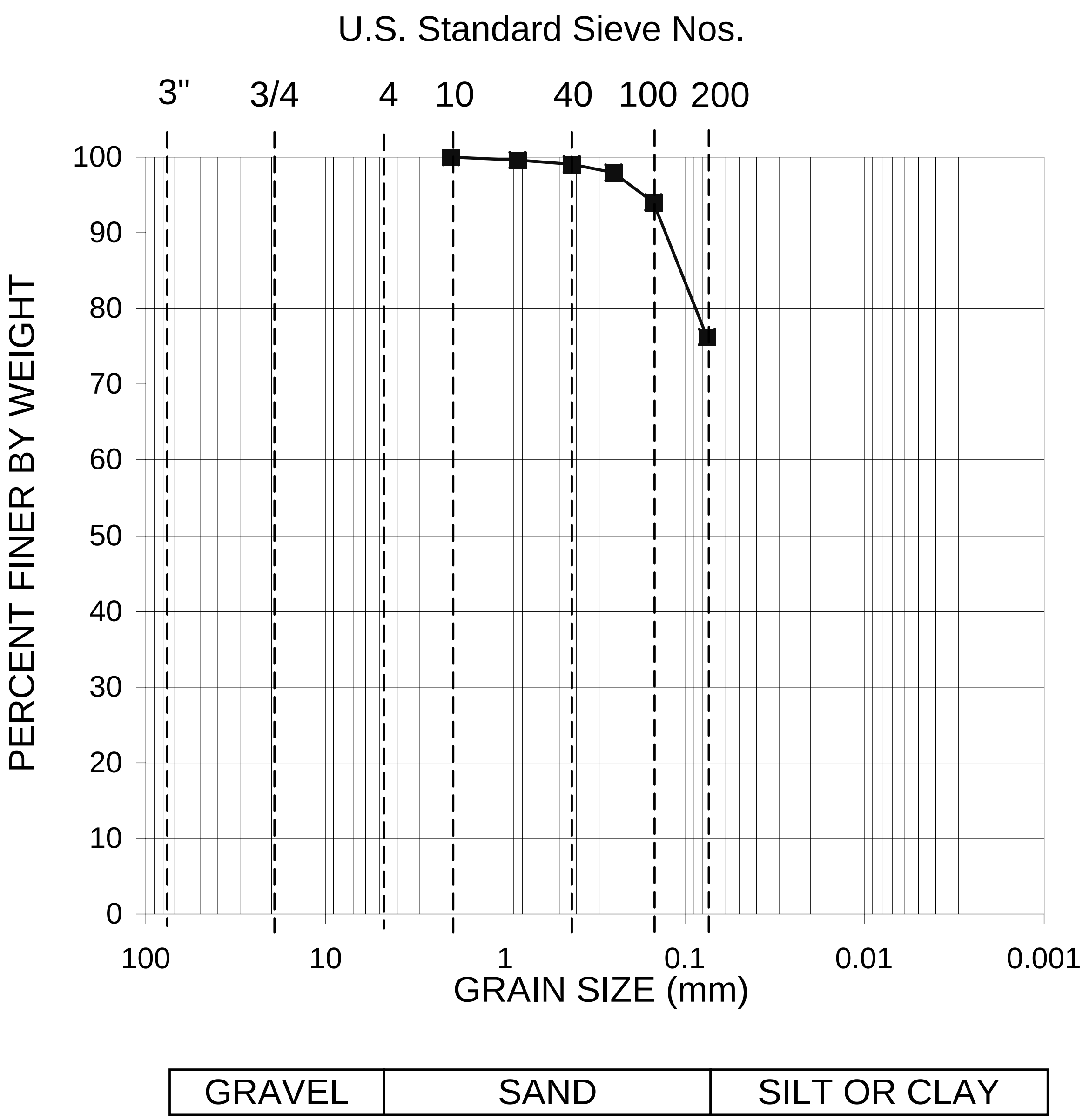
Liquid Limit: *45*
Plasticity Index: *15*
% finer that No. 200: *76.3*
Specific Gravity: *2.65*

Remarks: *Oven-dried Liquid Limit = 38*

Reading No.	Deviator Load (lbs)	Corrected Dev. Load[1] (lbs.)	Axial Displacement (in.)	Axial Strain (%)	Corrected Area[2] (in^2)	σ_1 (psi)	σ_3 (psi)	Deviator Stress (psi)
Initial	0.0	0.0	0.000	0.00	6.55	32.6	32.6	0.0
1	1.4	1.4	0.006	0.09	6.55	32.8	32.6	0.2
2	2.6	2.6	0.011	0.19	6.56	33.0	32.6	0.4
3	3.6	3.5	0.018	0.31	6.57	33.1	32.6	0.5
4	4.2	4.1	0.023	0.39	6.57	33.2	32.6	0.6
5	4.8	4.7	0.029	0.49	6.58	33.3	32.6	0.7
6	5.3	5.2	0.036	0.61	6.59	33.4	32.6	0.8
7	5.9	5.8	0.041	0.69	6.59	33.5	32.6	0.9
8	6.4	6.2	0.046	0.79	6.60	33.5	32.6	0.9
9	6.9	6.7	0.052	0.89	6.60	33.6	32.6	1.0
10	7.3	7.1	0.058	0.98	6.61	33.7	32.6	1.1
11	9.7	9.3	0.087	1.48	6.64	34.0	32.6	1.4
12	11.9	11.4	0.116	1.98	6.68	34.3	32.6	1.7
13	13.9	13.3	0.146	2.47	6.71	34.6	32.6	2.0
14	14.4	13.7	0.175	2.97	6.75	34.6	32.6	2.0
15	15.0	14.1	0.233	3.96	6.81	34.7	32.6	2.1
16	18.3	17.2	0.292	4.95	6.89	35.1	32.6	2.5
17	20.9	19.6	0.350	5.94	6.96	35.4	32.6	2.8
18	21.4	19.9	0.409	6.95	7.03	35.4	32.6	2.8
19	23.6	21.8	0.467	7.92	7.11	35.7	32.6	3.1
20	26.7	24.7	0.531	9.01	7.19	36.0	32.6	3.4
21	27.3	25.1	0.589	10.00	7.27	36.1	32.6	3.5
22	27.8	25.4	0.648	10.99	7.35	36.1	32.6	3.5
23	30.6	28.0	0.706	11.98	7.44	36.4	32.6	3.8
24	32.0	29.2	0.764	12.97	7.52	36.5	32.6	3.9
25	31.5	28.5	0.823	13.96	7.61	36.3	32.6	3.7
26	33.9	30.6	0.881	14.95	7.70	36.6	32.6	4.0



Notes: 1. Deviator load corrected for membrane effects.
2. Right Cylinder Correction Method



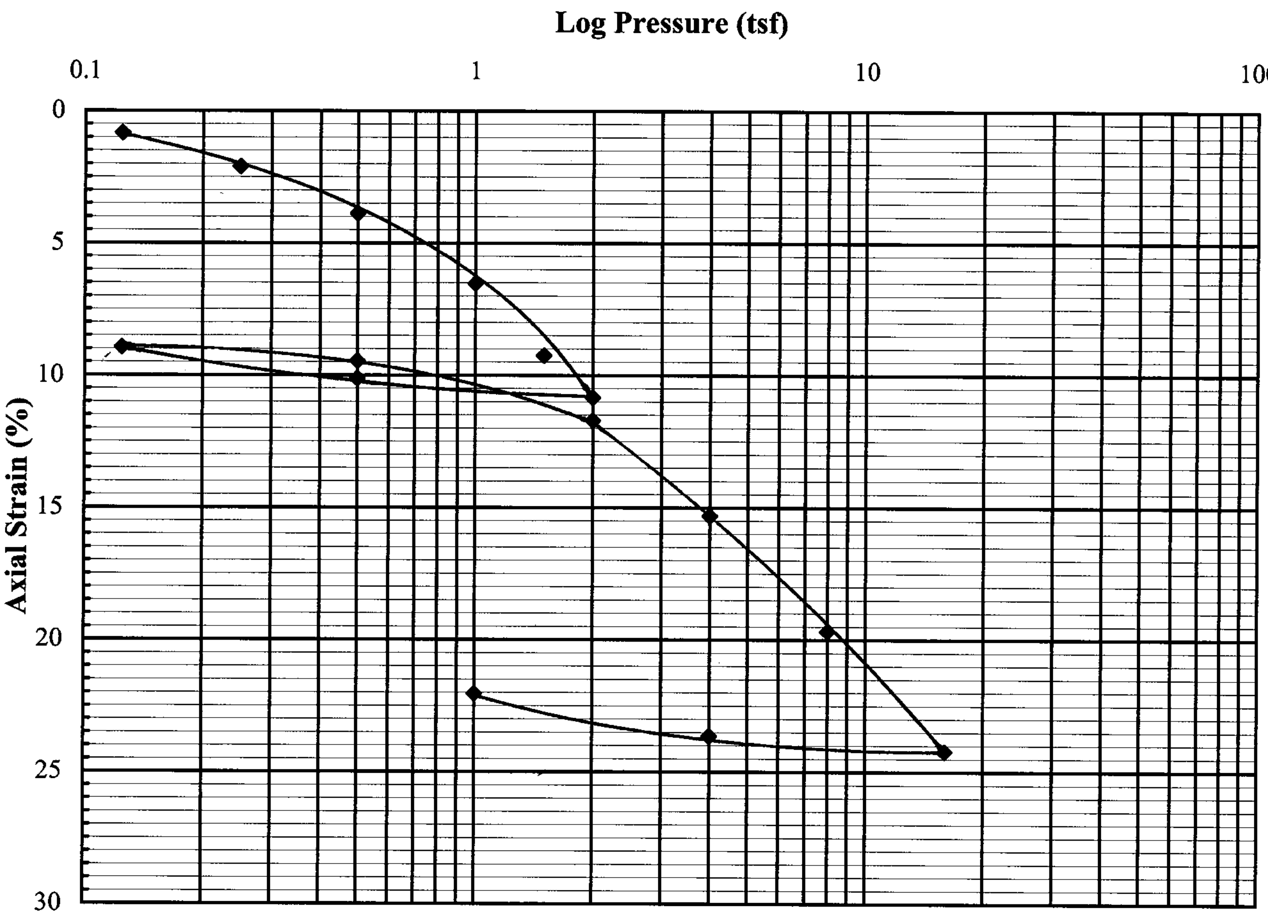
Key	Sample	Depth(ft.)	Sample Description	Class.	LL	PI
■	JMI-03	35-37	SILT with sand - gray brown	ML	45	15
			$LL_{oven\text{-}dried} = 38$			

Schnabel
Schnabel Engineering

GRADATION CURVES

Project:
Jefferson Memorial
Settlement Study

Contract No. 06150078



Probable Preconsolidation Pressure (Pp), tsf:	*1.1*
Recompression Ratio (Cεr):	*0.027*
Compression Ratio (Cεc):	*0.148*

Type of Specimen: *Tube Sample*

Description: *LEAN CLAY (CL), trace sand - gray brown*

LL:	PI:	Gs:	P_o' (tsf):
40	*16*	*2.71*	*0.70*

% < No. 200: *97.7* **Test Method:** *ASTM D2435 Method A*

Test Condition: *Inundated @ 0.05tsf*

Remarks: *Oven-dried Liquid Limit = 43*

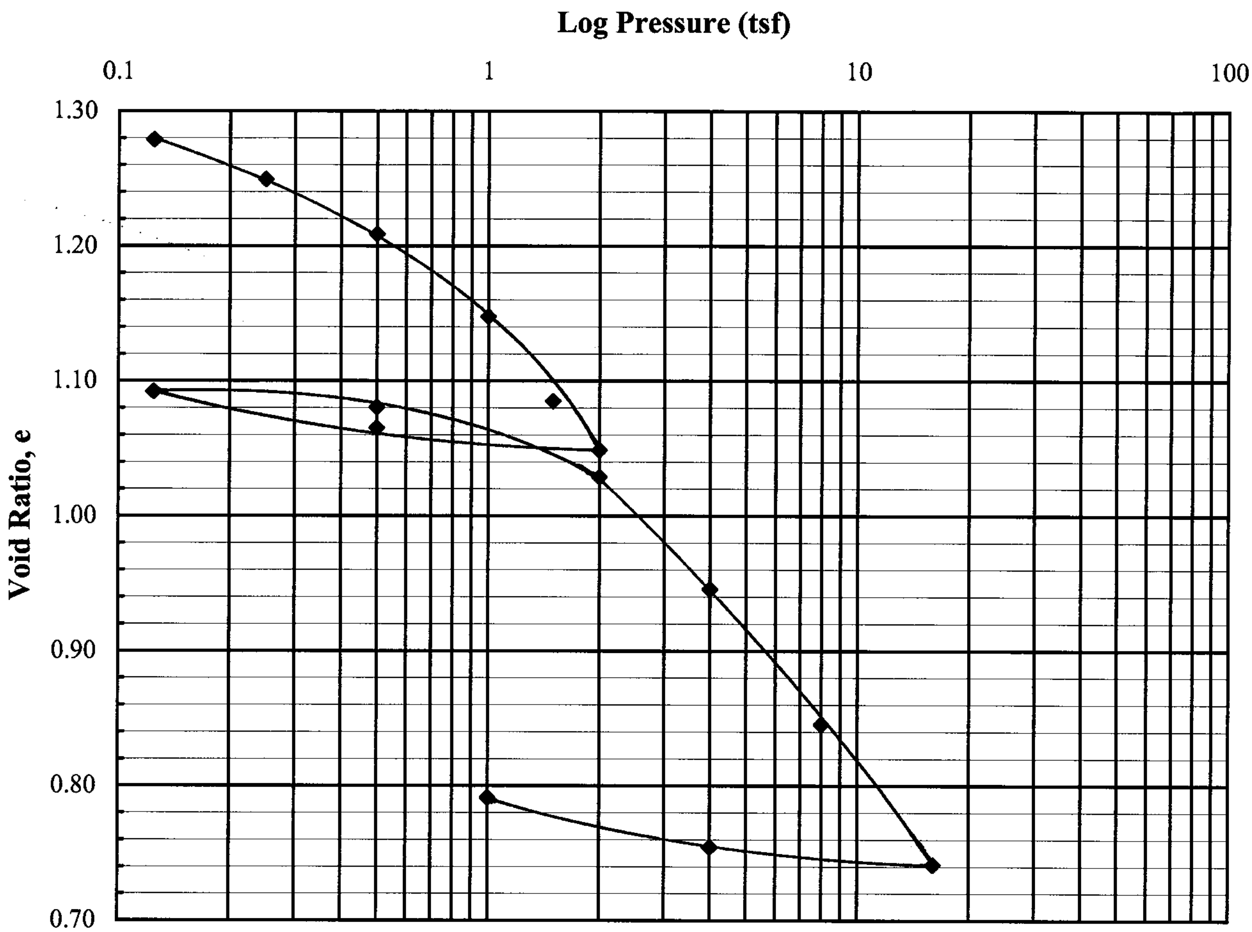
	Initial	Final
Water Content, %	44.7	32.4
Void Ratio	1.30	0.79
Saturation, %	93	100
Dry Unit Weight, pcf	73.6	94.4

Project: Jefferson Memorial Settlement Study

Location:	*Washington, DC*		
Boring:	*JMW-01*	**Schnabel No.:**	*06150078*
Depth:	*20-22 ft.*	**Elevation:**	*-12.7 to -14.7*
Date:	*2/7/2007*	**Reviewed by:**	*CJS*

Schnabel
Schnabel Engineering

Consolidation Test Report



Probable Preconsolidation Pressure (Pp'), tsf:	*1.1*	**Recompression Index (Cr):**	*0.061*
Type of Specimen:	*Tube Sample*	**Compression Index (Cc):**	*0.340*

Description: *LEAN CLAY (CL), trace sand - gray brown*

LL:	*40*	**PI:**	*16*	**Gs:**	*2.71*	**P_o' (tsf):**	*0.70*
% < No. 200:	*97.7*	**Test Method:**	*ASTM D2435 Method A*				
Test Condition:	*Inundated @ 0.05tsf*						

	Initial	Final
Water Content, %	44.7	32.4
Void Ratio	1.30	0.79
Saturation, %	93	100
Dry Unit Weight, pcf	73.6	94.4

Remarks: *Oven-dried Liquid Limit = 43*

Project: Jefferson Memorial Settlement Study

Location:	*Washington, DC*		
Boring:	*JMW-01*	**Schnabel No.:**	*06150078*
Depth:	*20-22 ft.*	**Elevation:**	*-12.7 to -14.7*
Date:	*2/7/2007*	**Reviewed by:**	*CJS*

Schnabel
Schnabel Engineering

Consolidation Test Report

Consolidation Test Data Sheet

Consolidometer ID: 1 2/7/07

Schnabel Contract: *06150078*

Test Method: *ASTM D2435 Method A*

Project: *Jefferson Memorial Settlement Study*

Test Condition: *Inundated @ 0.05tsf*

Initial Height of Specimen (H_o), in.: 0.7498

Boring No.: *JMW-01*

Height of Solids (H_s), in.: 0.3263

Depth: *20-22 ft.*

Seating Press. (tsf): 0.05

Initial Dial Gauge Reading (D_o), in.: 0.0024

Reviewed by: CJS

Pressure, P (tsf)	TimeReadings Required	Date Load Applied	Time Load Applied	Load Applied By	A: Final[1] Dial Reading, D_{fi} x 10^{-4} in.	B: Apparatus Correction[2], D_{ci} x 10^{-4} in.	C: Cumulative Change in Height[3], ΔH_i in.	D: Height of Voids[4], H_{vi} in.	Vertical Strain[5], ε_i (%)	Void Ratio[6], e_i
0.125		12/28/2006	9:00	DWC	87	1	0.0062	0.4173	0.83	1.279
0.25		12/29/2006	9:00	DWC	188	6	0.0158	0.4077	2.11	1.249
0.5		12/30/2006	9:00	DWC	323	8	0.0291	0.3944	3.88	1.209
1		1/2/2007	9:00	DWC	527	13	0.0490	0.3745	6.54	1.148
1.5		1/3/2007	9:00	DWC	733	15	0.0694	0.3541	9.26	1.085
2		1/4/2007	9:00	DWC	854	17	0.0813	0.3422	10.84	1.049
0.5		1/5/2007	9:00	DWC	791	8	0.0759	0.3476	10.12	1.065
0.125		1/6/2007	9:00	CJS	696	1	0.0671	0.3564	8.95	1.092
0.5		1/8/2007	9:00	DWC	741	8	0.0709	0.3526	9.46	1.080
2		1/9/2007	9:00	DWC	919	17	0.0878	0.3357	11.71	1.029
4		1/10/2007	9:00	DWC	1198	25	0.1149	0.3086	15.32	0.946
8		1/11/2007	9:00	DWC	1539	39	0.1476	0.2759	19.69	0.845
16		1/12/2007	9:00	DWC	1888	48	0.1816	0.2419	24.22	0.741
4		1/15/2007	9:00	DWC	1822	25	0.1773	0.2462	23.65	0.754
1		1/16/2007	9:00	DWC	1690	13	0.1653	0.2582	22.05	0.791

Notes:
1. "Final" based on test method; 24 hrs for Method A, end of primary for Method B.
2. Correction value, for the current pressure, from the consolidometer's calibration curve.
3. $\Delta H = D_{fi} - D_o - D_{ci}$ = Col. A - D_o - Col. B
4. $H_{vi} = (H_o - H_s) - \Delta H$
5. $\varepsilon_i = (\Delta H / H_o) \times 100$ = (Col. C / H_o) x 100
6. $e_i = H_{vi} / Hs$ = Col. D / Hs

Schnabel Engineering

Load Time Readings

2/7/07

Project: Jefferson Memorial Settlement Study
Schnabel Contract: 06150078
Boring No.: JMW-01 Depth: 20-22 ft.

Consol. ID: 1

Reviewed by: CJS

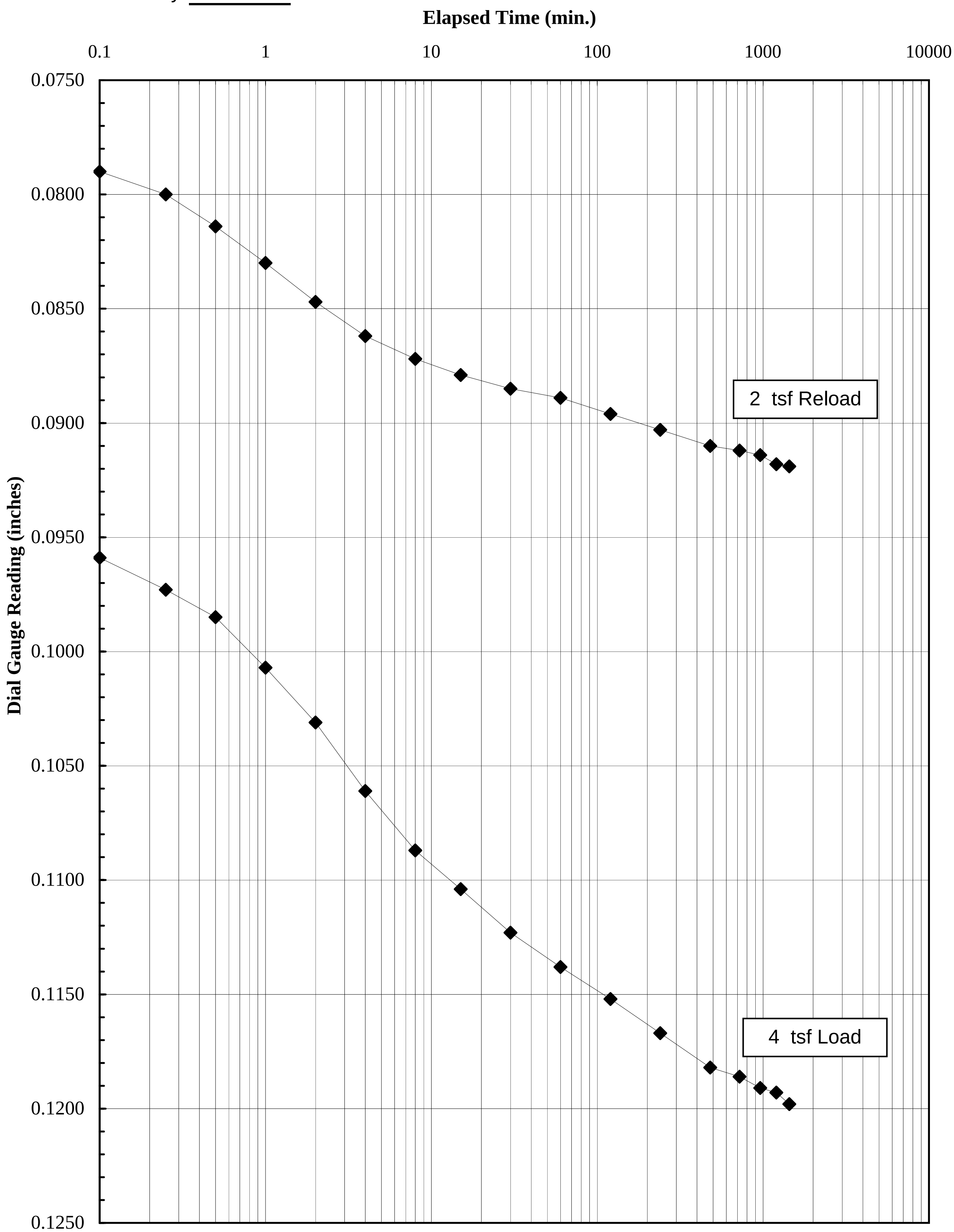
Elapsed Time (min.)	Dial Guage Readings (inches)					
	2 tsf Reload 1/9/2007	4 tsf Load 1/10/2007	X tsf Load Date	X tsf Load Date	X tsf Load Date	X tsf Load Date
0.1	0.0790	0.0959				
0.25	0.0800	0.0973				
0.5	0.0814	0.0985				
1	0.0830	0.1007				
2	0.0847	0.1031				
4	0.0862	0.1061				
8	0.0872	0.1087				
15	0.0879	0.1104				
30	0.0885	0.1123				
60	0.0889	0.1138				
120	0.0896	0.1152				
240	0.0903	0.1167				
480	0.0910	0.1182				
720	0.0912	0.1186				
960	0.0914	0.1191				
1200	0.0918	0.1193				
1440	0.0919	0.1198				
1680						
1920						
2160						
2400						
2640						
2880						

Consolidation Time Curves

2/7/07

Project: Jefferson Memorial Settlement Study
Schnabel Contract: 06150078
Boring No.: JMW-01 Depth: 20-22 ft.

Reviewed by: CJS



Schnabel Engineering

Unconsolidated Undrained Triaxial Compression Test

ASTM D2850

Project: *Jefferson Memorial Settlement Study*

Location: *Washington, D.C.*

Schnabel Contract: *06150078*
Boring No.: *JMW-01*
Depth: *20-22 ft.*
Elevation: *-12.7 to -14.7*
Confining Stress (psi) *18.8*

Date: *2/7/2007*

Reviewed by: *CJS*

Specimen Conditions	
Diameter (in)	2.877
Height (in)	5.594
Area (in^2)	6.50
Moisture (%):	42.2
Weight (lbs)	2.49
ρ_{wet} (pcf)	118.2
ρ_{dry} (pcf)	83.1
Void Ratio	1.04
Saturation, %	100

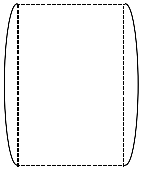
Shear Testing Conditions	
Cell Pressure (psi):	18.8
Rate of Strain (%/min):	1.0

Specimen Type: *Tube Sample*

Axial Strain at Failure (%): *10.02*
Compressive Strength (psi): *3.5*
Major Principal Stress (psi): *22.3*
Minor Principal Stress (psi): *18.8*

Soil Description: *LEAN CLAY (CL) trace sand - gray brown*

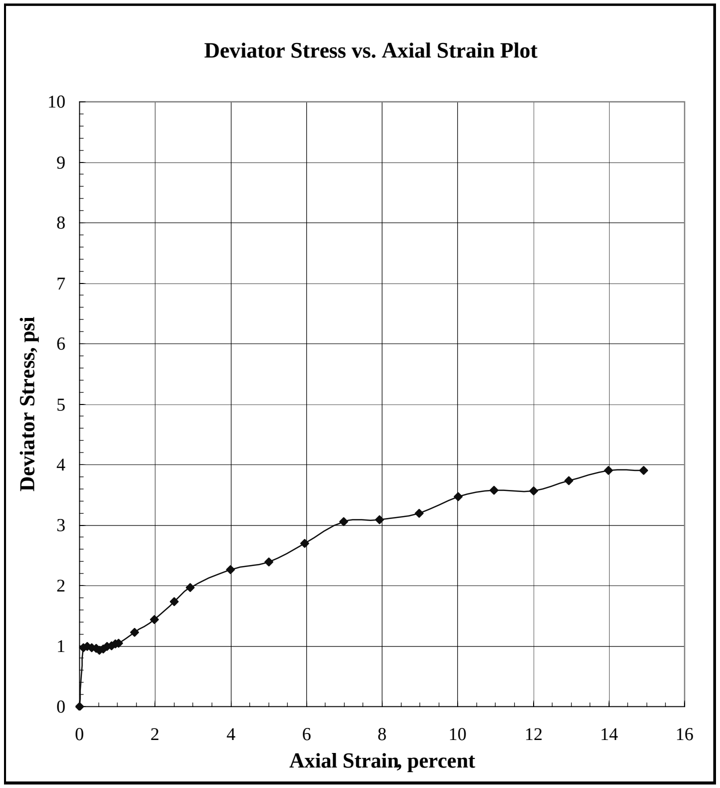
Failure Sketch



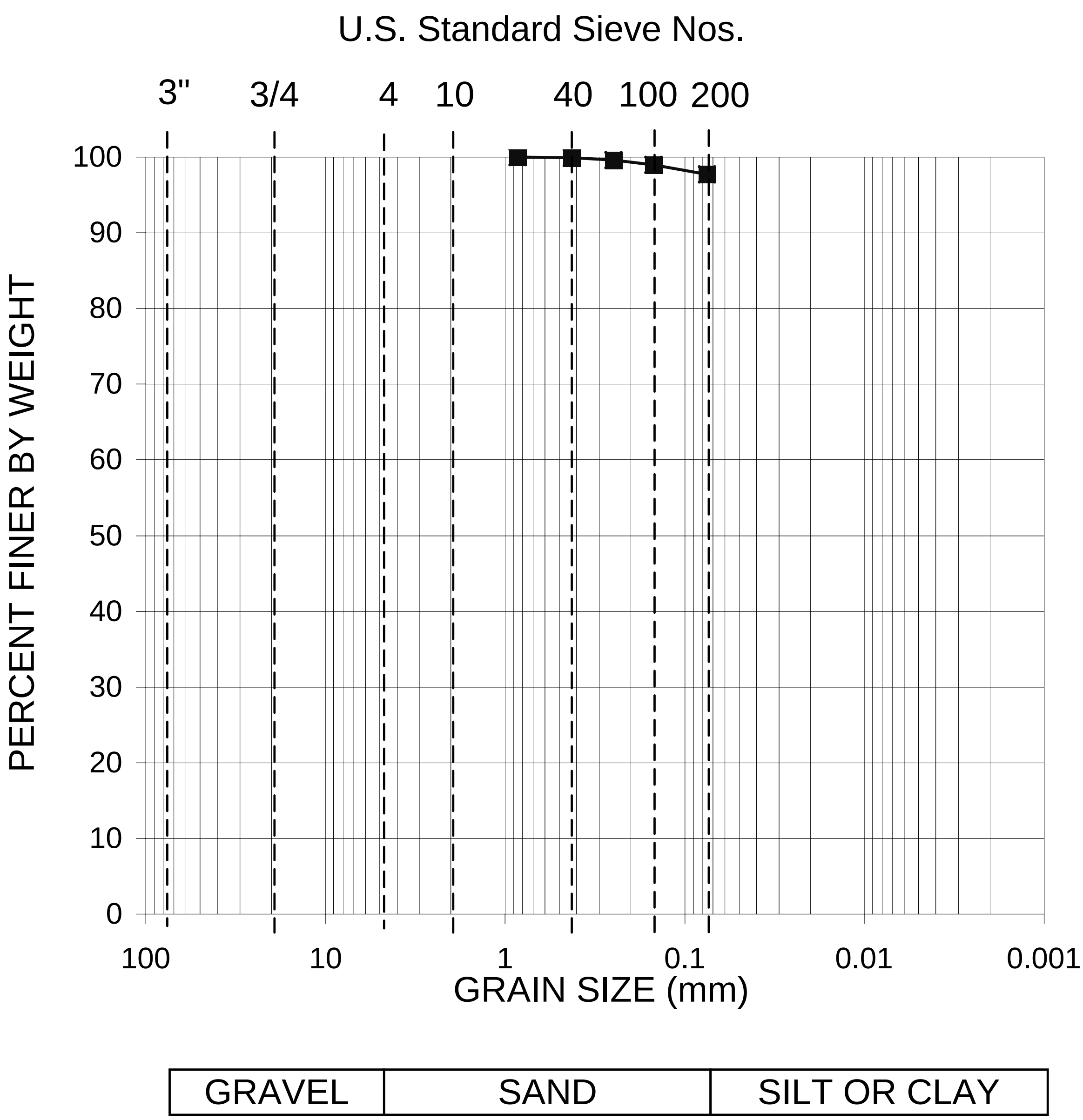
Liquid Limit: *40*
Plasticity Index: *16*
% finer that No. 200: *97.7*
Specific Gravity: *2.71*

Remarks: *Specimen appeared to flow at start of loading.*
Oven-dried Liquid Limit = 43

Reading No.	Deviator Load (lbs)	Corrected Dev. Load[1] (lbs.)	Axial Displacement (in.)	Axial Strain (%)	Corrected Area[2] (in^2)	σ_1 (psi)	σ_3 (psi)	Deviator Stress (psi)
Initial	0.0	0.0	0.000	0.00	6.50	18.8	18.8	0.0
1	6.4	6.3	0.006	0.10	6.51	19.8	18.8	1.0
2	6.5	6.5	0.012	0.21	6.52	19.8	18.8	1.0
3	6.4	6.3	0.018	0.32	6.53	19.8	18.8	1.0
4	6.4	6.3	0.025	0.45	6.53	19.8	18.8	1.0
5	6.2	6.1	0.029	0.52	6.54	19.7	18.8	0.9
6	6.4	6.3	0.035	0.63	6.55	19.8	18.8	1.0
7	6.7	6.5	0.041	0.73	6.55	19.8	18.8	1.0
8	6.8	6.6	0.047	0.84	6.56	19.8	18.8	1.0
9	7.0	6.8	0.053	0.95	6.57	19.8	18.8	1.0
10	7.1	6.9	0.058	1.04	6.57	19.8	18.8	1.0
11	8.4	8.1	0.082	1.46	6.60	20.0	18.8	1.2
12	10.0	9.5	0.111	1.98	6.64	20.2	18.8	1.4
13	12.1	11.6	0.140	2.50	6.67	20.5	18.8	1.7
14	13.9	13.2	0.163	2.92	6.70	20.8	18.8	2.0
15	16.2	15.3	0.223	3.99	6.77	21.1	18.8	2.3
16	17.4	16.4	0.280	5.01	6.85	21.2	18.8	2.4
17	19.9	18.7	0.333	5.95	6.92	21.5	18.8	2.7
18	22.9	21.4	0.391	6.99	6.99	21.9	18.8	3.1
19	23.5	21.8	0.444	7.93	7.06	21.9	18.8	3.1
20	24.8	22.8	0.502	8.97	7.15	22.0	18.8	3.2
21	27.3	25.1	0.560	10.02	7.23	22.3	18.8	3.5
22	28.5	26.1	0.613	10.96	7.31	22.4	18.8	3.6
23	29.0	26.4	0.671	12.00	7.39	22.4	18.8	3.6
24	30.7	27.9	0.724	12.94	7.47	22.5	18.8	3.7
25	32.6	29.6	0.782	13.98	7.56	22.7	18.8	3.9
26	33.1	29.8	0.835	14.92	7.65	22.7	18.8	3.9



Notes: 1. Deviator load corrected for membrane effects.
2. Right Cylinder Correction Method



Key	Sample	Depth(ft.)	Sample Description	Class.	LL	PI
■	JMW-01	20-22	LEAN CLAY, trace sand - gray brown	CL	40	16
			$LL_{oven\text{-}dried}$ = 43			

Schnabel Engineering

GRADATION CURVES

Project: Jefferson Memorial Settlement Study

Contract No. 06150078

Laboratory Test Data, SEA 1992

SUMMARY OF SOIL LABORATORY TESTS

Contract: W920238

BORING NO.	DEPTH (ft.)	SAMPLE TYPE	STRATUM	DESCRIPTION OF SOIL SPECIMEN	SIEVE RESULTS		ATTERBERG LIMITS			NATURAL MOISTURE (%)	REMARKS
					PERCENT PASSING NO. 200	PERCENT RETAINED NO. 4	LL	PL	PI		
1	14.0	JAR		silty SAND (SM), trace gravel, brown	48.0	8.2	26	22	4	15.9	
1	19.0	JAR		sandy LEAN CLAY (CL), trace gravel, grey-brown	51.0	10.8	24	14	10	10.7	
1	22.0	JAR		WELL GRADED SAND (SW),trace gravel, grey	7.2	1.8	--	--	--	21.1	
1	29.0	JAR		ELASTIC SILT (MH), grey	98.7	0.0	53	33	20	42.6	
1	34.0	JAR		silty SAND (SM), grey	25.6	0.0	66	38	28	10.7	
1	44.0	JAR		sandy SILT (ML), grey	59.4	0.0	49	32	17	37.6	

NOTES:

1. Soil tests are in accordance with applicable ASTM standards.
2. Soil classification symbols are in accordance with Unified soil classification system, based on testing indicated and visual identification.
3. Visual identification of samples is in accordance with the system used by this firm.
4. Key to abbreviations:
   LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; NP = Nonplastic

Contract: W920238

SUMMARY OF SOIL LABORATORY TESTS

BORING NO.	DEPTH (ft.)	SAMPLE TYPE	STRATUM	DESCRIPTION OF SOIL SPECIMEN	SIEVE RESULTS		ATTERBERG LIMITS			NATURAL MOISTURE CONTENT (%)	DENSITY		G_s	CONSOLIDATION DATA	REMARKS
					PERCENT PASSING NO. 200	PERCENT RETAINED NO. 4	LL	PL	PI		WET (pcf)	DRY (pcf)			
1	39.0-41.0	3" TUBE		sandy SILT (ML), grey	51.2	0.0	36	27	9	32.5	116.2	87.7	2.50		
1	56.0-58.0	3" TUBE		ELASTIC SILT (MH) with sand, grey	70.4	0.0	64	39	25	47.5	105.2	71.3	2.54		

NOTES:

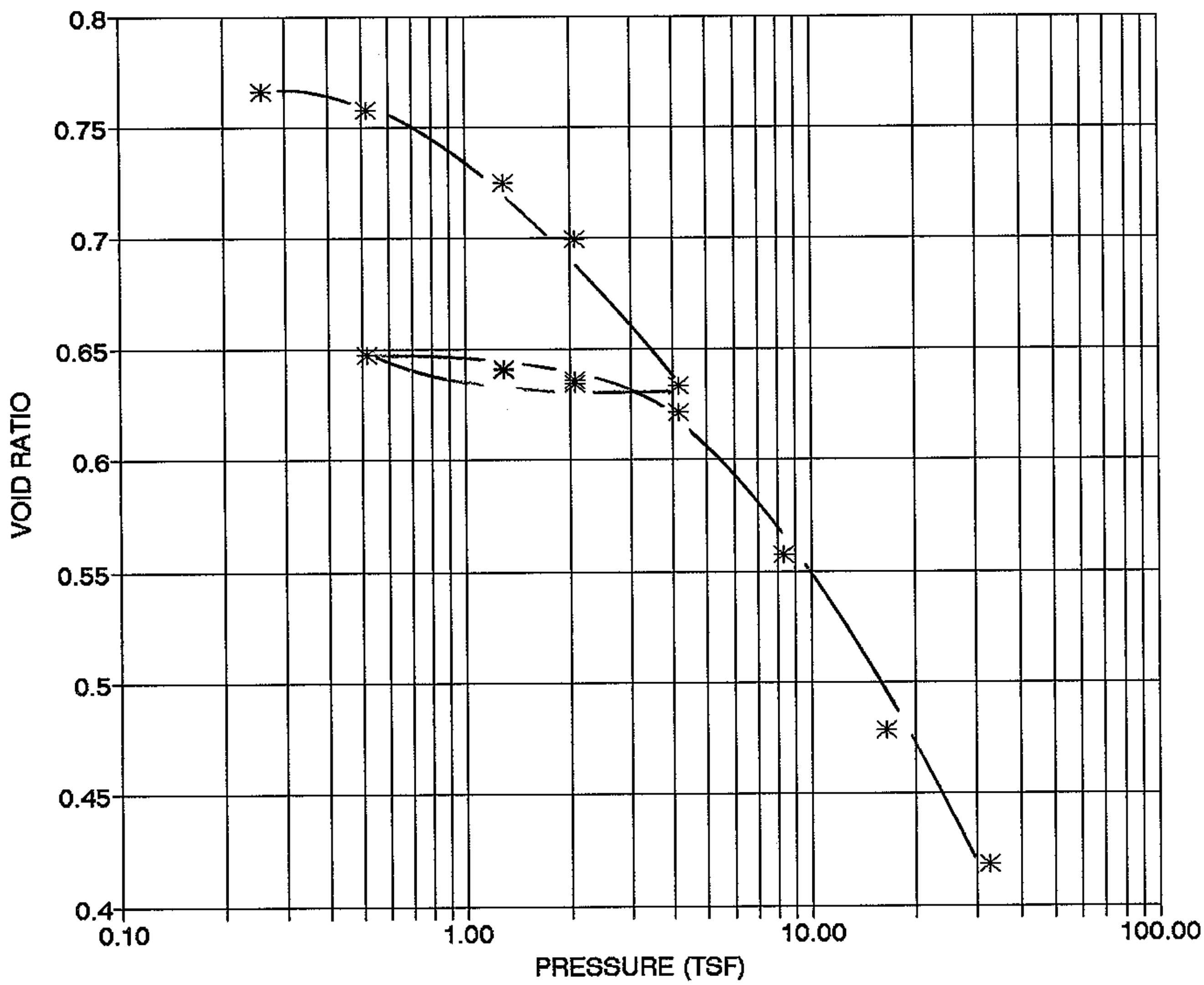
1. Soil tests are in accordance with applicable ASTM standards.
2. Soil classification symbols are in accordance with Unified soil classification system, based on testing indicated and visual identification.
3. Visual identification of samples is in accordance with the system used by this firm.
4. Key to abbreviations:
   LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; NP = Nonplastic

SUMMARY OF SOIL LABORATORY TESTS Contract: W920238

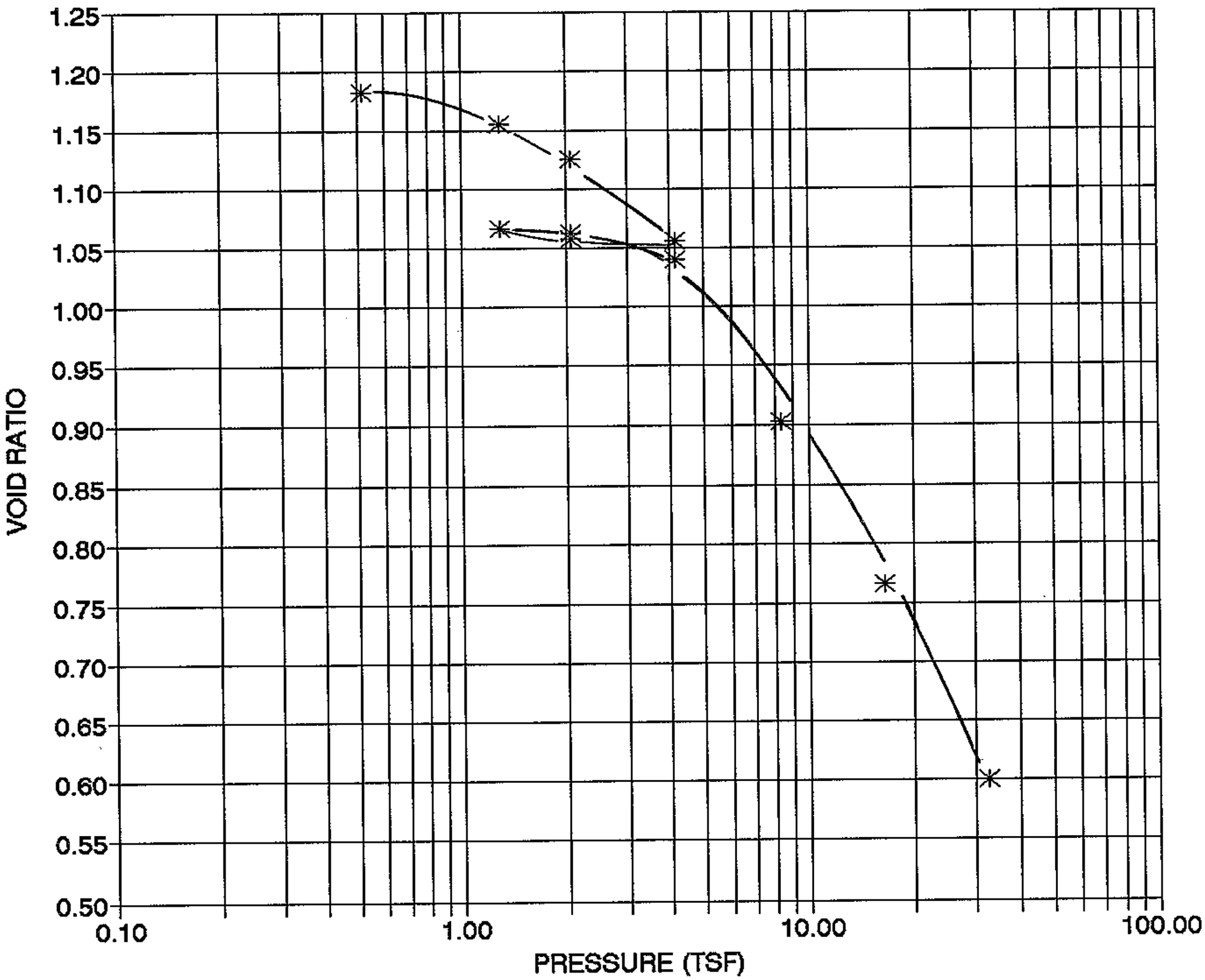
BORING NO.	DEPTH (ft.)	SAMPLE TYPE	STRATUM	DESCRIPTION OF SOIL SPECIMEN	SIEVE RESULTS		ATTERBERG LIMITS			NATURAL MOISTURE (%)	REMARKS
					PERCENT PASSING NO. 200	PERCENT RETAINED NO. 4	LL	PL	PI		
HA-1	1.5	JAR		LEAN CLAY (CL) with sand, brown	82.8	0.0	43	26	17	35.6	
HA-1	2.5	JAR		LEAN CLAY (CL) with sand, brown	74.7	0.0	40	23	17	35.1	
HA-1	4.5	JAR		silty SAND (SM), trace gravel, brown	48.3	4.7	--	--	--	14.1	
HA-1	4.8	JAR		silty SAND (SM), brown	27.7	0.0	--	--	--	13.2	
INSIDE PIT	1.0	JAR		silty SAND (SM), trace gravel, brown	48.0	2.9	--	--	--	----	

NOTES:

1. Soil tests are in accordance with applicable ASTM standards.
2. Soil classification symbols are in accordance with Unified soil classification system, based on testing indicated and visual identification.
3. Visual identification of samples is in accordance with the system used by this firm.
4. Key to abbreviations:
   LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; NP = Nonplastic



SOIL DESCRIPTION:	sandy SILT, grey		SCHNABEL ENGINEERING ASSOCIATES
CLASSIFICATION:	ML		
BORING NO.: B-1		DEPTH: 39 T0 41 FT	ONE DIMENSIONAL CONSOLIDATION TEST PRESSURE VS. VOID RATIO CURVE SPECIFICATION: ASTM D2435
DIAMETER of SPECIMEN:	2.5 IN	INITIAL MOISTURE: 32.5%	
INITIAL HEIGHT:	1.0 IN	FINAL MOISTURE: 22.6%	
SPECIFIC GRAVITY:	2.5	INITIAL VOID RATIO: 0.78	PROJECT:
INITIAL PERCENT SATURATION:	104%		JEFFERSON MEMORIAL
ESTIMATED PRECONSOLIDATION PRESSURE, Pc	: 1.9 tsf		
APPROXIMATE OVERBURDEN STRESS, Po	: 1.5 tsf		
COMPRESSION RATIO	(from 10.0 to 30.0 tsf): --		
COMPRESSION INDEX	(from 10.0 to 30.0 tsf): 0.24		
RECOMPRESSION RATIO	(from 1.0 to 4.0 tsf): --		
RECOMPRESSION INDEX	(from 1.0 to 4.0 tsf): 0.02		CONTRACT NO.: W920238



SOIL DESCRIPTION:	ELASTIC SILT with sand, grey		
CLASSIFICATION:	MH		
BORING NO.: B-1		DEPTH: 56 T0 58 FT	
DIAMETER of SPECIMEN:	2.5 IN	INITIAL MOISTURE: 47.5%	
INITIAL HEIGHT:	1.0 IN	FINAL MOISTURE:	30.4%
SPECIFIC GRAVITY:	2.5	INITIAL VOID RATIO:	1.224
INITIAL PERCENT SATURATION:	98.4%		
ESTIMATED PRECONSOLIDATION PRESSURE, Pc	:	--	
APPROXIMATE OVERBURDEN STRESS, Po	:	2.0 tsf	
COMPRESSION RATIO	(from 10.0 to 50.0 tsf):	--	
COMPRESSION INDEX	(from 10.0 to 50.0 tsf):	0.55	
RECOMPRESSION RATIO	(from 1.0 to 4.0 tsf):	--	
RECOMPRESSION INDEX	(from 1.0 to 4.0 tsf):	0.03	

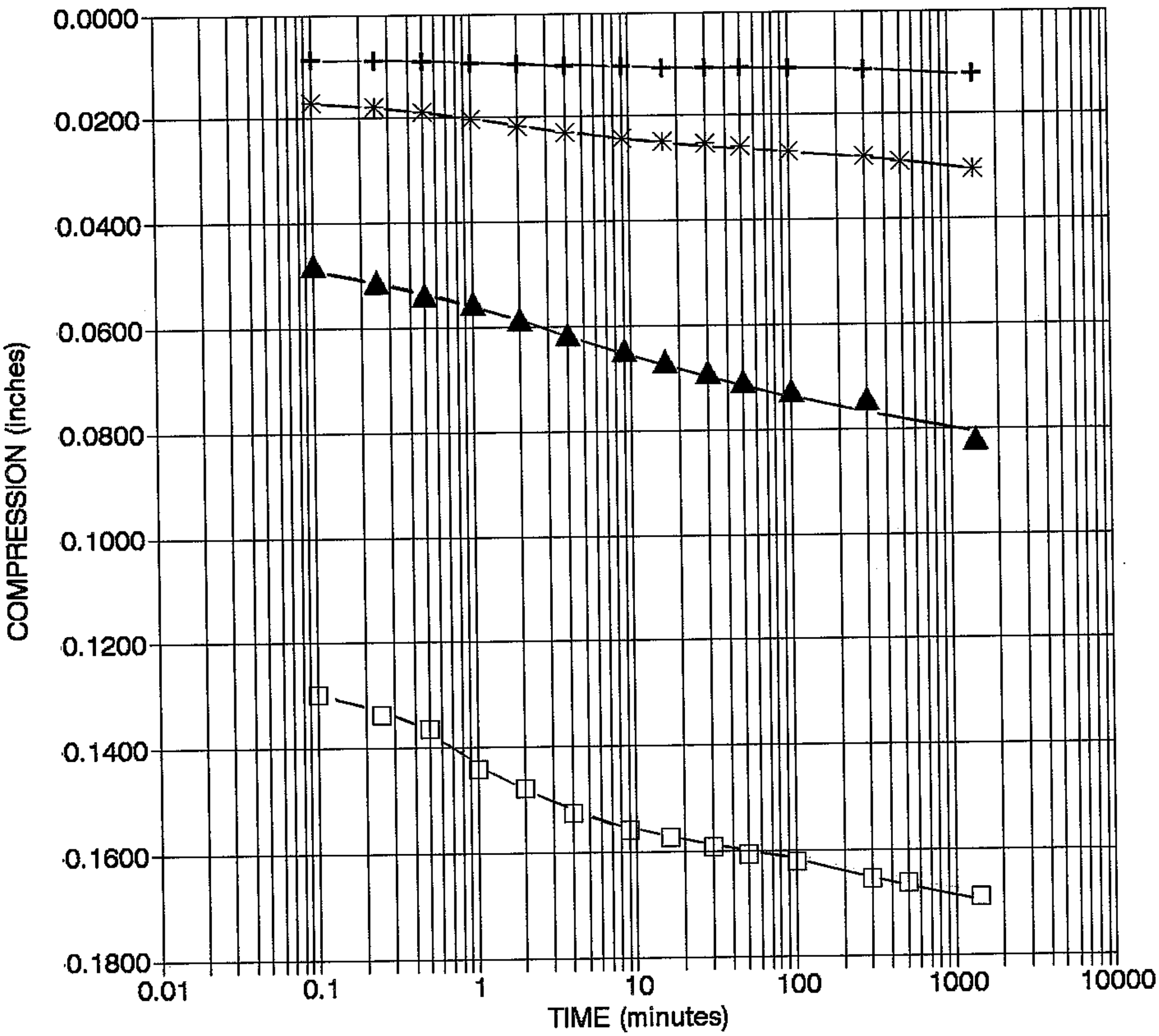
SCHNABEL ENGINEERING ASSOCIATES

ONE DIMENSIONAL CONSOLIDATION TEST
PRESSURE VS. VOID RATIO CURVE
SPECIFICATION: ASTM D2435

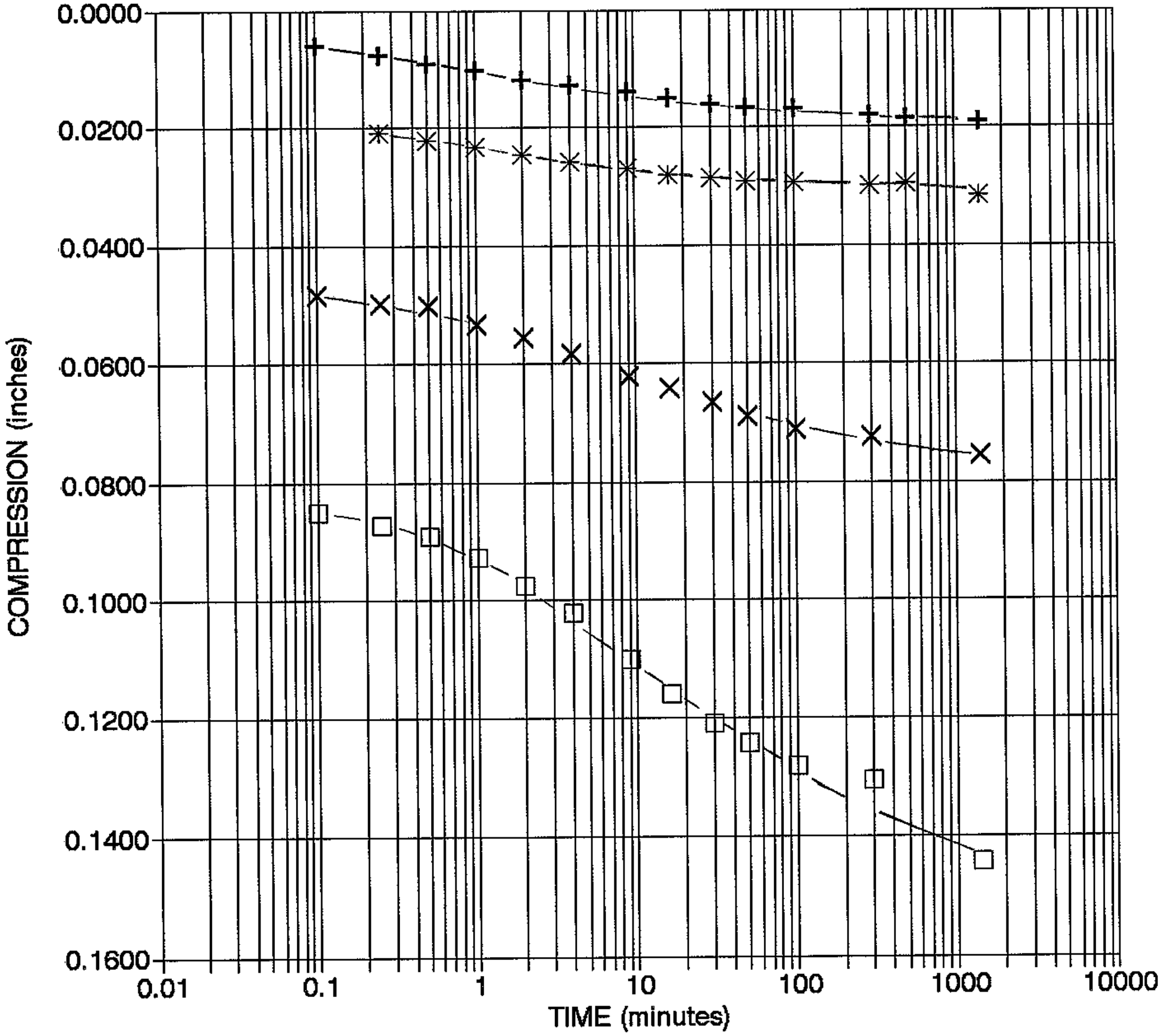
PROJECT:

JEFFERSON MEMORIAL

CONTRACT NO.: W920238



DESCRIPTION OF SOIL:		ELASTIC SILT, with sand, gray			SCHNABEL ENGINEERING ASSOCIATES
CLASSIFICATION:		MH			
KEY	BORING NO.	DEPTH (FT)	LOAD (tsf) from	to	ONE DIMENSIONAL CONSOLIDATION TIME VS. COMPRESSION CURVES
+	B-1	39-41	0.25	0.5	SPECIFICATION: ASTM D2435
✳	B-1	39-41	0.5	1.2	PROJECT:
▲	B-1	39-41	2.0	4.0	JEFFERSON MEMORIAL
□	B-1	39-41	8.0	16.0	CONTRACT NO.: W920238



DESCRIPTION OF SOIL:	ELASTIC SILT, with sand, gray				SCHNABEL ENGINEERING ASSOCIATES
CLASSIFICATION:	MH				
KEY	BORING NO.	DEPTH (FT)	LOAD (tsf) from	LOAD (tsf) to	ONE DIMENSIONAL CONSOLIDATION TIME VS. COMPRESSION CURVES
+	B-1	56-58	0.0	0.5	SPECIFICATION: ASTM D2435
*	B-1	56-58	0.5	1.2	PROJECT:
X	B-1	56-58	2.0	4.0	JEFFERSON MEMORIAL
□	B-1	56-58	4.0	8.0	CONTRACT NO.: W920238

Laboratory Test Data, Storch Engineers, 1965

Note: The survey datum used for these boring logs is the historical low water datum for Washington Harbor, Subtract 1.41 ft from these elevations to obtain elevations in the North American Vertical Datum of 1929 (NAVD 29).

JOB NO.

Prepared By VE Date 3/22/65

Checked By ___ Date ___ Project 661

STORCH ENGINEERS

SUMMARY OF LABORATORY TEST RESULTS

BORING & SAMPLE NUMBER	DEPTH	CLASSIFICATION	NATURAL WATER CONTENT PER CENT	ATTERBERG LIMITS		UNCONFINED COMPRESSION		UNIT DRY WEIGHT LB/CU FT	SPECIFIC GRAVITY	PERMEABILITY CM/SEC	OPTIMUM MOISTURE	GRAIN SIZE	CONSOLI-DATION	TRIAXIAL	ph
				LIQUID LIMIT	PLASTIC LIMIT	STRESS TONS/SQ FT	STRAIN PER CENT								
MU-8 UP-1	35'-37'	Gray organic clayey SILT with trace of fine sand	42	46	35									*	
UP-2	82'-84'	Gray organic clayey SILT with lenses of fine sand.	60	69	38	*	*								
MU-9A UP-1	35'-37'	Gray organic clayey SILT with lenses of fine sand	59	79	45									*	
UP-2	67'-69'	Gray organic clayey SILT with trace of fine sand	63	84	36									*	
MU-10 UP-1	46.5'-48.5'	Gray organic clayey SILT with lenses of fine sand	47	65	35				2.63				*		7.4
UP-2	60.5'-62.5'	Gray organic clayey SILT with lenses of fine sand	48	57	35				2.77				*		7.2
UP-3	73.5'-75.5'	Gray organic clayey SILT with lenses of fine sand	60	70	38				2.65				*		7.4
UP-4	87'-89'	Gray organic clayey SILT with lenses of fine sand	53	65	34				2.74				*		7.4
MU-12 UP-1	30'-32'	Gray organic clayey SILT trace of fine sand	67	67	36				2.67				*	*	
MU-12A UP-2	10'-12'	Gray organic clayey SILT.	56	60	34				2.65				*	*	

* SEE TEST CURVES

JOB NO.

Prepared By VE Date 3/22/65

Checked By ___ Date ___ Project 661

STORCH ENGINEERS

SUMMARY OF LABORATORY TEST RESULTS

BORING & SAMPLE NUMBER	DEPTH	CLASSIFICATION	NATURAL WATER CONTENT PER CENT	ATTERBERG LIMITS		UNCONFINED COMPRESSION		UNIT DRY WEIGHT LB/CU FT	SPECIFIC GRAVITY	MAX. MIN. pcf	OPTIMUM MOISTURE	GRAIN SIZE	CONSOLI-DATION	TRIAXIAL	ph
				LIQUID LIMIT	PLASTIC LIMIT	STRESS TONS/SQ FT	STRAIN PER CENT								
MU-13 UP-2	44'-46'	Gray organic clayey SILT with lenses of fine sand	53	57	35				2.67				*	*	
UP-3	57.5'-59.5'	Gray organic clayey SILT with lenses of fine sand	58	68	35				2.75				*		
TP #1		Brown silty fine SAND, trace gravel	19.6					77.0		89.0 71.4	*	*			6.1
TP #2		Brown silty fine SAND, trace coarse to fine sand	17.3					76.4							
TP #8		Brown silty fine SAND	18.9					59.0							
TP #5		Brown silty fine SAND	30.5					72.0		89.0 62.3		*			6.1
TP #6		Gray silty fine SAND	30.0					78.0							

* SEE TEST CURVES

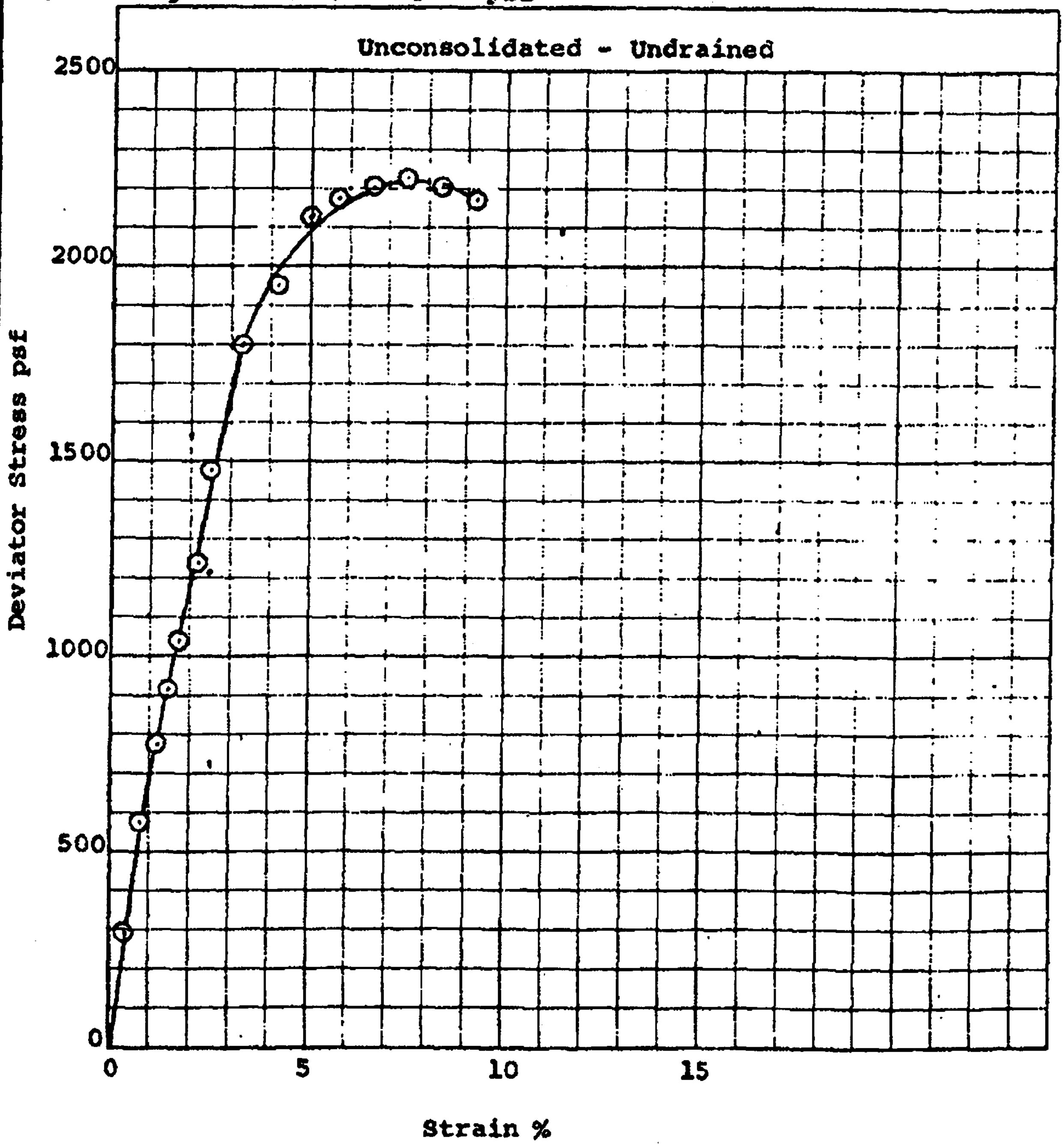
STORCH ENGINEERS

TRIAXIAL COMPRESSION TEST

Boring: MU-8 Sample: UP-1 Depth: 35'-37'

Material: Gray organic clayey SILT with occasional thin layers of fine sand

Moisture Content: 55.8%
Unit Wet Weight: 102.0 pcf
Unit Dry Weight: 65.4 pcf
Confining Pressure: 18 psi



Prepared By VE Date 3/8/65 Project 661

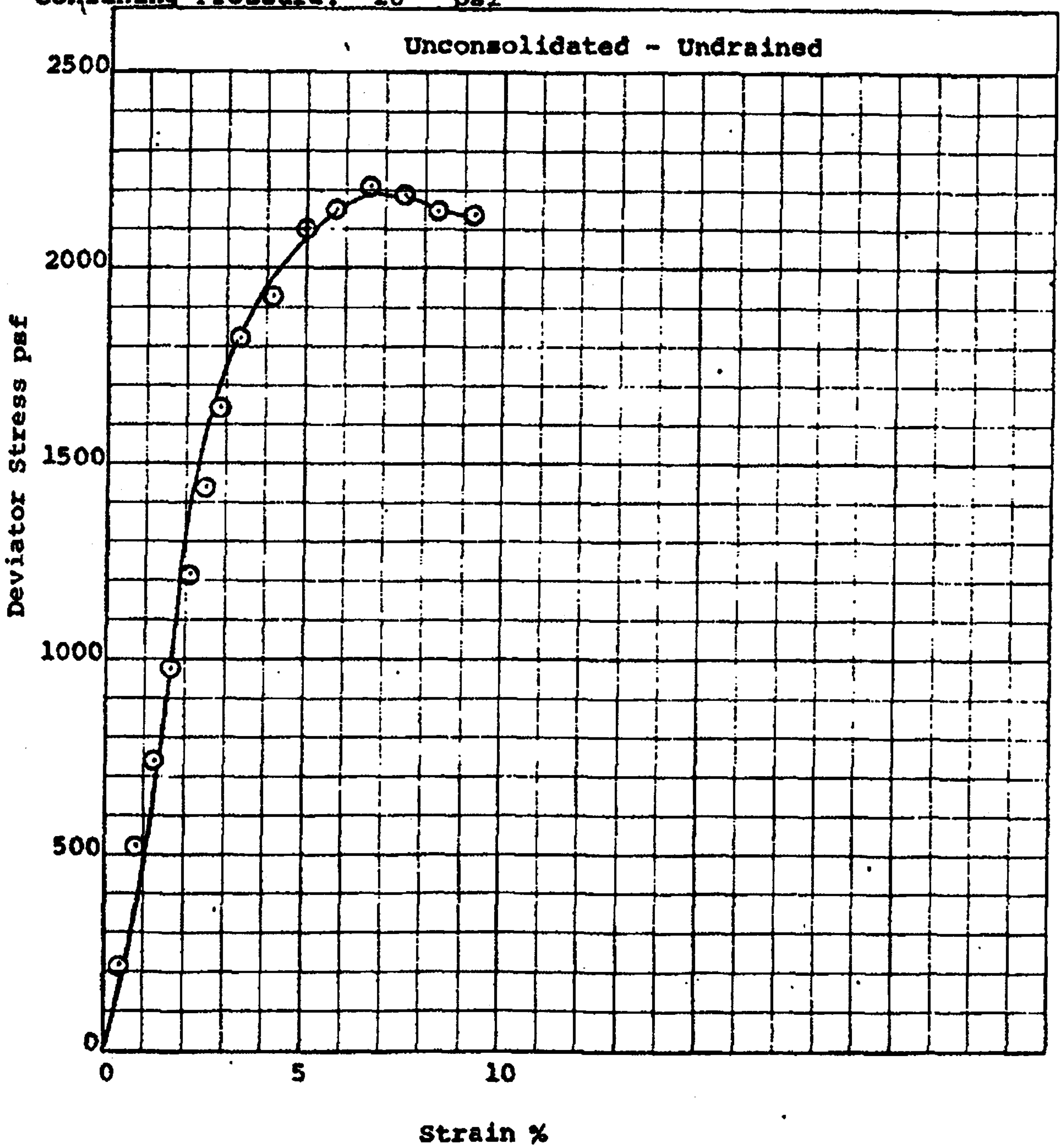
Checked By Date

TRIAXIAL COMPRESSION TEST

Boring: MU-9A Sample: UP-1 Depth: 35'-37'

Material: Gray organic clayey SILT with occasional thin layers of fine sand

Moisture Content: 46.2%
Unit Wet Weight: 107.8 pcf
Unit Dry Weight: 73.6 pcf
Confining Pressure: 20 psi



Prepared By VB Date 3/8/65 Project 661

Checked By Date

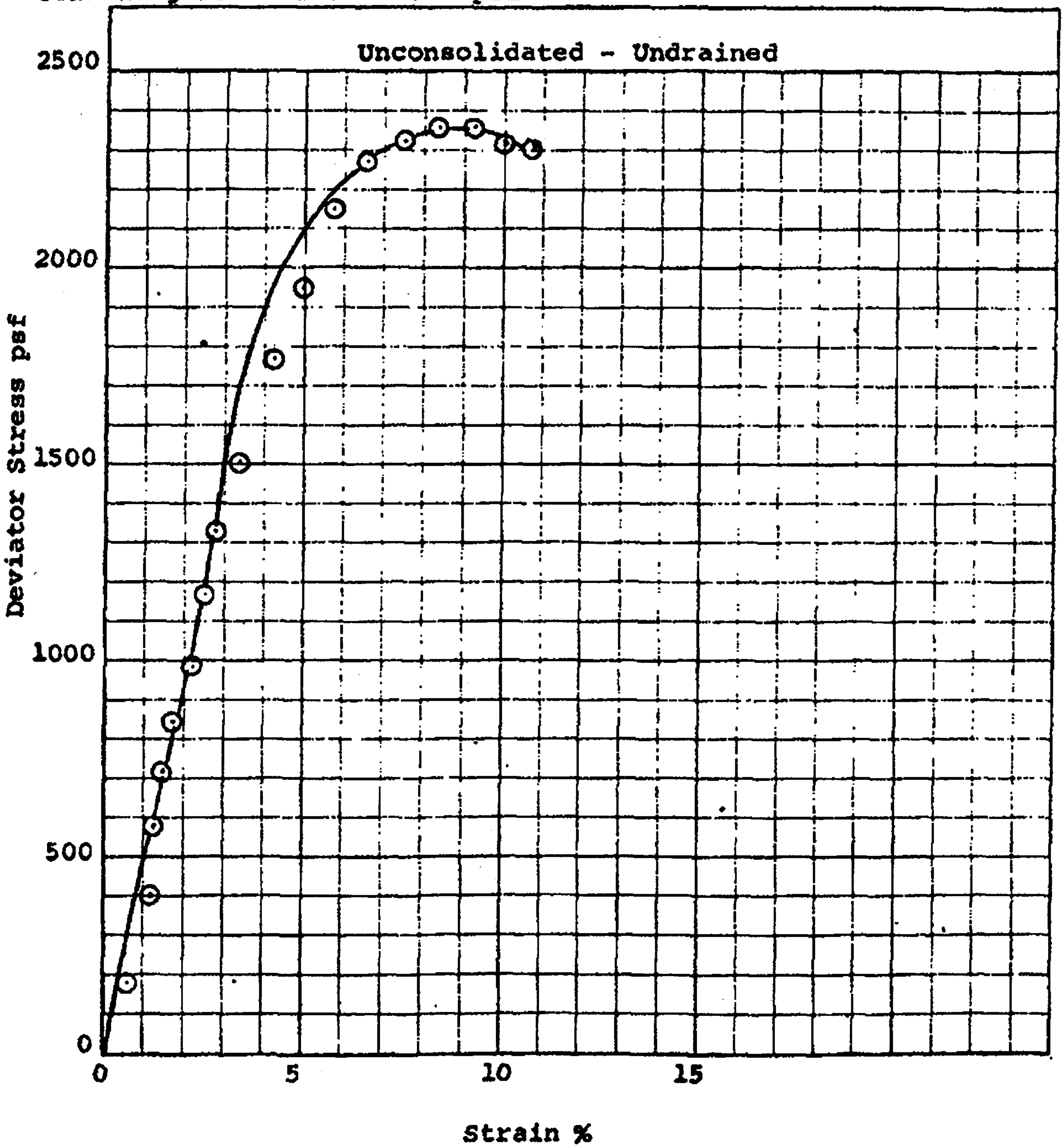
STORCH ENGINEERS

TRIAXIAL COMPRESSION TEST

Boring: MU-9A Sample: UP-2 Depth: 67'-69'

Material: Gray organic clayey SILT with occasional thin layers of fine sand

Moisture Content: 69.5%
Unit Wet Weight: 98.1 pcf
Unit Dry Weight: 58.0 pcf
Confining Pressure: 33 psi



Prepared By....VE....Date....3/8/65....Project....661

Checked By..........Date..........

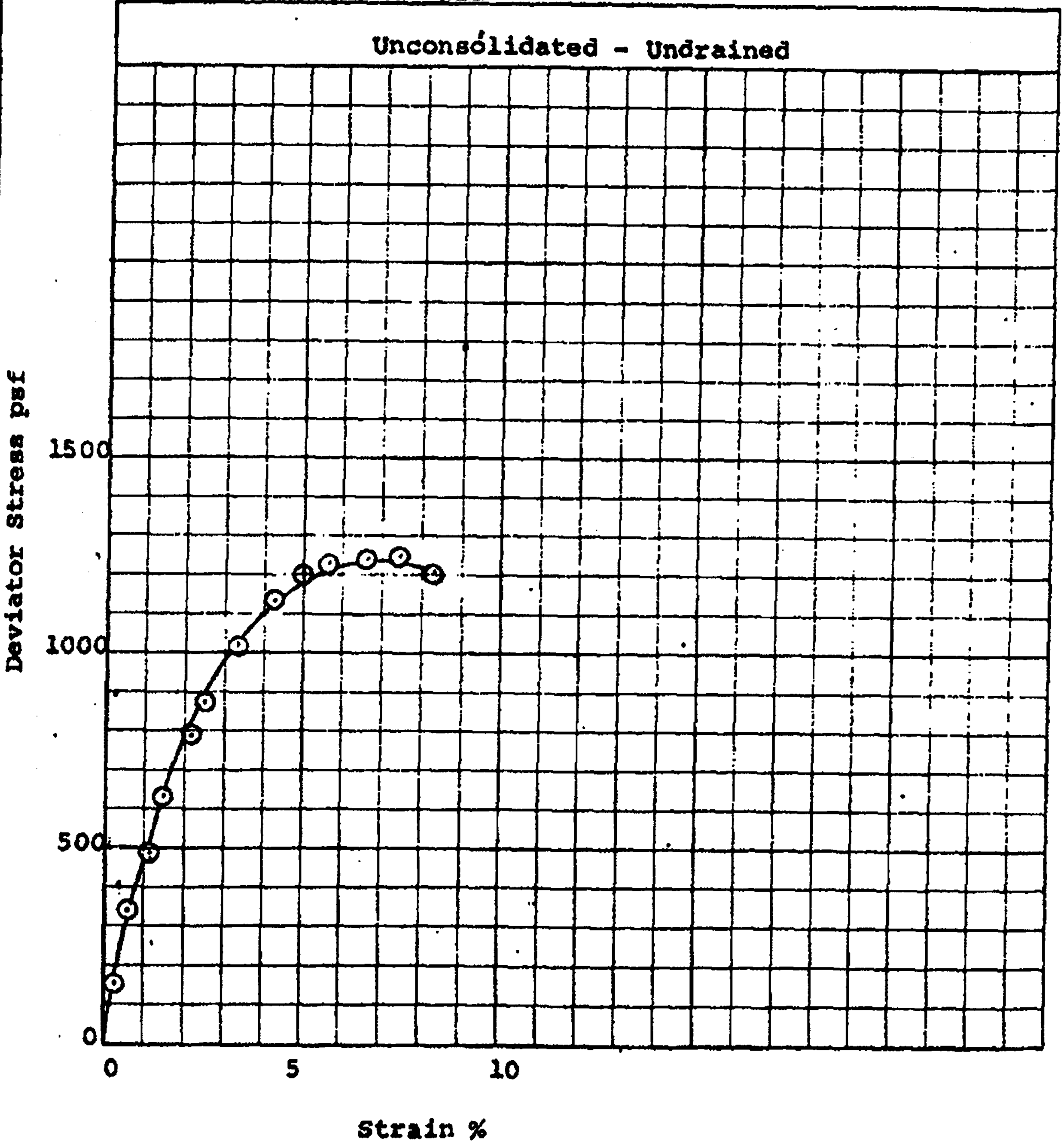
STORCH ENGINEERS

TRIAXIAL COMPRESSION TEST

Boring: MU-12　　Sample: UP-1　　Depth: 30'-32'

Material: Gray organic clayey SILT with occasional thin layers of fine sand

Moisture Content: 62%
Unit Wet Weight: 99.0 pcf
Unit Dry Weight: 61.2 pcf
Confining Pressure: 13 psi



Prepared By VE Date 3/8/65 Project 661

Checked By ______ Date ______

STORCH ENGINEERS

TRIAXIAL COMPRESSION TEST

Boring: MU-12A *Sample:* UP-2 *Depth:* 10'-12'

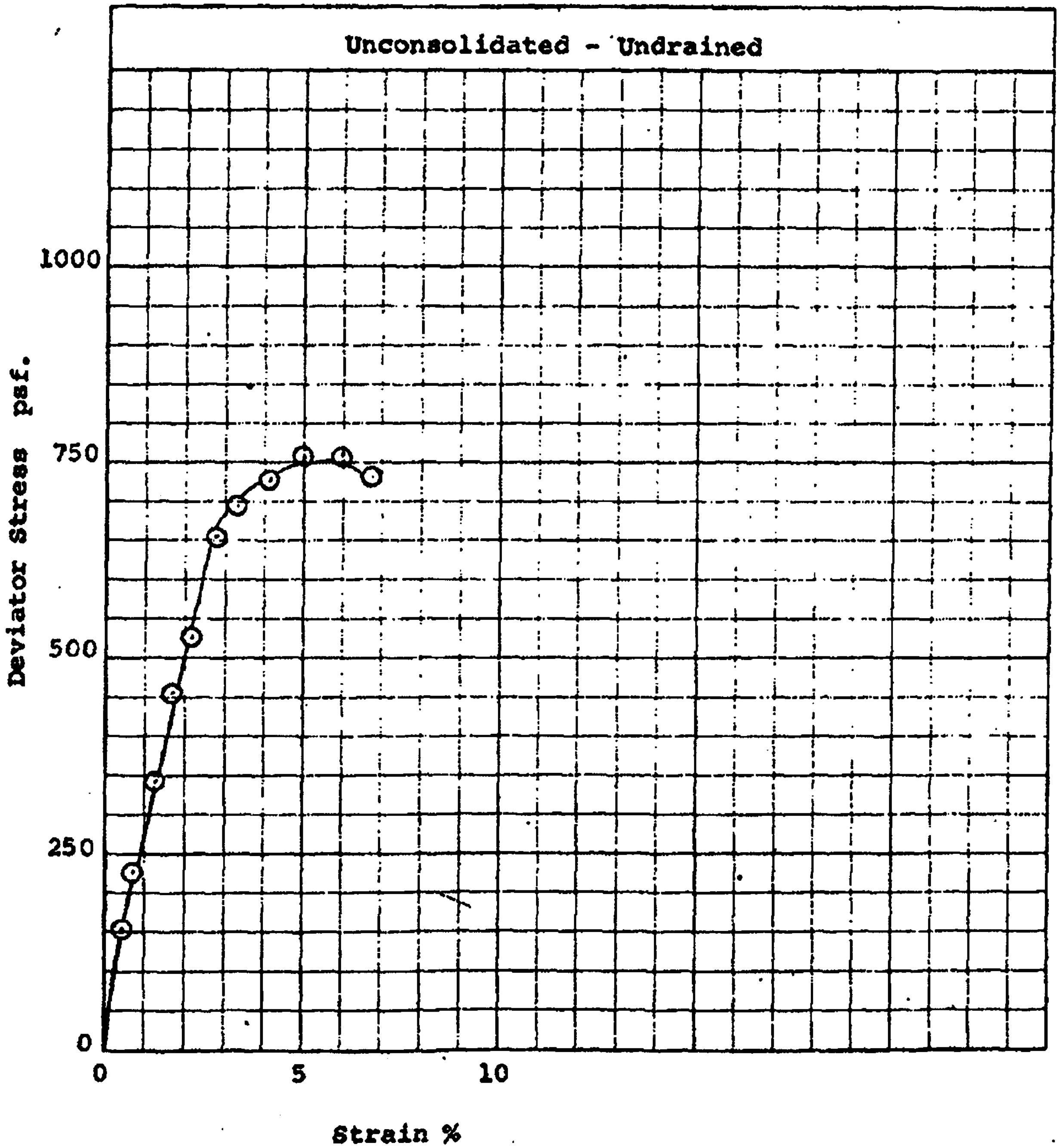
Material: Gray organic clayey SILT

Moisture Content: 59.4%

Unit Wet Weight: 99.0 pcf

Unit Dry Weight: 62.1 pcf

Confining Pressure: 6 psi



Prepared By VE Date 3/8/65 Project 661

Checked By .... Date ....

STORCH ENGINEERS

TRIAXIAL COMPRESSION TEST

Boring: MU-13 Sample: UP-2 Depth: 44'-46'

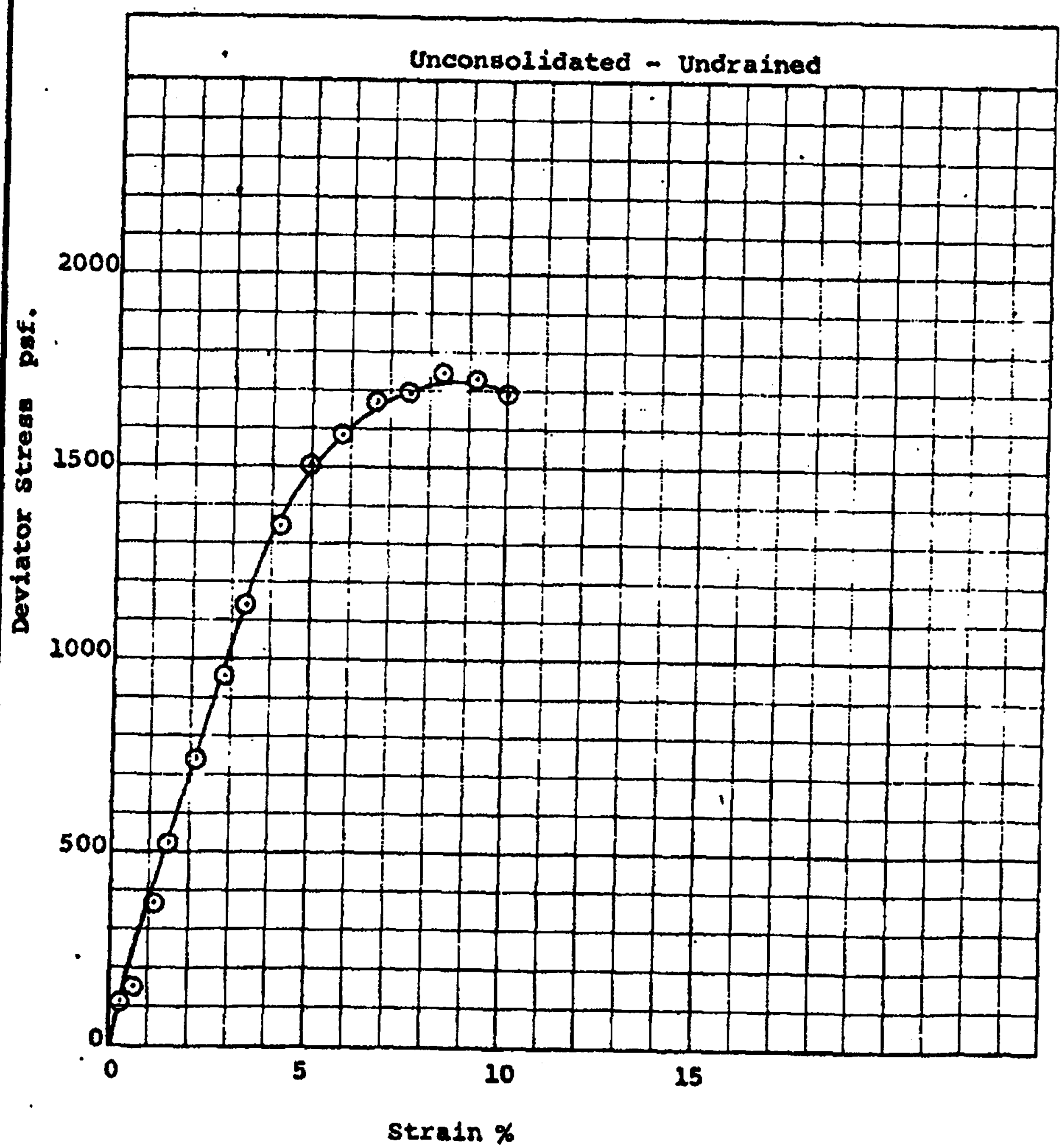
Material: Gray organic clayey SILT with occasional thin layers of fine sand

Moisture Content: 58.5%

Unit Wet Weight: 101.5 pcf

Unit Dry Weight: 64.0 pcf

Confining Pressure: 21 psi



Prepared By VB Date 3/8/65 Project 661

Checked By Date

STORCH ENGINEERS

UNCONFINED COMPRESSION TEST

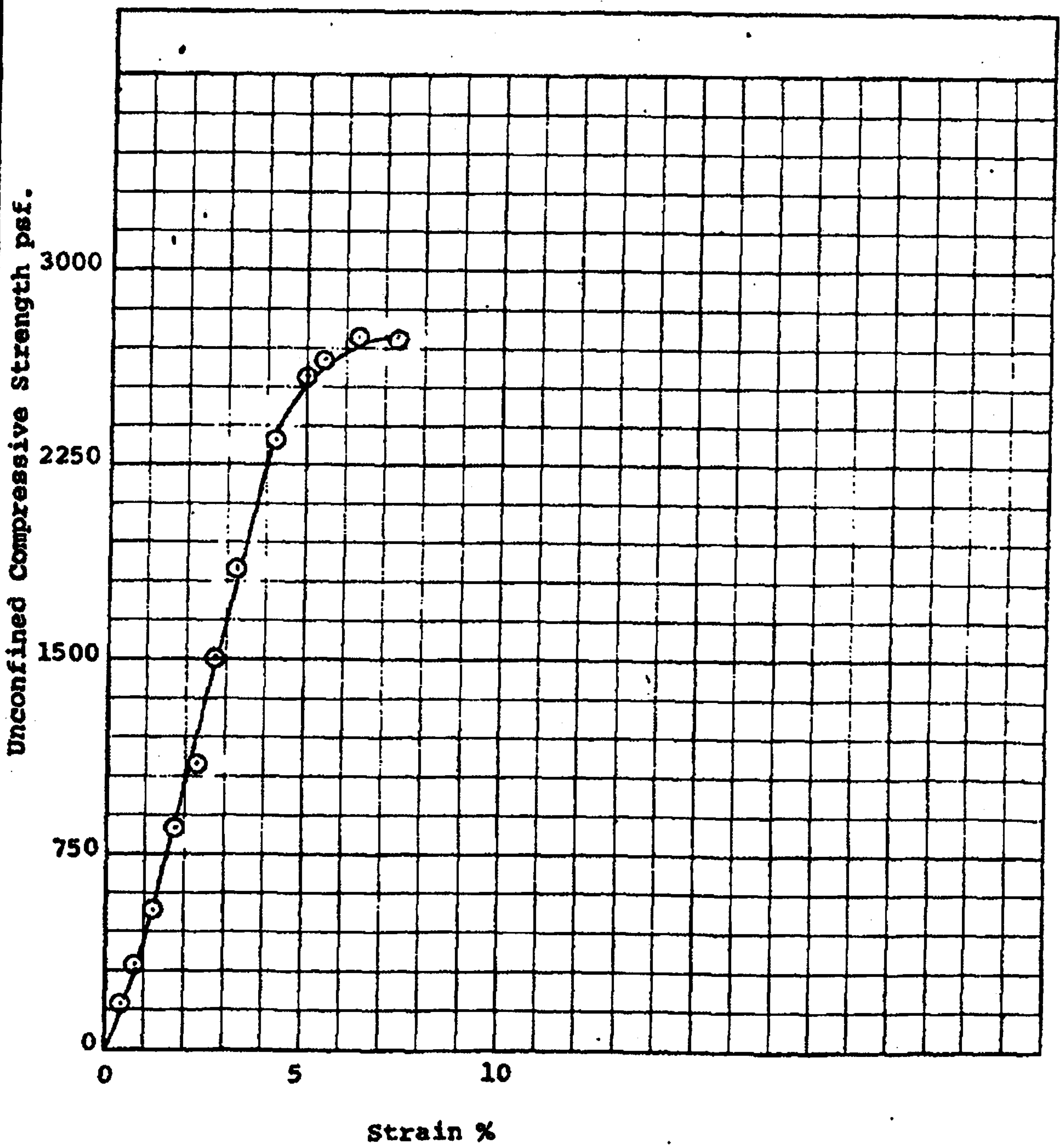
Boring: MU-8 **Sample:** UP-2 **Depth:** 82' - 84

Material: Gray organic clayey SILT, trace fine sand

Moisture Content: 57.9%

Unit Dry Weight: 64.0 pcf

Unit Wet Weight: 102.2 pcf



Job No. 661

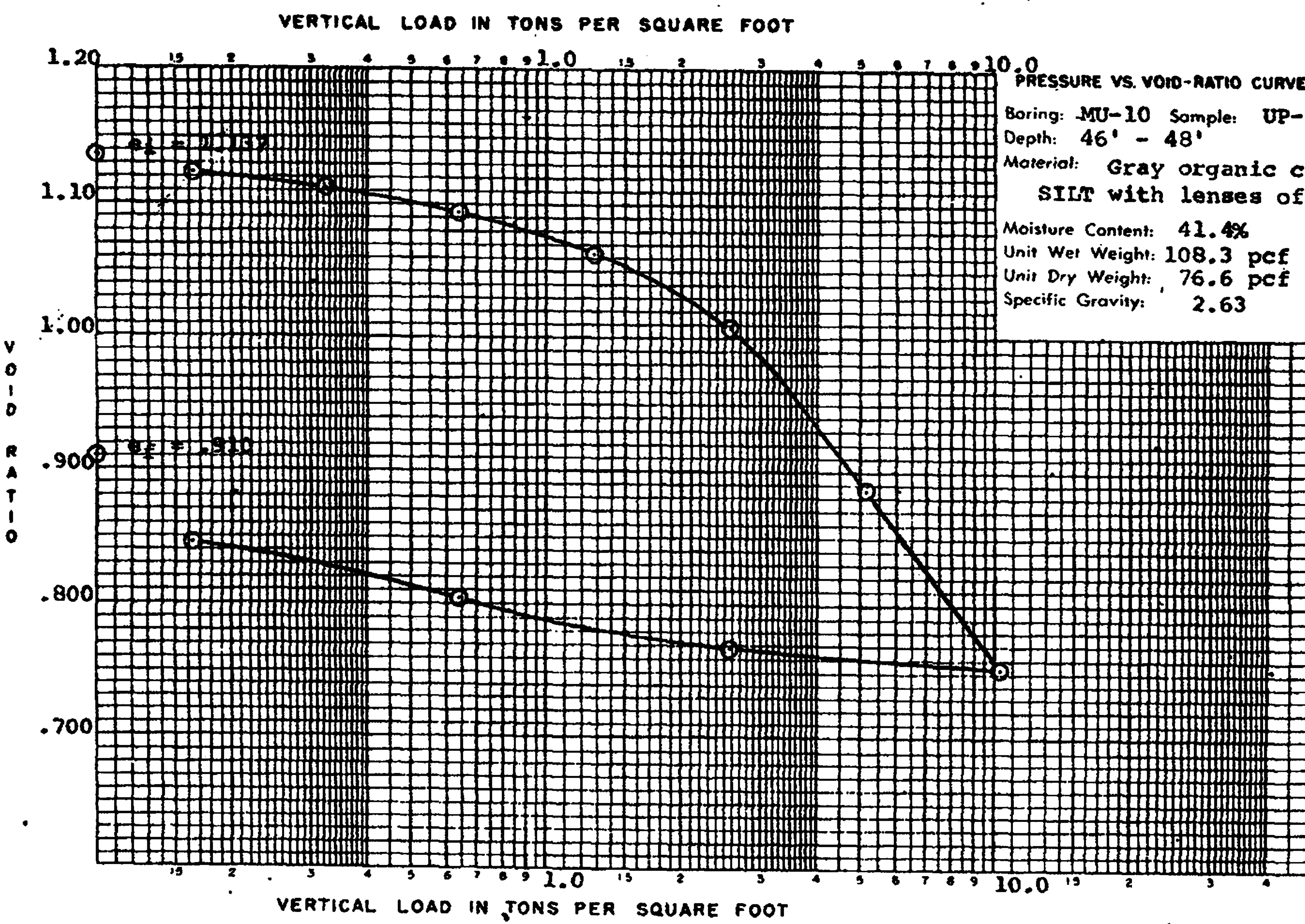
Prepared By VR Date 3/8/65

Checked By .... Date ....

Prepared By VE Date 3/9/65 Project 661

Checked By Date

STORCH ENGINEERS



PRESSURE VS. VOID-RATIO CURVES

Boring: MU-10 Sample: UP-1

Depth: 46' - 48'

Material: Gray organic clayey SILT with lenses of sand

Moisture Content: 41.4%

Unit Wet Weight: 108.3 pcf

Unit Dry Weight: 76.6 pcf

Specific Gravity: 2.63

Prepared By VE Date 3/9/65 Project 661

Checked By ________ Date ________

STORCH ENGINEERS

TIME - DEFLECTION CURVES

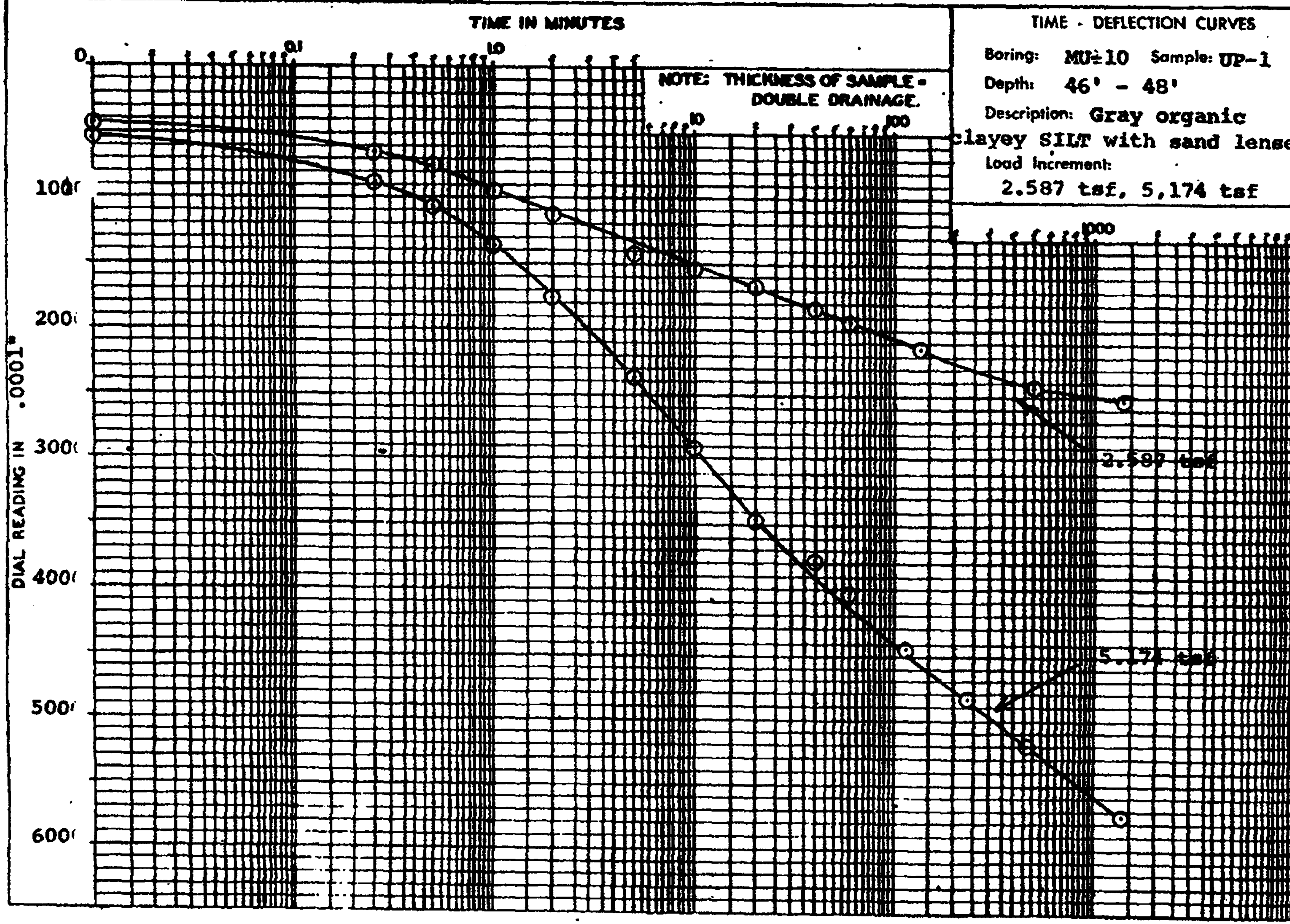
Boring: MU-10 Sample: UP-1

Depth: 46' - 48'

Description: Gray organic clayey SILT with sand lenses

Load Increment:

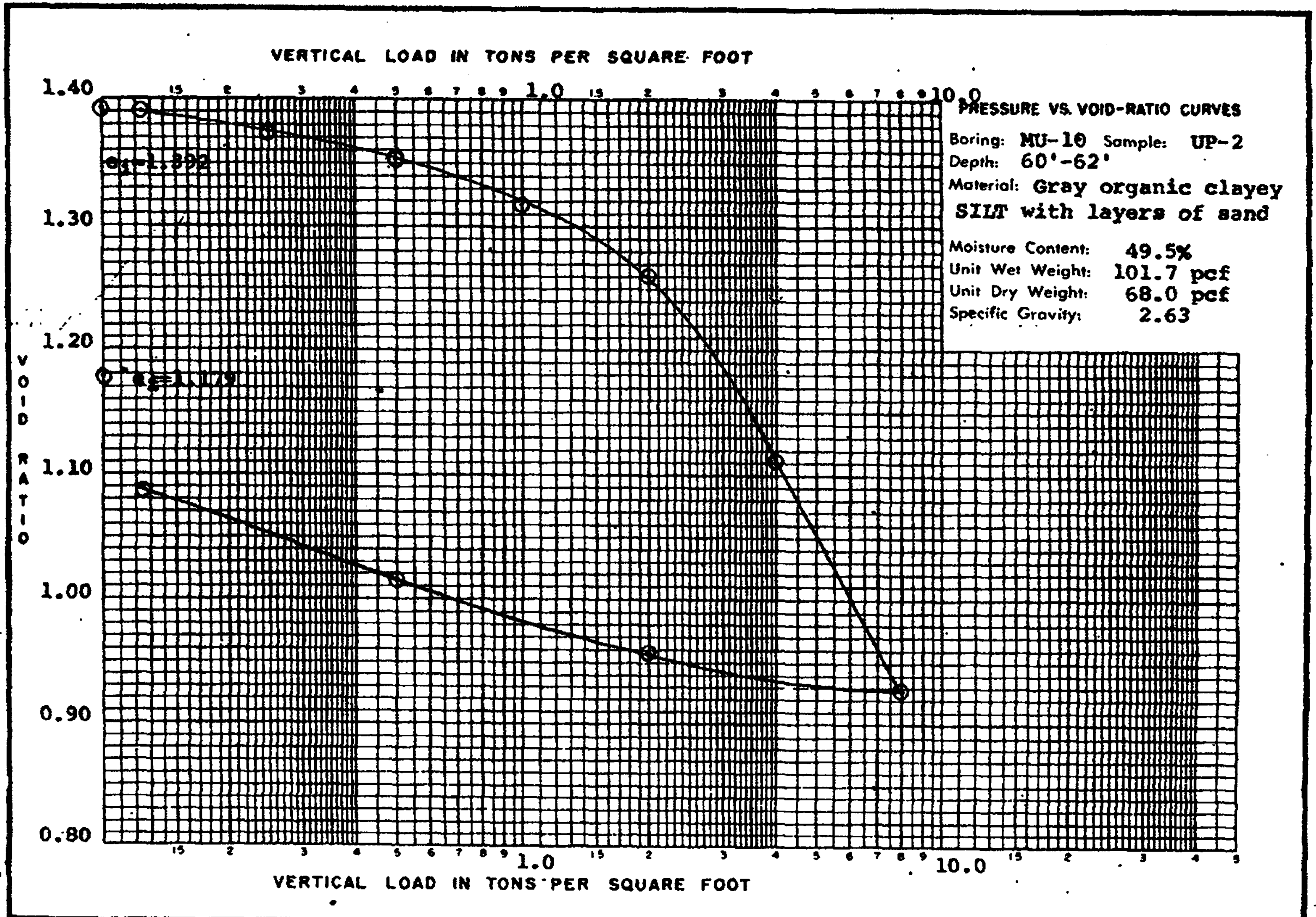
2.587 tsf, 5,174 tsf



Prepared By MDA Date 3/10/65 Project 661

Checked By __________ Date __________

STORCH ENGINEERS



Prepured By VE Date 3/9/65 Project 661

Checked By Date

STORCH ENGINEERS

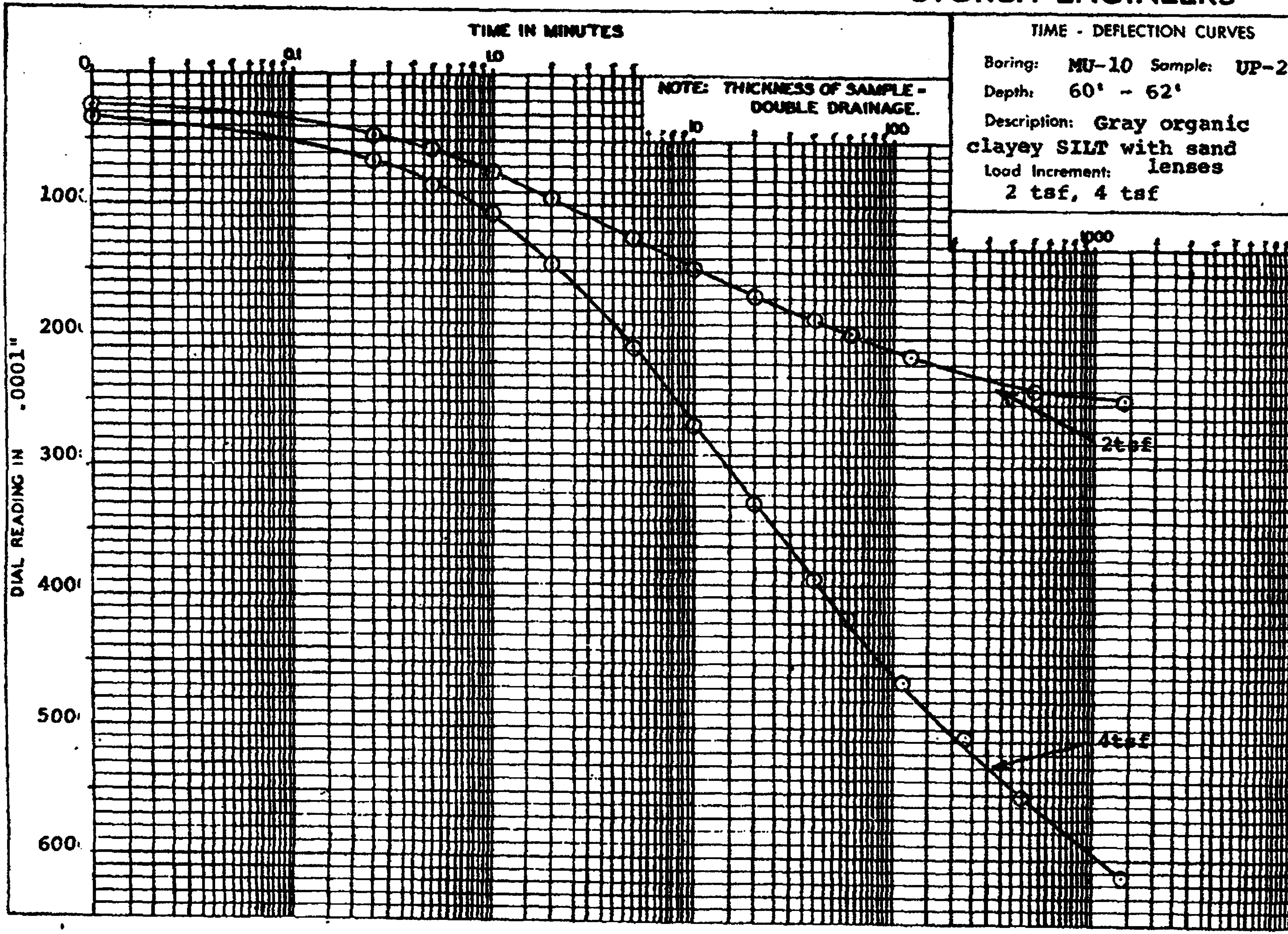
TIME - DEFLECTION CURVES

Boring: MU-10 Sample: UP-2

Depth: 60' - 62'

Description: Gray organic clayey SILT with sand lenses

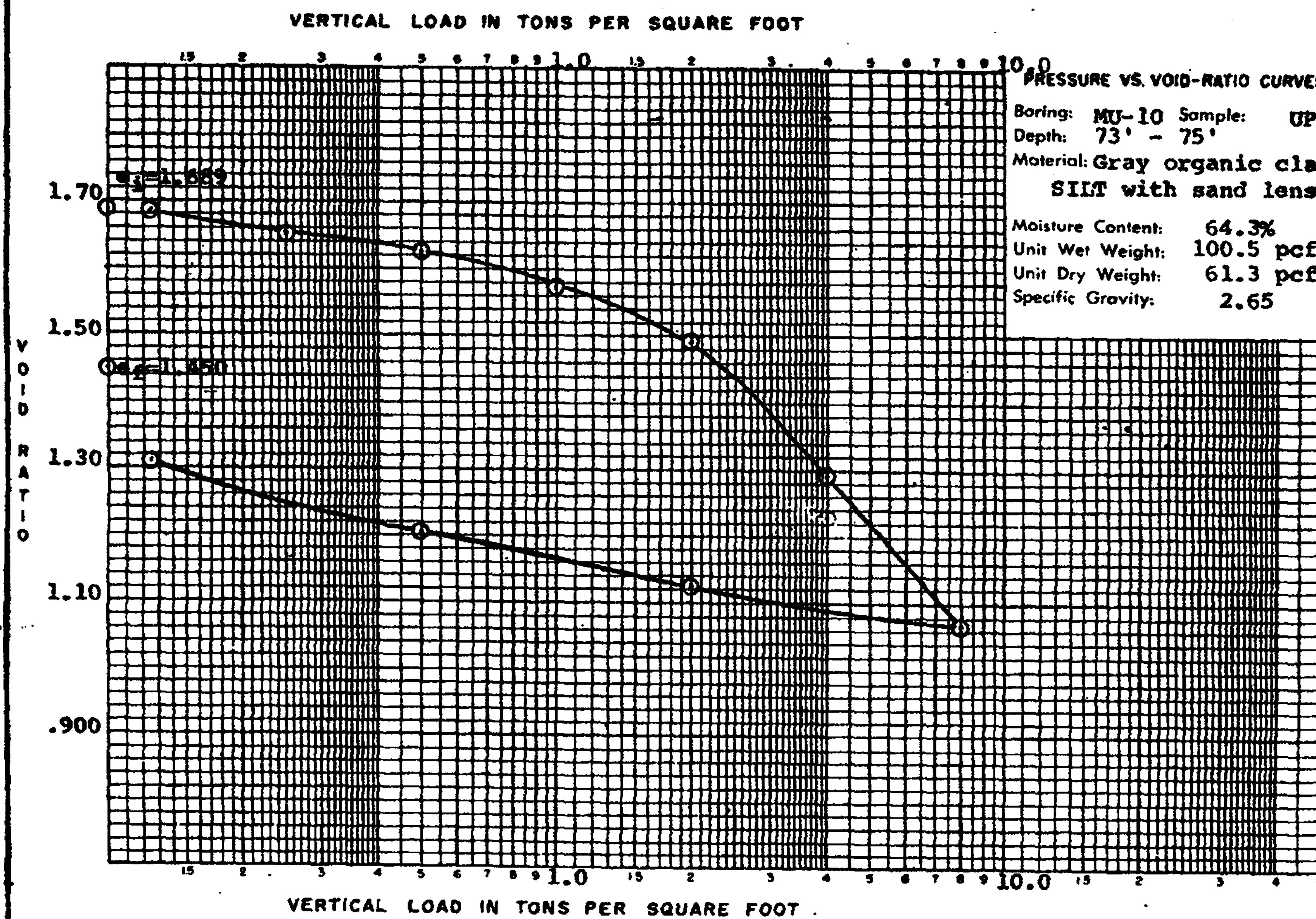
Load Increment: 2 tsf, 4 tsf



Prepared By VR Date 3/9/65 Project 661

Checked By Date

STORCH ENGINEERS



PRESSURE VS. VOID-RATIO CURVES

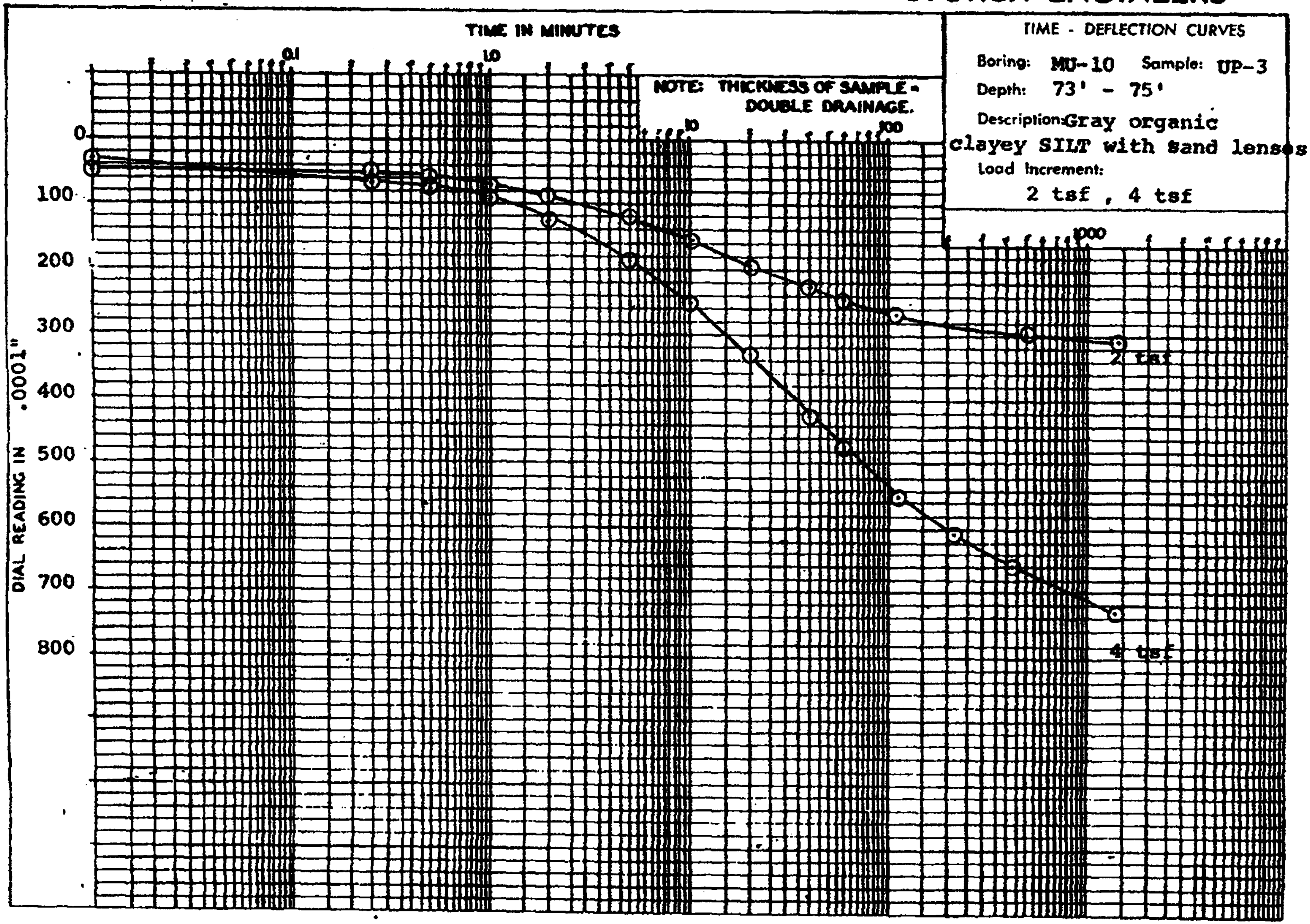
Boring: MU-10 Sample: UP-3
Depth: 73' - 75'
Material: Gray organic clayey SILT with sand lenses

Moisture Content: 64.3%
Unit Wet Weight: 100.5 pcf
Unit Dry Weight: 61.3 pcf
Specific Gravity: 2.65

Prepured By VB Date 3/9/65 Project 661

Checked By Date

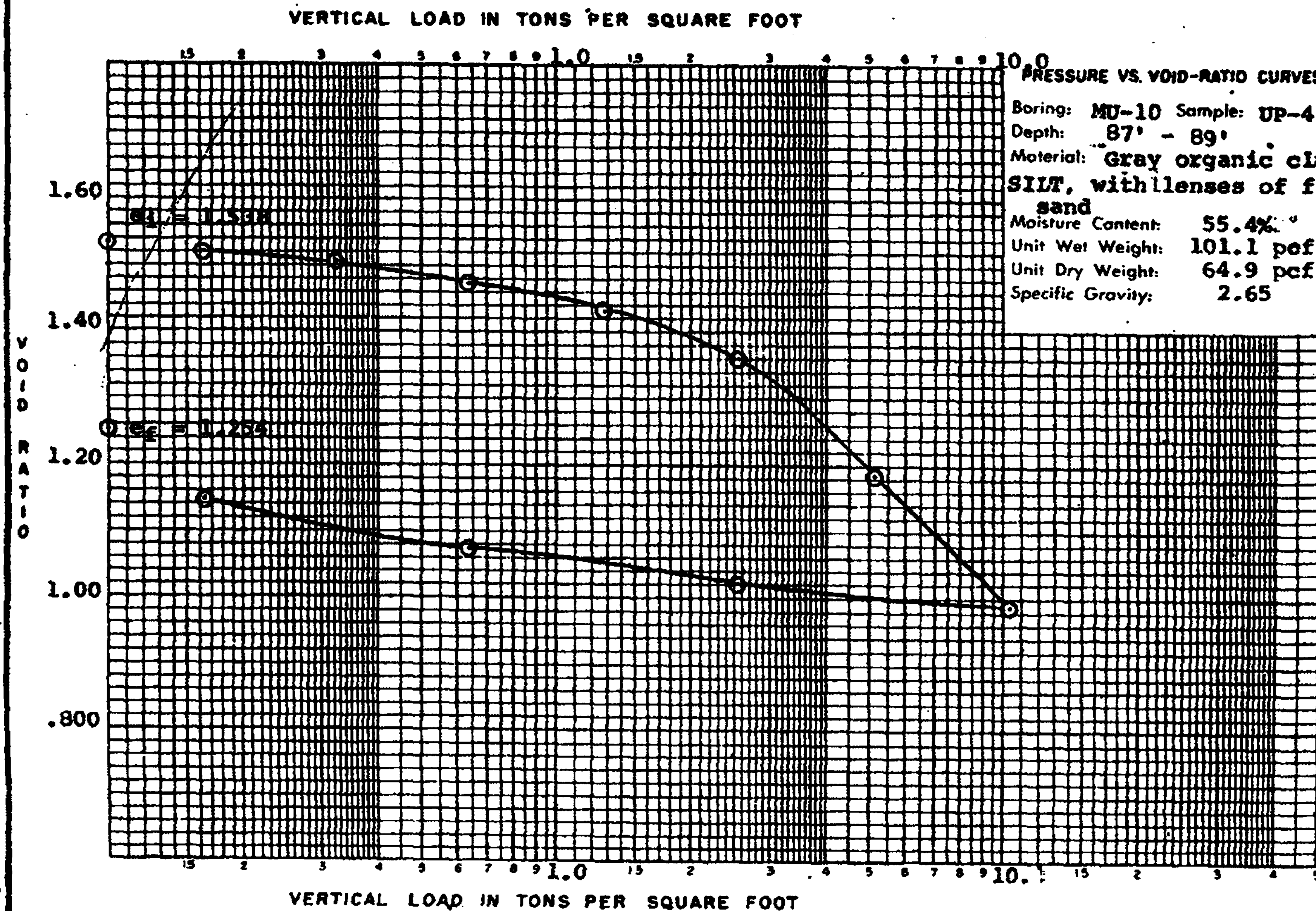
STORCH ENGINEERS



Prepared By VB Date 3/11/65 Project 661

Checked By Date

STORCH ENGINEERS



PRESSURE VS. VOID-RATIO CURVES

Boring: MU-10 Sample: UP-4
Depth: 87' - 89'
Material: Gray organic clayey SILT, with lenses of fine sand
Moisture Content: 55.4%
Unit Wet Weight: 101.1 pcf
Unit Dry Weight: 64.9 pcf
Specific Gravity: 2.65

Prepared By VB Date 3/9/65 Project 661

Checked By Date

STORCH ENGINEERS

TIME - DEFLECTION CURVES

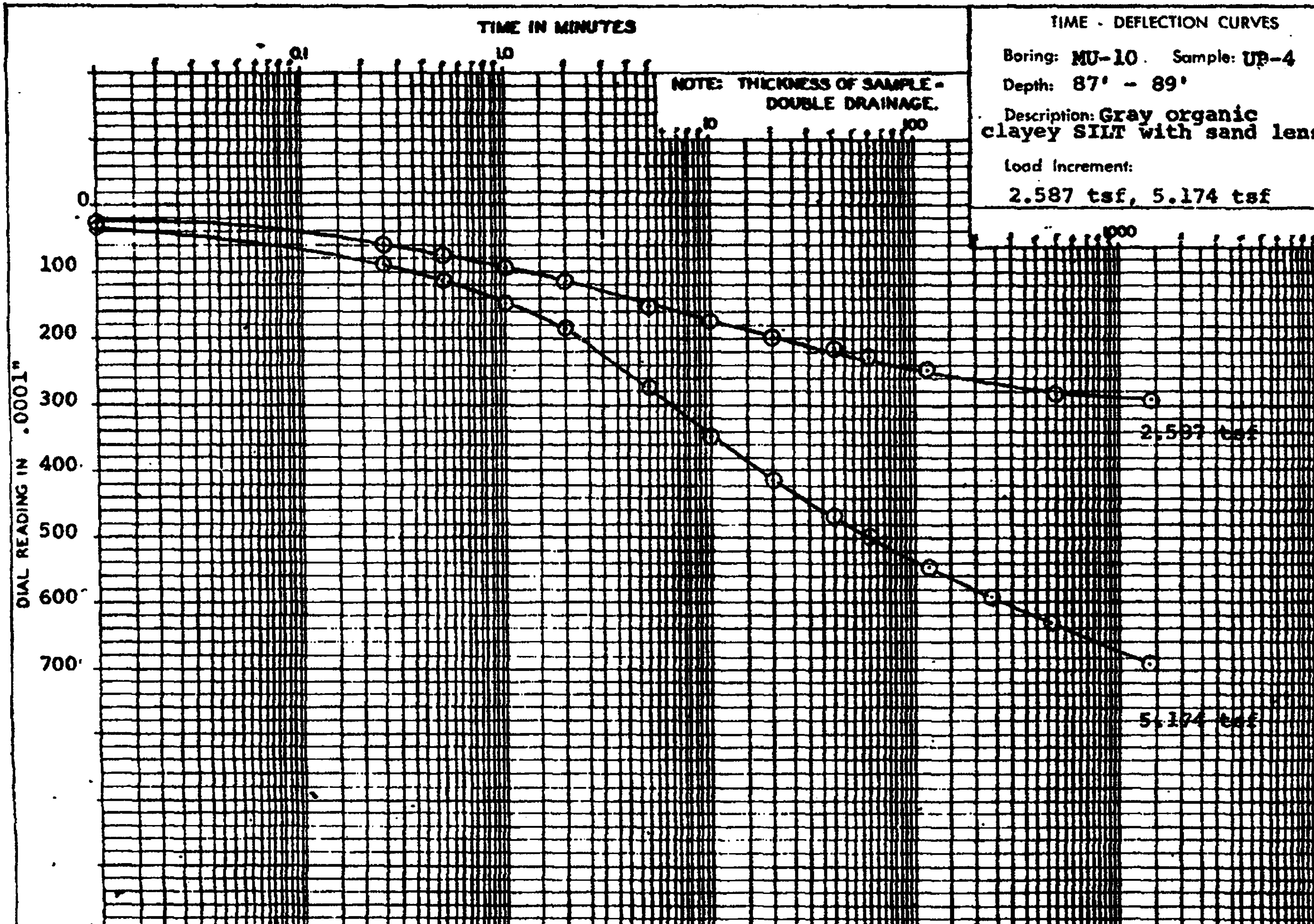
Boring: MU-10 Sample: UP-4

Depth: 87' - 89'

Description: Gray organic clayey SILT with sand lenses

Load Increment:

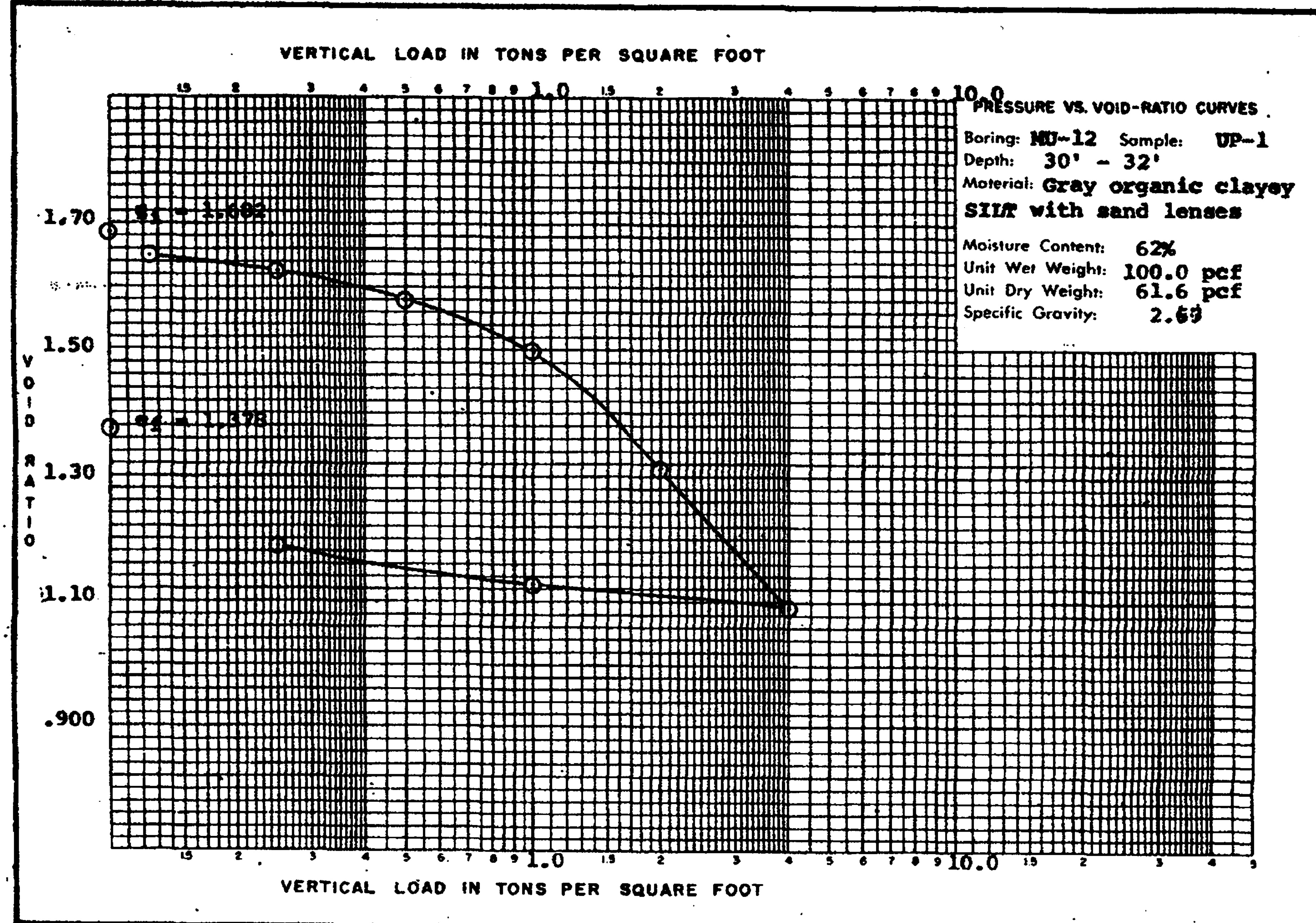
2.587 tsf, 5.174 tsf



Prepared By VR Date 3/20/65 Project 661

Checked By Date

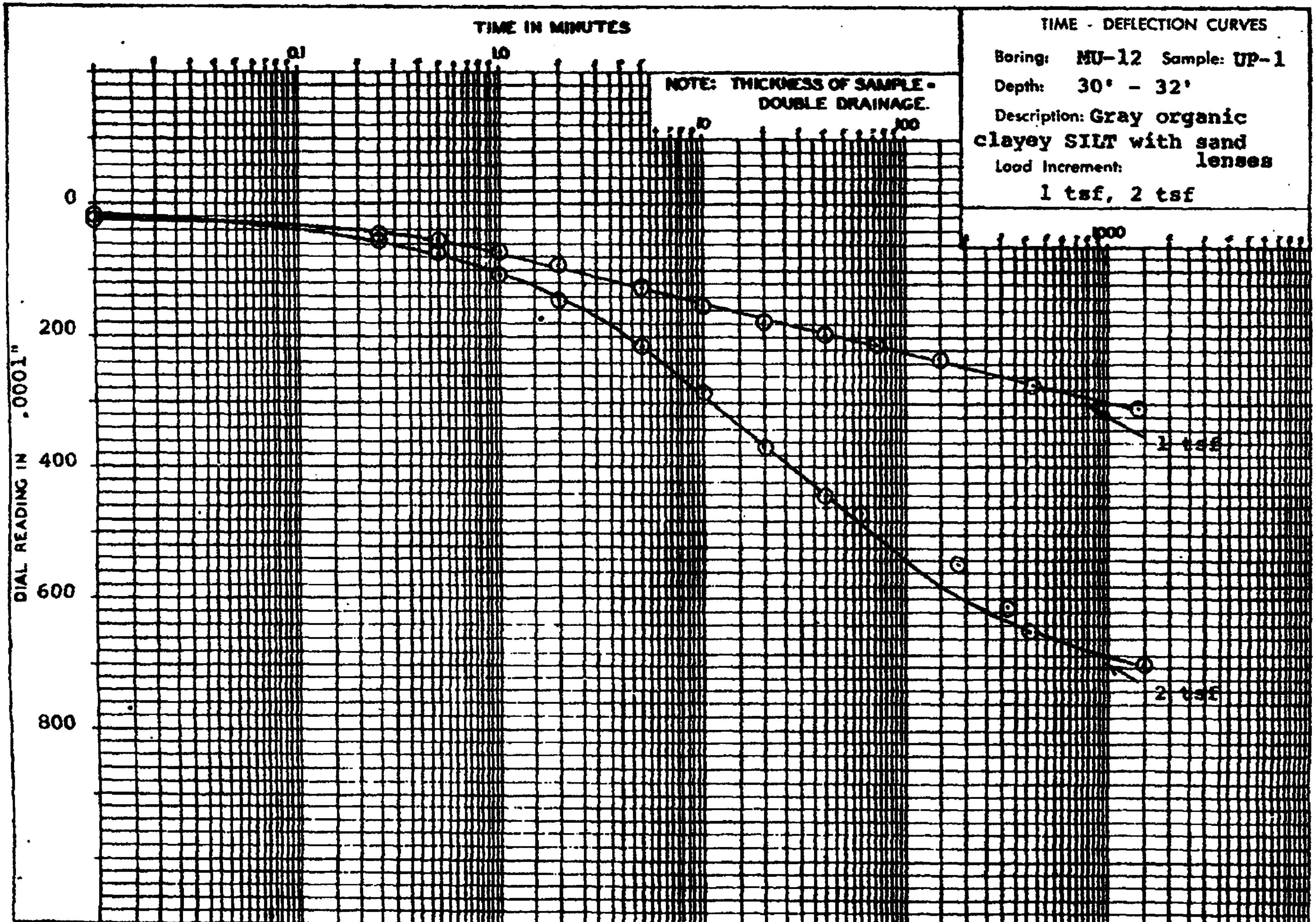
STORCH ENGINEERS



Prepared By VE Date 3/23/65 Project 661

Checked By ________ Date ________

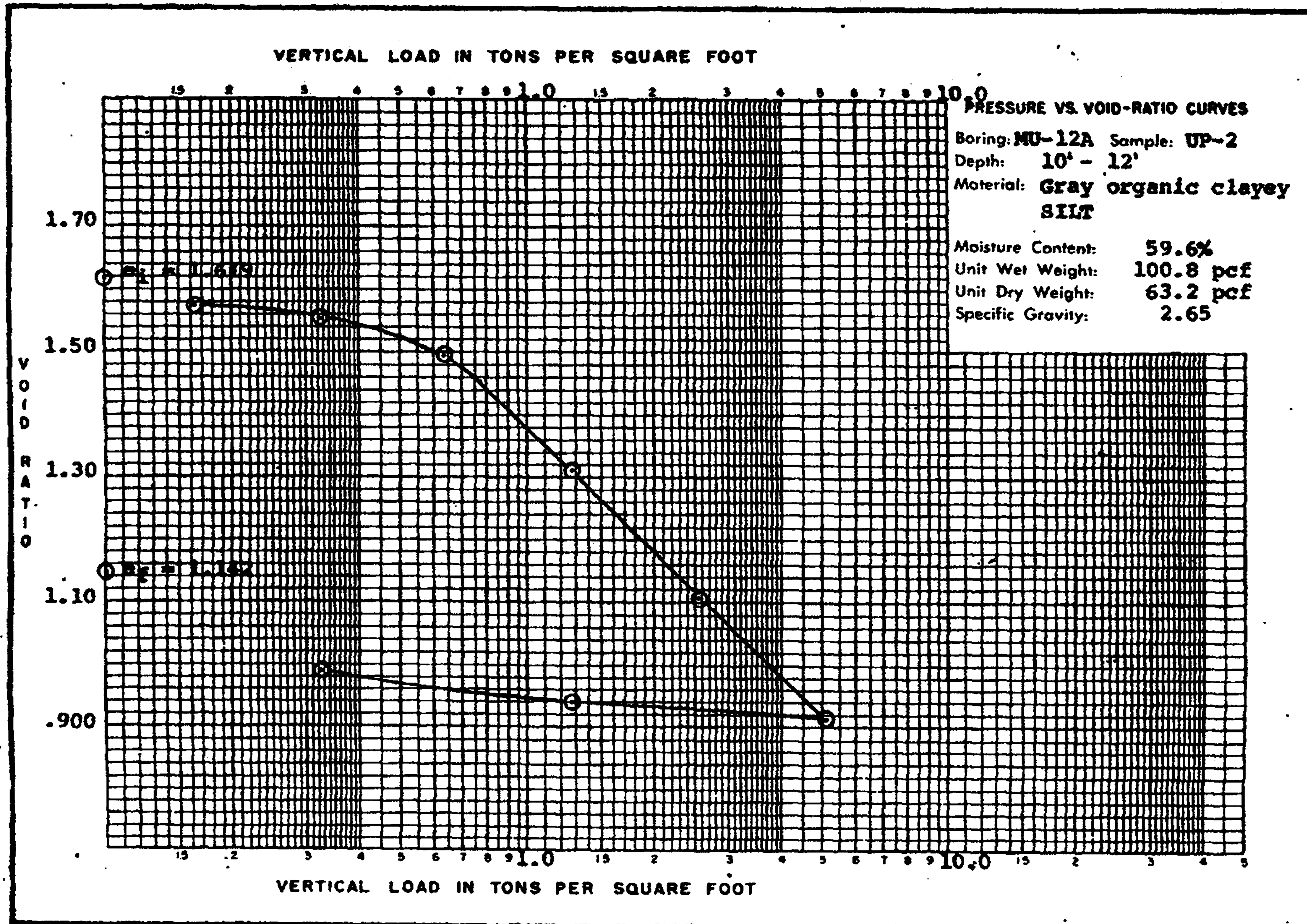
STORCH ENGINEERS



Prepared By VR Date 3/20/65 Project 661

Checked By Date

STORCH ENGINEERS



Prepared By VE Date 3/24/65 Project 661

Checked By ________ Date ________

STORCH ENGINEERS

TIME - DEFLECTION CURVES

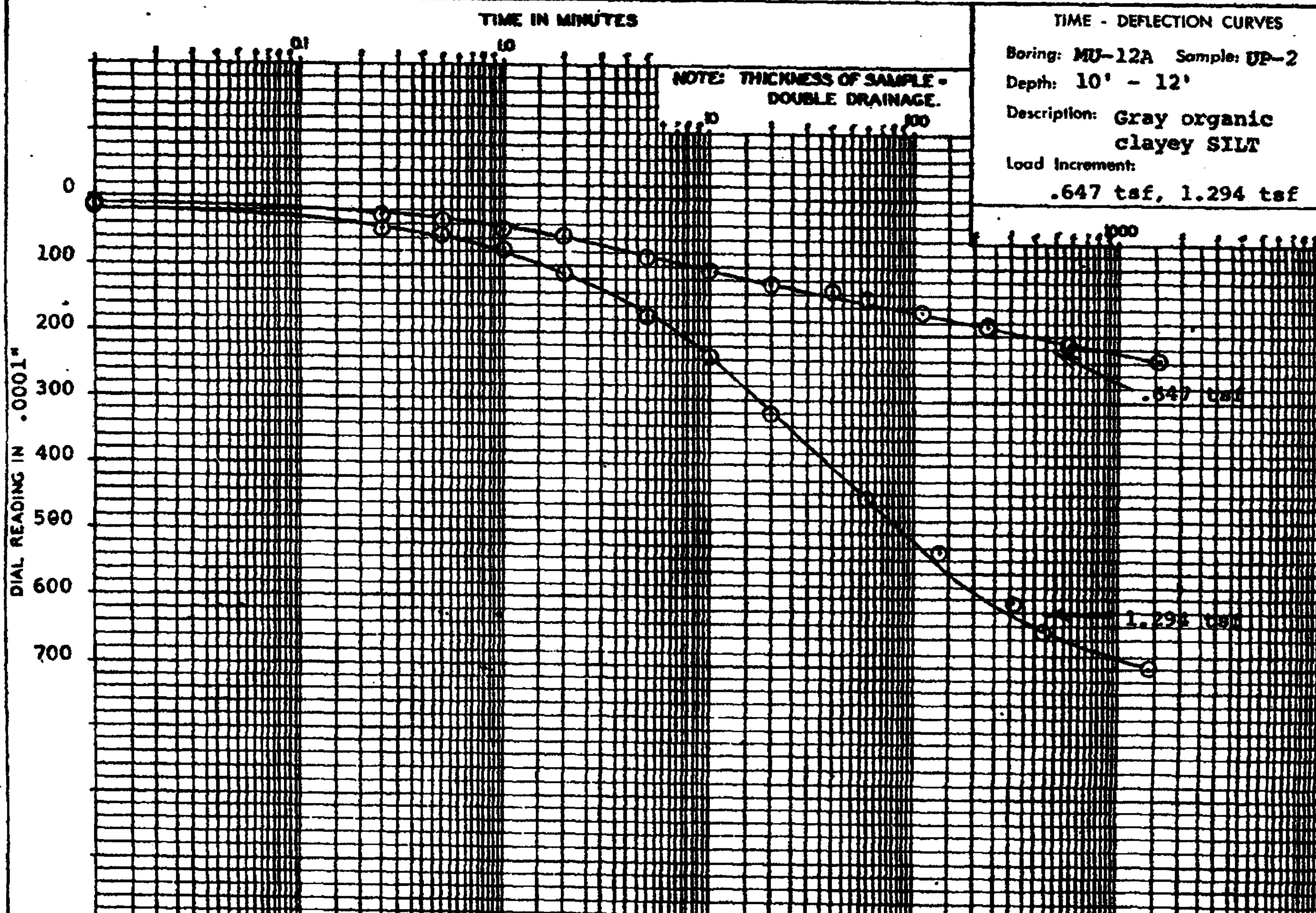
Boring: MU-12A Sample: UP-2

Depth: 10' - 12'

Description: Gray organic clayey SILT

Load Increment: .647 tsf, 1.294 tsf

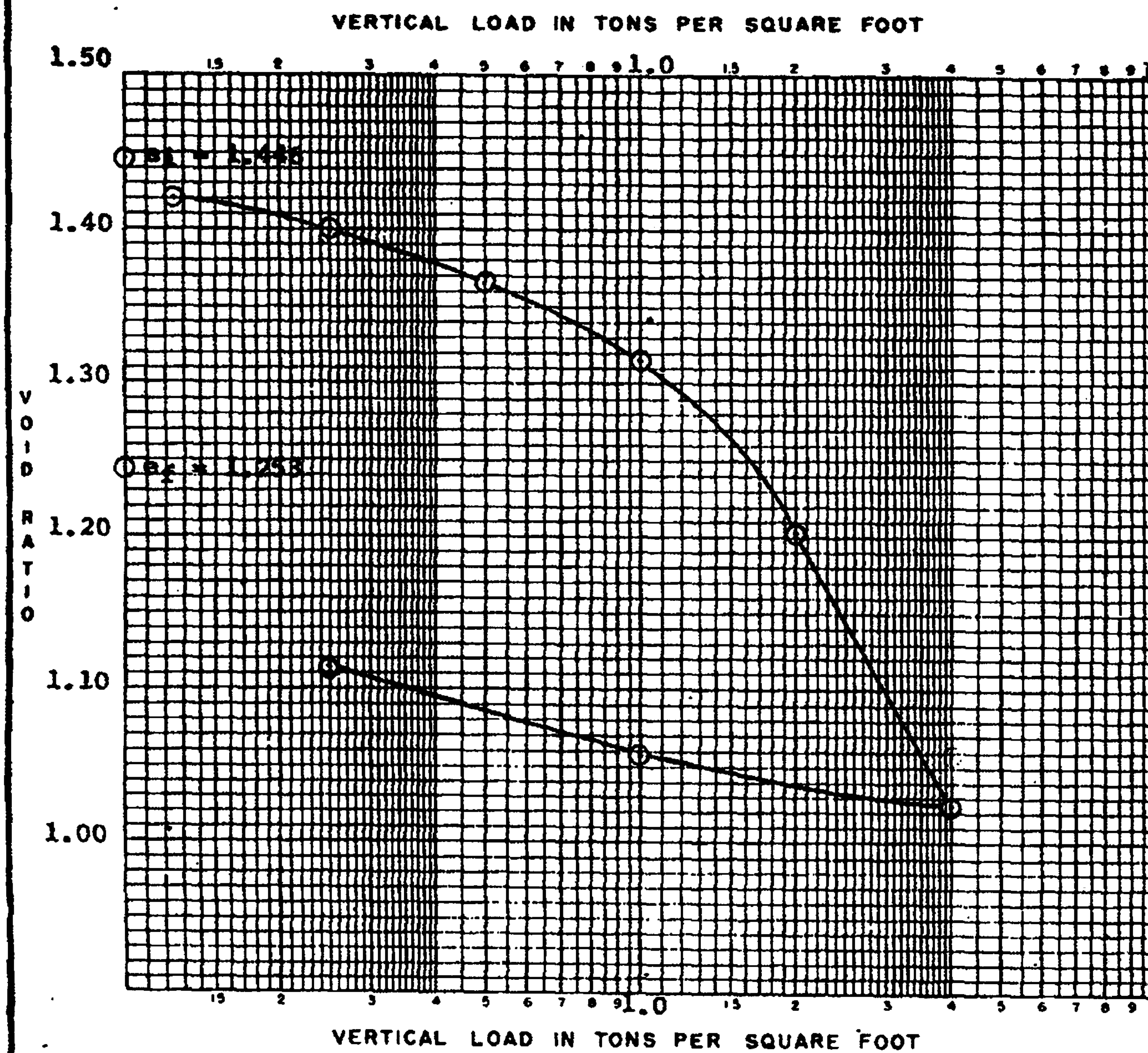
NOTE: THICKNESS OF SAMPLE = DOUBLE DRAINAGE.



Prepared By VR Date 3/20/65 Project 661

Checked By ________ Date ________

STORCH ENGINEERS



PRESSURE VS. VOID-RATIO CURVES

Boring: MU-13 Sample: UP-2

Depth: 44' - 46'

Material: Gray organic clayey SILT with lenses of fine sand

Moisture Content: 51.1%

Unit Wet Weight: 101.7 pcf

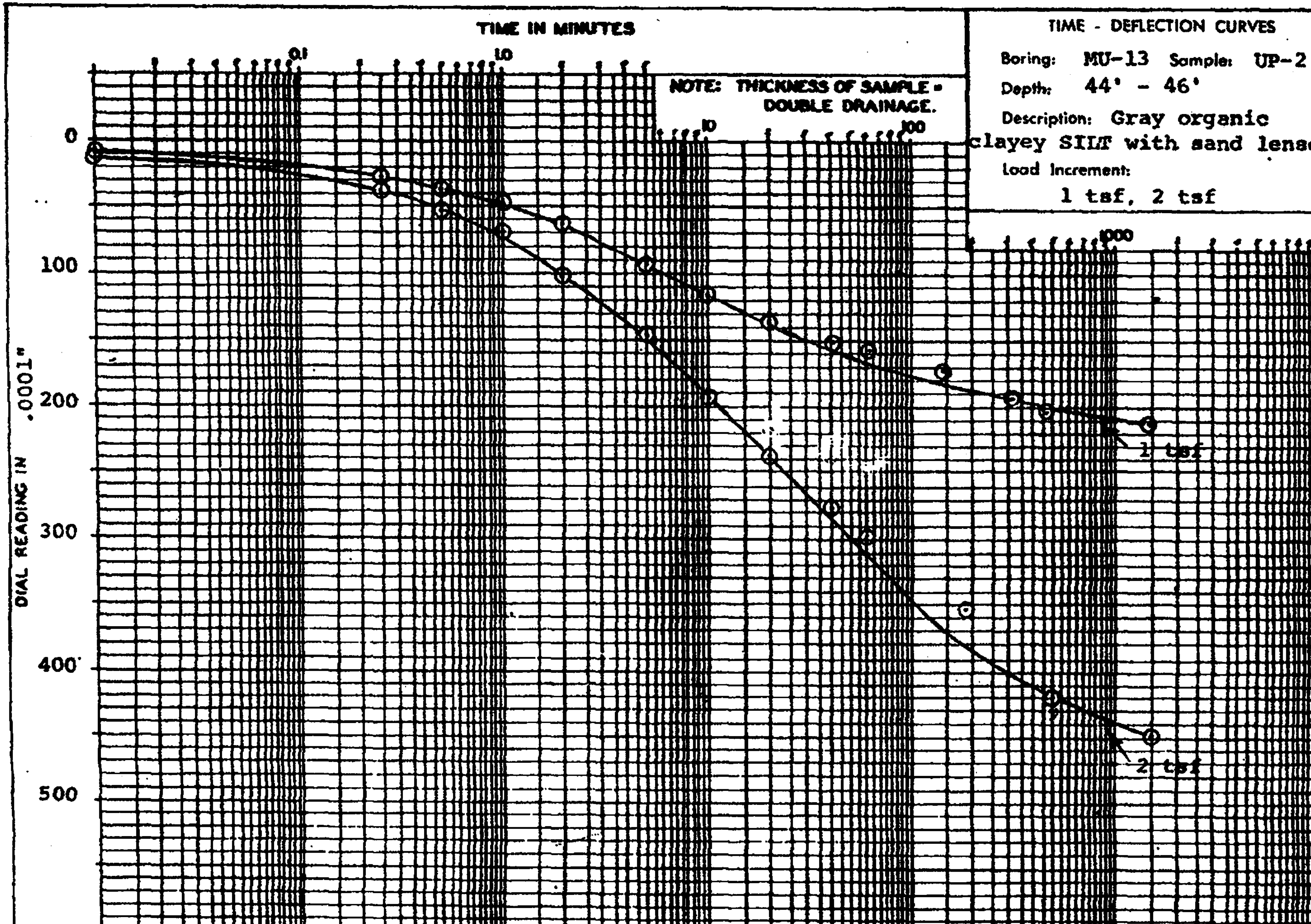
Unit Dry Weight: 67.2 pcf

Specific Gravity: 2.67

Prepared By VE Date 3/24/65 Project 661

Checked By Date

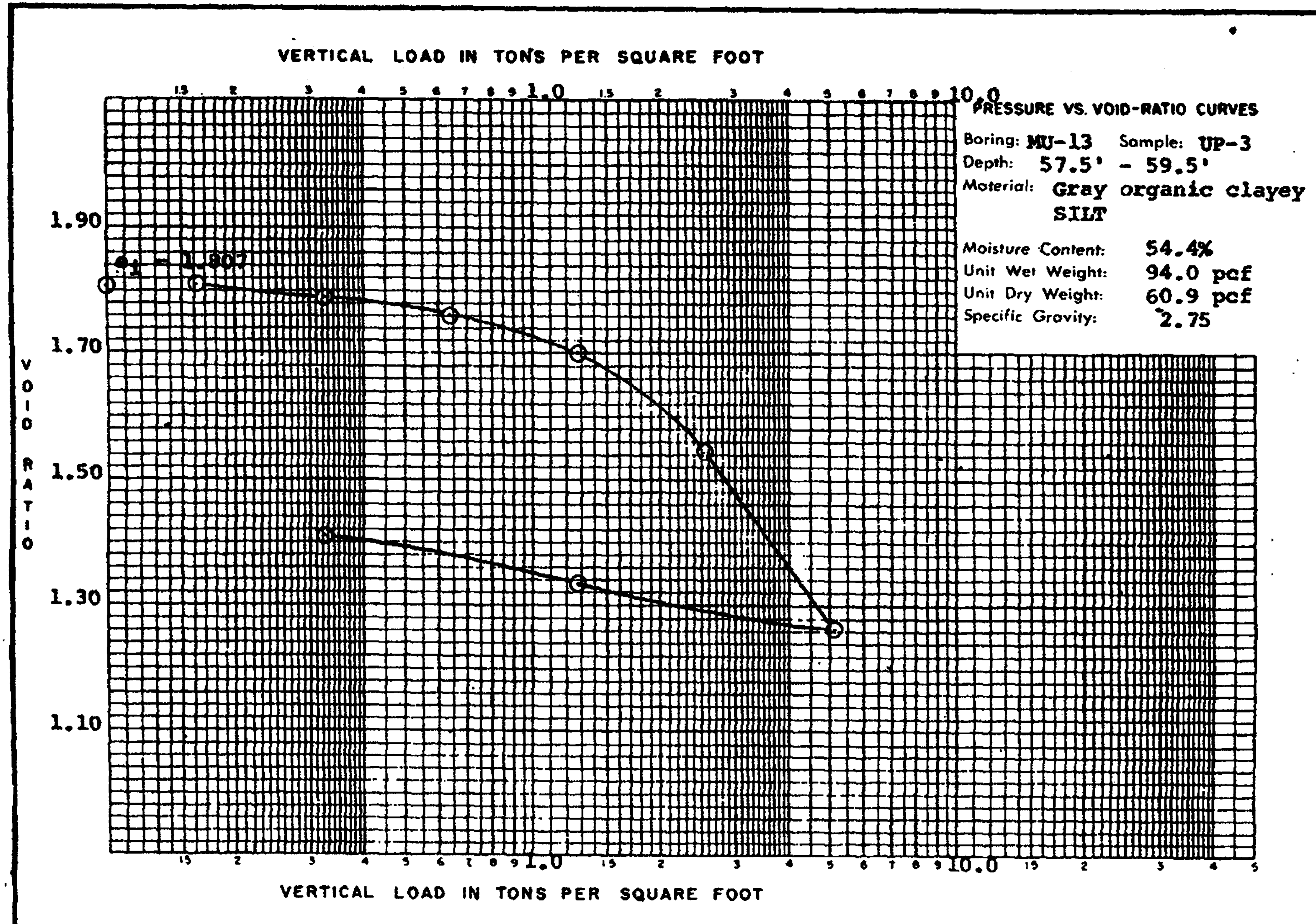
STORCH ENGINEERS



Prepared By VE Date 3/20/65 Project 661

Checked By __________ Date __________

STORCH ENGINEERS



Prepured By VE Date 3/24/65 Project 661

Checked By________ Date________

STORCH ENGINEERS

TIME - DEFLECTION CURVES

Boring: MU-13 Sample: UP-3

Depth: 57.5'-59.5'

Description: Gray organic clayey SILT with fine sand lenses

Load Increment:

1.294 tsf, 2.587 tsf

NOTE: THICKNESS OF SAMPLE = DOUBLE DRAINAGE.