STATE HIGHWAY COMMISSION OF KANSAS

June, 1947

MEMORANDUM TO: Mr. Paul G. Martin
Engineer of Design

FROM: S. E. Horner, Chief Geologist
By Rennie V. Tye, J.D. McNeal
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Geologists

SUBJECT: Geological Report
Project No. 24-75 F 605 (1) From K-99, West
Pottawatomie County

INTRODUCTION

This report presents geological information obtained by the Kansas State Highway Commission through field study and is submitted for use in the design and construction of the above project with reference to the formations that occur and the engineering problems affected by the geology of the project.

The report is divided into three sections for the purpose of grouping the information and discussions of different phases. This report is intended to be complete within itself but is best used in connection with Geo-Engineering Survey.

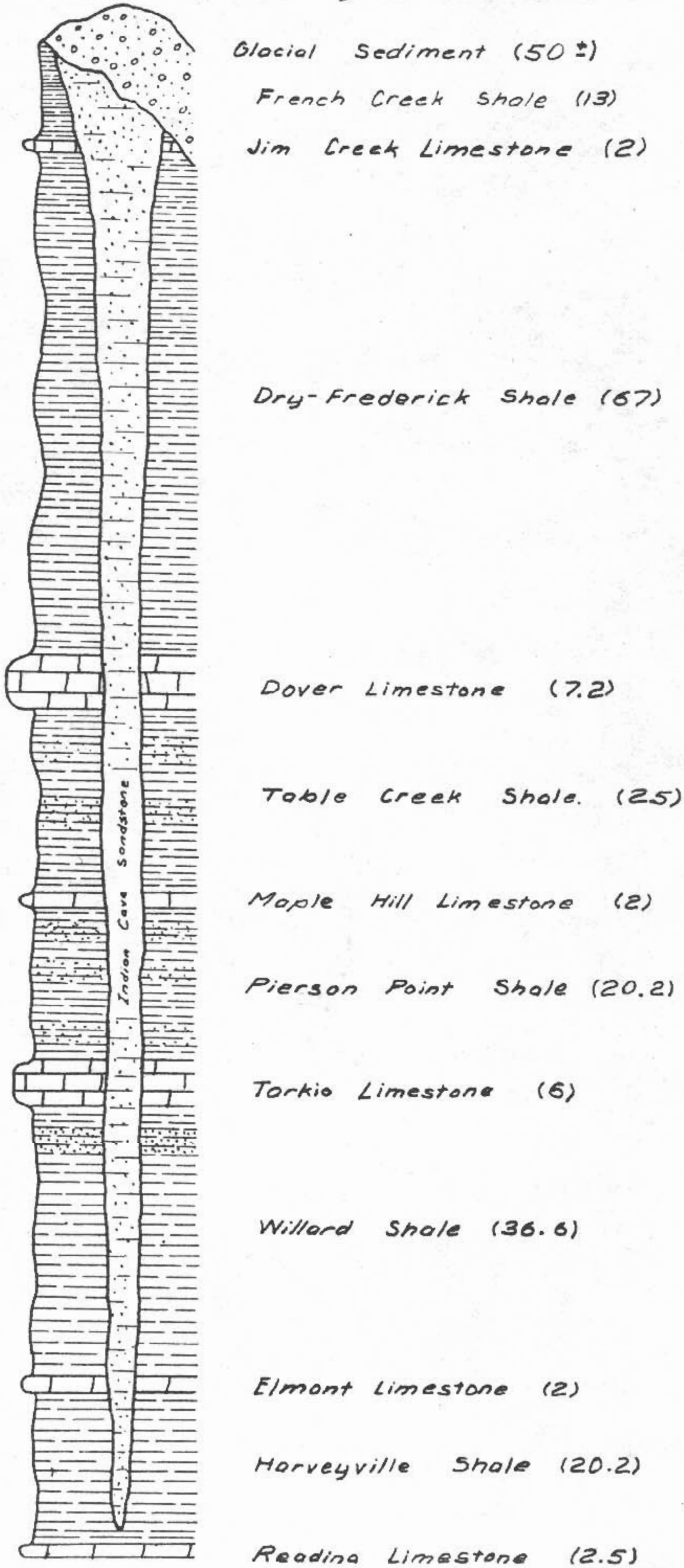
RESUME OF SECTIONS

Section I. Geological description and formational sequence.

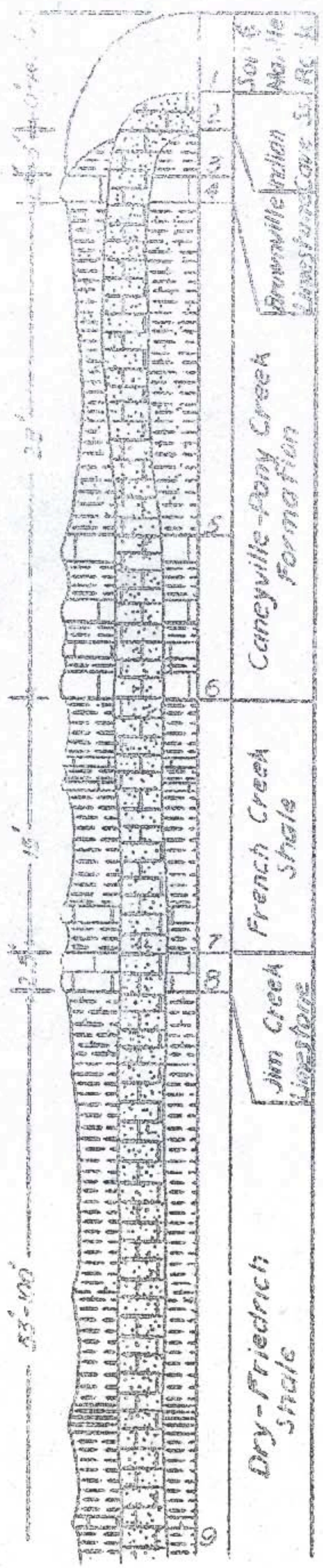
Section II. Geological Engineering aspects of the project.

Section III. Subsurface hydrology

Generalized Geologic Section



SECTION I



Soil and Mantle Rock

1. Medium to fine sand, gravel, glacial clays, and silts.

Indian Cave Sandstone

2. Sandstone: Buff to dark grey very argillaceous, fine grained, highly micaceous sandstone.

Brownville Limestone

3. Shale: Olive drab clay shale.

4. Limestone: Hard, gray to tan limestone.

Chaneyville - Pony Creek Fm.

5. Shale: Alternating layers of hard sandy shale, and black to gray clay shale.

6. Limestone and Shale: Alternating gray to buff limestones and gray to dark gray clay shale.

French Creek Shale

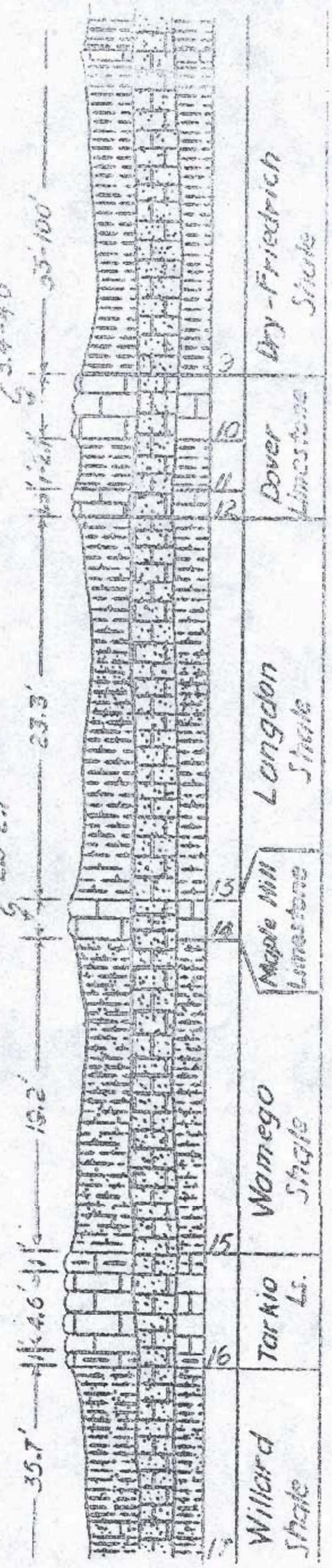
7. Shale and Limestone: Several thin buff limestone horizons, and alternating layers of gray to black clay shale.

Jim Creek Limestone

8. Limestone: Hard, blue to gray limestone.

Dry - Friedrich Shale

9. Shale: Gray to buff shale, calcareous and carbonaceous in part. There is a 0.2 limestone near the middle. The lower part consists of clay shale which becomes very slick when wet.



Dover Limestone

10. Limestone: Gray to blue, weathers tan to light gray, contains abundant fusulines.

11. Shale: Gray to green clay shale, locally calcareous.

12. Limestone: Gray, weathers light to almost white, slabby to shaly, contains fusulines and crinoids.

Langdon Shale

13. Shale: Blue to gray calcareous to arenaceous, weathers buff, thin non-persistant sandstone near the middle.

Maple Hill Limestone

14. Limestone: Hard, gray to blue, fossiliferous limestone, weathers dark gray to buff.

Wamego Shale

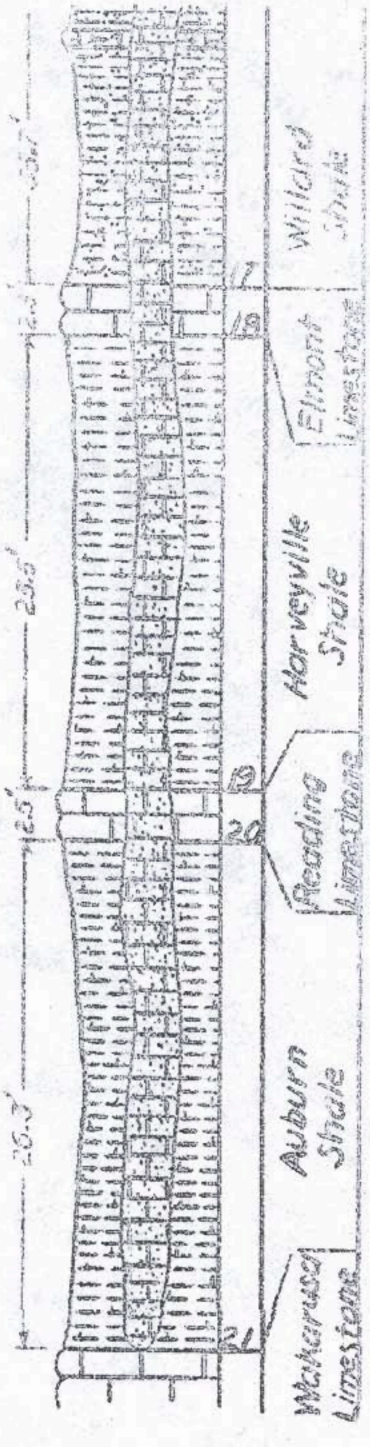
15. Shale: Blue to gray, calcareous and arenaceous, very dark gray in the upper part.

Tarkio Limestone

16. Limestone: Dark gray massive, limestone, weathers brown to yellow, abundant robust fusulines, upper and lower one foot are thin bedded and somewhat argillaceous.

Willard Shale

17. Shale: Blue to gray arenaceous shale. There is a non-persistant sandstone in the upper 10 to 12 feet.



Elmont Limestone

18. Limestone: Dark gray to blue, massive limestone. Weathers tan to light buff. The upper 0.2 are slightly argillaceous.

Harvey ville Shale

19. Shale: Gray to green, somewhat blocky shale, slightly calcareous.

Reading Limestone

20. Limestone: Dark gray, fossiliferous limestone, weathers light gray to tan. There are two distinct partings, one 0.5 below the top, and another 0.7 above the base.

Auburn Shale

21. Shale: Gray to buff slightly calcareous shale.

SECTION II

GEOLOGICAL, ENGINEERING ANALYSIS

Erosion and Stability of Materials

Extensive deposits of glacial outwash material, consisting principally of medium to fine sand, occur on this project. The unconsolidated nature of these materials render them highly susceptable to both wind and water erosion. See photographs, Figures I and II. Erosion of these materials can; however, be controlled, at least in part, if an aggressive erosion control program is devised to proceed concurrently with construction.

Backslopes and shoulder slopes between Stations 80 + 00 and 220 + 00, and between 222 + 50 and 310 + 00, may be expected to erode very rapidly unless they are constructed to a very gentle slope, and protected by a vegetative growth.

Wind action and surface drainage throughout the area just described remove large amounts of surface material from cultivated fields. At locations where drainage will empty into the ditches it may be desirable to make some provision to prevent the ditches from becoming clogged.

The glacial outwash materials located East of Station 310 + 00 appear to contain more clay than those west of that station; therefore while these materials are highly erodeable, and deserving of special attention, they will probably not present an erosional problem as serious as the one which exists west of Station 310 + 00.

A comparison of the photographs in Figures II and III will serve to demonstrate the affect of native vegetation on the erodeability of the glacial sands.

Backslopes and shoulder slopes cut into the Indian Cave sandstone, or any of the various shales which may be encountered on the project will probably stand at a rather steep angle.

WASH CHECK MATERIAL

Satisfactory wash check material may be obtained from the Maple Hill limestone, the Upper Dover limestone, or from the Tarkio limestone; however, throughout most of the project these formations are so deeply buried beneath glacial materials that it would probably not be economically feasible to obtain them in usable quantities.

There are; however, several locations north of U.S. Highway 24, between St. George and Wamego, where suitable material may be obtained.

QUESTIONABLE MATERIALS

The Dry--Friedrich shale should be thoroughly studied prior to its use as a construction material. The basal part, which is exposed at Station 364 ≠ 00, consists of a gray to buff clay shale which becomes unusually slick when wet. The upper and middle portions of the formation are not exposed near the project; however, cuttings from core drill operations indicated the presence of several potentially harmful horizons in this formation.

The Dry--Friedrich shale may be encountered in excavation between Stations 273 ≠ 00 and 283 ≠ 00, and between 360 ≠ 00 and 362 ≠ 50.

CLASSIFICATION OF EXCAVATION

The rock and common line for the classification of excavation is shown in red on the geological profile which accompanies this report; however, glacial erratics of sufficient size to warrent their being classified as rock excavation may be encountered throughout the entire project. It is anticipated that most of the erratics will be found between Station 310 ≠ 00 and the East end of the project. This belief is prompted by the fact that no erratics are exposed at the surface east of Station 310 ≠ 00.

SECTION III

SUBSURFACE HYDROLOGY

General

The subsurface hydrology of the St. George, Wamego area North of the Kansas River, has been greately effected by the following two events in the geologic history of that area:

1. Erosion of the Pre-Pleistocene land surface.

2. The deposition of vast amounts of glacial material on the eroded surface.

This combination of events has resulted in perched water tables at several locations on the project. The glacial deposits consist, for the most part, of sand, and minor amounts of gravel, silt and clay. These materials are generally quite pervious, allowing surface water to percolate down through them rather rapidly until some more impervious material, such as the Indian Cave sandstone or a shale, is reached. Water tends to accumulate along this contact and to flow along the path of least resistance. During wet seasons the amount of water which enters the glacial material may far exceed that which is able to escape, resulting in a saturated condition for a considerable distance above the contact with more impervious material. In many instances this accumulation may be seasonal; however, in some cases it may exist throughout much of the summer, depending on the extent of the drainage area, and the speed with which the water escapes along the contact of the glacial sands and the more impervious underlying materials.

When dealing with the perched water table conditions discussed in this report it may be well to bear in mind that the surface materials are largely sand and therefore possess rather a low capillary limit.

In addition to the perched water table conditions which have just been discussed a few limestone aquefers may be encountered on the project.

These observations were made during a very wet season; therefore, it is probable that the subsurface hydrology conditions discussed in this report are at, or near a maximum.

SPECIAL SITUATIONS

1. In the vicinity of Station 221 ≠ 00, water was found to be moving along the contact of the glacial sand and the underlying shale. The mantle of glacial sand at this location is rather thin, and the drainage area is quite limited in extent. If the grade line of the proposed structure intersects the contact of the glacial sand and the shale, a ditch of standard depth will probably supply sufficient protection at this location.

2. A small pre-glacial valley exists between Stations 223 ≠ 00 and 230 ≠ 00. The valley is now almost completely filled with medium to fine sand. At the time these observations were made the uppermost level of accumulated subsurface water was 8 or 10 feet below the surface of the ground. The lack of an outlet will make this location most difficult to drain.

3. A high water level condition exists in the valley section located between Stations 241 ≠ 00 and 248 ≠ 00. The maximum observed water level was found at Station 246 ≠ 00, where the level in a test hole rose to within 3.9 feet of the surface of the ground. The mantle material consists of medium to fine sand. There is no feasible drain outlet at this location.

4. A perched water table of limited extent is located between Stations 254 ≠ 00 and 256 ≠ 00. A test hole at Station 254 ≠ 80 contacted free water at 0.7 of a foot below the surface of the ground. This water level was maintained even though the hole was completed to a depth of 11.4 feet. This high water level is probably a seasonal condition, and will be found to be considerably reduced during dry weather.

5. The perched water table between Stations 263 ≠ 00 and 270 ≠ 00 appears to be more or less permanent as evidenced by a number of small willow trees

which are growing at the East side of the cultivated field near Station 260 + 00. A test hole at Station 264 + 00 revealed the presence of free water at a depth of 2.9 feet. A similar hole at Station 263 + 00 contacted free water at 5.2 feet below the surface of the ground. This location does not appear to be drainable.

6. The mantle of sand overlying the Dry-Fredrich shale between Stations 278 + 00 and 284 + 00 was found to be saturated to rather a high level. Free water was found 2.0 feet below the surface at Station 278 + 00, and 3.8 feet below the surface at Station 280 + 00. These observations were made the day following a rather heavy rain; therefore, it may be reasonable to assume that the condition is somewhat temporary.

7. Subsurface water was found to move along the contact of the glacial sands and the Indian Cave sandstone between Station 292 + 00 and 305 + 00. At Station 292 + 14 free water was contacted at a depth of 6.2 feet. A test hole 12.0 feet left of Station 294 + 50 revealed the presence of free water 6.1 feet below the surface. The mantle of glacial sand at Station 304 + 00 was found to be saturated at 3.6 feet below the surface. If the grade line of the proposed project is within the capillary limits of the water level at this location a capillary break of some very granular material may prove to be desirable.

8. A seepage condition was found to exist between Stations 312 + 00 and 314 + 00. The county road which is located a few feet right of centerline of the project at the above described location has cut through part of a small knob of Indian Cave sandstone which rests unconformably on the Langdon shale. There is a slow movement of water through the entire thickness of sandstone, and a copious flow of water at the contact of the Indian Cave sandstone and the underlying Langdon shale. A concrete pavement placed over the sandstone at this location will probably possess sufficient strength to eliminate the

the necessity of a drain; however, the flow of water at the contact of the sandstone and the shale should be intercepted.

9. Subsurface water was contacted in test holes between Stations 344 ≠ 00 and 351 ≠ 00. At the time of observation the water level was from 12 to 15 feet below the surface of the ground. The surface material consists essentially of sand. Unless a cut of considerable proportion is designed for this location the low capillary limit of the surface material should supply sufficient protection to the structure.

10. At Station 359 ≠ 50, both the Upper and Lower Dover limestones carry rather large amounts of free water. This seepage has been responsible for a failure on the county road which parallels the project at the above location. This flow of water will not be difficult to intercept.

11. The Maple Hill limestone, where it is exposed in a road cut a few feet right of Station 404 ≠ 35 was observed to carry a copious flow of water. Interception of this water; however, may be easily accomplished.

12. The Tarkio limestone which is exposed at about Station 405 ≠ 50 was found to carry a minor amount of water. A drain may be easily designed to intercept this flow.

13. Between Stations 411 ≠ 00 and 430 ≠ 00 a perched water table condition exists. At the above location the relatively impervious Indian Cave sandstone is overlain by a variable thickness of reddish brown slightly sandy silt. Surface water percolates down through the mantle until the Indian Cave sandstone is reached, where in wet seasons the water tends to accumulate. At the time of observation free water was found 2.5 feet below the surface of the ground at Station 411 ≠ 00, 3.0 feet below the surface at Station 412 ≠ 00, 5.1 feet below the surface at Station 418 ≠ 00, 6.8 feet below the surface at Station 420 ≠ 00, and 5.7 feet below the surface at Station 424 ≠ 97.

The high capillary limit of the silty surface material between Station 411 ≠ 00' and the East end of the project will probably cause this perched water table condition to present a more serious problem than most of those which have been previously discussed.

The thickness of the mantle overlying the Indian Cave sandstone, the difficulty of procuring outlets, and the size of the area in question, will probably render this location undrainable.