GEOTECHNICAL DESIGN REPORT
TUSSING PARK RESTROOMS
GRANTS PASS, OREGON

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1.0 INTRODUCTION

In accordance with your authorization we have completed our subsurface investigation and design evaluation of the subject project. This report includes a description of 1) the site and proposed project, 2) our field and office work and 3) our geotechnical design recommendations for the project, which consists of constructing a new restroom at the site.

2.0 SITE AND PROJECT DESCRIPTION

The subject property is located between West Park Street and the south bank of the Rogue River, just off the south end of the All Sports Park Pedestrian Bridge. See Figure 1, Vicinity Map. The restroom structure will be somewhat embedded into the steep slope below West Park Street and upslope of the river. The slope above has numerous trees and understory. The subsurface soils conditions in this area generally consist of silty Sand and Gravels with scattered to abundant cobbles. Manmade fill was apparently used to create the walking path in this area.

We understand the project to consist of constructing a new bathroom structure with a 9'4"x16'8" footprint. We understand the structure will have a concrete slab-on-grade floor and likely concrete walls on at least three sides. At this time we also understand that the plan has been altered such that the back wall and both ends will be embedded into the slope. We assume the doors will be relocated to the front of the building (toward the walking path). Please see Figure 2 for a Preliminary Site Plan.

3.0 FIELD EXPLORATION

On April 3, 2014, personnel from The Galli Group performed a subsurface investigation at the site. Two borings were advanced to depths of 21.5 and 21.0 feet near the restroom location. **Note:** Due to obstructions that we could not move we were unable to gain access to the toe of the slope. Drilling was accomplished with a CME 55 Hollow Stem Auger drill rig provided by Lawrence and Associates from Redding, California.

During the drilling process samples were obtained by the Standard Penetration Test (SPT) at periodic intervals in the borings. This test is accomplished by driving a 2-inch

O.D. steel split spoon sample tube in the bottom of the boring by dropping a 140-pound weight from a height of 30 inches. The total blows to drive the last 12 inches of an 18-inch drive is called the SPT N-Value. These values can be used to correlate soil density and strength parameters at the site with those of hundreds of other projects. We also had the area coned off and a second technician standing by the walking path to keep pedestrians out of the work area for the duration of the drilling.

When completed, the borings were sealed with bentonite/cement hole plug and the tops were backfilled with the soil spoils. The top was tamped firm. Soil samples were taken to the laboratory for review and moisture content testing.

4.0 SUBSURFACE CONDITIONS

4.1 SOILS

The subsurface conditions were fairly similar between the two holes. Surficial crushed rock was underlain by silty Sand decomposed granite Fill to between 5 ½ and 8 feet. This Fill was underlain by soft to stiff sandy Silt. Below this we encountered dense Sand in B-2 and then silty Sand and Gravel and Gravels with Cobbles in both borings. These materials were dense to very dense. For more detail please see the Boring Logs in Appendix A.

4.2 GROUNDWATER

Groundwater was not present in the borings at the time of drilling. Given the sandy and gravelly nature of the soils and the location (adjacent to a slope down to the river) it is unlikely that a free water surface gets within 10 feet of the ground surface. During very wet weather it is possible that runoff from the slope above could cause a shallow, perched water zone (saturated upper soils) for short periods of time. Therefore, drainage of any structure embedded into the slope is critical to good long-term performance.

5.0 GEOLOGIC HAZARDS EVALUATION

The subject site does <u>not</u> have expansive soils or loose zones subject to liquefaction. There are no active faults which bisect the site. Reservoirs or lakes are not nearby and the site elevation is almost 1,000 feet. Therefore, damage due to sieche or tsunami is nonexistent.

There is a steep slope above the site. This slope consists of dense, silty Sand and Gravel soils. These soils are not prone to sloughing and failures. However, during a strong seismic event it is possible that some rockfall and/or slump out failures could take place.

The structure will be subjected to strong shaking during a seismic event. Therefore, it must be designed to resist the anticipated seismic forces.

Other than the items listed above, which can be accounted for in the project design, in our professional opinion, the subject site is acceptable for the proposed restroom project. A properly constructed project will not adversely impact the stability of this or adjacent parcels.

6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

The subject project requires detailed recommendations for shoring walls (lateral loads due to embedded walls), sliding resistance, foundation support, wall and floor drainage and related items. These are included in the following sections.

6.1 SITE PREPARATION AND GRADING

6.1.1 Clearing, Grubbing and Stripping

All areas proposed for structures, access and sidewalks or structural fill beneath these items should be cleared and grubbed of all trees, stumps, brush and other debris and/or deleterious materials. The site should then be stripped and cleared of all vegetation, sod, organic topsoil, asphalt and asphalt grindings. It appears that a stripping depth of from 4 to 8 inches will be required to remove the organic topsoil and rootzone. Additional stripping (or excavations) will most likely be required to remove root balls beneath larger bushes and any waste fill areas encountered. The stripped materials and old fills soils removed should be hauled from the site or stockpiled for use in landscape areas only. This material should not be used in structural fill. All old, undocumented fill must be removed beneath buildings and roadways due to the possibility of it consolidating/densifying under new load.

Holes or depressions resulting from the removal of underground obstructions and old ditches or excavations for stump removal or old fill that extend below the finish subgrade and will be beneath structures, access or walkways, shall be cleared of all loose material and dished to provide access for compaction equipment. These areas shall then be backfilled and compacted to grade with structural fill, as described later in this report.

It is recommended that grubbing and stripping of the site, old fill removal, backfill and compaction of depressions below finish subgrade be observed by the project engineer or his representative from The Galli Group.

6.1.2 Subgrade Proofrolling

The exposed subgrade throughout the site which will support structures, access, fills and sidewalks should be proofrolled (after grubbing and stripping and overexcavation where required) under the observation of a representative from The Galli Group. The proofrolling may be accomplished with a loaded dump truck, loaded water truck or large heavy roller (no vibration). Proofrolling should not be attempted in wet weather and should be discontinued if it appears the operation is pumping moisture up to the surface or otherwise disturbing the in-place soils. When proofrolling, the tires of a loaded truck should not deflect the soils more than ⅜ inch.

Where soils are disturbed or do not demonstrate a firm, unyielding condition when proofrolled, the soil should be removed and replaced with imported granular fill. The imported fill material should be compacted to a minimum of 98 percent of the maximum dry density as determined by ASTM Test Method D-698 (Standard Proctor). All soft and/or unstable areas should be over-excavated and backfilled with granular structural fill.

6.2 UTILITY AND SITE EXCAVATIONS

During the construction of the project, we anticipate utility excavations will be required for construction of utility lines. The utility excavations and cuts will generally encounter the loose to medium dense Fill soils.

Excavations. In our opinion all excavators of medium size or larger should be able to remove these materials, especially with a narrow bucket.

Trench excavations during dry weather should stand for short periods of time (several hours) in shallow trenches in the soils (less than 3 feet) which are not subjected to emerging groundwater seepages or surface water. Seepage or wet weather will cause the silt soils to cave and slough into the trench. Excavations deeper than 3 feet could require the use of temporary shoring, trench boxes and/or temporary cut slopes. Pumping from open sumps should be able to handle the majority of water in trenches. However, to help decrease sloughing, construction in the drier weather periods would be better. Workmen must still be protected in all trenches.

Please note that while we have commented on the anticipated stability of the soil in trenches, we are not responsible for job site safety. The contractor is at all times responsible for job site safety, including excavation safety. We recommend all local, state and federal safety regulations be adhered to.

6.3 STRUCTURAL FILL PLACEMENT AND COMPACTION

6.3.1 Beneath Structures and Roadways

Structural fill is defined as any fill placed and compacted to specified densities and used in areas that will be under structures, access and sidewalks and other load-bearing areas or that will create fill slopes. It appears that the building pad areas and sidewalks may require some structural fill below them. The subgrade needs to be prepared properly and the soils must be placed and compacted correctly for proper long-term performance.

Structural Fill Materials. Ideally, and particularly for wet weather construction, structural fill should consist of a free-draining granular material (non-expansive) with a maximum particle size of six to eight inches. The material should be reasonably well-graded with less than 5 percent fines (silt and clay size passing the No. 200 mesh sieve). During dry weather, any organic-free, non-expansive, compactable granular material, meeting the maximum size criteria, is typically acceptable for this purpose. Locally available crushed rock, jaw-run crushed shale, and sandy decomposed granite (DG) have performed adequately for most applications of structural fill.

Structural Fill Placement. Structural fill should be placed in horizontal lifts not exceeding 8 inches loose thickness (less, if necessary to obtain proper compaction) for heavy compaction equipment and four inches for light and hand-operated equipment. Each lift should be compacted to a minimum of 98 percent of the maximum dry density, as determined by ASTM Test Method D-698 (Standard Proctor).

Structural fill placed beneath footings or other structural elements must extend beyond all sides of such elements a distance equal to at least ½ the total depth of the structural fill beneath the structural element in question for vertical support (i.e. for 3 feet of structural fill beneath footings, extend the fill at least 1½ feet past all edges of the footing). These fills must extend further beyond edges of footings if lateral support is required (generally in the order of 5 to 6 feet or more).

To facilitate the earthwork and compaction process, the earthwork contractor should place and compact fill materials at or slightly above their optimum moisture content. If fill soils are too high on the wet side of optimum, they can be dried by continuous windrowing and aeration or by intermixing lime or Portland Cement to absorb excess moisture and improve soil properties. If soils become dry during the summer months, a water truck should be available to help keep the moisture content at or near optimum during compaction operations.

Fill Placement Observation and Testing Methods. The required construction monitoring of the structural fill utilizing standard nuclear density gauge testing and standard laboratory compaction curves (ASTM D-698 specified) is applicable to materials 2-inch size and under. Larger (2½" or above) jaw-run "shale", crushed rock and the pulverized DG do not yield consistent results with this type of testing. The high percentage of rock particles greater than ¾'s of an inch in these materials causes laboratory and field density test results to be erratic and does not provide an adequate representation of the density achieved. Therefore, construction specifications for this type of material typically specify method of placement and compaction coupled with visual observation during the placement and compaction operations, instead of nuclear density testing.

For these larger rock materials, we recommend the 8-inch lift (after being "worked in" with a dozer) be compacted by a minimum of 3 passes with a heavy vibratory roller. One "pass" is defined as the roller moving across an area once in both directions. The placement and compaction should be observed by our representative. After compaction, as specified above, is completed the entire area should be proofrolled with a loaded dump truck to verify density has been achieved. All areas which exhibit movement or compression of the rock material more than ¼ inch, under proofrolling, should be reworked or removed and replaced as specified above.

Field density testing by nuclear methods would be adequate for verifying compaction of 2-inch to ¾-inch minus crushed base rock, expansive clay and silt soils, Decomposed Granite and other materials 2 inches or smaller in size. Therefore, typical specifications would suffice. Testing should be accomplished in a systematic manner on all lifts as they are placed. Testing only the upper lifts is not adequate.

6.3.2 Non-Structural Fill

Any waste soil, organic strippings or other deleterious soil (such as wet or dried out expansive clay) would be considered non-structural fill. These materials may make reasonable landscape soils and lawn topsoil material. This material may be placed in landscape areas and waste soil areas such as berms with slopes at 3.5H:1.0V or flatter. It should not be placed under structures, sidewalks, roadways, parking areas or as part of a structural fill slope. It is recommended that when these soils are used they be given a moderate level of compaction (90 to 92 percent) to help seal them from surface water.

6.4 CUT AND FILL SLOPES

Cut and fill slopes will most likely be incorporated into the project and utilized during construction. Care must be taken to design and construct these for good long-term performance. These should be designed as described below.

6.4.1 Cut Slopes

Permanent Cut Slopes. Across the site, we anticipate permanent cut slopes ranging from 3 to 5 feet in height. We recommend permanent cuts made into these slopes be varied in steepness depending upon the strata type being excavated (or all be sloped at the flattest inclination given). The general permanent cut slope rule for this site should be as follows:

Strata Type	Cut Slope Inclination
Silty Sand, Sandy Silt	2H:1V
Dense Sand and Gravel	1¾ H:1V

It should be noted that at the slope angles provided above some sloughing and slumping near the top of the cut slopes should be expected. The upper portions of the slopes could be flattened in an attempt to alleviate more sloughing of the weaker materials, but that would typically increase the areas of the cut slopes and potential construction costs significantly. The above-listed cut slope recommendations also assume that concentrated surface water flows are not present and do not “run” down these slopes. Excessive amounts of surface water will most likely result in surficial sloughing of the upper silt and clay soil units

Temporary Cut Slopes. Temporary cut slopes will likely be used during construction. For this site we recommend the following:

Strata Type	Cut Slope Inclination
Silty Sand, Sandy Silt	1H:1V
Dense Sand and Gravel	¾ H:1V

Please note that these cut slope angles could be required to construct the project. They could also be subject to smaller sloughs and failures, especially in wet weather and where soil discontinuities exist. Rockfall also may take place when the gravelly unit is excavated into. In that case a chain link fence across the toe should be installed to protect the workmen. The contractor must inspect all cut slopes several times a day for signs of instability.

We strongly recommend that we inspect all temporary cut slopes when they are cut and periodically during project construction.

6.4.2 Fill Slopes

All fill slopes should be placed and compacted as structural fill as described earlier in this report and be no steeper than 2¼ H:1V for the native silty Sand and other silt soil structural fill. Imported DG and angular shale or rock may be placed as steep as 1.8H:1V, but 2H:1V will perform better over the long term (less raveling of the surface).

Compaction of the fill being placed, even for landscape purposes to "waste" expansive soils, is critical to its stability and to the stability of adjoining or upslope and downslope areas. Therefore, fills should be placed and compacted as structural fill as described earlier in this report.

We recommend, in order to decrease sloughing and erosion of any fill slopes that all fills be overbuilt laterally and the face cut back to a compacted fill face. This would not be required of slopes constructed of hard rock fill materials. It is critical to decrease long-term settlements that these fills be placed and compacted properly. All materials should be placed and compacted as described earlier in this report.

6.5 UTILITY LINE RECOMMENDATIONS

Below we have provided general recommendations for utility construction for the project. Recommendations are based upon observations from our field investigation and experience on other projects in the area.

Trench Excavation. Trenches will be required across the site for utility installation of various kinds. As discussed earlier, all soils encountered should be able to be excavated with a large excavator.

In areas of old fill, trench excavation should be relatively easy. Sideslopes can ravel and slough, especially in wet weather and in the old fill materials. Therefore, trench boxes could be required.

Trench Backfill and Compaction. The new utility lines will require trench backfill and compaction along the entire alignment. The pipes need to be adequately supported and the trenches need to be backfilled and compacted properly to prevent subsidence of the surface or damage to utility lines or the potential overlying pavement section. The on-site silt soils do not provide the best trench backfill due to difficulty getting good compaction. A crushed rock such as ¾" minus or sandy decomposed granite usually works well and are recommended for this project.

In our experience, utility trench backfill has been the source of the majority of post-construction fill settlement problems in paved areas. They are also areas which cause early pavement failure due to inadequate subgrade support.

Pipe Bedding. The bottom of the trench must be shaped out of acceptable bedding materials (refer to manufacturer’s recommendations) to fit the pipe base prior to placement of the pipe. It is critical to the long-term performance of the pipe that the bottom and haunches be fully supported by a dense bedding which decreases pipe distortion from load. The on-site soils may not be acceptable as bedding. Finer crushed rock materials (such as ¾-inch minus crushed rock) usually provide the best bedding material.

Pipe bedding should be compacted to 95% of ASTM D-698 (Standard Proctor) or to that which is specified by the pipeline designer. Cement-treated pea-gravel or sand/cement slurry (with at least 200 pounds of cement per cubic yard) will solidify and would typically not require compaction after placement and also makes good bedding material. Care must be taken to make sure the pipe does not “float” up in the fluid mix prior to it “setting”.

Pipe Zone Material. All of the lines should be backfilled around and to approximately 12-inches (more, if required by manufacturer) above the pipe with an acceptable “pipe zone” material. This may consist of finer crushed rock, cement-treated pea gravel, sand/cement slurry, coarse sand with fine gravel, or other material acceptable to the client and pipeline designers. The on-site soils could be difficult to compact within the confines of the trenches and therefore will <u>not</u> provide the desired level of support for the pipe and not normally recommended for this use. The pipe zone material should be well compacted <u>on each side of the pipe,</u> and to at least 12 inches above the pipe. <u>Mechanical means will typically be required to densify these materials to the required densities</u> (unless a cement-treated material is used).

Density requirements for "pipe zone" backfill should be per the manufacturer's specifications for the type of pipe being used (we recommend using 95% to 97% of ASTM D-698). Care should be taken when compacting close to and immediately above the pipe so as to not damage the pipe.

General Trench Backfill. Above the "pipe zone" the backfill materials would typically consist of any compactable material that does not have excessive voids (such as gap-graded large gravels and cobbles), organics, expansive clay, debris or other deleterious material. Crushed rock and sandy Decomposed Granite works well for general trench backfill. The on-site soils may work fine for this purpose.

Where laterals of any kind, or valuing, extend upward from the lines, we recommend the trench areas adjacent to these items be backfilled with the "pipe zone" backfill materials. This will prevent the larger pieces of other backfill materials from damaging the valves and/or other equipment.

We strongly recommend that all general trench backfill be placed and compacted in the same manner as for general structural fill. Trench backfill beneath asphalt pavements but not under structures should be compacted to at least 98 percent of the maximum dry density, as determined by ASTM Test Method D-698 (Standard Proctor) for the upper 36 inches. Below 36 inches the trench backfill should be compacted to between 95 and 98 percent of the maximum dry density. Trench backfill in landscape areas, that are not part of a cut or fill slope, may be compacted to at least 93 percent of the maximum dry density.

Water Conveyance. Clean granular fill material such as crushed rock or pea gravel and even the coarser, sandy granite, when used as trench backfill, will tend to collect and convey water. On sloping sites where trenches run up and down the slope it is recommended these porous materials have the potential flow line through this porous backfill broken up with periodic "checkdams" across the trenches. The checkdams may consist of lean mix concrete or compacted slightly clayey Silt soils. These checkdams should extend for between 2 and 3 feet along the trench at each trench location.

If the check dams are not placed across trenches on sloping sites, water may be channeled into lower areas, causing significant damage due to flooding, erosion or surface slumps. We recommend these periodic checkdams be used on sloping roadways and sites where granular materials are used for trench backfill. For this site, it appears a spacing of 25 to 50 feet would be prudent.

Alternately, a less permeable trench backfill could be used to decrease water collection or conveyance. Backfill such as silty or slightly clayey Decomposed Granite soils, sand/cement slurry or other materials with low permeability, would work well.

6.6 EXTERIOR FLATWORK

Concrete exterior flatwork at grade could be subjected to minor frost heave. These movements can cause cracking and vertical offsets at joints and connections with other structures. More uniform support can be achieved by placing 6 to 12 inches of compacted crushed rock, crushed "shale", or decomposed Granite beneath these areas. Slabs and walkways reinforced with #3 or #4 deformed reinforcing steel (both ways) will also withstand movements better than unreinforced flatwork. The reinforcing must extend across all joints and between dissimilar pours (or use dowels) to decrease vertical offset movements and potential trip hazards. Jointing or saw cut patterns to provide predetermined crack locations will also generally improve the appearance of the finished flatwork. These are generally recommended to be at intervals of 8 to 10 feet (or less) in both directions.

6.7 FOUNDATION RECOMMENDATIONS

In our opinion, the subject site soils will be adequate for foundation support. Due to their sandy and silty nature and because some were found to be loose, footing excavations should be overexcavated and have the redensified subgrade covered with 12 inches of compacted crushed rock. This would be helpful in minimizing subgrade disturbance in wet weather.

Footing Design Recommendations. Footings shall be designed as listed below:

1. Preparation of the subgrade should be consistent with earlier recommendations in this report. Any soft or disturbed soils must be removed and replaced with structural rock fill. Recompact the subgrade to a firm, undisturbed condition.
2. Place 12 inches of compacted crushed rock as structural fill to protect footings subgrade.
3. Footings constructed as listed above may be designed for an allowable bearing pressure of 2,000 pounds per square foot. A 1/3 increase in this allowable bearing pressure may be used when considering short-term transitory wind and seismic loads.
4. The width of the crushed rock structural fill placed beneath the footings should extend outward from both sides of the footing a horizontal distance equivalent to one half the depth of the fill placed (i.e. for 1 foot of fill beneath the footings, extend fill past all edges of footings at least 6 inches). It must then also be provided with lateral support such that the crushed rock will not ravel away.
5. All spread footings shall be buried a minimum of 12 inches below finish grade in order to provide lateral support and frost protection.
6. We recommend minimum lateral dimensions of 12 inches for continuous load bearing footings.

Anticipated Settlements. For properly constructed foundations founded on crushed rock over the silt and sand soils, we anticipate total and differential settlement to be less than 3/4-inch and 3/8-inch, respectively.

Foundation Drains. We recommend all footings be installed with a footing drain to intercept groundwater seepage. Footing drains consisting of a rigid, smooth-wall perforated pipe surrounded by drain rock (sides and above), all wrapped in a non-woven geotextile fabric and should be placed adjacent to the footings. This is addressed more fully later in this report.

6.8 INTERIOR FLOOR SLABS

A properly prepared 6-inch layer of crushed rock structural fill over the undisturbed subgrade would be reasonably adequate for support of concrete slabs-on-grade.

Slab Section. The following recommendations are provided for slabs constructed on at least 6 inches of compacted crushed rock fill over properly prepared subgrade soils.

1. An eight-inch layer of clean (less than 2% passing the no. 200 sieve and less than 5% passing the No. 10 sieve) crushed rock (½" to ¾" clean crushed rock works well) should be placed over the structural fill to provide a drainage layer, positive capillary moisture break and uniform slab support. The capillary break is especially helpful in areas with floors that will not "breathe" or where solid bases sit on the floor.
2. A tough impermeable membrane, such as Stego Industries 15-mil vapor barrier (or an equivalent product) should be placed over the "clean" rock layer to further retard upward migration of moisture vapor into and through the concrete slab. Seal all seams well.
3. In order to protect the membrane, one to two inches of clean coarse sand or ¾" minus crushed rock could be placed on top of the membrane. The sand should be moistened slightly prior to placing concrete.

Note: In some cases others have felt the sand layer and/or vapor barrier could trap moisture causing dampness in the floor. Many times they use concrete additives to decrease moisture transmission through the slab. While we disagree with this position, we leave the decision to the building designer to use or not use the sand layer, concrete additives and vapor barrier.

The subgrade preparation and structural fill beneath interior slabs shall be accomplished as described earlier in this report.

Floor Subdrains. Subdrains beneath the floor should be installed to help decrease dampness. These are described later in this report.

6.9 LATERAL LOAD RESISTANCE

Lateral loads exerted upon these structures can be resisted by passive pressure acting on buried portions of the foundations, retaining walls and other buried structures and by friction between the bottom of structural elements of the wall and slabs and the underlying soil.

We recommend the use of passive equivalent fluid pressures of the following values for portions of the structure and foundations embedded into the native soils.

• Silt and Sand Fill Soil	200 pcf
• Dense Sand and Gravel	400 pcf
• Dense Compacted Crushed Rock (3' wide minimum)	500 pcf

We also recommend that the first 8 inches below the ground surface be ignored when computing the passive resistance of the soils. A coefficient of friction of 0.45 can be used for elements poured neat against crushed rock structural fill. These should be reduced to 0.2 for areas over a vapor barrier and 0.30 over native silt or silty Sand soils.

6.10 RETAINING WALLS

6.10.1 Conventional CMU or Concrete Walls

Lateral earth pressures will be imposed on all below ground and backfilled structures or walls, including foundations which do not have uniform heights of fill on both sides. The following recommendations are provided for design and construction of conventional concrete or CMU block retaining walls:

- We recommend walls which are free to rotate at the top (unrestrained) when backfilled, be designed for an equivalent fluid pressure (EFP) of 40 pcf (applies to slope above also).
- Walls that are fixed at the top (restrained) when backfilled should be designed for an equivalent fluid pressure of 60 pcf.
- A wet soil unit weight of 135 pcf should be used for design of retaining walls which are backfilled with crushed rock or jaw-run "shale" or are up against the dense sand and gravel.
- These values are for properly compacted, free draining, non-expansive, granular soils, free of organics and other debris or for imported granular backfill. Imported crushed rock or jaw-run "shale" works well for wall backfill materials.
- These design values assume the wall or structure is fully drained, includes the slope load and has no surcharge loads from traffic or other structures. The structural designer should include surcharge loading from traffic, building loads and/or sloped backfill.
- We recommend designing retaining walls to resist seismic loading. A horizontal acceleration component of 0.13g (500 year event) should be applied to the mass of an enlarged active wedge of soil behind the walls and utilized in a pseudo-static analysis. The wedge length back from the wall along the ground surface may be taken to be 0.8H, where H is the height of the wall. This relates to an equivalent uniform load over the entire back of the wall of approximately 8 pounds per

square foot for each foot of backfill, for walls up to 10 feet tall (i.e. for a 6-foot wall, uniform seismic load will be 48 psf).

- The backfill should be placed in lifts at near the optimum moisture content and compacted to between 93 and 95 percent of the maximum dry density as determined by laboratory procedure ASTM D-698 (Standard Proctor). Loosely placed backfill will exert greater pressures on the wall than the pressures provided above and must be avoided.
- To prevent damage to the wall, backfill and compaction against walls or embedded structures should be accomplished with lighter hand-operated equipment within a distance of 1/2 h to 1/3 h (h being the vertical distance from the level being compacted down to the surface on the opposite side of the wall). Outside this distance, normal compaction equipment may be used.

While proper compaction of wall backfill is critical to the proper performance of the walls, care should be taken to not over-compact the backfill materials. Over-compaction can induce greater lateral loads on the wall or structure than the design pressures given above.

6.11 FOUNDATION, FLOOR AND WALL DRAINS

All exterior foundations, retaining walls and embedded structures should have proper drainage.

Wall Drains. Wall drains would typically have a minimum 12-inch wide drainage zone of drain rock wrapped in non-woven filter fabric immediately behind the wall extending up from the drainage section to within 12 to 18 inches of the surface. A preformed, fabric-wrapped, polymer sheet drain, such as Amerdrain, Linq Drain or Enkamat may be used on the back of the wall in lieu of the vertical drainage zone, provided this is backfilled with clean, free-draining material. The retaining walls must have the dirt side sealed with approved sealer. Exterior wall drainage sections, which will not be sealed on top by asphalt or concrete, should have the upper 12 inches backfilled with compacted onsite silt soils to minimize intrusion of surface waters into the wall drain system. Please see Figure 3 for details of typical wall drainage methods.

Footing Drains. Foundation and base of wall drainage should consist of a rigid smooth wall perforated pipe surrounded by at least 8 inches of drain rock on top and sides, all wrapped in a non-woven geotextile designed as a filter fabric (such as Mirafi 140N or equivalent). We recommend the fabric be covered with a two to three-inch layer of sand to protect it against damage during backfilling operations and potential plugging from soil fines. The perforated pipe should be located on the footing next to the stem wall (or beside the footing), provided this is at least 6 inches below underslab drain rock or crawlspace (for footing drains). Please see Figure 4.

Floor Drains. Where the drain rock layer below slabs will be lower than the adjacent exterior grades, water will tend to accumulate in this low area. This is especially true with embedded structures. One method to drain this water is to include a series of subdrains at the bottom of the drain rock layer beneath the slab. The drain rock section should be thickened to at least 8 inches for such restroom projects. The subdrain lines typically consist of 3-inch diameter, smooth interior, solid wall, perforated pipe at spacing of 10 feet (or less) across the structure (and around the interior perimeter). The perforated pipe is placed in a deepened zone of the drain layer as shown on Figure 5. The pipes are sloped to drain and collected by a tightline which leads to the stormwater disposal system. We recommend we be allowed to review the subdrain system design prior to final plan submittal or construction bidding.

Note: Walls that are part of an embedded structure and that must remain reasonably dry, must have additional water proofing. We recommend a rolled, sprayed or troweled on bitumen-base sealer (sealcoats that do not harden are less likely to crack and allow moisture into the wall) on the exterior, covered by plastic sheeting or the polymer sheet drain, backfilled with free draining granular materials. While applying the sealer to the entire wall is important, attaining an excellent seal in the lower two feet of the wall, as well as at the wall to footing/floor interface, is critical.

All drains should be tightlined and positively sloped to an approved stormwater disposal location into the public storm drain system. **Note:** In no case shall water be collected and/or directed or discharged close to or on slopes. Such water discharge will cause added slope instability and erosion.

We strongly recommend against connecting roof drains or surface area drains to foundation and wall drain systems or floor subdrains. Foundation drains should consist of rigid smooth-wall perforated pipe. The rigid smooth-wall pipe can be cleaned out by means of a “roto-rooter” type system should it become plugged with sediment or fine roots. We recommend cleanouts be placed periodically by the designer to facilitate cleaning and maintenance of the drains.

6.12 SITE DRAINAGE

The site should be graded during construction such that surface water does not pond within the building footprint. Surface runoff should be controlled during construction and with final site grading. All areas adjacent to the structures should have a permanent slope away from the foundations at an inclination of at least 6 inches in eight (8) feet. This surface water should be channeled into landscape area drains or catch basins, or should be conveyed around the structures and to the public right-of-ways or storm drain system by means of tightline pipes. Where items such as landscape areas and walkways block the flow of surface water, small area drains should be installed to collect the surface runoff. Good site design accommodates all site runoff and conveys it away from the structures and off the site to an acceptable disposal location, without undue erosion problems.

All roof downspouts should be connected to a sealed tightline system, which discharges to an acceptable disposal location. In no case should these be connected to footing drains, base of retaining wall drains or subdrains beneath floors.

7.0 EROSION CONTROL

The site soils are moderately susceptible to erosion, depending upon which soil layer is exposed. The site grades are relatively flat, especially in the area which will be disturbed by construction. Therefore, site erosion should be low.

Construction Erosion Control. All disturbed areas shall have the low side surrounded by a silt fence with the bottom edge embedded in the soil at least two (2) inches. At select locations settling ponds of hay-bale backed silt fence should be established to decrease silt content of water flowing off site. Hay bales or wattles should be used to protect street catch basins within 300 feet of the site (if water flow from the site can reach them).

Permanent Erosion Control. Permanent project landscaping and paving as required by the City of Grants Pass will meet most needs of long-term erosion control. All disturbed areas on the site but outside the developed area of the project must be reseeded with local native grasses for erosion prevention. These areas shall be graded reasonably smooth and the surface scarified to ½ inch deep. The area should then be hydroseeded with a combination of erosion control grass seed, fertilizer and mulch.

8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

We should review construction plans and specifications for this project when they have been developed. In addition, The Galli Group should be retained to review all geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in our report. Also, to observe compliance with the intent of our recommendations, design concepts, and the plans and specifications, all construction operations dealing with earthwork and foundations should be observed by a representative from The Galli Group.

For this project, we anticipate additional services could include the following:

- Review of final construction plans and specifications for compliance with geotechnical recommendations.
- Possible project team meetings to clarify issues and proceed smoothly into and through the construction process.
- Observation of onsite cut slopes and trenches to verify stability.

- Observation of drilled shafts and pile installation (design under separate cover).
- Observation and/or testing of over-excavated areas, building pads, structural fill placement, fill subdrains, subgrade proofrolling, footing subgrade, crushed rock placement and compaction and wall and floor drainage.
- Periodic construction field reports, as requested by the client and required by the building department.

We would provide these additional services on a time-and-expense basis in accordance with our current Standard Fee Schedule and General Conditions at the time of construction. If we are not retained to provide these services we cannot be held responsible for the decisions by others or geotechnical related issues in the constructed product.

8.2 LIMITATIONS

The analyses, conclusions and recommendations contained in this report are based on site conditions and assumed development plans as they existed at the time of the study, and assume soils, rock and groundwater conditions exposed and observed in the borings during our investigation are representative of soils and groundwater conditions throughout the site. If during construction, subsurface conditions or assumed design information is found to be different, we should be advised at once so that we can review this report and reconsider our recommendations in light of the changed conditions. If there is a significant lapse of time between submission of this report and the start of work at the site, if the project is changed, or if conditions have changed due to acts of God or construction at or adjacent to the site, it is recommended that this report be reviewed in light of the changed conditions and/or time lapse.

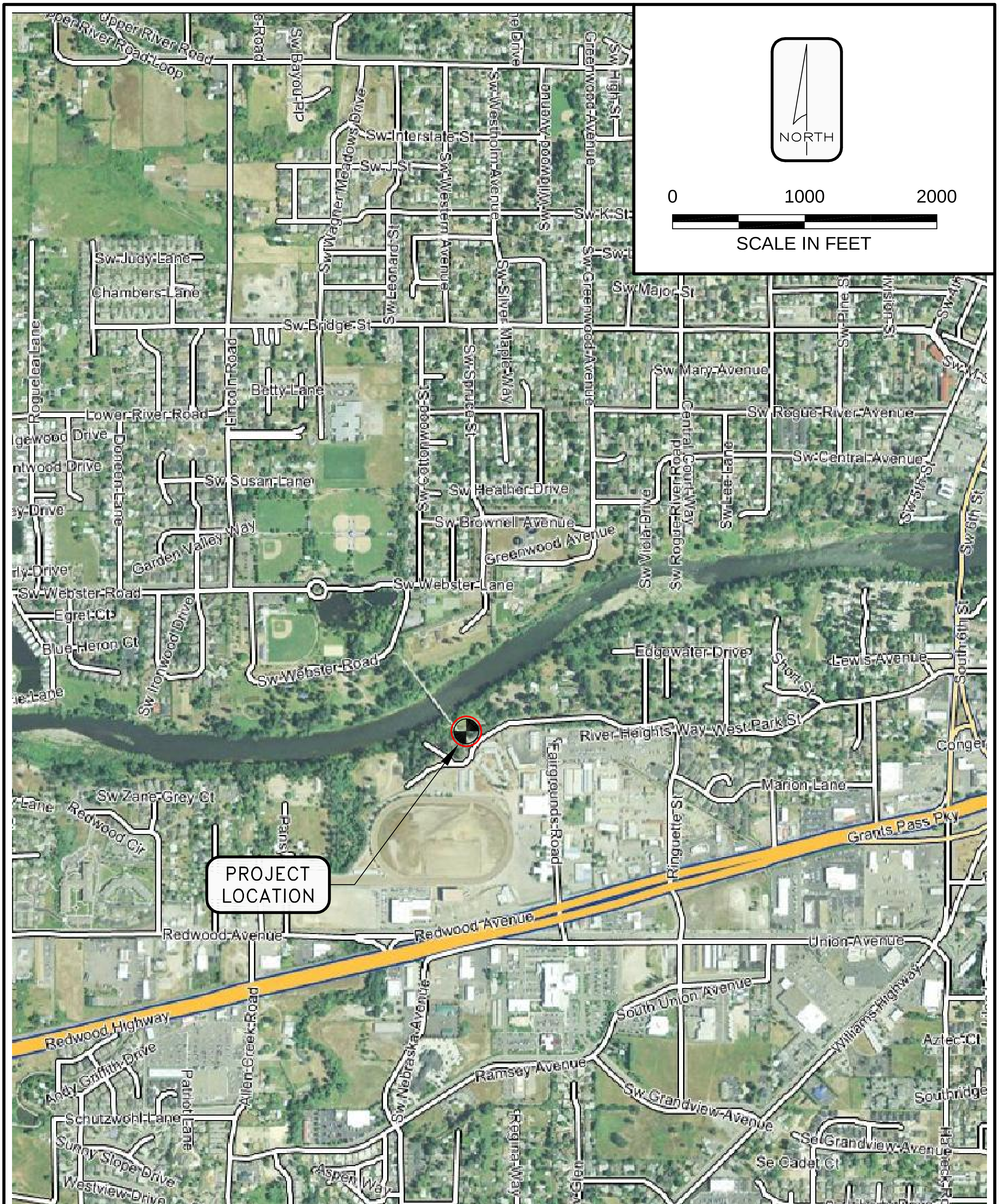
This report was prepared for the use of the owner and his design and construction team for the design and construction of the project. It should be made available to contractors for information and factual data only. This report should not be used for contractual purposes as a warranty of site subsurface conditions. It should also not be used at other sites or for projects other than the one intended.

We have performed these services in accordance with generally accepted geotechnical engineering practices in southern Oregon, at the time the study was accomplished. No other warranties, either expressed or implied, are provided.

THE GALLI GROUP
GEOTECHNICAL CONSULTING

William F. Galli, PE, GE
Senior Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
12162
OREGON
JULY 15, 1983
WILLIAM F. GALLI
EXPIRES: 06/15



THE GALLI GROUP
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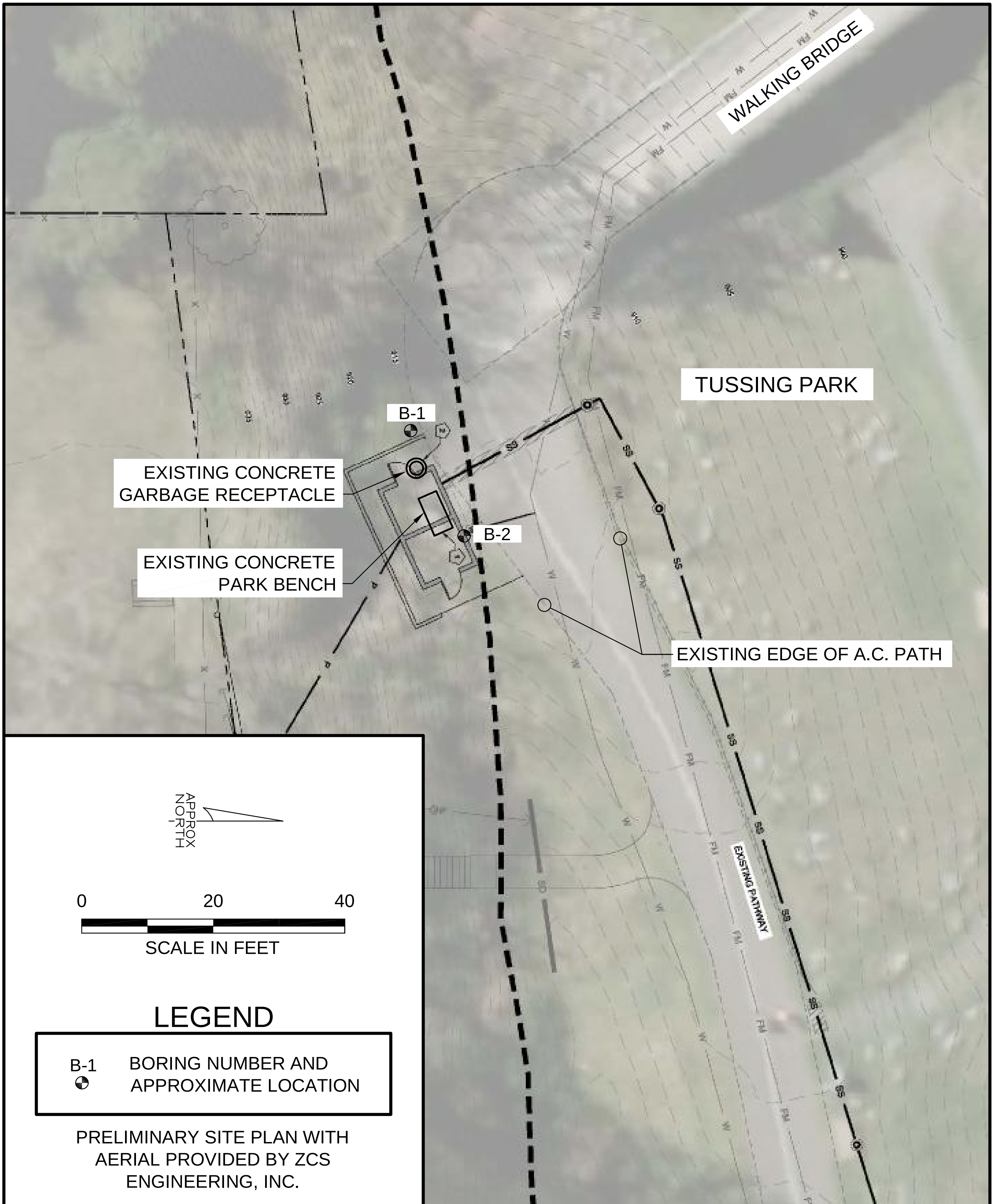
612 NW 3rd Street
Grants Pass, OR 97526

VICINITY MAP

TUSSING PARK RESTROOMS
GRANTS PASS, OREGON

DATE:	APRIL 2014
JOB NO:	02-4924-01
REV:	4/11/2014 9:57 AM
PREPARED BY:	MG3
4924 Tussing Park - Vicinity.dwg	

FIGURE:
1



THE GALLI GROUP
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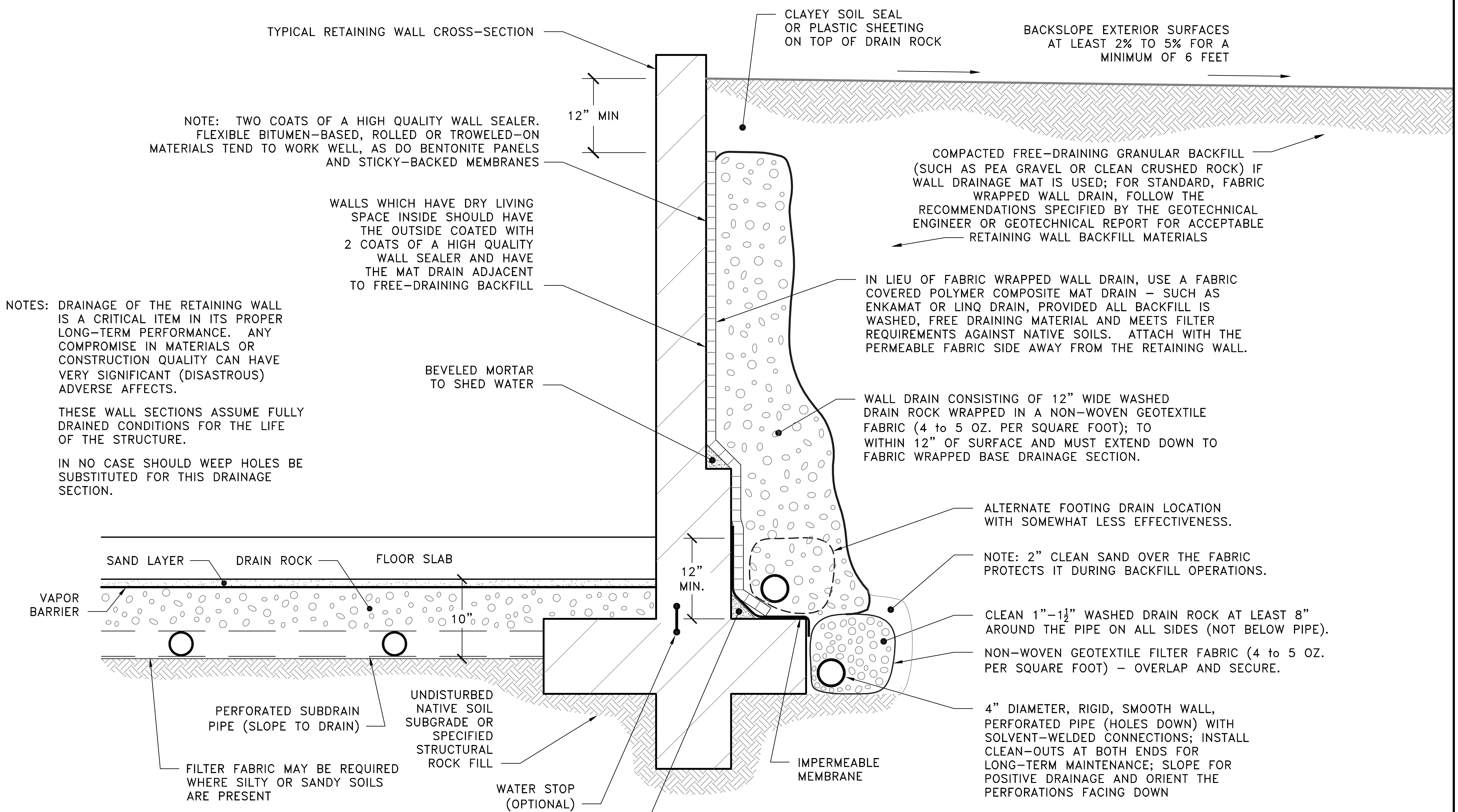
612 NW 3rd Street
Grants Pass, OR 97526

PRELIMINARY SITE PLAN

TUSSING PARK RESTROOMS
GRANTS PASS, OREGON

DATE: APRIL 2014
JOB NO: 02-4924-01
REV: 4/29/2014 9:05 AM
PREPARED BY: MG3
4924 Tussing Park - Site Plan.dwg

FIGURE: 2



FOR ILLUSTRATION PURPOSES ONLY
NOT TO SCALE

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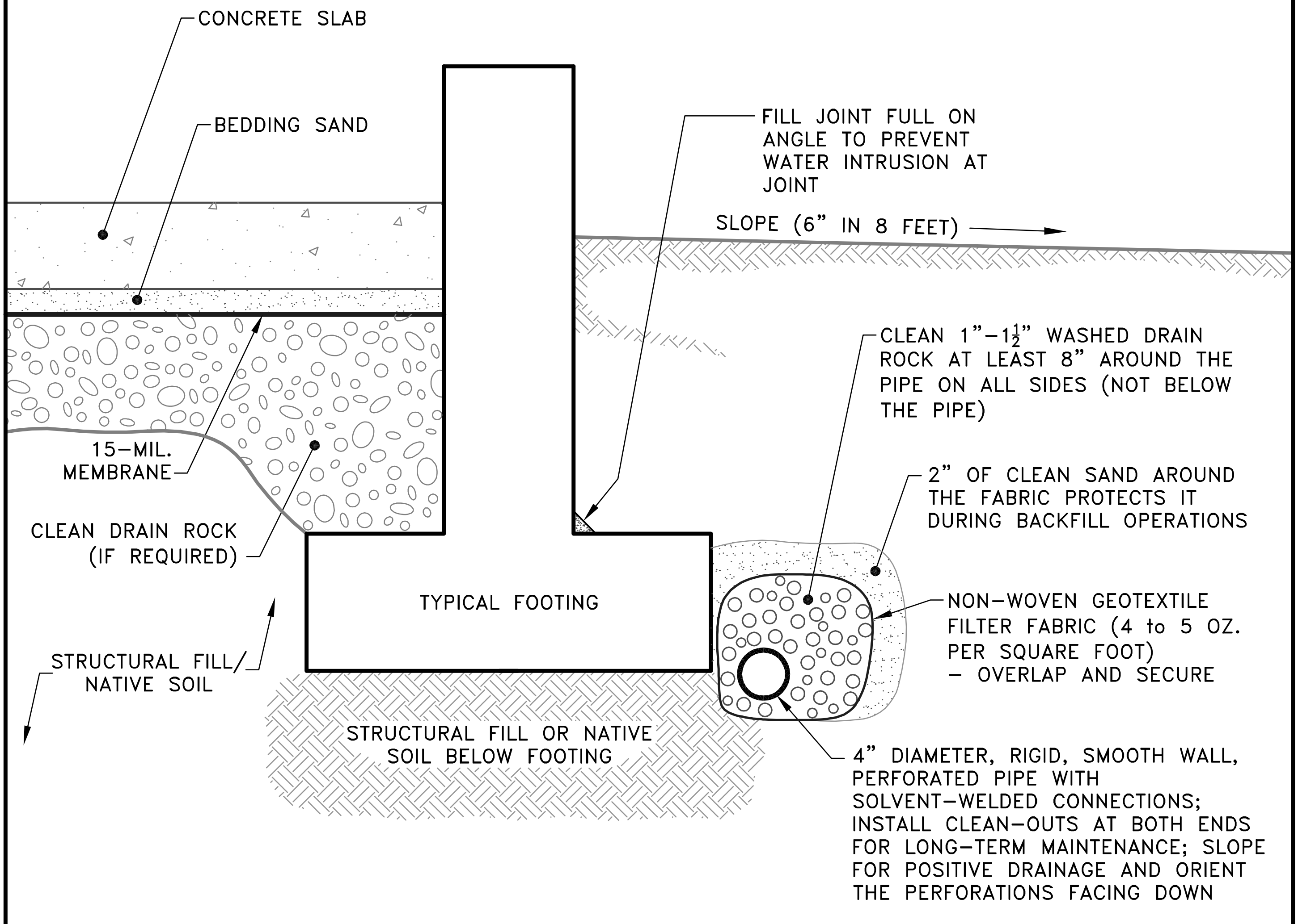
Grants Pass, OR 97526

RETAINING WALL
DRAINAGE CROSS-SECTION

TUSSING PARK RESTROOMS
GRANTS PASS, OREGON

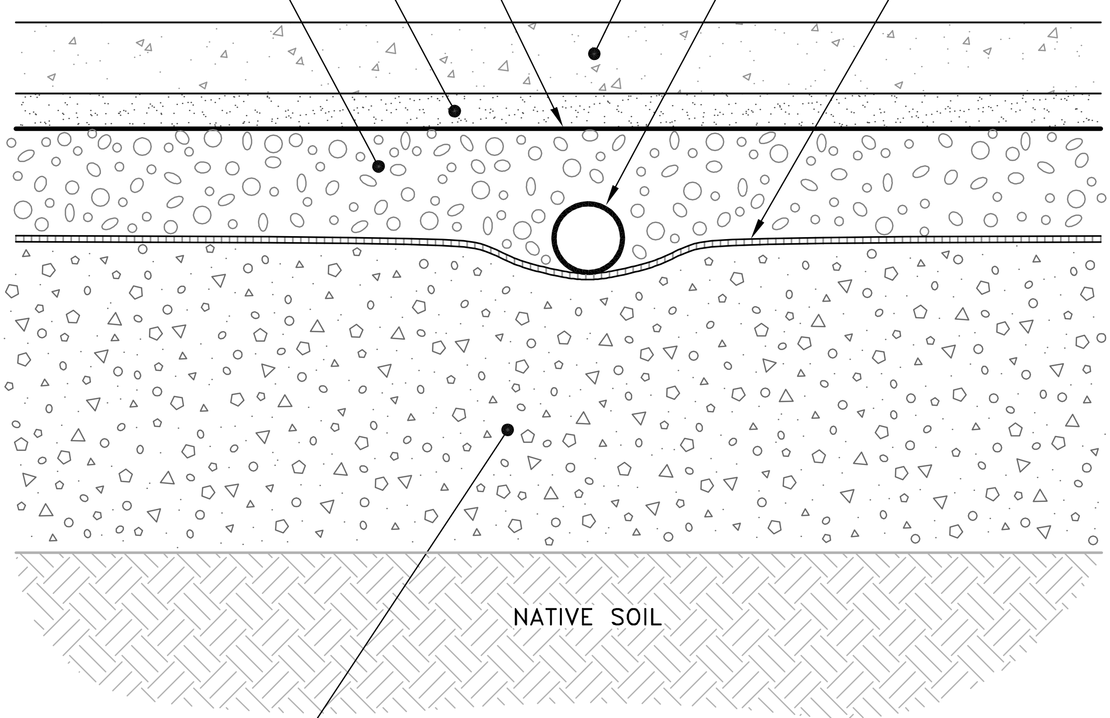
DATE: APRIL 2014
JOB NO: 02-4924-01
REV: 4/29/2014 9:15 AM
PREPARED BY: MG3
4924 Tussing Park - retwall drain-basement-02.dwg

FIGURE: 3



FOR ILLUSTRATION PURPOSES ONLY
NOT TO SCALE

THE GALLI GROUP GEOTECHNICAL CONSULTING 612 NW 3rd Street Grants Pass, OR 97526	TYPICAL FOUNDATION DRAIN SLAB ON GRADE FLOOR TUSSING PARK RESTROOMS GRANTS PASS, OREGON	DATE: APRIL 2014 JOB NO: 02-4924-01 REV: 4/29/2014 9:08 AM PREPARED BY: MG3 4924 Tussing Park - found drain-slab.dwg	FIGURE: 4



NOTES:

(1) MAXIMUM SPACING IS 15 FEET.

(2) ORIENT PIPE PERFORATIONS TO BOTTOM.

(3) ASSEMBLE PIPE USING SOLVENT–WELDED CONNECTIONS.

(4) DO NOT DRIVE OVER DRAIN LINES.

(5) DRAIN ROCK AND STRUCTURAL FILL TO MEET SPECS. IN REPORT BODY – SLOPE PIPE TO DRAIN.

(6) MAY REQUIRE FILTER FABRIC ON NATIVE SUBGRADE OR IF STRUCTURAL FILL IS VERY SILTY OR SANDY.

FOR ILLUSTRATION PURPOSES ONLY

NOT TO SCALE

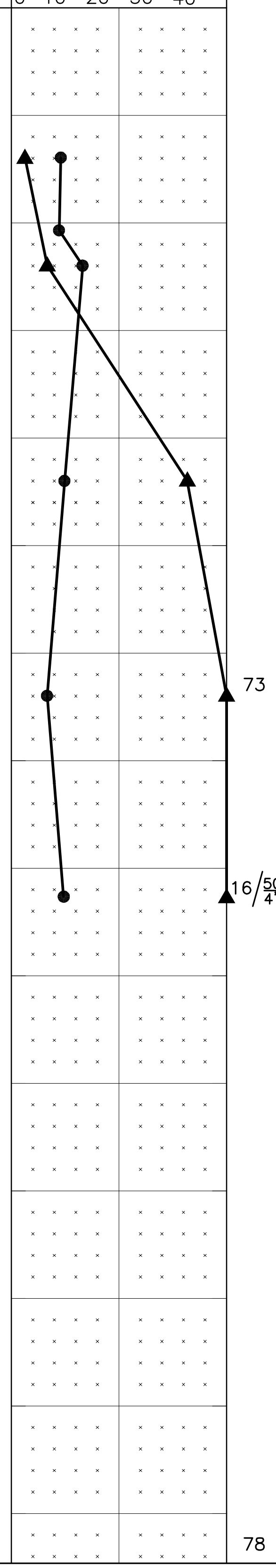
THE GALLI GROUP GEOTECHNICAL CONSULTING 612 NW 3rd Street Grants Pass, OR 97526	FLOOR SUBDRAIN DETAIL TUSSING PARK RESTROOMS GRANTS PASS, OREGON	DATE: APRIL 2014 JOB NO: 02-4924-01 REV: 4/29/2014 9:15 AM PREPARED BY: MG3 4924 Tussing Park - subdrain sog.dwg	FIGURE: 5

APPENDIX A

BORING LOGS

DEPTH IN FEET	MATERIAL DESCRIPTION SURFACE ELEV. (FT.)	SAMPLES NO.	S.P.T.	GROUND WATER DEPTH IN FEET
1	(FILL) Landscaping bark & soil [1.5" thick] over loose, tan & gray, 3/4-inch Minus Crushed Rock; slightly moist.			
	(FILL) Loose to medium dense, light brown, silty SAND [DG]; moist. (SM)	S-1	3	2½
5½	Soft to medium stiff, dark brown to brown, sandy SILT; scattered to numerous fine, subrounded gravels, moist. (ML)	S-2	8	5
7	Dense, brown & red, gravelly SAND; some silt, medium to coarse, rounded to subrounded gravels, moist and damp. (SP)	S-3	41	7½, 10
13	Very dense, light brown & gray, GRAVELS & COBBLES in a silty sand soil matrix; rounded to subrounded gravels, damp to moist. (GP)	S-4	73	12½, 15, 17½
21	Bottom of boring at 21 feet. No free groundwater or seepage encountered.	S-5	16/50/4"	20, 22½, 25, 27½, 30, 32½, 35

STANDARD PENETRATION TEST
▲ BLOWS PER FOOT



LEGEND

- 2" S.P.T. SAMPLE
- GRAB SAMPLE
- 3" DAMES & MOORE SAMPLE (140 LB SPT HAMMER)
- * SAMPLE NOT RECOVERED
- ESTIMATED EXTENTS OF PERCHED WATER TABLE
- 3" THIN WALL SAMPLE (U)
- PITCHER SAMPLE (P)
- IMPERVIOUS SEAL
- WATER LEVEL
- PIEZOMETER TIP
- LIQUID LIMIT / NATURAL WATER CONTENT / PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT
- USC UNIFIED SOIL CLASSIFICATION

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. GROUNDWATER LEVELS DO RISE AND FALL DUE TO THE SEASONS. GROUNDWATER LEVELS MAY RISE CLOSE TO

DRILLER LAWRENCE & ASSOCIATES
DATE START 04/03/14 FINISH 04/03/14
DRILLING TECHNIQUE 8"ø HSA

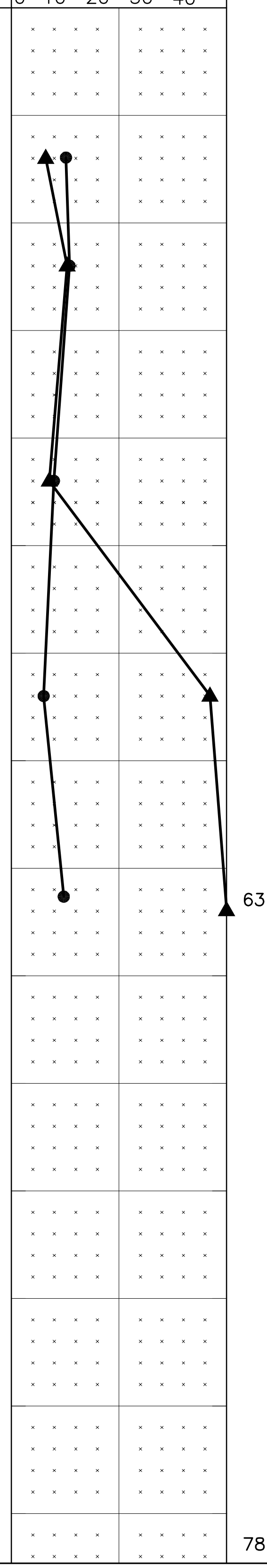
THE GALLI GROUP
GEOTECHNICAL CONSULTING
612 NW 3rd Street
Grants Pass, OR 97526

SUMMARY BORING LOG
B-1
TUSSING PARK RESTROOMS
GRANTS PASS, OREGON

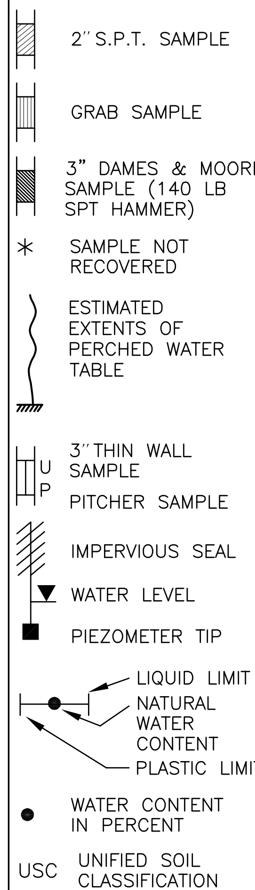
DATE APRIL 2014
JOB NO. 02-4924-01
FIG. A1

DEPTH IN FEET	MATERIAL DESCRIPTION SURFACE ELEV. (FT.)	SAMPLES NO.	SAMPLES S.P.T.	GROUND WATER DEPTH IN FEET
1	(FILL) Loose, gray, 3/4-inch Minus Crushed Rock; slightly moist.			
	(FILL) Loose to medium dense, light brown, silty SAND [DG]; moist. (SM)	S-1	8	2½
		S-2	13	5
8	Stiff, dark brown to brown, fine sandy SILT; numerous fine, subrounded gravels, trace organic fibers, damp to dry. (ML)			7½
		S-3	9	10
14	Dense to very dense, orange-brown & gray, sandy GRAVELS & COBBLES; some silt, subrounded gravels, damp to moist. (GP)	S-4	46	12½, 15
	.. occasional moist to wet, yellow, silt/clay pockets (≈⅛"ø) encountered in soil matrix at 20 feet.	S-5	63	17½, 20
21½	Bottom of boring at 21½ feet. No free groundwater or seepage encountered.			22½, 25, 27½, 30, 32½, 35

STANDARD PENETRATION TEST
▲ BLOWS PER FOOT



LEGEND



NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. GROUNDWATER LEVELS DO RISE AND FALL DUE TO THE SEASONS. GROUNDWATER LEVELS MAY RISE CLOSE TO

DRILLER LAWRENCE & ASSOCIATES
DATE START 04/03/14 FINISH 04/03/14
DRILLING TECHNIQUE 8"ø HSA

THE GALLI GROUP
GEOTECHNICAL CONSULTING
612 NW 3rd Street
Grants Pass, OR 97526

SUMMARY BORING LOG
B-2

TUSSING PARK RESTROOMS
GRANTS PASS, OREGON

DATE APRIL 2014
JOB NO. 02-4924-01
FIG. A2