NorthWest Colorado Consultants, Inc.

Geotechnical / Environmental Engineering • Materials Testing

March 27, 2024

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Job Number: 24-13254

Subject: Preliminary Subsoil and Foundation Investigation, Proposed Berlet Live/Work Units, 38980 Main Street, Town of Milner, Routt County, Colorado.

Luke,

As requested, NWCC, Inc. (NWCC) has prepared this Preliminary Subsoil and Foundation Investigation for the proposed live/work unit to be constructed within 38980 Main Street, Town of Milner in Routt County, Colorado.

NWCC's scope of work includes making visual observations during a preliminary site visit and our review of data from previous investigations completed at adjacent and other nearby sites in the Town of Milner. This report presents recommendations for economically feasible foundations, as well as allowable soil pressures and other design and construction considerations that are advisable, but not necessarily routine to quality design and building practices.

Proposed Construction: NWCC understands the proposed live/work building will be approximately 70 feet by 40 feet in dimension and will consist of a two-story wood framed building. We understand the lower level of the live/work unit will be constructed with a concrete slab-on-grade floor system placed near or slightly above the existing ground surface.

For design purposes, we have assumed that the building loads will be light to moderate typical of this type of live/work unit construction. If loadings or conditions are significantly different from those above, we should be notified to reevaluate the recommendations in this report.

Site Conditions: The project site is situated south of US Highway 40, east of Main Street and west of the existing alley in Milner, Colorado. The subject property was vacant at the time of our investigation. Approximately 1 to 2 feet of snow was on the ground surface at the time of our visit.

The topography of the site is fairly level and appears to slope gently down to the southwest on the order of 0 to 2 percent. It appears that an elevation difference of 1 to 2 feet exists across the property.

Assumed Subsurface Conditions: It should be noted that our firm has not completed a subsurface investigation at this site and the recommendations provided in this report have been developed assuming the soil conditions will be similar to those encountered at the adjacent and nearby building sites within the Town of Milner. We have assumed the subsurface conditions will most likely consist of a variable layer of fill materials and/or a layer of natural topsoil and organic materials overlying natural clays.

The thickness of the fill materials or natural topsoil and organic materials generally ranges from 1 to 3 feet in thickness in this area. The fill materials are highly variable and typically consist of clays and sands with gravels and occasional organics.

Natural clays are typically encountered beneath the topsoil and organic materials and existing fill materials. The clays are typically slightly sandy to very sandy, low to moderately plastic, stiff to medium stiff, slightly moist to moist and brown in color.

The natural clays will typically exhibit a low swell potential and a low degree of consolidation when wetter under constant loads.

Based on anticipated geologic site conditions, NWCC recommends a **Site Class C** designation be used in structural design calculations in accordance with Table 20.3-1 in Chapter 20 of ASCE 7-10.

Foundation Recommendations: Based on the visual observations during a preliminary site visit, our review of data from previous investigations, and our understanding of the proposed construction, NWCC believes an economically feasible type of foundation system is spread footings or individual pads with grade beams founded on the natural clays. The precautions and recommendations itemized below will not prevent the movement of the foundations if the underlying clays swell. However, they should reduce the amount of differential movement beneath the foundation system.

1) Footings placed on the natural clays should be designed using an allowable soil bearing pressure of 2,000 psf. Footings should also be designed for a minimum deadload pressure of at least 600 psf.

2) Footings or pad sizes should be computed using the above soil pressures and placed on the natural undisturbed clays found below the existing fill materials or topsoil and organic materials.

3) Any existing fill materials or topsoil and organic materials or loose or soft natural soils encountered within the foundation excavations, should be removed and the excavations extended to competent clays prior to concrete placement.

4) Foundation walls should be designed and reinforced to span an unsupported distance of 10 feet or the length between pads, whichever is greater.

5) Footings or pads should be placed well enough below final backfill grades to protect them from frost heave. Forty-eight (48) inches is typical for this location considering normal snow cover and other winter factors.

6) Based on experience, NWCC estimates total settlement for footings and pads designed and constructed as discussed in this section will be approximately 1 inch. Additional bearing capacity values along with the associated settlements are presented in Figure #1.

7) The client must retain our firm to observe the foundation excavations when they are near completion to identify the bearing soils and confirm the recommendations in this report.

Alternate Foundation Recommendations: An alternative type of foundation system would consist of helical screw piles advanced into the sands and gravels typically underlying the clays. The helical screw pile foundations will place the bottom of the foundation in a zone of relatively stable moisture content and mitigate the risk of foundation movement associated with the swelling of the natural clays.

Utilizing this type of foundation, each column is supported on a single or group of screw piles, and the structures are founded on grade beams or pile caps supported by a series of piles. Load applied to the piles is transmitted to the natural soils through the end bearing pressure at the helices of the screw pile. Foundation movement should be less than ½-inch if the following design and construction conditions are observed.

The helical screw pile foundation system should be designed by a qualified engineer, using industry standards and be installed by a licensed/certified installer. If pile groups are required, we recommend a minimum pile spacing of 3 times the largest helix to achieve the maximum capacity of each individual pile. Lateral loads should be resisted using battered piles or tiebacks or through passive soil pressures against foundation walls or grade beams.

We strongly recommend at least two test piles be advanced at the site to confirm subsoil conditions and establish torque versus depth relationships to determine the proper shaft and helix size and type. In addition, load testing of the helical screw piles is strongly recommended to verify the design capacity of the piles. A representative of this office should observe the test piles, load test and helical screw pile installations.

NWCC also recommends the following:

- Minimum 6-inch diameter helix;
- Minimum 8 foot depth of top helix;
- Minimum installation torque of 4,000 ft-lbs;
- Full-time installation observation by a qualified special inspector;
- Review of the Contractor's quality control plan regarding instrumentation calibration and testing, materials QC and pile installation procedures.

Floor Slabs: NWCC understands the lower level of the live/work unit will be constructed utilizing a concrete slab-on-grade floor system. The on-site soils, exclusive of the topsoil and organic materials and any existing fill materials, are capable of supporting slab-on-grade construction. However, floor slabs present a very difficult problem where swelling materials are present near floor slab elevation because sufficient dead load cannot be imposed on them to resist uplift pressure generated when expansive soils are wetted and expand.

If the client elects to construct a concrete slab-on-grade floor system, we recommend that the following special design and construction precautions be followed so that the amount of movement in the floor slabs can be reduced, if the clays become wetted.

1) Floor slabs must be separated from all bearing walls; columns and their foundation supports with a positive slip joint. NWCC recommends the use of ½-inch thick cellotex or impregnated felt.

2) Interior non-bearing partition walls resting on floor slabs must be provided with a slip joint, preferably at the bottom, so that in the event the floor slab moves, this movement is not transmitted to the upper structure. This detail is also important for wallboard and doorframes and is shown in Figure #2.

3) A minimum 6-inch gravel layer must be provided beneath all floor slabs to act as a capillary break and to help distribute pressures. Prior to placing the gravel, excavations should be shaped so that if water does get under the slab, it will flow to the low point of the excavation. In addition, all topsoil and organic materials and any existing fill materials should be removed prior to placement of the underslab gravels or new fill materials.

4) Floor slabs must be provided with control joints placed a maximum of 10 to 12 feet on center in each direction, depending on slab configuration, to help control shrinkage cracking. Joints locations should be carefully checked to assure natural, unavoidable cracking will be controlled. The depth of the control joints should be a minimum of ¼ of the thickness of the slab.

5) Underslab soils must be kept as close as possible to their in-situ moisture content. Excessive wetting or drying of these materials prior to placement of the floor slab could result in differential movement after slabs are constructed.

6) It has been our experience that the risk of floor slab movement can be reduced by removing at least 2 feet of the expansive materials and replacing them with a well compacted, non-expansive fill. If this is done or if fills are required to bring the underslab soils to the desired grade, the fill should consist of non-expansive, granular materials. The fill should be uniformly placed and compacted in 6 to 8 inch lifts to at least 95% of the maximum standard Proctor density at or near the optimum moisture content, as determined by ASTM D-698.

The above precautions and recommendations will not prevent floor slab movement in the event the clays supporting the floor slabs undergo moisture changes. However, they should reduce the amount of damage if such movement occurs. The only way to eliminate the risk of all floor slab movement due to expansive soils is to construct a structural floor system over well-vented crawl space areas or void form materials.

Perimeter Drainage System: To enhance site drainage and improve foundation and interior slab-on-grade performance, NWCC recommends a perimeter drainage system be installed around the building perimeter. Localized perched water or runoff can infiltrate the structure at the foundation level. This water can be one of the primary causes of differential foundation and slab movement.

The drainage system should be located around the entire building perimeter and be placed at least 12 inches below interior slab or crawl space grades and a minimum of 24 inches below final grades to provide frost protection. Ideally, the drainage system should be centered along roof drip-line locations. In locations where roof driplines are not present, the drainage system may be located within 24 inches of foundation walls. Drains should be insulated using 2-inches of rigid polystyrene insulation board in locations higher than 48 inches below final grade to provide protection against freezing.

Perimeter drainage system piping should be constructed using perforated PVC pipe that meets or exceeds ASTM D-3034/SDR 35 requirements to provide satisfactory long-term function and rapid runoff of water. The holes in the drainpipes should be oriented down between 4 o'clock and 8 o'clock to promote rapid runoff of the water. The drainpipes should be covered with at least 12

inches of free draining gravel and be protected from contamination by a geotextile filter fabric covering of Mirafi 140N subsurface drainage fabric or an equivalent product. The drainpipes should have a minimum slope of 1 percent and be daylighted at positive outfalls that are protected from freezing. If the drainpipes cannot be daylighted, the drains should be led to sumps where the water can be pumped. Multiple daylights or sumps are recommended for the proposed structures. A typical perimeter/underdrain detail is shown in Figure #3.

Caution should be taken when backfilling so as not to damage or disturb the installed drains. NWCC recommends the drainage piping include cleanouts provided at minimum 100-foot intervals, be protected against intrusion by animals at the outfalls and be tested prior to backfilling. NWCC should be retained to provide periodic observations of underdrain construction to verify installation has been accomplished in general accordance with these recommendations. Flow testing of the system is recommended.

Foundation Walls and Retaining Structures: Foundation walls and retaining structures, which are laterally supported and can be expected to undergo only a moderate amount of deflection, may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 55 pcf for the on-site soils.

Cantilevered retaining structures on the site can be expected to deflect sufficiently to mobilize the full active earth pressure condition. Therefore, cantilevered structures may be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of 45 pcf for the on-site soils.

Foundation walls and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent buildings, traffic and construction materials. An upward sloping backfill and/or natural slope will also significantly increase the earth pressures on foundation walls and retaining structures and the structural engineer should carefully evaluate these additional lateral loads when designing the foundation and retaining walls.

The lateral resistance of retaining wall foundations placed on undisturbed natural soils materials at the site will be a combination of the sliding resistance of the footings on the foundation materials and the passive pressure against the sides of the footings. Sliding friction can be taken as 0.4 times the vertical dead load. Passive pressure against the sides of the footing can be calculated using an equivalent fluid pressure of 250 pcf. The fill placed against the sides of the footings to resist lateral loads should be compacted to at least 100% of the maximum standard Proctor density and near the optimum moisture content.

NWCC recommends backfilling the exterior of the foundation walls with the on-site clays to minimize infiltration of surface water into the exterior wall backfill materials. Wall backfill should be carefully placed in uniform lifts and compacted to at least 95 percent of the maximum standard Proctor density and near the optimum moisture content. Care should be taken not to overcompact the backfill since this could cause excessive lateral pressure on the walls. Some

settlement of deep foundation wall backfill materials will occur even if the material is placed correctly.

Surface Drainage: Proper surface drainage at this site is of paramount importance for minimizing the infiltration of surface drainage into the wall backfill and bearing soils, which could result in increased wall pressures, differential foundation and slab movement. The following drainage precautions should be observed during construction and at all times after the structures have been completed:

1) Ground surface surrounding the structures should be sloped (minimum of 1.0 inch per foot) to drain away from the structures in all directions to a minimum of 10 feet. Ponding must be avoided. If necessary, raising the top of foundation walls to achieve a better surface grade is advisable.

2) Non-structural backfill placed around the structures should be compacted to at least 95% of the maximum standard Proctor density at or near the optimum moisture content in order to minimize future settlement of the fill. The backfill should be placed immediately after the braced foundation walls are able to structurally support the fill. Puddling or sluicing must be avoided.

3) Roof downspouts and drains should discharge well beyond the limits of all backfill. Roof overhangs, which project two to three feet beyond the foundations, should be considered if gutters are not used.

4) Landscaping, which requires excessive watering and lawn sprinkler heads, should be located a minimum of 10 feet from the foundation walls of the structures.

5) Plastic membranes should not be used to cover the ground surface adjacent to foundation walls.

Limitations: The recommendations provided in this report are based on the soils encountered at adjacent and nearby sites and NWCC's understanding of the proposed construction. NWCC believes this information gives a high degree of reliability for anticipating the behavior of the proposed structures; however, our recommendations are professional opinions and cannot control nature, nor can they assure the soils profiles beneath those or adjacent to those observed. No warranties expressed or implied are given on the content of this report.

Swelling soils are anticipated at this site. These soils are stable at their natural moisture content but can shrink or swell with changes in moisture and loading. The behavior of swelling soils is not fully understood. The swell and/or consolidation potential of any particular site can change erratically both in lateral and vertical extent. Moisture changes also occur erratically, resulting in conditions, which cannot always be predicted. The recommendations presented in this report are

based on the current state of the art for foundations and floor slabs constructed on swelling soils. The owner and any future owners should be aware that there is a risk in construction on these types of soils. The performance of the structures will depend on following the recommendations and in proper maintenance after construction is complete. As water is the main cause for volume change in the soils, it is necessary that the changes in moisture content be kept to a minimum. This requires judicious irrigation and providing positive surface drainage away from the structures. Any distress noted in the structures should be brought to the attention of NWCC.

This report is based on visual observations during a preliminary site visit and our review of data from previous investigations and on the specific anticipated construction as state herein. If either of these conditions is changed, the results would also most likely change. Therefore, NWCC strongly recommends that our firm be contacted prior to finalizing the construction plans so that we can verify that our recommendations are being properly incorporated into the construction plans. We also recommend that a subsurface investigation be completed at the site prior to finalizing the building plans. At a minimum, NWCC must be retained by the client to observe the foundation excavations to verify the assumed soil conditions and confirm the recommendations made in this report.

Man-made or natural changes in the conditions of a property can also occur over a period of time. In addition, changes in requirements due to state of the art knowledge and/or legislation do from time to time occur. As a result, the findings of this report may become invalid due to these changes. Therefore, this report is subject to review and not considered valid after a period of 3 years or if conditions as stated above are altered.

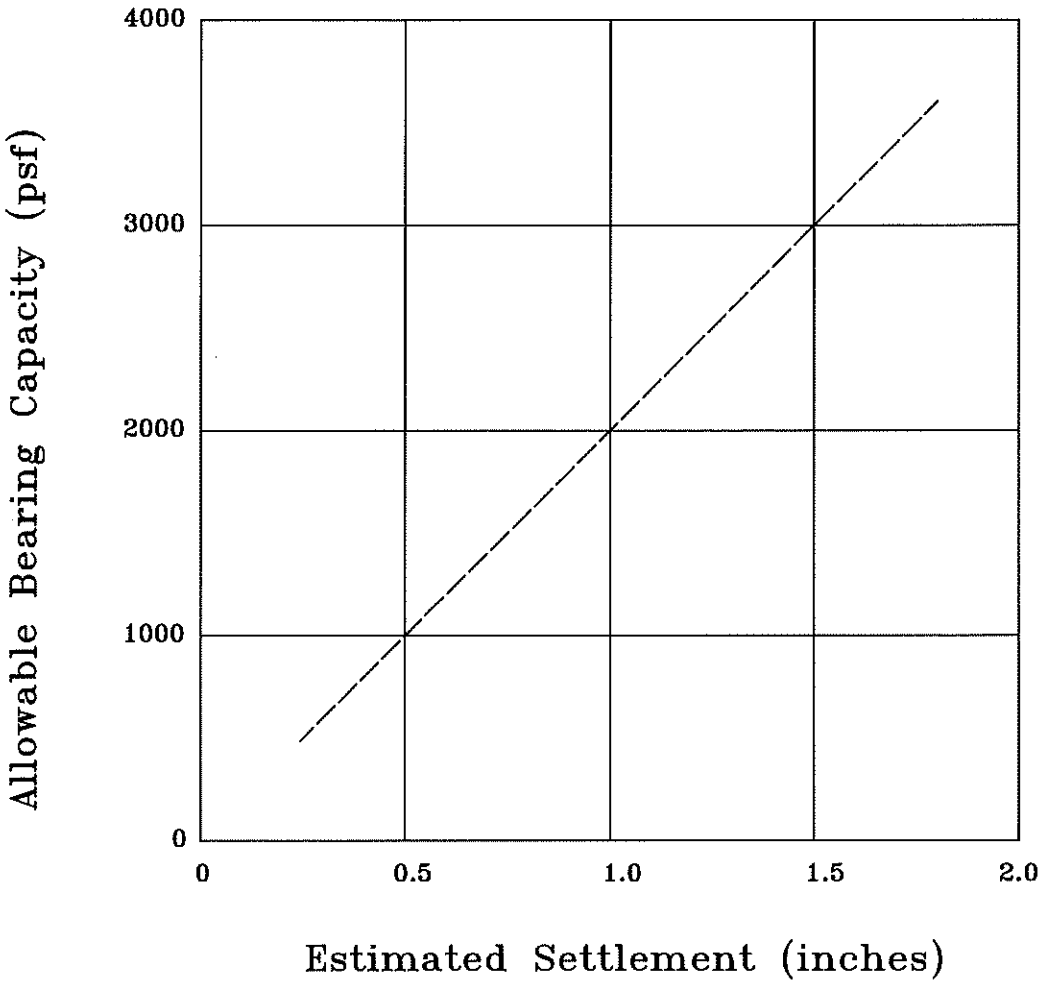
It is the responsibility of the owner and any future owners or their representative to ensure the information in this report is incorporated into the plans and/or specifications and construction of the project. It is advisable that a contractor familiar with construction details typically used to dealing with the local subsoils and climatic conditions be retained to build the structures.

If you have any questions regarding this report or if we may be of further service, please do not hesitate to contact us.

Sincerely,
NWCC, INC.

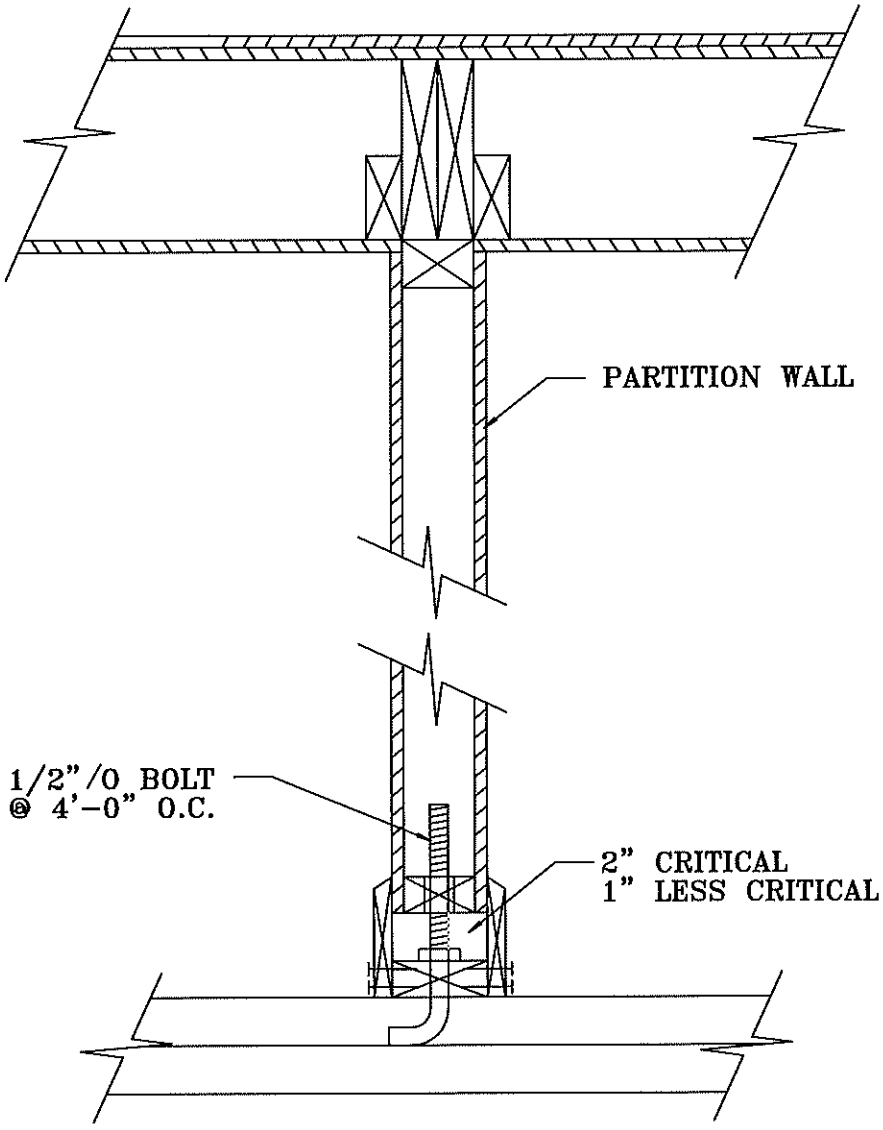
Enrique M. Lopez
Project Engineer

Reviewed by Brian D. Len, P.E.
Principal Engineer ***3/29/2024***



Note: These values are based on footing widths of 1 to 4 feet. If the footing width is to be greater than 4 feet in width, then we should be notified to re-evaluate these recommendations.

Title: BEARING CAPACITY CHART	**Date:** 3/27/24	NWCC North West Colorado Consultants, Inc. Geotechnical / Environmental Engineering - Materials Testing
Job Name: Proposed Berlet Live/Work Unit	**Job No.** 24-13254	(970)879-7688 · Fax (970)879-7691 2580 Copper Ridge Drive Steamboat Springs, Colorado 80487
Location: 38980 Main Street, Milner, Colorado	**Figure** #1	



Title: HUNG PARTITION WALL DETAIL		Date: 3/27/24
Job Name: Proposed Berlet Live/Work Unit		Job No. 24-13254
Location: 38980 Main Street, Milner, Colorado		Figure #2

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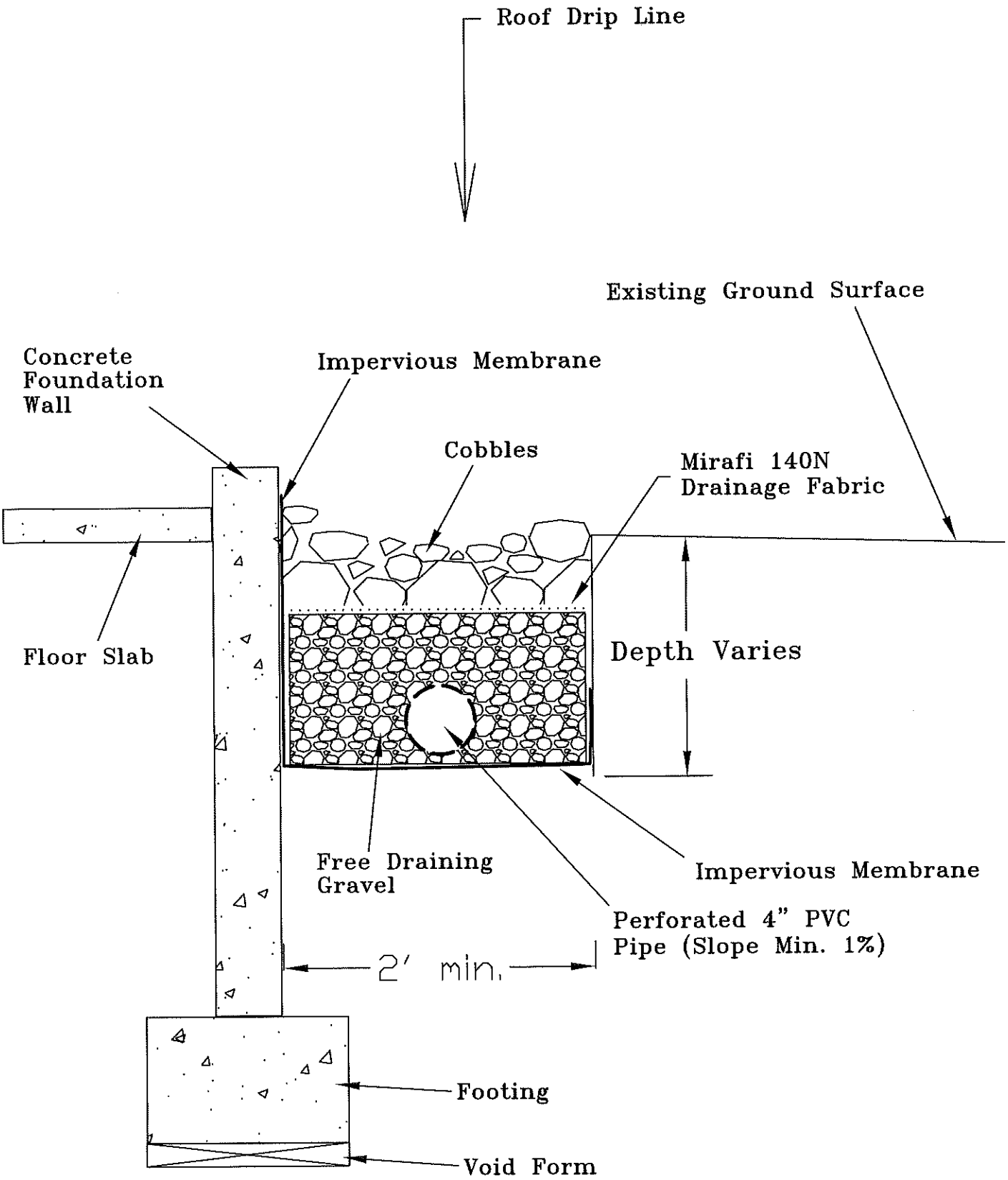

Title: EXTERIOR SURFACE DRAIN CROSS SECTION		Date: 3/27/24
Job Name: Proposed Berlet Live/Work Unit		Job No. 24-13254
Location: 38980 Main Street, Milner, Colorado		Figure #3

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