Subsurface Exploration: Organization, Equipment, Policies and Practices

● THIS SURVEY was conducted by the Committee on Surveying, Mapping and Classification of Soils, Department of Soils, Geology and Foundations, Highway Research Board, in order to collect and disseminate information concerning the organization, equipment, policies and practices employed by the various states in performing subsurface investigations for the design and construction of highways. It is believed that this information will be of value to the highway engineering profession by promoting an interchange of information on the subject among the states and increasing the quality, quantity, and efficiency of subsurface investigation operations, necessary for the proper design and economical construction of any highway project.

SCOPE OF SURVEY

A questionnaire (Appendix) was sent to 52 states and territories in September 1960. Replies were not received from 5 states (Mass., Miss., N.J., R.I., S.C.).

The questionnaire consisted of the following parts:

1. State organization and administration.
2. Organizational structure.
3. Subsurface investigations by contract.
4. Methods of subsurface investigation.
5. 1959 calendar year volume of subsurface exploration work.

SUMMARY OF DATA

The tabulation of information (Appendix) derived from the survey indicates that the organizations employed by the various states to perform subsurface investigations range from rudimentary units scattered throughout the highway department to units staffed and equipped to furnish complete and comprehensive services in the fields of soil and foundation engineering and engineering geology. How much of this extreme variation in personnel, equipment, and practices is due to the effect of local conditions and how much is due to the lack of appreciation of the influence of soil and foundation conditions on highway costs and performance could not be determined from the questionnaire answers.

Conflicting or inadequate answers were given for some items in replies from a few states. The Subcommittee did not ask the specific state for clarification.

The survey indicates, however, that some of the states, by providing well-staffed and equipped subsurface investigation organizations, do have a proper understanding of the vast importance of adequate and thorough subsurface investigation information on the cost and performance of their highway systems.

ACKNOWLEDGMENTS

Preparation of the questionnaire, tabulation of the answers, and analysis of the results were accomplished by the Soil Surveying Subcommittee, comprised of the following members: Walter H. Zimpfer, Chairman; William P. Hofmann, Neil E. Mason, and Arnold C. Orvedal.

A. General
1. Relative to the organization in your Department:
   a. Does a single department unit have the responsibility of all phases of soil engineering work?
   b. Is the responsibility for different phases of soil engineering work divided among staff members in different departmental subdivisions?
2. In case of a unit being responsible for all phases of soil engineering work, is the unit:
   a. A separate unit serving two or more agencies or branches of State government?
   b. A separate unit of the Highway Department serving two or more of the departmental divisions or subdivisions?
   c. A unit of a major departmental division?
   d. A unit of a major departmental subdivision?

B. Subsurface Investigations
1. Is it the general practice of your Department to conduct, by test borings and sample testing, subsurface investigations for:
   a. Roadway design and construction?
   b. Bridge foundation design and construction?
2. In case of divided responsibility relative to the various phases of soil engineering in your Department:
   a. Are subsurface investigations considered a separate phase of soil engineering work?
   b. Are all subsurface investigations performed by one departmental unit?
   c. Are subsurface investigations for the roadway design and those for bridge foundation design performed by separate departmental units?
3. Does performance of the subsurface investigation include:
   a. Planning of the test boring and sampling program and the specifying of laboratory sample testing?
   b. Supervision and performance of field test boring and sampling work?
   c. Laboratory testing?
   d. Preparation of investigation report?
4. Does the subsurface investigational report include:
   a. Complete test boring and sample test data?
   b. Graphical presentation of test boring information, sample test data, and general observations?
   c. Interpretation of findings and analysis of problems of stability, bearing capacity, and settlement?
   d. Recommendations relative to design treatment and construction procedures and controls?
5. Is subsurface information in the form of test boring logs and laboratory physical test data, either in graphical or tabular form, provided as a part of the construction plans for:
   a. The general roadway
   b. Bridges
   c. Use in preparation of Bid Proposals by prospective bidders?
   d. Use by the contractor during construction of the project?
6. In your Department is it the practice in construction contracts to treat excavation, relative to type of material, as:
   a. Unclassified
   b. Classified as to soil excavation or rock excavation, with estimated quantities of each based on test boring information?
7. In the performance of subsurface investigations, is it the general practice of your Department to:
   a. Utilize only Departmental facilities?
   b. Utilize only contracted services?
   c. Utilize Departmental facilities and contracted services?
8. If the answer to 7c is "Yes", state the approximate percentage performed by:
   a. Departmental facilities
   b. Contracted services

State	General						Subsurface Investigations																								
	1a	1b	2a	2b	2c	2d	1a	1b	2a	2b	2c	3a	3b	3c	3d	4a	4b	4c	4d	5a	5b	5c	5d	6a	6b	7a	7b	7c	8a	8b	
Ala.	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	-	-	-	-	Ala.
Alaska[1]	Yes	-	Yes	-	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes[3]	Yes[2]	No	No	Yes	90	10	Alaska[1]
Ariz.	No	Yes	-	-	-	-	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	90	10	Ariz.
Ark	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No[3]	Yes	No	No	-	-	Ark
Calif.	No	Yes	-	-	-	-	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	Yes	No	No	-	-	Calif
Colo.	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	97	3	Colo.
Conn.	Yes	No	No	Yes	Yes	No	Yes	Yes	-	-	-	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	No	Yes	50	50	Conn
Del.	Yes	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	80	20	Del
Fla.	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	90	10	Fla
Ga.	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	No	No	-	-	Ga
Hawaii	Yes	No	No	Yes	Yes	No	Yes	Yes	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	5	95	Hawaii
Idaho	No	Yes	-	-	-	-	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	-	-	Idaho
Ill.	No	Yes	-	-	-	-	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	85	15	Ill.
Ind	Yes[4]	No[4]	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	-	No	No	Yes	Yes	No	No	Yes	65	35	Ind.
Iowa	Yes	Yes	No	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	99	1	Iowa
Kan.	No	Yes	-	-	-	-	Yes	Yes	-	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	-	-	Kan
Ky.	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	Yes	Yes	No	No	Yes	75	25	Ky.
La.	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	90	10	La.
Me.	Yes	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	-	-	Me.
Md.	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	60	40	Md.
Mich.	Yes	No	No	Yes	Yes	No	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	-	-	Mich
Minn	Yes	No	No	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	-	99	1	Minn
Mo.	Yes	No	No	No	Yes	No	Yes	Yes	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	Yes	Yes	-	-	-	-	Mo.
Mont.	No	No	No	Yes	-	Yes	-	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	-	Yes	Yes	Yes	Yes	No	No	No	Yes	98	2	Mont
Neb.	No	Yes	-	-	-	-	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	93	7	Neb
Nev.	Yes	Yes	-	Yes	-	-	Yes	-	-	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	-	Yes	No	Yes	No	Yes	Yes	-	No	No	Yes	-[5]	-[6]	Nev
N. H.	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No	No	Yes	98	2	N. H.
N. M.	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No	Yes	No	Yes	No	No	-	-	N. M.
N. Y.	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No	No	Yes	80	20	N. Y.
N. C.	No	Yes	-	Yes	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	No	No	Yes	95	5	N. C
N. D.	No	Yes	-	-	-	-	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	99	5	0.5	N. D.
Ohio	No	Yes	-	-	-	-	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	95	5	Ohio
Okla.	No	Yes	-	-	-	-	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No	No	Yes	No	Yes	No	No	-	-	Okla.
Ore.	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No	No	Yes	98	2	Ore.
Pa.	No	Yes	-	-	-	-	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	Yes	50	50	Pa.
S. D.	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	-	-	S. D
Tenn.	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	90	10	Tenn.
Tex	No	Yes	No	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No	-	-	Yes	99	1	Tex.
Utah	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	No	No	No	Yes	50	50	Utah
Vt.	No	Yes	No	No	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	No	No	No	Yes	No	No	Yes	Yes	No	No	No	Yes	No	No	No	Yes	90	10	Vt.
Va.	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No	95	5	Va.
Wash.	Yes	No	No	No	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	95	5	Wash.
W. Va.	Yes	Yes	No	-	Yes	-	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	-	-	Yes	50	50	W. Va.
Wisc.	No	Yes	-	-	-	-	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	No	Yes	60	40	Wisc.
Wyo.	No	Yes	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	Yes	80	20	Wyo.
D. C.	Yes	Yes	No	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	15	85	D. C
P. R.	No	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	-	No	Yes	45	55	P. R.

Note Dash (—) indicates data were not available or answer was not given in questionnaire.

[1]Some items not answered because Alaska Highway Department did not assume responsibility for Alaska highway system until July 1, 1960.
[2]Applies only to some contracts.
[3]For bridges-yes, for roadway-no.
[4]Soils Section has major responsibility, Bridge Dept. responsible for bridge sites.
[5]Roadway-95 percent, bridge-25 percent.
[6]Roadway-5 percent, bridge-75 percent.

II. ORGANIZATIONAL STRUCTURE

NOTE: Complete questions in the following sections A through D if your Department has either a soil engineering unit or a subsurface exploration unit.

A. General

1. Does the following information pertain to a unit having responsibilities relative to:
   a. All phases of soil engineering?
   b. Only the subsurface investigational phase of soil engineering?
2. Name of Unit: _____
3. Unit Supervisor:
   a. Name: For Specific States Contact Unit (a and b)
   b. Title: _____
   c. Major professional field of supervisor: (Check appropriate box)

[1] Soil and Foundation Engineer	[4] Materials Engineer	[7] Civil Engineer
[2] Structural Engineer	[5] Geologist	[8] Engineer-Geologist
[3] Photogrammetrist	[6] Geophysicist	[9] Soil Scientist

Other 10

   d. Qualifications in soil mechanics and foundation engineering:
      (1) Undergraduate courses? Yes_____ No_____
      (2) Graduate courses? Yes_____ No_____
      (3) Number of years experience? _____ Years

B. Organization Details

1. Is the organization comprised of a single centralized headquarters and facilities?
   (NOTE: If the answer to this question is "Yes", do not answer question 2 through 5).
2. Does the organization contain district or division offices responsible to a central headquarters?
3. Are uniform policies and practices established by a central headquarters where district or division offices occur?
4. Do district or division offices have complete drilling and testing facilities?
5. Are analyses, recommendations and report functions performed only by a central headquarters? (Please submit organization chart of subsurface exploration unit).

C. Personnel

1. Total number of personnel in subsurface exploration unit
2. Number of soil and foundation engineers employed
3. Number of geologist employed
4. Number of aerial photographic interpreters employed
5. Number of geophysicists employed
6. Number of soil scientists employed

D. Salary Range per Month

(NOTE: If the Department has 2 or more units responsible for subsurface investigations, give salary information regarding personnel in each unit)

1. Chief Soil Engineer (Unit Supervisor)?
2. First Assistant to Chief Soil Engineer?
3. District or Division Soil Engineer?
4. Soil Engineer?
5. Entrance salary for:
   a. Soil Engineer (Engineering graduate)
   b. Soil Engineer (Engineering graduate with advanced study in soil mechanics)

State	Organization						Details					Personnel						Salary Range						State
	1a	1b	2	3c	3d1	3d2	3d3	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5a	D5b	
Ala	Yes	No	Soils and Foundations	1, 7	Yes	Yes	12	No	Yes	Yes	No	Yes	25	2	3	1	1	2	$575-700	$550-675	$575-700	$400-625	$400	$440	Ala
Alaska	Yes	No	Materials Section	1, 4, 5, 9	Yes	No	8	No	Yes	Yes	No	Yes	20[7]	5[7]	5[7]	0	0	-	-	-	-	-	-	-	Alaska
Ariz	Yes	Yes	Materials Division	4	No	No	30	No	No	No	No	Yes	35-40	3	2	1	0	1	825-975	650-775	-	-	-	-	Ariz
Ark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Ark
Calif	Yes	-	Materials and Research Dept	4, 7	-	-	-	No	Yes	Yes	No	No	-	-	-	-	-	-	950-1, 155	821-988	821-988	710-862	530	584	Calif
Colo	No	Yes	Engineering-Geology Unit	8	Yes	No	20	Yes	-	-	-	-	8	-	3	-	-	-	628-802	492-628	-	-	447-543	-	Colo
Conn	Yes	No	Soils and Foundations Div	1	Yes	Yes	20	Yes	-	-	-	-	33	6	3	0	0	0	575-775	510-710	510-710	460-620	410-485	425-485	Conn
Del	Yes	No	Soils Section	1, 7	Yes	Yes	5	Yes	-	-	-	-	8	1	1	0	0	0	600-715	-	-	475-572	450-572	-	Del
Fla	No	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Fla
Ga	No	No	Soils Section	7	Yes	Yes	1	Yes	-	-	-	-	35	1	3	0	0	0	585-755	545-700	-	400-525	-	-	Ga
Hawaii	No	Yes	Subsurface exp (unit)	1, 7	Yes	No	10	Yes	-	-	-	-	3	1	0	0	0	0	796-1, 016	722-922	655-836	655-836	489-624	-	Hawaii
Idaho	No	Yes	Engineering	5	No	No	10	No	Yes	Yes	No	No	13	0	10	2	2	0	700-750	521-675	425-600	-	425-500	-	Idaho
Ill	Yes	No	Soils Section	4	Yes	-	10	No	Yes	Yes	Yes	No	44	12	0	0	0	0	650-850	550-750	650-850	550-750	480	530	Ill
Ind	Yes	No	Soils Engineering	1, 4, 7	No	No	25	Yes	-	-	-	-	5	4	0	0	0	0	750-1, 000	641-883	-	525-775	465-575	-	Ind
Iowa	Yes	No	Soils Division	1, 7	Yes	Yes	6	Yes	-	-	-	-	75	2	0	0	0	0	675-750	625-700	-	-	475-550	500-575	Iowa
Kan	No	No	Materials and Design	7, 8	Yes	No	20	Yes	-	-	-	-	62	4	31	1	0	0	616-714	557-616	-	436-505	436	-	Kan
Ky	Yes	No	Division of Materials	4, 5, 7, 9	-	-	-	Yes	-	-	No	Yes	14	-	2	-	-	7	710-862	556-676	504-612	457-556	-	-	Ky
La	Yes	No	Testing and Research	7	-	-	25	No	Yes	Yes	No	No	100	15	5	1	1	1	650-750	525-650	525-650	480-580	440-540	480-580	La
Me	Yes	No	Soils Division	1, 7	Yes	Yes	5	Yes	-	-	-	-	28	3	8	2	0	0	485-780	425-689	-	-	425-529	425-529	Me
Md	Yes	No	Soils and Bridges	1, 2, 4, 7	Yes	Yes	35	Yes	-	-	-	-	86	10	0	0	0	0	808-1, 010	650-813	-	-	-	-	Md
Mich	Yes	No	Soils Division	7	No	No	33	No	Yes	Yes	No	Yes	90	5	4	5	5	0	905-1, 128	809-1, 009	748-931	633-800	489	534	Mich
Minn	Yes	No	Soils Unit	7	Yes	Yes	26	No	Yes	Yes	No	No	98	14	3	0	0	0	722-878	641-781	641-781	569-694	450-547	450-547	Minn
Mo	Yes	-	Geology and Soils Section	8, 9	No	No	28	No	Yes	Yes	No	No	70	0	0	0	0	0	-800	-749	616-749	-713	460	500	Mo
Mont	Yes	Yes	Materials Section	4	-	-	-	No	Yes	Yes	No	No	15	1	2	1	0	0	-	-	535-650	535-650	435	-	Mont
Neb	No	No	Division of Materials and Tests	7	Yes	No	-	No	No	-	-	-	-	-	-	-	-	-	610-685	-	-	-	475	-	Neb
Nev	No	Yes	Materials Survey and Soils Crew	4	No	No	5	Yes	-	-	-	-	7	0	0	0	0	0	648-786	535-648	-	465-561	-	-	Nev
N H	Yes	-	Soils and Foundation Section	8	Yes	-	15	Yes	-	-	-	-	29	4	1	0	0	1	578-700	474-578	-	334-460	388-424	424-460	N H
N M	Yes	No	Materials and Testing Laboratory	4, 7	Yes	No	21	Yes	-	-	-	-	15	-	8	1	0	0	-	-	-	-	-	-	N M
N Y	Yes	No	Bureau of Soil Mechanics	1	Yes	Yes	13	No	Yes	Yes	No	Yes	250	35	2	1	5	1	980-1, 150	800-952	535-785	436-785	436-531	436-531	N Y
N C	No	Yes	Geological Division	8	No	No	10	No	Yes	Yes	Yes	Yes	17	1	7	0	0	0	570-727	469-598	405-517	350-447	350-447	405-517	N C
N D	-	Yes	Materials Department	4, 7	No	No	26	Yes	-	-	-	-	17	1	1	0	0	0	-	-	-	475-700	450-475	500-525	N D
Ohio	No	Yes	Foundation Exploration Section	1, 7	Yes	Yes	17	Yes	-	-	-	-	155	2	10	0	0	0	860-1, 070	720-860	-	550-785	440-550	440-550	Ohio
Okla	No	No	Soils Laboratory	4	-	-	18	Yes	-	-	-	-	24	0	1	0	0	0	580-725	490-615	490-615	465-580	490-615	490-615	Okla
Ore	Yes	-	Soils and Geol Sect of Constr Div	5, 7	No	No	28	Yes	-	-	-	-	11	3	2	0	3	0	655-810	500-625	500-625	575-715	575-715	575-715	Ore
Pa	Yes	-	Soils Unit of Material Division	1, 4	No	No	24	No	Yes	Yes	No	No	40	17	11	5	1	0	680-870	618-779	560-715	484-618	424-532	484-618	Pa
S D	Yes	No	Materials and Soils Division	1, 4	Yes	-	24	Yes[8]	Yes	Yes	No	Yes	27	4	4	0	0	0	670-820	585-705	520-615	520-615	460-550	495	S D
Tenn	Yes	No	Soils	7	Yes	No	7	Yes	-	-	-	-	27	1	5	0	0	0	470-560	445-530	420-470	350-420	420-470	445-530	Tenn
Tex	-[9]	-[9]	-[9]	5, 7, 8, 10	Yes	No	-	No	Yes	Yes	Yes	No	6	-	-	0	0	0	600-716	500-834	600-716	585-668	450-500	450-500	Tex
Utah	Yes	No	Soil Mechanics Department	1	Yes	Yes	15	Yes	-	-	-	-	10	1	6	0	0	0	750	500	500	475	435	475	Utah
Vt	Yes	No	Soils Laboratory	7	Yes	No	5	Yes	-	-	-	-	24	1	4	0	0	0	-	-	-	500-710	-	-	Vt
Va	Yes	No	Soil Sect of Mater and Tests Division	4, 5	Yes	No	4	No	Yes	Yes	Yes	No	88	0	10	0	0	0	510-640	450-560	376-470	-	450	-	Va
Wash	Yes	No	Soil and Geol Section, Material Div	7	-	-	-	No	Yes	Yes	Yes	Yes	52	11	1	-	-	-	-	-	-	-	-	-	Wash
W Va	Yes	-	Soil Mech Br of Engineering Div	7, 10	-	-	12	Yes	-	-	-	-	16	1	3	0	0	0	700-800	600-700	-	-	475	-	W Va
Wisc	No	Yes	Soils Unit of Material Section	1	Yes	Yes	6	Yes	-	-	-	-	14	2	2	0	0	0	665-940	565-890	615-730	-	475-565	565-675	Wisc
Wyo	-	Yes	Engineering Geology	7	-	-	30	Yes	-	-	-	-	8	0	3	2	0	0	-	-	-	-	-	-	Wyo
D C	Yes	No	Soils Section of Material Dev Div	1	Yes	Yes	6	Yes	-	-	-	-	9	2	0	0	0	0	786-866	673-740	-	-	-	-	D C
P R	Yes	No	Soils Investigation Section	1	-	Yes	8	Yes	-	-	-	-	7	4	1	0	0	0	575-625	400-475	-	300-350	300-350	350-400	P R

Number of personnel when unit is fully staffed

South Dakota is in process of setting up district offices for field investigations

[9]Texas Highway Department has central Bridge Division that is responsible for subsurface investigations for all bridges in State District Laboratory is responsible for other subsurface investigations in the specific district

III. SUBSURFACE INVESTIGATIONS BY CONTRACT

A. General
1. Does your Department contract:
   a. Drilling services?
   b. Testing services?
   c. Engineering interpretation and analysis services?
2. Does your Department have an official set of specifications for subsurface investigation for engineering purposes?
3. Are subsurface investigation contracts awarded on the basis of:
   a. Competitive bidding?
   b. Negotiated agreement?
4. Do your official specifications set forth minimum requirements for contractor supervisory personnel qualifications?

B. Design Consultants
1. With respect to soil investigations, are design consultants governed by Departmental specifications for such work?
2. In case of a design consultant being employed for preparation of construction plans, are subsurface investigations performed by:
   a. A subcontract awarded by the design consultant?
   b. A contract awarded by the Department?
3. In case of a design consultant performing subsurface investigations by subcontract, is the consultant reimbursed on the basis of:
   a. Only a part of the agreement percentage fee for plan development?
   b. A percent of the estimated or actual cost of the project?
   c. Only the actual cost of the subsurface investigation work?
   d. The cost of the subsurface investigation plus an extra work percentage fee?

IV. METHODS OF SUBSURFACE EXPLORATION

A. General
1. In planning of the subsurface investigation, is the test boring program prepared by the test boring locations being selected on the basis of:
   a. Only office review of plans of contemplated construction and other information of a general nature?
   b. Actual field inspection and study of the alignment, or site, with the aid of plans and other information of a general nature.
2. In the planning of subsurface investigations, do you employ aerial photography?
   a. For soil or ground interpretations?
   b. As a map only for location of boring sites based on cultural and other planimetric features identified on the photography?
3. Do you utilize the earth resistivity method of subsurface exploration:
   a. For location of bedrock?
   b. For identifying soil strata?
   c. In exploration for sand-gravel deposits?
   d. In exploration of sand-gravel deposits?
4. Do you utilize the seismic refraction method of subsurface exploration:
   a. Single-channel equipment?
   b. Multiple-channel equipment?
   c. For determining depth to bedrock?
   d. For locating sand-gravel deposits?
   If used for other purposes, state them _____

	Investigations by Contract											Methods of Exploration - General												
	1a	1b	1c	2	3a	3b	4	B1	B2a	B2b	B3	1a	1b	2a	2b	3a	3b	3c	3d	4a	4b	4c	4d	
Ala	No	No	No	No	No	-	No	No	-	-	-	No	Yes	-	Yes	Yes	Yes	-	-	No	No	-	-	Ala
Alaska	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	d	No	Yes	Yes	No	Yes	No	No	No	No	No	No	No	Alaska
Ariz	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	-[2]	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No[11]	Ariz
Ark.	-	-	-	-	-	-	-	-	-	-	-	No	Yes	No	No	Yes	Yes	No	No	No	No	No	No	Ark
Calif.	No	No	No	-	-	-	-	-	-	-	-	-	Yes	No	Yes	Yes	No	No	Yes	-	Yes	Yes	No[11]	Calif
Colo.	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	c	No	Yes	No	No	Yes	No	No	Yes	No	No	No	No	Colo
Conn.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	c	No	Yes	No	No	No	No	No	No	No	Yes	Yes	No	Conn
Del	Yes	Yes	Yes	No	Yes	No	-	Yes	No	Yes	-	No	Yes	No	Yes	No	No	No	No	No	No	No	No	Del.
Fla	Yes	No	No	No	Yes	No	No	Yes	Yes	Yes	c	No	Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	Fla
Ga	-	-	No	No	Yes	No	-	-	-	-	-	No	Yes	No	Yes	Yes	-	No	No	No	No	No	No	Ga
Hawaii	Yes	No	No	Yes	Yes	Yes	No	No	Yes	-	c	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No	Hawaii
Idaho	No	No	No	No	No	No	No	No	No	No	-	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No[11]	Idaho
Ill.	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	b	No	Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	Ill.
Ind.	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	a, b, c, d	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	Ind.
Iowa	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No	a	No	Yes	Yes	No	No	No	No	No	No	No	No	No	Iowa
Kan	No	No	No	No	No	No	No	No	No	No	-	No	Yes	Yes	-	Yes	No	No	No	No	No	No	No	Kan
Ky	Yes	Yes	Yes	No	-	Yes	No	Yes	Yes	Yes	a	No	Yes	No	Yes	No	No	No	No	No	No	No	No	Ky
La	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	a, d	No	Yes	No	Yes	No	Yes	Yes	Yes	No	No	No	No	La
Me	No	No	Yes	No	No	No	Yes	Yes	No	No	-	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Me.
Md	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	d	No	Yes	Yes	No	No	No	No	No	No	No	No	No	Md.
Mich	Yes	No	No	No	No	Yes	No	-	-	-	-	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Mich
Minn.	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	d	Yes	Yes	No	No	No	No	No	No	No	No	No	No[11]	Minn
Mo	No	No	No	No	-	-	-	-	No	No	-	No	Yes	No	No	Yes	No	Yes	No	No	Yes	Yes	No[11]	Mo.
Mont.	No	-	-	No	-	-	-	-	-	Yes	-	Yes	-	Yes	-	No	-	-	-	No	-	-	-	Mont
Neb	Yes	Yes	Yes	No	No	Yes	-	-	Yes	-	-	-	Yes	Yes	-	No	No	No	No	No	No	No	No	Neb
Nev	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	-	c, d	-	Yes	Yes	-	No	No	No	No	No	No	No	No	Nev
N. H	Yes	No	No	No	Yes	-	No	Yes	-	-	-	-	Yes	No	Yes	No	No	No	No	No	No	No	No	N. H.
N M	No	No	No	-	-	-	-	-	-	-	-	No	Yes	No	No	No	No	No	No	No	No	No	No	N M
N Y.	Yes	No	No	Yes	Yes	No	No	-	No	Yes	-	No	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	No	N Y.
N. C	Yes	Yes	Yes	No	Yes	-	Yes	-	-	-	c	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	N. C
N. D	Yes	Yes	Yes	No	No	Yes	-	No	No	Yes	-	No	Yes	No	-	No	No	Yes	No	No	No	No	No	N D.
Ohio	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	c	No	Yes	Yes	No	No	No	No	No	No	No	No	No[11]	Ohio
Okla.	No	No	No	No	No	No	No	No	No	No	-	-	Yes	No	-	-	No	No	No	No	No	No	No	Okla
Ore.	Yes	No	Yes	No	No	Yes	No	-	-	-	-	-	Yes	No	-	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes[11]	Ore
Pa	Yes	Yes	Yes	Yes	-	Yes	No	Yes	Yes	-	d	No	Yes	Yes	-	Yes	Yes	Yes	Yes	No	No	No	No	Pa.
S. D.	No	No	No	-	-	-	-	Yes	No	No	-	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	S D.
Tenn.	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	a	No	Yes	No	No	No	No	No	No	No	No	No	No	Tenn
Tex	No	No	No	-	-	-	-	-	-	-	-	No	Yes	No	No	No	No	No	No	No	No	No	No	Tex.
Utah	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	d	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Utah
Vt.	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	e[12]	Yes	Yes	No	No	No	No	No	No	No	No	No	No	Vt
Va	No	No	No	Yes	Yes	No	-	No	Yes	No	d	No	Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	Va
Wash.	Yes	No	No	No	No	Yes	No	-	-	-	-	No	Yes	Yes[13]	Yes[13]	Yes[13]	Yes[13]	Yes[13]	Yes[13]	No	No	No	No	Wash.
W Va	Yes	Yes	Yes	No	No	Yes	-	No	Yes	Yes	d	No	Yes	Yes	-	No	No	No	No	No	No	No	No	W Va
Wisc.	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	No	c	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	-	Yes	-	Wisc.
Wyo	Yes	Yes	No	No	-	Yes	No	Yes	Yes	-	c	-	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No	No	Wyo
D C	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	c	No	Yes	No	No	No	No	No	No	No	No	No	No	D C.
P. R.	Yes	Yes	Yes	No	Yes	Yes	-	No	Yes	Yes	a	No	Yes	No	No	No	No	No	No	Yes	Yes	Yes	No[11]	P R

[10] Reimbursement based on lump sum.

[11] Other purposes of seismic test
Arizona—Classify materials, locate geologic structures, and slope design.
California—Determining material for slope design and cost estimates.
Idaho—Classifying excavation material
Minnesota—Experimented with single channel apparatus for various purposes, results we were unreliable
Mississippi—Summer experiment only.
Ohio—Have 10 trace century portable unit, no qualified personnel
Oregon—Landslide and foundation analysis.
Puerto Rico—Depth of unstable materials.

[12] Only low bid of subsurface investigation work.

[13] Occasionally

IV. METHODS OF SUBSURFACE EXPLORATION (Cont'd)

B. Methods of Disturbed Sampling for Classification Testing Utilized:
1. Test pits?
2. Hand auger-posthole type?
3. Hand auger-screw type?
4. Peat sampler?
5. One-inch retractable piston sampler?
6. Power, sectionalized, continuous spiral auger?
7. Power, hollow stem, sectionalized, continuous spiral auger?
8. Power, bit-on-kelly auger?
9. Small diameter press samplers? (2-in. D. or less)
10. Driven samplers?
11. Wash boring samples?
12. Other?_____

C. Undisturbed Sampling
1. Most commonly used thin-wall, "Shelby Tube" sampler (2"OD__), (2½"OD__), (3"OD__), (3½"OD__), other:_____
2. Most commonly used piston sampler (2"OD__), (2½"OD__), (3"OD__), (3½"OD__), other:_____
3. Most commonly used split tube sampler with liner ( ), (state size).
4. Other:_____

D. Drive Sampling (including Rock Coring)
1. Method (s) of maintaining open hole:

Check applicable method (s)

a. Drive pipe? _____
b. Flush joint casing? _____
c. Flush coupled casing? _____
d. Hollow stem auger? _____
e. Drilling fluid? _____

2. Drilling fluid used:
a. Clean water? _____
b. Recirculated water? _____
c. Drilling mud? _____
d. Air? _____

3. Rock coring barrels employed?
a. DCDMA single tube core barrel (EX__), (AX__), (BX__), (NX__).
b. DCDMA double tube core barrel (EX__), (AX__), (BX__), (NX__).
c. DCDMA double tube core barrel (EXM__), (AXM__), (BXM__), (NXM__).
d. Other size barrels_____
e. Full flow-type barrels (Yes__) (No__)?

	Disturbed Sampling												Undisturbed Sampling				Drive and Coring			
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	C1	C2	C3	C4	D1	D2	D3	
Ala	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	-	2", 3"	-	2"	-	b, e,	a, c,	a, AX and BX	Ala
Alaska	Yes	Yes	Yes	-	-	Yes	Yes	-	Yes	Yes	No	-	3"	-	2¼"	-	b, c, d	-	-	Alaska
Ariz	Yes	No	No	No	No	Yes	No	No	Yes	Yes	Yes	-	-	-	2 42 and 1 40 inches[14] ⟶		a, b	b	b, AX,d, BX, NX,e, Yes	Ariz
Ark	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	-	2"	-	-	2" split tube sampler W/O liner	e	b, c	b, NX	Ark
Calif	Yes	Yes	-	-	Yes	Yes	Yes	Yes	Yes	Yes	No	-	3"	2½ '	-	-	c, d, e	All	b, BX and NX,c, NXM	Calif
Colo	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes	No	-	-	-	-	-	a	b, d	None	Colo
Conn	Yes	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	-	3⅛"	3", 3⅛"	None	-	a	a	b, NX,d, DCDMA single, 2", DCDMA, double, 2", Shot core 2", 3⅛"	Conn
Del	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	-	3"	3½"	2½" I D	-	a, b, c, d, e	c	b, AX, NX	Del
Fla	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	-	2"	2"	2"	-	a, b, c, d, e	a, b	a, NX,e, Yes	Fla
Ga	No	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	-	3'	-	2"	-	a, b, e	a, b, c	b, EX, AX, BX	Ga
Hawaii	Yes	Yes	No	No	Yes	Yes	No	No	No	Yes	Yes	-	2", 2½"	-	-	-	a, b, c, e	a, d	b, EX, NX, AX	Hawaii
Idaho	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	No	-	3"	-	-	-	a, b, e	a, b, c	a, EX,b, AX, BX, NX,c, BxM,e, No	Idaho
Ill	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	-	2"	-	-	-	a, c, d, e	a, b	a, NX,b, AX, BX	Ill
Ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	-	2", 3"	2', 3"	2"	-	a, d	-	b, BX	Ind
Iowa	No	Yes	No	No	No	Yes	No	No	No	Yes	No	-	2", 4"	-	1 4"	-	b, e	a, b, c	c, BXM,d, N,e, Yes	Iowa
Kan	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No	-	3"		5"	-	a, e	b, c	a, EX,b, BX, NX,c, BXM, NxM,d, 4" Denison	Kan
Ky	Yes	Yes	Yes	-	-	Yes	Yes	-	-	Yes	Yes	-	2½"	2½"	-	-	b, d	a, b	a, AX, BX	Ky
La	Yes	Yes	No	Yes	No	No	No	No	No	Yes	Yes	-	3⅛"	3½"	-	Split spoon D S 2" O D	a, e	b, c	d, Double tube C B (oil field t p) 2", 4" I D	La
Me	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	-	2", 3½"	3⅛"	-	Split tube No liner 2" O D	a	a, b, c	c, EXM, 4XM	Me
Md	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	-	2", 3"	-	1⅞", 1⅜"	-	a, c, d, e	b	a, EX, AX,bEX	Md
Mich	No	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	-[a]	-	-	1¼ '	-	b, d, e	a	-	Mich
Minn	Yes	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	-	2	2"	1⅞"	-	a, b, c, e	a, b, c	a, EX, AX,b, NX,c, EXM, AXM, BXM, NXM,d, Dennison, e, No	Minn
Mo	-	-	Yes	No	No	Yes	No	No	Yes	Yes	No	-	3", 1⅛, 5 '	3", 5'	4½"	-	a, b, e	b, d	a, NX,b, NX,d, 4"Double tube, e, No	Mo
Mont	Yes	Yes	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-	-	2"	-	2 '	-	d, e	a, b, c, d	a, AX,b, AX, NX,e, No	Mont
Neb	Yes	Yes	No	No	No	Yes	Yes	No	No	Yes	No	-	2¼"	-	-	-	d	-	-	Neb
Nev	Yes	-	-	-	-	Yes	-	-	-	-	-	-	-	-	-	-	-	b	-	Nev
N H	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	-[b]	-	-	2"	-	a, b, c	a	a, AX,b, AX	N H
N M	Yes	Yes	Yes	No	No	Yes	No	Yes	No	Yes	Yes	-	-	-	3"	-	c	a, b, d	b, BX, NX,e, Yes	N M
N Y	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	No	-	3⅛"	3⅛"		-	a, c, e	a, b, c	a, AX, NX,b, Ax, NX,c, AXM, NXM,d, 4⅛", 6",e, No	N Y
N C	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	-	2	-	2"	-	a, c	a, b	b, AX,C, AXM, BXM, e, Yes	N C
N D	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	No	-	2"	-	-	-	a	b	a, AX,b, AX,e, No	N D
Ohio	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	-	3"	3"	3"	-	a, b, d, e	a, b, c	a, NX,b, NX,c, NXM,d, Damco 3⅛" Full flow (2⅜₁₆"), e, Yes	Ohio
Okla	Yes	Yes	No	No	No	No	No	Yes	No	No	No	-	2½"	-	-	-	e	b	a, NX	Okla
Ore	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	2½	-	a, c	a, b	b, AX,NX,	Ore
Pa	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No	-	2"	-	2⅛"	-	a	a	-	Pa
S D	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	No	-	-	-	-	Calif , Porter Type 2' O D	a, c, d, e	b, c	d, PK-2⅞" Double Tube Core Barrel, e, Yes	S D
Tenn	No	No	Yes	No	No	Yes	No	No	No	Yes	Yes	-	3"	2"	-	-	a, b, e	a, b	a, BX, NX	Tenn
Tex	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes	Yes	-	4"	-	-	Dennison 4"	-	b	-	Tex
Utah	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	-	2"	-	2"	-	a, b, d	a, b	a, AX,b, AX,e, No	Utah
Vt	Yes	Yes	Yes	No	No	Yes	No	Yes	No	Yes	Yes	-	2"	-	-	-	a, b, c, e	a, c, d	a, AX, c, AXM	Vt
Va	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	-	3"	3"	2"	-	a, d	a	b, AX,e, Yes	Va
Wash	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	-	-	-	2"	2½" O D Open drive sampler	a, b, c, d, e	b, c	b, AX, NX,e, No	Wash
W Va	Yes	No	No	No	No	Yes	Yes	No	No	No	-	-	3, 4"I D	-	-	-	a, b, e	a, c, d	d, 4"I D and 2 5" I D	W Va
Wisc	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	-	2"	3'	-	-	a, c, e	a, b, c	a, AX, BX,b, AX,c, AXM, NXM,d, EXW,e, Yes	Wisc
Wyo	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	-	-	-	-	Back hoe	b, d	a, c, d	b, NX	Wyo
D C	Yes	No	Yes	No	No	No	No	No	No	Yes	No	-[c]	3"	3"	2"	-	c	a	b, EX	D C
P R	Yes	Yes	No	No	No	Yes	No	No	Yes	Yes	Yes	-	2"	3"	-	Split spoon without liner (1⅝" I D)	a	a, b	a, AX,b, AX	P R

[a] Standard bull-nose penetrometer [b] Hydraulic core drill

[b] Davis Peat Sampler [c] 2" O D Piston Sampler

IV. METHODS OF SUBSURFACE EXPLORATION (Cont'd)

E. Mechanized Subsurface Exploration Equipment (State-Owned)

a. Total No. of Units	Model	Manufacturer	Mounting (Truck, Trailer, Trailer-Skid, Skid)	Feed (Hand, Screw, Hydr., Chain, Cable)	b.* Principal Type of Units and Number (Auger, Core Drill, Power Winch and Pump (P.W.P.), Cable Tool, Portable Rotary (P.R.))

Detailed information may be obtained from the Highway Research Board

*Descriptions have been abbreviated for tabulation

V. 1959 CALENDAR YEAR VOLUME OF SUBSURFACE EXPLORATION WORK

A. Number of projects? _____
B. Miles of roadway? _____
C. Number of bridge sites? _____
D. Linear feet of auger borings? (State and contract forces) _____
E. Linear feet of drive sample-core borings? (State and contract forces) _____
F. Linear feet of rod soundings? _____
G. Approximate number of electrical resistivity tests made? _____
H. Approximate number of seismic refraction tests made? _____
I. Approximate number of field vane shear tests? _____
J. Approximate number of field cone penetrometer tests? _____

	Mechanized Exploration Equipment		Volume of Subsurface Exploration Work									
	a	b	A	B	C	D	E	F	G	H	I	J
Ala	20	16-Auger, 4-Core drill (P W P)	150[15]	800[15]	300[15]	20,000[15]	5,000[15]	-	50[15]	50[15]	-	-
Alaska	-	-	-	-	-	-	-	-	-	-	-	-
Ariz.	12	1-Core drill, 5 Back hoe, 6 Air compressors	85	-	50	1,500	3,000	-	2 Proj	1 Proj	-	150
Ark	6	5-Auger, 1-Core drill (P W P , P R)	65	197	99	31,285	1,205	0	50	0	20	0
Calif	18	4-Core drill, 8-Combination, 6-Auger	300	2,000	450	-	-	-	-	-	-	-
Colo	4	2-Auger, 1-Combination, 1 Back hoe	120	600	37	-	-	-	15	0	0	0
Conn	6	6-Core drill	73	75	65	5,000[15]	30,000[15]	15,000[15]	0	0	25	0
Del	1	1-Auger	316	201	15	12,783	1,759	0	0	0	0	0
Fla	11	3-Core drill, 4 Electric generators, 2 water pumps, 2 Hvy Dty drills	-	-	-	-	-	-	-	-	-	-
Ga	9	6-Auger, 1 auger and core drill, 2-core drill	164	555	132	28,000	25,000	2,000	800	0	0	0
Hawaii	-	-	10	4	7	421	2,469	0	0	0	0	0
Idaho	5	2-Core drill, 1-auger, 2-pump	-	-	-	-	-	-	400	210	100	-
Ill	14	2-Auger, 12-Core drill	383	615	179	133,687	56,844	9,798	0	0	0	35
Ind	2	2 Auger	-	-	-	-	-	-	0	0	0	0
Iowa	17	17-Auger	143	742	349	340,062	6,336	0	0	0	0	0
Kan	19	12-Auger, 1 Auger (P W), 4-Core drill, 2-Penetrometer	160	880	110	222,000	436	-	2	-	-	53
Ky	26	7-Auger (P W), 10-Auger, 9-Core drill	50	270	60	36,700	5,000	10,800	0	0	0	0
La	6	6-Portable rotary	417	683	126	220,172	52,861	3,127	392	0	0	0
Me.	5	4-Core drill, 1-core drill and auger	40	100	22	2,300	11,066	8,000	30	0	797	0
Md	8	2-Core drill, 5 auger, 1 wash boring	127	263	165	61,000	2,300	27,000	0	0	0	0
Mich.	16	8-Core drill (P W P), 6 auger, 2 wash boring	400	695	250	40,000	45,000	420,000	4,806	350	0	0
Minn	26	19-Auger, 4-core drill, 3-soil sampler	-	-	-	-	-	-	-	-	-	-
Mo	21	8-Core drill, 13-Auger	300	1,050	350	-	-	-	300	50	-	-
Mont	4	3-core drill, 1 auger	32	-	28	3,800	9,199	-	0	0	-	-
Neb	7	7-Auger	80	400	150	140,000	3,000	0	0	0	0	0
Nev	5	2-Auger, 2-Back hoe, 1 -(P W P)	21	155	8	8,902	1,861	0	0	0	0	0
N H	5	4-Core drill, 1-(Hand W P)	62	149	67	4,100	18,000	-	-	-	15	-
N M	7	1-Auger (P W P.), 1-Auger, 3-Backhoe, 1-Port Rotary, 1-Hammer drop	120	-	40	8,115	6	7,009	0	0	0	0
N Y	49	47-Core drill, 2-Auger	672	-	-	58,798	121,720	41,666	25	2,080	100	0
N C	7	5-Augers, 2 Core drills	85	220	70	400,000	2,500	600	25	0	0	0
N D	6	3-Core drill (Port Rotary), 3-Auger	30	203	41	8,180	16,692	0	0	0	0	0
Ohio	41	9-Auger, 16-Core drill, 2-Rotary drill, 14-Drop Hammer	560	258	313	88,200	51,100	66,700	0	0	50	0
Okla.	1	1-Portable Rotary	78	-	-	-	-	0	0	0	0	0
Ore	13	3-Churn, 4-Core Drill, 6-Auger	70	703	64	5,719	843	4,682	30	380	1	0
Pa	16	16-Auger	128	704	-	105,600	-	-	200	0	18	0
S.D	5	1-Core Drill, 4-Auger	75	762	124	17,640	6,314	0	75	-	-	-
Tenn.	10	10-Auger	144	576	225	220,500	4,000	0	0	0	0	0
Tex	12	12-Portable Rotary	401	-	816	-	185,000	-	-	-	40	30,000
Utah	4	2-Auger, Core drill (P W P) 2-Auger	25	110	26	7,500	5,000	-	20	0	0	0
Vt	13	2-Core drill, 8-Auger, 3 Wash bore	21	52	45	100,000	3,000	5,000	0	0	0	0
Va	29	10-Core drill, 19-Auger	99[15]	400[15]	133	-	45,695	-	7	0	0	0
Wash	12	5-Core drill (Wash Boring), 1-Core drill, Auger, 6-Auger	-	-	121	493	15,460	1,080	2	2	3	0
W Va	10	2-Core drill, 2-Auger, 2-Rotary comb , 3 water pump, 1 Air Comp	-	-	-	-	-	-	0	0	0	0
Wisc	5	3-Core drill, 2 Power Cat-Head and pump, port core drill	50	-	-	-	14,000	7,000	-	-	-	-
Wyo	11	3-Auger, 2 Core drills, 6-Back Hoes	33	220	55	-	-	-	40	0	0	0
D C	1	1-(P W P)	-	-	-	-	-	0	0	0	0	0
P R	7	2-(P W P), 2-Core drill (P W P), 2-Core drill, 1-Port Rotary	50	-	-	22,700	0	0	0	0	0	0

[15]Estimated.