Foster Gambee
GEOTECHNICAL, PC
14355 NW McNamee Road
Portland, OR 97231

INVEST 0969

October 5, 2010

David Harman
Wallowa County Health Care District
601 Medical Parkway
Enterprise, OR 97828

SUBJECT: GEOTECHNICAL INVESTIGATION, WALLOWA MEMORIAL HOSPITAL, MEDICAL OFFICE BUILDING, ENTERPRISE, OREGON

At your request, Foster Gambee Geotechnical, P.C., (Foster Gambee) has conducted a geotechnical investigation for the above-referenced medical office building, which will be located west of the existing Wallowa Memorial Hospital. The purpose of our investigation was to evaluate site conditions with respect to the office building plans and to provide geotechnical guidelines and criteria for suitably founding the office building and associated improvements on the site. The Vicinity Map, Figure 1, shows the general location of the project site on the north side of the City of Enterprise approximately ½ mile northwest of the intersection of Highway 82 and Highway 3.

Our scope of work for this investigation was limited to:

- Reviews of the available geologic literature for the property area and available geotechnical-related documents for the adjacent hospital site.
- A detailed ground level reconnaissance of the property in the vicinity of the proposed office building and associated improvements, including condition surveys of existing pavements and exposed portions of existing hospital building foundations and floor slabs.
- Exploration of subsurface conditions in the area of the proposed office building and associated improvements with hand auger borings and backhoe-excavated test pits.
- A site visit to a local rock quarry to evaluate potential fill/surcharge materials.
- Laboratory testing.
- Engineering studies and analyses.

We understand that existing pavements have performed satisfactorily to date and that new pavement sections will be constructed to match existing pavement sections. In this regard, our scope of work did not include the investigation of subsurface conditions in pavement areas or the design of pavement sections.

P: 503-284-1370 **F:** 503-284-1113
E: john@fostergambee.com

Our fee for the above work and terms under which services were provided are in accordance with our August 13, 2010 proposal. This letter report describes the work accomplished and provides our conclusions and recommendations regarding geotechnical aspects of the project.

PROJECT DESCRIPTION

As shown on the Site Plan, Figure 2, the proposed office building will be located approximately 70 ft west of the existing Wallowa Memorial Hospital, the construction of which we understand was completed approximately 5 years ago. We understand the office building will be a single-story-with-mezzanine, wood-frame structure with a footprint measuring approximately 90-by-190-ft. As currently envisioned, the office building will be supported using conventional spread footing foundations and will have a concrete slab-on-grade floor. We anticipate the building will have relatively lightly loaded foundations (perimeter line foundation and interior column loads less than about 3 kips/ft and 50 kips, respectively). As currently planned, the building's finish floor elevation will be 3727 ft (Site Plan datum). In this regard, nominal cuts and fills up to about 4-ft-thick will be required to establish the building on the site.

Associated improvements planned in conjunction with the proposed office building include pavements, walkways, and a stormwater retention pond(s).

BACKGROUND INFORMATION

As part of this investigation, Foster Gambee reviewed the following geotechnical-related documents pertaining to the adjacent hospital site. The documents were provided to Foster Gambee by Clark/Kjos Architects, LLC and are listed below in chronological order (oldest to most recent).

1. Patrick B. Kelly Consulting Engineer, Technical Memorandum, "Preliminary Geotechnical Engineering Report; Proposed New Wallowa Memorial Hospital Site; Enterprise, OR," August 8, 2004.
2. Patrick B. Kelly Consulting Engineer, Technical Memorandum, "Geotechnical Design Recommendations; Proposed New Wallowa Memorial Hospital; Enterprise, OR," October 18, 2004.
3. Patrick B. Kelly Consulting Engineer, Technical Memorandum, "Summary Report on Pavement Design; Proposed New Wallowa Memorial Hospital Site; Enterprise, OR," November 16, 2004.
4. Patrick B. Kelly Consulting Engineer, Technical Memorandum, "Surcharge Fill; Proposed New Wallowa Memorial Hospital Site; Enterprise, OR," January 27, 2005.
5. Patrick B. Kelly Consulting Engineer, Technical Memorandum, "Comments Regarding Materials and Related Items Regarding Surcharge Filling and Site Grading; Proposed New Wallowa Memorial Hospital Site; Enterprise, OR," February 4, 2005.

6. Patrick B. Kelly Consulting Engineer, Memorandum, “Settlement Plate Readings @ Surcharge Fill; Wallowa Memorial Hospital Site; Enterprise, OR,” July 20, 2005.

The following background information regarding the adjacent hospital site was obtained from our review of the above-referenced documents.

> Subsurface explorations (borings and test pits) performed by Patrick B. Kelly Consulting Engineer (PBK) indicate the hospital site is mantled by fine-grained (primarily silt) deposits to depths in the range of about 7 to 8.5 ft. The silt has a relative strength of medium dense and is of medium to low compressibility in the upper 2 ft or so. Below a depth of about 2 ft, the silt has a relative strength of soft to very soft and is generally highly compressible. The relatively soft silt soils are underlain by a deposit of dense to very dense sand and gravel that extends to an estimated depth of 50 to 60 ft. At the time of exploration (late summer/fall of 2004), groundwater was encountered at depths in the range of about 2 to 5 ft and is expected to rise to near the ground surface during the wet season.
>
> PBK concludes that the fine-grained soils that mantle the site are not well suited for supporting building loads using conventional spread footings due to the potential for excessive total and differential settlements. PBK provides specific recommendations for surcharging building areas (i.e., placing a temporary fill in excess of that required to establish the building on the site in order to increase the rate and magnitude of settlement of compressible soils so as to effectively limit post construction building settlement). The surcharge consisted of 1½-in.-minus crushed rock from a local quarry (Moffit Bros.). Following site stripping and placement of a geotextile strength/separation fabric, the surcharge was placed to an elevation of about 5 ft above floor slab subgrade. Monitoring of settlement plates indicated that the surcharge induced total and differential settlements on the order of 2 in. and 0.75 in., respectively. The surcharge achieved its planned objective after 10 weeks and was approved for removal.
>
> The hospital and associated maintenance building are supported on conventional spread footing foundations and have concrete slab-on-grade floors.

Based on a September 28, 2010 telephone conversation with Eric Arnst of Anderson Perry & Associates, Inc., the firm that performed laboratory compaction and field density testing during placement and compaction of the 1½-in.-minus crushed rock structural fill and surcharge material, a typical dry density of 125 pcf was achieved. Based on modified Proctor (ASTM D1557) compaction testing the surcharge material had a maximum dry density of 137.7 pcf at an optimum moisture content of 8.5%.

SITE CONDITIONS

Geology

A review of the available geologic literature indicates the project area is mantled by Holocene alluvium which is underlain by Miocene basalt and andesite flows and breccia.[1] The alluvium generally consists of mixtures of silt, sand, gravel and cobbles and contains local deposits of loess and poorly sorted pyroclastic and glacial debris.

Surface Conditions

A ground-level reconnaissance of the proposed building area was conducted on September 15 and 16, 2010. The purpose of the reconnaissance was to evaluate surface materials and conditions. As part of the reconnaissance, we also observed the condition of exposed portions of existing hospital building foundations, floor slabs, exterior flatwork, and pavements with respect to settlement.

The site of the proposed office building is bounded by the existing hospital facility to the east, Medical Parkway to the south and west, and a gravel surface road and undeveloped property to the north. We understand that prior to hospital ownership the property was used for agricultural purposes (grazing and/or crop production). The ground surface over the majority of the site is relatively flat to gently sloping down to the west with surface elevations typically in the range of 3723 to 3726 ft. As shown on Figure 2, a soil stockpile that we understand dates from the initial hospital construction is located in the southwestern portion of the site and rises several ft (up to elevation 3730 ft) above surrounding grades. An existing stormwater retention pond is located within the east end of the proposed building area. The pond appears to have been constructed by excavating and placing excavation spoils to create a perimeter berm at about elevation 3726 ft. The surface elevation of the pond water was measured by Anderson Perry & Associates, Inc., the project surveyor, to be 3724.7 ft on August 10, 2010. The pond discharges through a culvert to a surface ditch that directs the water to the north and off of the property. Probing with a steel rod at several locations indicates that up to several in. of soft sediment has accumulated/developed in the bottom of the pond.

The majority of the site is vegetated with a thick growth of field grass. The eastern portion of the building area in the vicinity of the stormwater pond has a finished landscape that includes walkways, lawn, trees, and shrubbery. Surface soils at the site generally consist of brown-gray silt. In general, the surface soils within the proposed development area appear moderately well drained. With the exception of the aforementioned pond, we observed no ponded water or currently active springs within the area to be developed.

A condition survey of exposed portions of existing hospital and service/maintenance building foundations and floor slabs was performed on September 15, 2010 during a walk-through of the facility with Dan McCarthy, Plant Operations Manager. Exposed portions of the hospital building's perimeter foundation were observed to be free of significant (wider than hairline) cracks. The hospital floor slab is covered with carpet and marmoleum and could not be directly observed. However, we observed no significant reflective cracking through the marmoleum. The perimeter foundation for the service/maintenance building is generally not exposed. Several cracks up to 1/8-in.-wide were observed in exposed portions of the slab on-grade floor of the service/maintenance building. The floor slab cracks have no significant vertical offset and are in an area of widely spaced crack control joints, indicating that they are primarily the result of concrete shrinkage (as opposed to settlement). According to Mr. McCarthy, interior sheet rocked walls in the hospital buildings are free of cracks (with the exception of localized areas), doors operate freely without sticking in their jambs, and he is not aware of any other indicators of noticeable building settlement.

Exterior flatwork (walkways, patios, etc.) and pavements (asphalt concrete) were observed to be free of significant cracks, depressions, or other indicators of significant settlement.

FIELD EXPLORATIONS AND LABORATORY TESTING

Subsurface conditions in the area of the proposed office building were explored on September 15, 2010 with three hand auger borings, designated B-1 through B-3 and on September 16, 2010 with four test pits, designated TP-1 through TP-4. The hand auger borings were drilled to depths of 6.3 to 7.7 ft. The test pits were excavated to depths in the range of 8.5 to 9 ft using a Hitachi 225 tracked excavator equipped with a 3-ft-wide bucket. The excavator is owned and operated by Moffit Brothers Excavation, LLC, of Lostine, Oregon. The approximate locations of the explorations are shown on Figure 2.

The relative consistency or density of subsurface materials was evaluated by observing excavation/ boring spoils and noting the relative ease of test pit excavation and hand-auger advancement. A geotechnical engineer from our firm observed the drilling of the hand auger borings and the excavation of the test pits, maintained a detailed log of the conditions and materials encountered, and obtained representative disturbed (grab) and undisturbed (Shelby tube) samples of the soils disclosed by the explorations. The samples were saved for further examination and laboratory testing. The approximate undrained shear strength of fine-grained soils encountered in the test pits was determined using a Torvane shear device, a hand-held apparatus inserted into the sidewalls of the test pit. The torque required to fail the soil in shear around the vanes is measured using a calibrated spring.

Materials and conditions encountered in the test pits and borings, along with field and laboratory test data, are summarized in the Test Pit Logs, Figure 3 and the Boring Logs, Figure 4. The terms used to describe the soils encountered in the explorations are defined in Table 1.

All samples obtained as part of the field exploration program were examined in the laboratory where their field classifications were noted and modified where necessary. In addition to visual classification, the laboratory testing program completed for this investigation included determinations of natural moisture content (ASTM D2216), Torvane shear strength, dry density (ASTM D2937), and consolidation characteristics (ASTM D2453). Consolidation testing was performed on two samples to obtain data on the compressibility characteristics of the fine-grained soils that mantle the site.

Moisture content, field and laboratory Torvane shear strength, and dry density values are presented on Figures 3 and 4. The results of the two consolidation tests performed as part of this investigation are presented on Figure 5 in the form of curves showing effective stress versus percent strain. The initial and final moisture contents and dry unit weights of the samples were determined in conjunction with the consolidation tests and are presented at the top of the figure.

SUBSURFACE CONDITIONS

Soils

As disclosed by the subsurface explorations performed as part of this investigation, the native soil profile in the area of the proposed office building consists of several (6 to 8.5) ft of silt overlying sandy gravel. The relative consistency of the native silt typically decreases with depth from stiff to very stiff (Torvane shear strength values in excess of 0.5 tsf) to soft to medium stiff (Torvane shear strength values less than 0.5 tsf) below depths in the range of 3 to 3.5 ft. The upper, more competent silt generally contains a trace to some clay (locally clayey with depth) and scattered organics and is heavily rooted in the upper 4 to 8 in. Locally, the upper silt unit is loose to a depth of about 10 in. possibly as the result of disturbance during hospital construction or past agricultural activities. The lower, softer silt has a more varied clay content (trace to clayey), scattered to frequent organics, and a gravel content that increases from essentially no gravel to gravelly with depth. Natural moisture contents for the native silt range from 24 to 53%. Consolidation testing indicates the compressibility characteristics of the native silt are highly variable. Preconsolidation pressures for the two samples are approximately 0.5 and 1.0 tsf. The test data also indicate the compressibility of the native silt is relatively low for stresses below the preconsolidation pressure and moderate to very high for stresses above the preconsolidation pressure.

Sandy gravel was encountered below the native silt in all of the explorations performed as part of this investigation. The gravel is typically fine to coarse and subrounded. The sandy gravel unit contains a trace to some silt (grading cleaner, i.e., less silt, with depth) and scattered cobbles to about 6 in. size. Based on the relative difficulty of excavator advancement and the results of Standard Penetration Testing performed as part of the investigation of the adjacent hospital site, the relative density of the sandy gravel is generally in the range of dense to very dense.

Based on surface exposures and as disclosed by borings B-2 and B-3, up to several ft of fill material is present locally within the proposed office building area, including the soil stockpile in the southwest corner of the building area, the berm associated with the stormwater retention pond, and minor amounts of fill elsewhere. Based on our observations, the fill is comprised primarily of loose silt. In general, the fill does not appear to have been systematically placed and compacted as structural fill.

Groundwater

Groundwater was encountered in all of the explorations performed as part of this investigation. Heavy groundwater seepage was encountered in the four test pits within the sandy gravel unit at depths of 7 to 8.5 ft with lighter seepage occurring locally at shallower depths. Due to the fact that the test pits were backfilled shortly after excavation, the water levels were not allowed to equilibrate. Groundwater levels were allowed to equilibrate in the three hand auger borings. Groundwater levels were measured on September 16, 2010 at depths of 4 to 5 ft (corresponding elevations of 3719 to 3721 ft). In our opinion, these water levels are at, or near, seasonal lows and are expected to rise to near the existing ground surface during the wet winter and spring months.

SUMMARY AND CONCLUSIONS

The ground surface within the majority of the proposed office building area is relatively flat to gently sloping down to the west. Approximately 3 to 4 ft of fill will be required over much of the building area to accommodate a finish floor elevation of 3727 ft. A soil stockpile, which rises several ft above surrounding grades, is located in the southwestern portion of the site and a stormwater retention pond is located within the east end of the proposed building area. The pond appears to have been constructed by excavating and placing excavation spoils to create a perimeter berm. Up to several in. of soft sediment has accumulated/developed in the bottom of the pond.

The native soil profile in the area of the proposed office building consists of several ft of silt overlying sandy gravel. The relative consistency of the native silt decreases with depth from stiff to very stiff to soft to medium stiff below a depth of about 3 ft. Consolidation testing indicates the compressibility of the native silt is highly variable (relatively low for stresses below the preconsolidation pressure and moderate to very high for stresses above the preconsolidation pressure). Dense to very dense, relatively incompressible sandy gravel underlies the site at depths of 6 to 8.5 ft.

In addition to the soil stockpile in the southwest corner of the building area and the pond berm in the east end of the building area, fill soils comprised primarily of loose silt mantle the ground surface locally within the building area. The fill soils do not appear to have been systematically placed and compacted as structural fill and are unsuitable for the support of building foundations, floor slabs, exterior concrete flatwork, pavements, or other settlement sensitive structures.

Groundwater was measured within the building area at depths of 4 to 5 ft on September 16, 2010. In our opinion, these water levels are at, or near, seasonal lows and are expected to rise to near the existing ground surface during the wet winter and spring months.

Observations made during our condition survey of the existing buildings and information provided by Dan McCarthy indicate the existing buildings and pavements have performed satisfactorily from a settlement standpoint. In this regard, the surcharge program implemented to limit post construction building settlement appears to have been effective.

Due to the highly compressible nature of some of the native silt soils that underlie the site at relatively shallow depths and the potential for excessive total and differential settlements resulting from site fill and building loads, it is our opinion that the native silt soils are not suitable for support of the proposed building foundations unless treated by surcharge. Support for the building can be provided by conventional spread footing foundations and a concrete slab-on-grade floor following an effective surcharge program.

The upper stiff to very stiff native silt soils are suitable for the support of lightly loaded floor slabs, pavements, and exterior concrete flatwork without surcharging as long as the thickness of stiff to very stiff native silt soils is not reduced significantly (more than 1 ft or so) by site grading.

RECOMMENDATIONS

The following sections of this report present our recommendations for site development, including site preparation, excavation, and grading, structural fill, surcharge fill, foundation and floor slab support, seismic design criteria, subdrainage, and design review and construction observation.

Site Preparation, Excavation, and Grading

The ground surface within the limits of the planned facility (including the building area; exterior walkway, patio, and pavement areas; and areas to receive structural fill) should be stripped of vegetation and heavily rooted and organic-rich topsoil. We anticipate that stripping to a depth of about 6 in. will generally be required in areas of native ground. Deeper stripping and grubbing will be necessary locally to remove existing fill and heavily rooted, organic-rich, loose, or otherwise unsuitable soils. Upon completion of draining, soft sediment should be removed from the bottom of the existing stormwater retention pond. In our opinion, strippings should be removed from the site or stockpiled on-site for use in landscaped areas.

Upon completion of the site stripping and prior to the placement of structural fill, the exposed subgrade should be observed by a qualified geotechnical engineer or engineering geologist. Areas of soft subgrade or otherwise unsuitable materials should be overexcavated to firm soil and backfilled with structural fill.

The fine-grained soils that mantle the site are moisture-sensitive and are susceptible to disturbance/ softening by construction activities particularly during periods of wet weather or in areas of wet ground conditions. To minimize the potential for ground disturbance, we recommend that the site preparation and earthwork phases of this project be accomplished during the dry summer and early fall months, if feasible. We also recommend that the contractor employ construction techniques that prevent or minimize disturbance and softening of the subgrade soils. The use of scrapers for stripping and earthwork or heavy dump trucks operating directly on the exposed subgrade may result in subgrade disturbance. To prevent subgrade disturbance, it will likely be necessary to use dozers and/or tracked excavators equipped with smooth-edged bucket for stripping and excavation. In addition, the movement of construction traffic should be limited to granular haul roads and work pads. In general, a minimum of 18 to 24 in. of relatively clean, granular material is required to support concentrated construction traffic, such as dump trucks and concrete trucks, and protect the subgrade. A 12-in.-thick granular work pad should be sufficient to support occasional truck traffic and light construction operations. A geotextile strength/separation fabric may be used between the granular work pad/haul road materials and the underlying fine-grained subgrade soils as a separation filter to prevent the movement of fines into the rock.

Final grading of the areas around the building should provide for positive drainage of surface water away from the building. Permanent cut and fill slopes should be no steeper than 2H:1V.

Structural Fill

All fill (surcharge fill excluded) placed within the limits of the building and in exterior flatwork (walkway, terrace, etc.) and pavement areas should consist of structural fill. Due to the moisture-sensitive nature of the on-site soils and the limited quantity of excavation spoils anticipated, we recommend that structural fill consist of import granular material. Imported granular material used to construct structural fills should consist of crushed, hard and durable rock with a maximum size of about 2 in. and with not more than about 7% passing the No. 200 sieve (washed analysis). Based on our observations, 1½–in.-minus crushed rock stockpiled in the Moffit Brothers quarry a few miles southeast of Enterprise is suitable for use as structural fill.

We recommend that the structural fill material be placed in lifts and compacted with suitable equipment to at least 92% of the maximum dry density as determined by ASTM D 1557. The first lift of granular fill material placed over the fine-grained subgrade should be on the order of 18-in.-thick (loose). Subsequent lifts should be placed 12-in.-thick (loose). All lifts should be compacted with a medium-weight (48-in.-diameter drum), smooth, steel-wheeled, vibratory roller to the above, minimum compaction specification. The moisture content of the structural fill at the time of compaction should be controlled to within about 2% of optimum. Moisture conditioning, (i.e., aeration and drying or wetting) of the fill material may be necessary to achieve the above compaction criteria. Generally, a minimum of four passes with the roller is required to achieve uniform compaction.

Structural fills should extend a minimum horizontal distance of 5 ft beyond the building limits. If the fill will be placed during wet weather or ground conditions, we recommend that a geotextile strength/separation fabric (Amoco 2002 or similar) be placed on the stripped subgrade prior to fill placement. The geotextile should be installed in accordance with Section 00350.41 of the Oregon Department of Transportation (ODOT) Standard Specifications for Construction and have a minimum edge overlap of 24 in.

Surcharge Fill

In our opinion soft, compressible soils that underlie the site can be treated by surcharge to effectively limit post-construction building settlement. We estimate that post-construction building settlement can be effectively limited by a surcharge that induces a ground contact pressure of at least 625 pcf at the floor slab subgrade elevation. Assuming the surcharge material has a moist unit weight of 125 pcf, a surcharge height of 5 ft above floor slab subgrade elevation will be required. In our opinion, 1½–in.-minus crushed rock stockpiled in the aforementioned Moffit Brothers quarry is suitable for use as surcharge material. The surcharge should extend full height a minimum of 6 ft beyond the perimeter of the building. Based on the results of consolidation testing and settlement monitoring data from the adjacent hospital site, we estimate that the surcharge will induce total settlements in the range of 2 to 3 in. over a period of 8 to 12 weeks.

We recommend that field density testing be performed during surcharge placement and compaction to verify that a minimum density of 125 pcf is achieved. In addition, we recommend that a series of settlement plates be installed as part of the surcharge program and that the plates be monitored by qualified professional land surveyor retained by the owner. The purpose of the settlement plate monitoring program is to provide the data (settlement magnitude and time rate) necessary to evaluate the effectiveness and duration of the surcharge. We recommend a minimum of six settlement plates be installed spatially throughout the limits of the office building. Typical settlement plate details are provided on Figure 6.

The 3-ft-square base plate, with vertical riser pipes attached, should be established on a 1-in.-thick layer of clean sand placed directly on the subgrade. Prior to the placement of any surcharge fill, the surveyor should measure the elevation of the top of the base plate and the top of each initial riser pipe. All settlement plate measurements should be referenced to a benchmark located a minimum horizontal distance of 100 ft from the surcharge. Settlement plate elevations should be measured immediately upon completion of the surcharge fill placement, at least twice a week for the first two weeks following surcharge placement, and at least once a week thereafter. Settlement plate monitoring data should be provided to the geotechnical engineer for evaluation as soon as practicable.

We recommend that settlement plates be clearly marked with flagging and brightly colored paint to minimize the risk of damage from construction equipment. If damaged, the affected settlement plate should be replaced by the contractor as soon as practicable, and the settlement plate replacement should be reported to the geotechnical engineer.

Foundation Support

In our opinion, foundation support for the building can be provided by conventional wall and column-type spread footing foundations following an effective surcharge program. Footings should be established on a minimum 6-in.-thick layer of structural fill, have a minimum width of 18 in., and be embedded a minimum depth of 24 in. below the lowest adjacent exterior finished grade.

Footings established in accordance with the above criteria can be designed to impose an allowable soil bearing pressure of up to 1,500 psf. This value applies to the total of dead load plus frequently and/or permanently applied live loads and can be increased by one-third for the total of all loads: dead, live, and wind or seismic. We estimate that the total settlement of spread footings supporting column and wall loads of up to 50 kips and 3 kips/ft, respectively, will be less than 1 in. Differential settlements between adjacent comparably loaded footings should be less than half the total settlement. Past experience indicates these settlements will occur rapidly, with the majority of settlement occurring during construction.

Horizontal shear forces can be resisted partially or completely by frictional forces developed between the base of the spread footing and the underlying soil and by passive soil resistance. The total frictional resistance between the footing and the soil is the normal force times the coefficient of friction between the soil and the base of the footing. We recommend an ultimate value of 0.40 for the coefficient of friction; the normal force is the sum of the vertical forces (dead load plus real live load). If additional lateral resistance is required, passive earth pressures against embedded footings can be computed on the basis of an equivalent fluid having a unit weight of 225 pcf. This design passive earth pressure would be applicable only if the footing is cast neat against undisturbed soil or if backfill for the footings is placed as granular structural fill.

Floor Slab Support

To provide uniform support for concrete floor slabs and a capillary break, we recommend that concrete floor slabs be underlain by a minimum 6-in.-thick granular base course. The base course material should consist of crushed rock of up to 1-in. maximum size with less than about 2% passing the No. 200 sieve (washed analysis). In our opinion, a coefficient of subgrade reaction, k, of 225 pci can be assumed for the design of concrete slabs-on-grade. If moisture-sensitive flooring will be installed on the slab or if moisture-sensitive materials will be stored in slab areas, installing a suitable vapor-retarding membrane, such as MoistStop or TuTuf4, may be appropriate beneath slab-on-grade floors. Properly installed vapor-retarding membranes are also an effective way to reduce the presence of moisture vapors in the buildings. The membrane should be installed in accordance with the manufacturer's recommendations.

Seismic Design Criteria

Based on the results of our subsurface investigation and our review of the State of Oregon Structural Specialty Code, we recommend using a Site Class C to evaluate the seismic design of the proposed office building. Based on our understanding of the subsurface conditions at the site and the regional seismicity, it is our opinion that the primary seismic hazard at the site is ground motion amplification In our opinion, the potential is low for earthquake-induced ground rupture, slope instability, liquefaction, settlement, subsidence, and damage by tsunamis and/or seiches at the site during the anticipated ground motions associated with a design level seismic event.

Subdrainage

Due to the potential for seasonal, shallow perched groundwater, a subsurface drain should be installed around the building's perimeter foundation. We recommend that the foundation drain consist of a minimum 4-in.-diameter perforated line that is placed at the foundation grade and covered with a minimum 1-ft-wide column of clean (containing less than 2% finer than the No. 200 sieve) drain rock that extends up to within 1 ft of the finished ground surface grade. The drain rock and drain line should be encapsulated in filter fabric (AMOCO 4545 or similar) to prevent soil contamination of the drain. Water collected in foundation drains should be transmitted in closed pipes to the storm water system.

Design Review and Construction Observation

We recommend that a qualified geotechnical engineer review final grading, surcharge, and foundation, plans prior to the start of construction. During construction we recommend that a qualified geotechnical engineer observe stripping within the limits of the proposed office building, evaluate the results of field density testing performed during the placement and compaction of structural and surcharge fills, and evaluate the results of settlement plate monitoring.

LIMITATIONS

Foster Gambee has prepared this report to aid in the design and construction of the proposed office building and associated improvements. The scope is limited to the specific project and location described herein. Our description of the project represents our understanding of significant aspects relevant to the design and construction of the office building and associated improvements at the specified locations. If changes are planned in the design and location of the building and associated improvements, as outlined in this report, we should be given the opportunity to review those changes and to modify or reaffirm, in writing, our conclusions and recommendations.

Our conclusions and recommendations are based on data obtained from the test pits and borings made at the locations indicated on Figure 2 and from other sources of information discussed herein. In the performance of subsurface explorations, specific information is obtained from specific locations at specific times. However, it is acknowledged that variations in subsurface conditions may exist away from exploration locations. This report does not reflect any variations that may occur away from the explorations, the nature and extent of which may not be evident until construction. If, during construction, subsurface conditions different from those found in the explorations are observed or encountered, we should be advised at once so that we can observe and review those conditions and reconsider our recommendations if necessary.

Please contact us if you have any questions.

Sincerely,
FOSTER GAMBEE GEOTECHNICAL, P.C.

John E. Gambee, P.E., G.E.
Principal

Kevin M. Foster, P.G., C.E.G., P.E., G.E.
Principal

REFERENCES

1 Walker, George W., Geologic Map of Oregon East of the 121st Meridian, Oregon Department of Geology and Mineral Industries, 1977

Table 1
GUIDELINES FOR CLASSIFICATION OF SOIL

Description of Relative Consistency for Fine-Grained (Cohesive) Soils

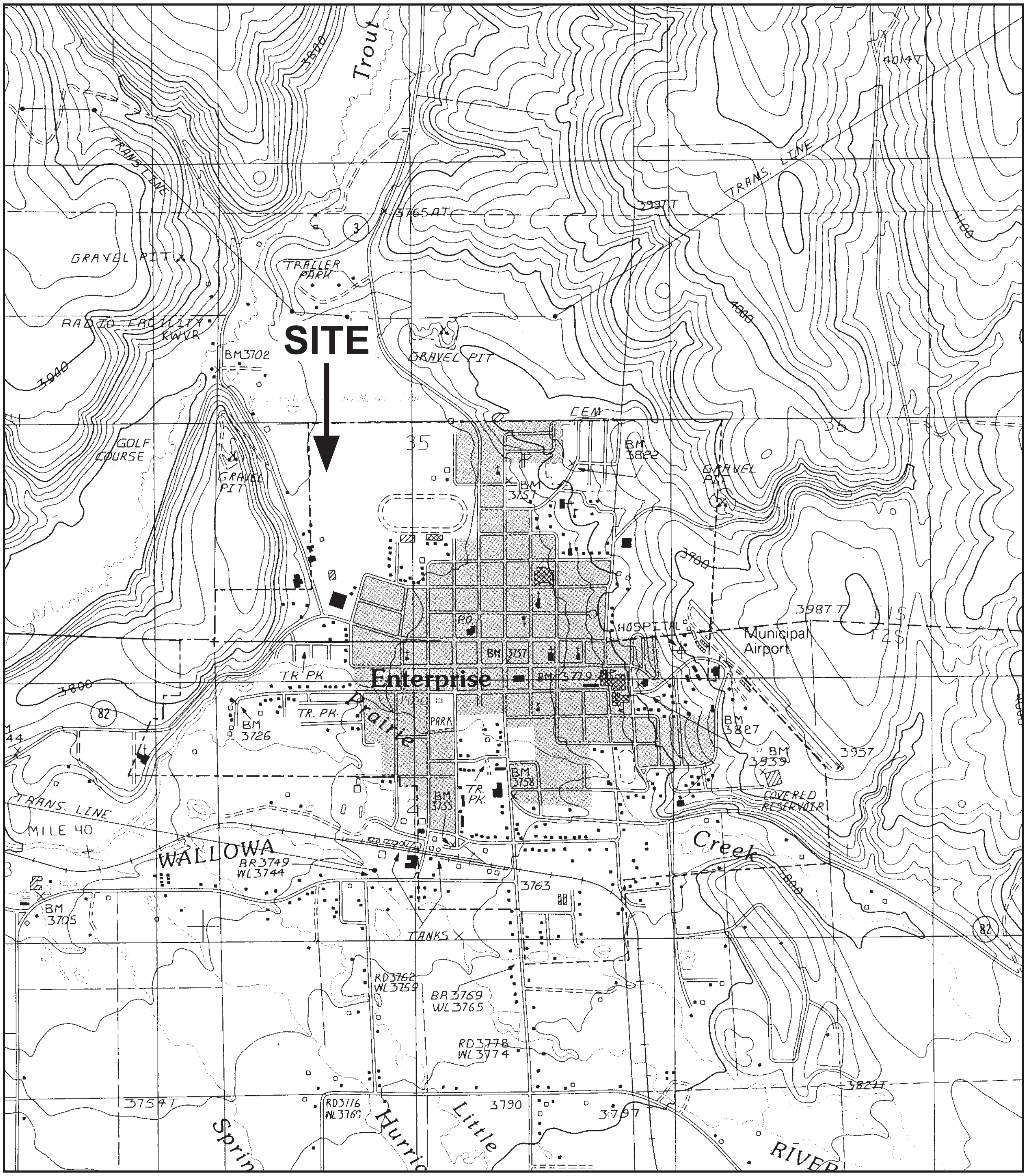
Relative Consistency	Standard Penetration Resistance (N-values), blows/ft	Torvane Undrained Shear Strength, tsf
Very soft	2	Less than 0.125
Soft	2 to 4	0.125 to 0.25
Medium stiff	4 to 8	0.25 to 0.50
Stiff	8 to 15	0.50 to 1.0
Very stiff	15 to 30	1.0 to 2.0
Hard	Over 30	Over 2.0

Sandy silt materials that exhibit general properties of granular soils are given relative density description.

Description of Relative Density for Granular Soils

Relative Density	Standard Penetration Resistance (N-values), blows/ft
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	over 50

Grain-Size Classification	Modifier For Subclassification	
Boulders		**Percentage of**
12 to 36 in.		**Other Material**
Cobbles	**Adjective**	**In Total Sample**
3 to 12 in.	Clean	0 to 2
Gravel	Trace	2 to 10
¼ to ¾ in. (Fine)	Some	10 to 30
¾ to 3 in. (Coarse)	Sandy, Silty	30 to 50
Sand	Clayey, etc.	
No. 200 to No. 40 sieve (Fine)		
No. 40 to No. 10 sieve (Medium)		
No. 10 to No. 4 sieve (Coarse)		
Silt/Clay		
Pass No. 200 sieve		



USGS Topographic Map
Enterprise, OR Quadrangle, Provisional Edition 1990

North

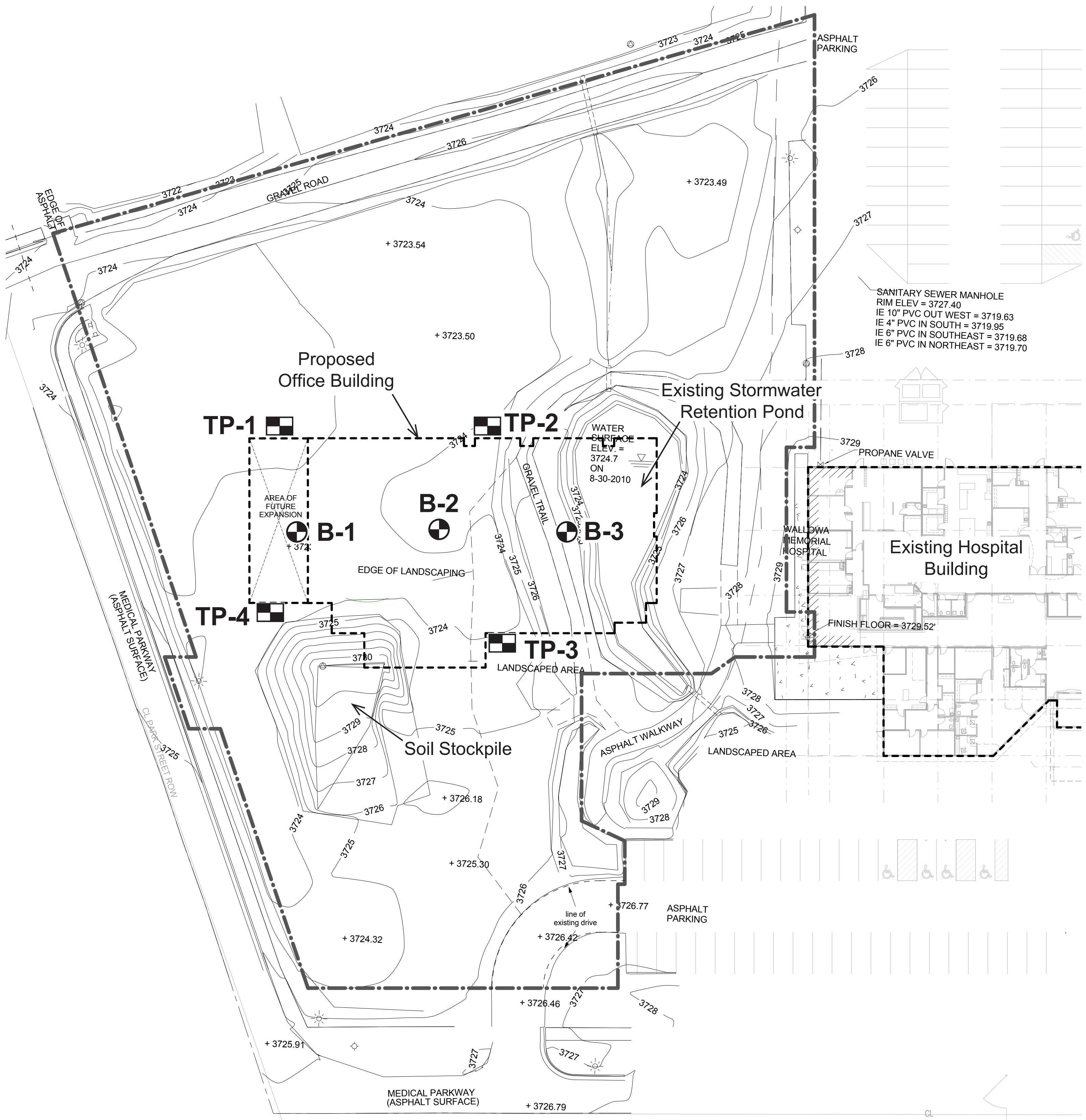
0 2000 4000 Ft

FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION
WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

VICINITY MAP

October 2010 Job No. 0969 Fig. 1



Boring by Foster Gambee Geotechnical, P.C. (9/15/10)
Test Pit by Foster Gambee Geotechnical, P.C. (9/16/10)
Site Plan from Drawing by Clark Kjos Architects, LLC (dated 9/10/10)

FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION

WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

SITE PLAN

October 2010 | Job No. 0969 | Fig. 2

TP-1 Surface elevation 3,723 ft (Site Plan datum)

Depth, ft

- 0 ft: Stiff, dark brown-gray SILT; trace clay, heavily rooted in upper 6 in., lightly rooted below, scattered organics
  - mixed gray-brown and light gray below 1.5 ft
- 1.8 ft: Stiff, gray-brown mottled rust and brown SILT; some clay to clayey
  - medium stiff to stiff below 2.3 ft
  - soft below 3.0 ft
- 4.2 ft: Soft, gray SILT; some clay to clayey, scattered organics
  - some fine to coarse, subrounded gravel below 5.5 ft
- 7.0 ft: Dense, sandy GRAVEL; fine to coarse, subrounded, trace to some silt, scattered cobbles to 6 in. size

Samples/tests: ■ S-1 w = 37% (1.0 ft); ■ S-2 w = 28% (2.5 ft); c = 0.60 tsf; c = 0.15 tsf (3.0 ft); ■ S-3 w = 33%, c = 0.25 tsf (4.5 ft)

Bottom of test pit 9.0 ft (9/16/10).
Heavy groundwater seepage encountered below 8.5 ft (9/16/10).

TP-2 Surface elevation 3,724 ft (Site Plan datum)

- 0 ft: Loose, brown-gray SILT; trace clay, heavily rooted in upper 6 in., lightly rooted below, scattered organics
- 0.8 ft: Stiff to very stiff, dark brown-gray SILT; trace to some clay, scattered fine roots
  - mixed dark brown-gray and light gray below 1.5 ft
- 2.3 ft: Stiff to very stiff, gray-brown mottled rust SILT; some clay, widely scattered roots
  - soft to medium stiff below 3.0 ft
- 4.0 ft: Soft to medium stiff, gray SILT; trace to some clay and fine-grained sand, scattered organics, trace sand
  - some gravel to gravelly below 5.5 ft
- 7.0 ft: Medium stiff to stiff, gray-brown mottled rust SILT; some clay, sand, and gravel
- 8.2 ft: Dense, sandy GRAVEL; fine to coarse, subrounded, trace to some silt, scattered cobbles to 6 in. size

Samples/tests: ■ S-1 w = 31% (2.0 ft); c = 1.4 tsf; ■ S-2 w = 29% (3.0 ft); S-4 (Shelby tube, 3.0–5.0 ft): w = 37%; c = 0.35 tsf; c = 0.40 tsf; γd = 82 pcf; c = 0.20 tsf; c = 0.30 tsf; w = 23%; ■ S-3 w = 22%, c = 0.25 tsf (5.0 ft)

Bottom of test pit 9.0 ft (9/16/10).
Heavy groundwater seepage encountered below 7.0 ft (9/16/10).

TP-3 Surface elevation 3,724 ft (Site Plan datum)

- 0 ft: Stiff to very stiff, brown-gray SILT; trace clay, scattered organics, widely scattered roots
- 1.8 ft: Stiff, gray-brown mottled rust SILT; trace to some clay
- 3.0 ft: Soft to medium stiff, gray SILT; trace to some clay, trace sand, scattered organics
  - scattered to trace gravel below 4.5 ft
  - some gravel to gravelly below 5.0 ft
- 6.5 ft: Dense, sandy GRAVEL; fine to coarse, subrounded, trace to some silt, scattered cobbles to 6 in. size

Samples/tests: ■ S-1 w = 46% (1.0 ft); ■ S-2 w = 35%, c = 0.10 tsf (2.5 ft); ■ S-3 w = 36% (4.0 ft); c = 0.30 tsf

Bottom of test pit 8.5 ft (9/16/10).
Very light groundwater seepare encountered at 4.0 ft.
Heavy groundwater seepage encountered below 8.0 ft (9/16/10).

TP-4 Surface elevation 3,724 ft (Site Plan datum)

- 0 ft: Loose, brown-gray SILT; trace clay, heavily rooted
- 0.8 ft: Stiff to very stiff, dark gray-brown SILT; trace to some clay, scattered to frequent fine roots
- 2.0 ft: Stiff to very stiff, light gray SILT; trace clay
- 2.7 ft: Medium stiff, gray-brown mottled rust SILT; some clay to clayey, scattered gravel
- 4.2 ft: Soft, gray SILT; trace clay to clayey, trace gravel to gravelly, trace sand, scattered to frequent organics
- 6.0 ft: Dense, sandy GRAVEL; fine to coarse, subrounded, trace to some silt, scattered cobbles to 6 in. size weathered

Samples/tests: ■ S-1 w = 50% (1.5 ft); ■ S-2 w = 33% (2.5 ft); S-5 (Shelby tube, 3.5–5.3 ft): c = 0.35 tsf; ■ S-3 w = 31%; c = 0.45 tsf; c = 0.20 tsf; w = 31%; γd = 87 pcf; w = 41%; c = 0.15 tsf; ■ S-4 w = 46%; c = 0.15 tsf

Bottom of test pit 9.0 ft (9/16/10).
Heavy groundwater seepage encountered below 7.0 ft (9/16/10).

■ Grab Sample
w Natural Moisture Content
c Torvane Shear Strength
γd Dry Density
3-in.-O.D. Shelby Tube Sample

FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION
WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

TEST PIT LOGS

October 2010 | Job No. 0969 | Fig. 3

B-1 Surface elevation 3,723 ft (Site Plan datum)

Depth, ft

Stiff, gray-brown SILT; trace clay, scattered organics, heavily rooted in upper 4 to 6 in., scattered to frequent roots below

S-1 w = 28%

gray-brown mixed with light gray below 1.5 ft

S-2 w = 29%

medium stiff, trace to some clay below 2.5 ft

Medium stiff, brown-gray mottled rust SILT; some clay to clayey

S-3 w = 30%

soft, scattered fine gravel below 3.5 ft

S-4 w = 35%

Soft to medium stiff, gray SILT; trace to some clay, sand and gravel, scattered organics

S-5 w = 24%

Practical refusal to hand auger advancement on gravel at 6.3 ft (9/15/10).
Groundwater at 4.0 ft (9/16/10).

B-2 Surface elevation 3,724 ft (Site Plan datum)

FILL: Loose, brown-gray SILT; trace clay and sand, scattered angular gravel, scattered organics (primarily bark chips), heavily rooted to a depth of 4 in., scattered to frequent roots below

Stiff, dark brown-gray SILT; trace clay, scattered organics, lightly rooted

S-1 w = 37%

Stiff, brown-gray mottled rust and brown SILT

trace to some clay below 2.8 ft

S-2 w = 30%

Soft, brown-gray mottled rust-brown, clayey SILT; scattered to frequent organics

trace to some sand and gravel below 4.5 ft

S-3 w = 41%

Medium dense, gray-brown SAND and GRAVEL; fine to coarse subrounded, some silt

Practical refusal to hand auger advancement on gravel at 6.3 ft (9/15/10).
Groundwater at 4.0 ft (9/16/10).

■ Grab Sample
w Natural Moisture Content

FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION
WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

BORING LOGS

October 2010 Job No. 0969 Fig. 4 (p. 1 of 2)

B-3 Surface elevation 3,726 ft (Site Plan datum)

Depth, ft

0 — FILL: Medium stiff, dark brown SILT; trace clay, scattered gravel and pieces of metal, organic-rich

1.2 — FILL: 1½ -in.-minus CRUSHED ROCK

2.2 — Medium stiff to stiff, dark brown-gray SILT; trace to some clay, scattered to frequent organics

■ S-1 w = 53%

— — — mixed dark brown-gray and light brown-gray below 4.0 ft

■ S-2 w = 49%

4.5 — Medium stiff, gray-brown mottled rust SILT; some clay to clayey, scattered organics

■ S-3 w = 30%

— — — soft below 5.5 ft

6 — Soft, gray SILT; some clay, scattered organics to locally organic-rich

■ S-4 w = 41%

— — — trace to some gravel below 7.5 ft

Practical refusal to hand auger advancement on gravel at 7.7 ft (9/15/10).
Groundwater at 5.0 ft (9/16/10).

■ Grab Sample
w Natural Moisture Content

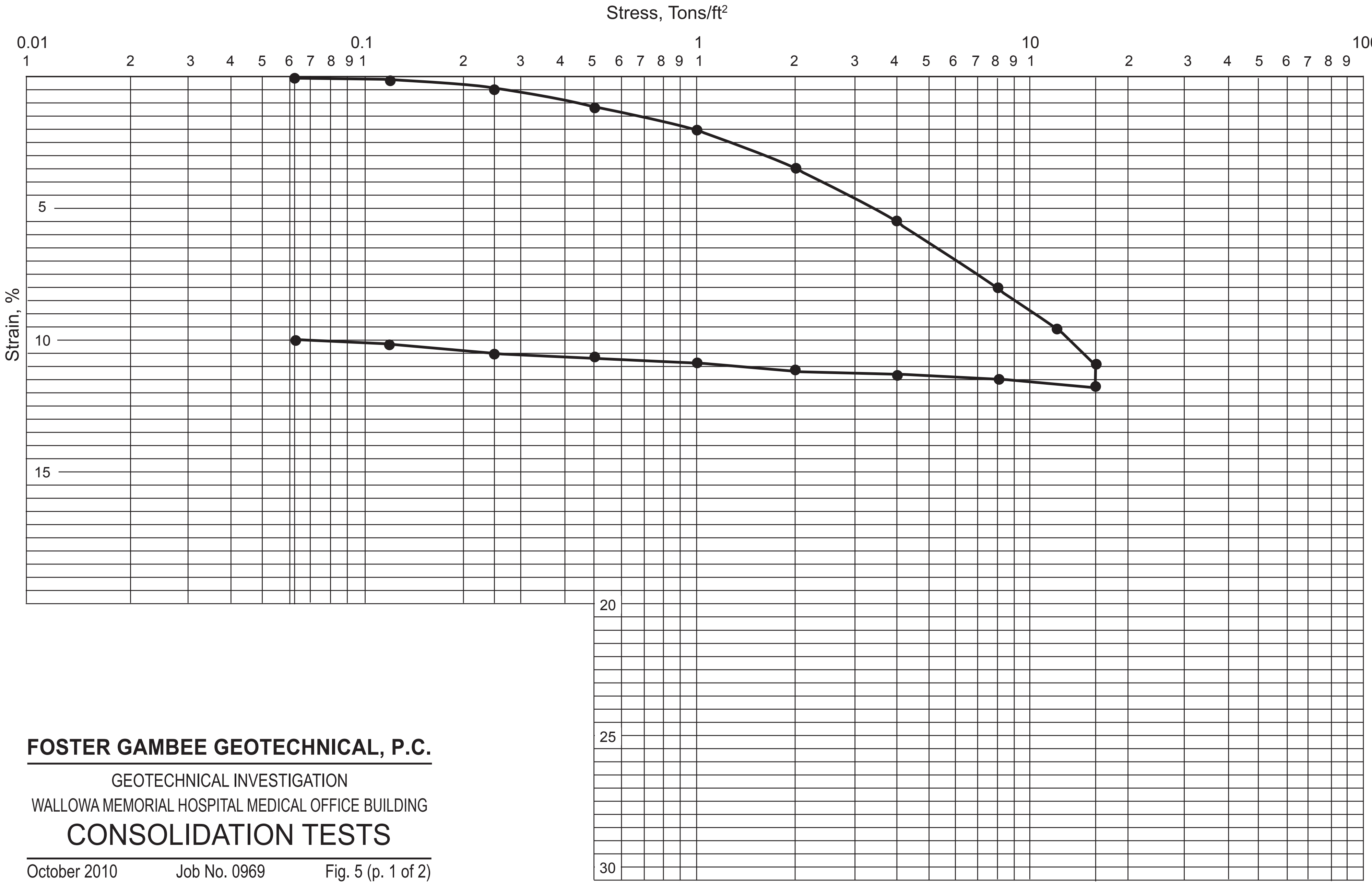
FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION
WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

BORING LOGS

October 2010 Job No. 0969 Fig. 4 (p. 2 of 2)

Boring	Sample	Depth, ft	Moisture Content, % (Initial)	(Final)	Dry Unit Weight, PDF (Initial)	(Final)	Soil Description
TP-2	S-4	4.5	27	21	101.6	112.9	Soft to medium stiff gray SILT; some fine-grained sand, trace clay



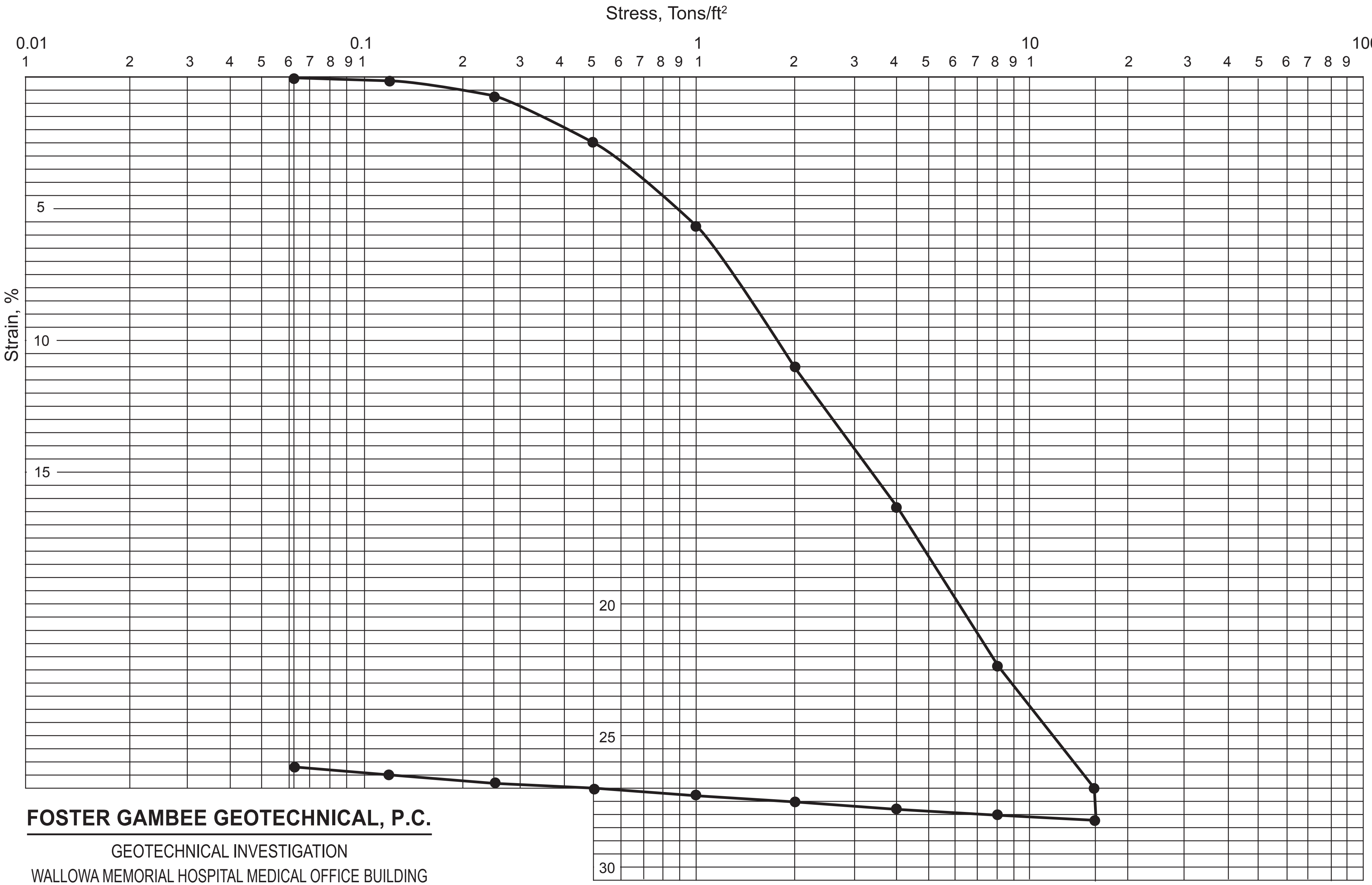
FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION
WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

CONSOLIDATION TESTS

October 2010 Job No. 0969 Fig. 5 (p. 1 of 2)

Boring	Sample	Depth, ft	Moisture Content, % (Initial)	Moisture Content, % (Final)	Dry Unit Weight, PDF (Initial)	Dry Unit Weight, PDF (Final)	Soil Description
TP-4	S-5	4.3	41	24	81.1	110.0	Soft, dark gray SILT; trace clay, fine-grained sand and organics



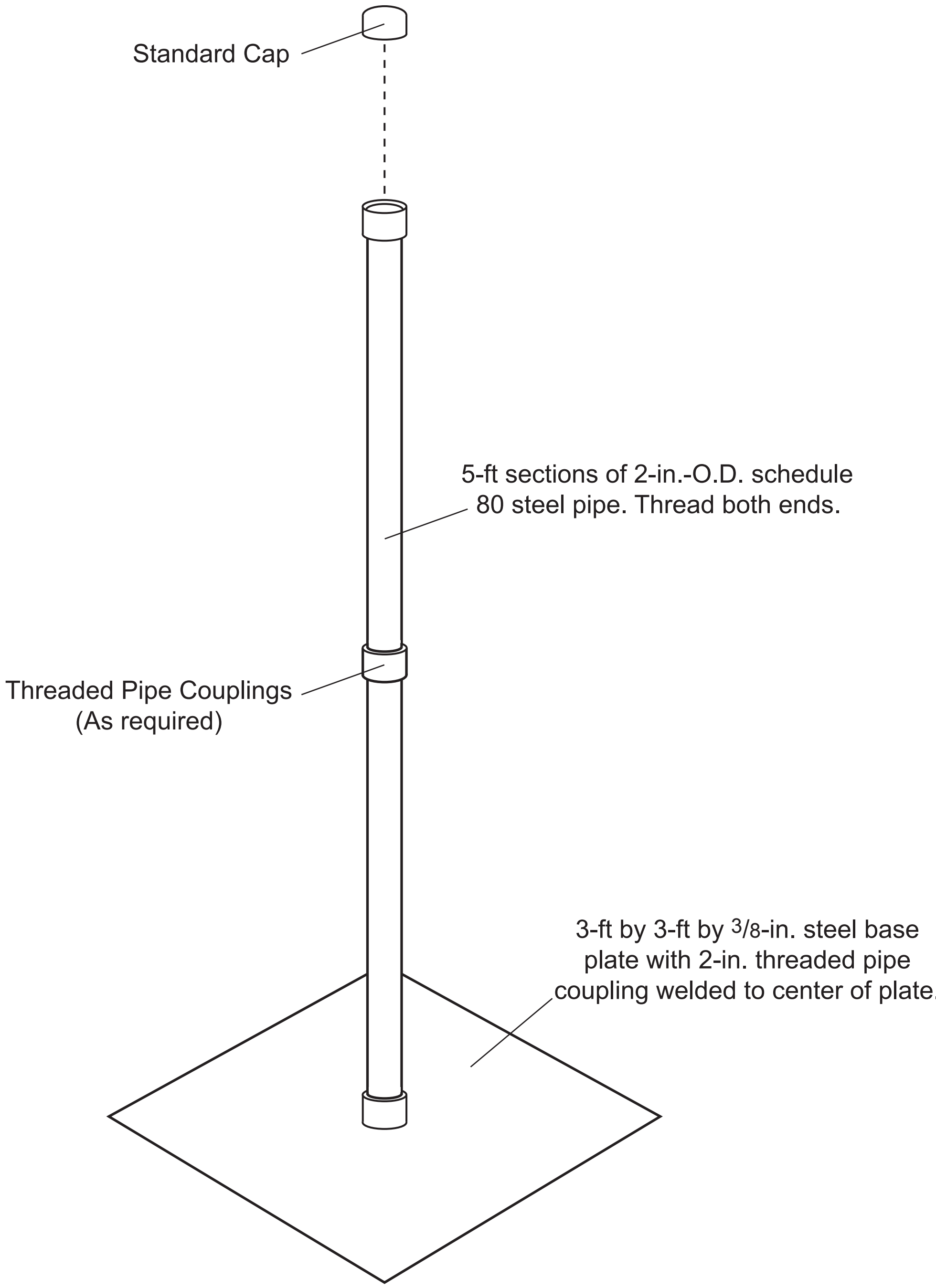
FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION

WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

CONSOLIDATION TESTS

October 2010 Job No. 0969 Fig. 5 (p. 2 of 2)



Not to scale

Notes:

1. Wrench tighten first riser to plate coupling.
2. Install base plate and first riser on 1-in.-thick (maximum) layer of sand over stripped subgrade. Riser to be vertical.
3. Take initial elevation readings on top of riser pipe and top of plate; later readings on top of cap.
4. Add additional risers as required.
5. Paint all risers bright orange and flag.
6. Protect all settlement plates from damage; report any damage or disturbance to owner's representative.
7. Place standard cap on top of uppermost riser pipe.

FOSTER GAMBEE GEOTECHNICAL, P.C.

GEOTECHNICAL INVESTIGATION

WALLOWA MEMORIAL HOSPITAL MEDICAL OFFICE BUILDING

SETTLEMENT PLATE DETAIL

October 2010 Job No. 0969 Fig. 6