EVALUATION OF SAND FILLS

BY

RICHARD W. KINCHEN
ASSISTANT RESEARCH ENGINEER

AND

JAMES L. MELANCON
SOILS RESEARCH GEOLOGIST

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ABSTRACT

A popular construction technique in south Louisiana for many years has been the use of river sand to establish foundations for highways. The abundance of river sand and the need for it in excavation-backfill operations across Louisiana's marshlands have fostered this concept.

Recent construction problems on Route I-10 in St. James Parish and the decline in pavement performance of several completed projects created questions regarding the stability of sand fills. Consequently, a "brushfire" research project was established wherein density values of sand fills at six locations along Route I-10 and along one segment of Route U. S. 90 were evaluated with depth by nuclear tests and Standard Penetration Tests.

CONCLUSIONS

1. Density values vary significantly with depth and with transverse position within sand fills. These values are most uniform near the centerline of sand fills, but vary quite erratically with depth near the outer portions. The greatest density values occur near the centerline of these fills.

2. A vibratory compactor readjusts the particles in a sand fill. Simultaneous tightening of certain levels and loosening of others produce volume changes in sand fills which cannot be predicted as construction proceeds on top of the said fills. Densification is most pronounced at the outer portions of sand fills where the as-placed density values vary the most with depth. This is considered the mechanism which produced the depressions in the black base of the Sorrento-LaPlace highway in St. James Parish.

3. The loose nature of the sand at and below the water table is not considered a serious problem for recently constructed thick sand fills. This phenomenon was observed at the Texas State Line - Toomey project constructed in 1952 and that roadway is performing satisfactorily except for the area wherein several feet of sand were removed in 1965 during a pavement reconstruction operation.

4. Densification within sand fills can be reflected in pavement performance. This occurrence might initially be most pronounced on flexible pavements, since rigid pavements (especially continuously reinforced concrete pavements) may provide a bridging effect which could initially minimize the results of density changes in underlying fills. Continuous action within sand fills will eventually cause a decrease in pavement performance of both rigid and flexible pavements.

5. Dry weight density values (pounds per cubic foot) and Standard Penetration Test values (blows per foot) vary very similarly with depth in sand fills.

RECOMMENDATIONS

1. Consideration should be given to widening the base and/or reducing the side slopes of mucked areas. The effect of adjustments at the backfill-muck interface would seemingly be reduced by this action, and a more stable sand fill platform could result.

2. Consideration should also be given to applying vibrations by means of heavy equipment such as tractors and rollers prior to construction on top of sand fills. If density adjustments are imminent, leveling would best be done with sand than with more expensive base course or surfacing material.

3. If serious questions still exist concerning the validity of the sand fill concept, controlled, long term research should be conducted to resolve the issue.

EVALUATION OF SAND FILLS

RESEARCH PROJECT S-23

INTRODUCTION

Route Interstate Highway 10 traverses many miles of mucklands as it connects the eastern and western borders of south Louisiana. Construction through most of the mucklands was accomplished by bridging or by excavating and backfilling with a suitable material. Sand available from the many rivers of south Louisiana has been pumped hydraulically or transmitted by barge and truck to serve as the backfill material for much of I-10 and a number of state primary routes. Recent construction problems on I-10 in St. James Parish and the decline in pavement performance of several completed projects created questions regarding the stability of the sand fills. Consequently, the density values of sand fills at six locations along I-10 and along one segment of Route U. S. 90 were evaluated at depth by nuclear and Standard Penetration Tests.

SCOPE

Nuclear depth gage tests and Standard Penetration Tests were conducted on sand fills at the following projects (see Figure 1):

1. State Project Number 450-12-02
   Sorrento LaPlace (McElroy-Reserve Relief Canal Bridge)
   Route I-10
   St. James Parish

2. State Project Number 450-15-15
   Williams Boulevard - Veterans Memorial Highway
   Route I-10
   Jefferson Parish

3. State Project Number 450-16-28
   Joffre Road - Paris Road
   Route I-10
   Orleans Parish

4. State Project Number 450-18-07
   Lake Pontchartrain Bridge - Slidell
   Route I-10
   St. Tammany Parish

5. State Project Number 450-18-10
   Slidell - Mississippi State Line (West Pearl River Bridge - Pearl River Bridge)
   Route I-10
   St. Tammany Parish

6. State Project Number 450-02-41
   Texas State Line - Toomey
   Route I-10
   Calcasieu Parish

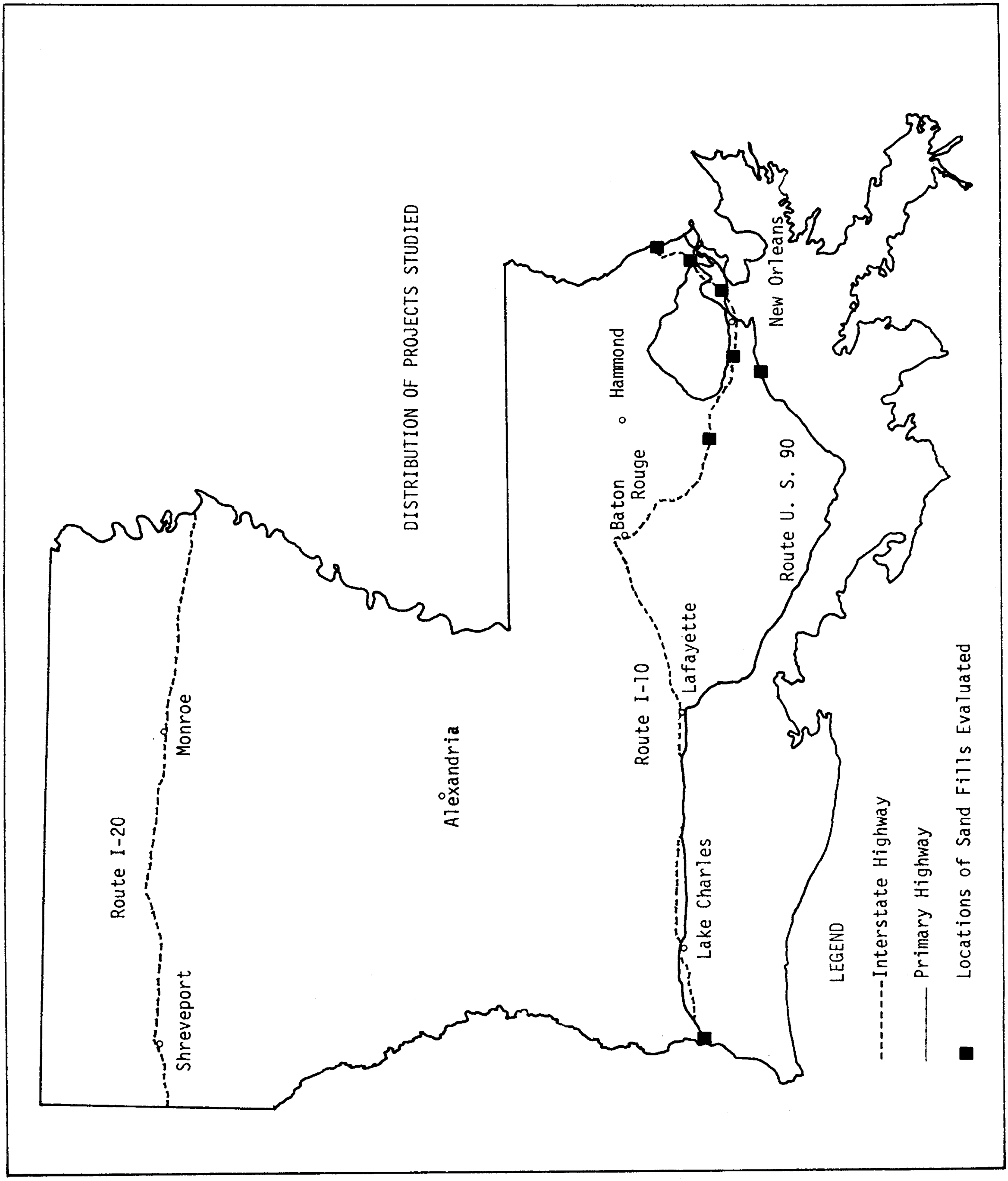

DISTRIBUTION OF PROJECTS STUDIED
Route I-20
Shreveport
Monroe
Alexandria
Route I-10
Lake Charles
Lafayette
Baton
Rouge
Hammond
New Orleans
Route U. S. 90
LEGEND
Interstate Highway
Primary Highway
Locations of Sand Fills Evaluated

FIGURE 1

7. State Project Number 5-07-29
   Raceland - Des Allemands Highway
   Route U. S. 90
   Lafourche Parish

METHOD OF PROCEDURE

Density and moisture values were obtained for the full depth of the sand fills. The Troxler Nuclear Depth Gage was used in a unique manner to determine these values. Two-inch (outside diameter) thin walled aluminum tubing was driven by impact approximately 20 feet into the sand fill and underlying natural soil. The nuclear probes for moisture and density were lowered down the tubing and tests conducted at each one foot level down to the base of the sand fills whenever possible.

Standard Penetration Tests were taken in conjunction with the nuclear tests. A split-spoon sampler was driven by impact through the sand fill and into the in-place soil. The number of blows (by a 140-pound hammer falling approximately 18 inches) required to drive the split spoon sampler one foot was recorded.

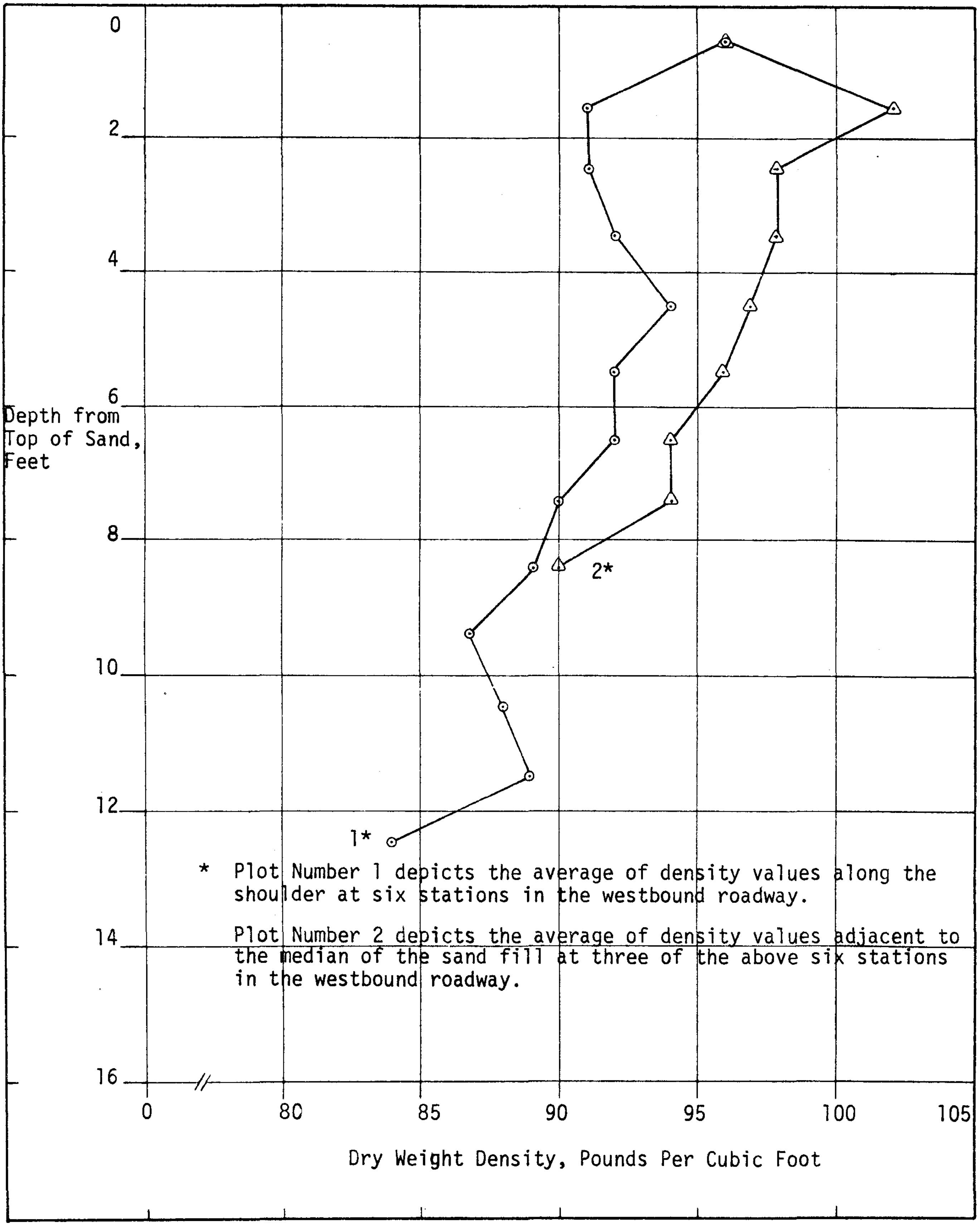
DISCUSSION OF RESULTS

1. Sorrento - LaPlace (McElroy - Reserve Relief Canal Bridge) Highway, Route I-10.

This project is under construction. The plans specified varying heights (13 1/2 feet to 37 feet) of sand fill covered by 12 inches of shell, 4 inches of hot mix asphaltic concrete (black base) and 8 inches of continuously reinforced concrete pavement (CRCP). Construction problems arose during placement of the second lift of black base. That is, radial depressions up to ten feet in diameter occurred intermittently along both the eastbound and the westbound roadway after passage of the vibratory roller over the black base. Physical measurement at the center of one such depression indicated a three inch level differential at the surface of the black base, four inches of black base, and 12 1/2 inches of shell. Evidently, the depression was a reflection of densification within the sand fill.

Nuclear tests were taken at nine locations along the westbound roadway and an attempt was made to correlate sand fill density values with base course stability. Table 1 in the Appendix lists the moisture-density values for the nine stations, and Figure 2 (and Figures 11 and 12 of the Appendix) depicts the variation in density value with depth. The nine test areas have been identified by alphabetical designation a through i. Locations b, e, and i are near the median of the sand fill and show the greatest density values with depth of the nine sites. This phenomenon is considered a characteristic of a hydraulically pumped sand fill because of the central location of the discharge pipe used in establishing such a fill. No depressions had appeared at these three spots. The density values at the remaining six locations (at the outer edge of the fill) reveal significant reductions in density with depth. Of course, lower density values reflect looser states, which can cause problems if re-adjustment of the sand to a more tight state ever occurs.

The depressions mentioned above were discernible only after the black base had been placed on the fill. This suggests that the depressions were precipitated by the action of the vibratory roller. However, no definite conclusions can be derived from this data since it indicates the condition of the fill after the fact only.



Relation of Density and Depth of Sand Fill
Sorrento - LaPlace Highway
Route I-10
FIGURE 2

Due to this lack of preliminary data, a 500 foot sand fill test section was chosen where the 12 inch shell sub-base had been placed without vibratory compaction and the black base had not yet been placed. Six spots were selected for density determination before and after various passes of a vibratory roller*. Figure 13 of the Appendix depicts the test section.

Two sets of density tests, three days apart, were performed in the top six feet of the fill prior to application of the roller in order to establish the degree of repeatability of the nuclear test method. Results of these tests are shown in Table 2 of the Appendix. It should be noted here that a heavy rain occurred one day prior to the second density readings and is reflected in the moisture content of the top three feet of the fill for the second set of results. A standard deviation of 0.48 pounds per cubic foot from a mean variation of 0.76 pounds per cubic foot was considered more than adequate for test purposes.

Results on Table 3 (Appendix) show the effect on density after two and four coverages by the vibratory roller. A coverage is defined herein as one complete set of passes of the roller to cover the full width of the roadway. Changes in density after listed passes of the roller are shown on Table 4 (Appendix). A positive value indicates an increase in density from the "as placed" condition, and a negative value a decrease from the "as placed" condition of the sand fill.

After two coverages a significant increase in density occurred at hole 5 (+3.2 pounds per cubic foot) and, conversely, a significant decrease occurred at one level in hole 4 (-5.6 pounds per cubic foot). Changes in density of +2.9 and -2.4 pounds per cubic foot occurred in hole 2 with 2 passes. Significant increases in density after 4 coverages occurred in holes 1 and 3 (+5.0 and +4.5 pounds per cubic foot, respectively).

It appears that a pattern did develop after four passes with the vibratory roller. That is, the top one to two feet experienced an increase in density and the next two to three feet tended to loosen somewhat.

It should be noted that vibration tends to draw water towards the surface of the sand fill. The negative changes in density reflect this phenomenon. For example, the -3.8 pounds per cubic foot density change at the two to three foot level in hole number 3 after four passes was accompanied by a +2.8 percent change in moisture due to vibration (see Table 3, Appendix). It is felt that the negative density adjustment would not have been so severe if time had been allowed to lapse sufficiently so that the moisture level would have stabilized at that depth.

Overall, vibration effected greater density changes in the areas nearest the outside edge of the shoulder (holes 1, 2, and 3) than in those areas nearest the inside shoulder (holes 4, 5, and 6) of the test strip. The densification which was achieved at the outer portions of the fill seem to justify vibration of sand fills prior to construction thereon.

* Ray-Go Rustler Dynamic 404-A vibratory roller, dead weight of 17,200 pounds, rated variable frequency of vibration 1200-1700 cycles per minute.

It seems worthy to note that vibratory rolling had been applied sporadically during construction of the shell sub-base course between Sorrento and LaPlace in St. James Parish. Depressions occurred after vibratory compaction of the black base. It is felt that the stiffness afforded by the black base transmitted the vibratory roller compaction energy to further depths in the sand fill than had the shell sub-base course alone, and sand fill subsidence resulted. It was therefore anticipated that a heavier pneumatic roller utilizing greater vibration energy would have been used on the test strip (with shell sub-base course only) in lieu of the roller used during general construction. As the construction vibratory roller was used, this may be a major contribution to the lack of vibration failures encountered in the test strip.

Construction schedules on the Sorrento - LaPlace project allowed only limited passages of the vibratory roller across the test strip. Therefore, an optimum rolling procedure was not determined. A more extensive evaluation would have to be accomplished in order to establish optimum rolling procedures over sand fills.

Analysis of density data from the area in which the black base experienced depressions and from the test strip indicate the following trends:

(a.) Density values for depths of six feet are greatest near the median of the sand fill.

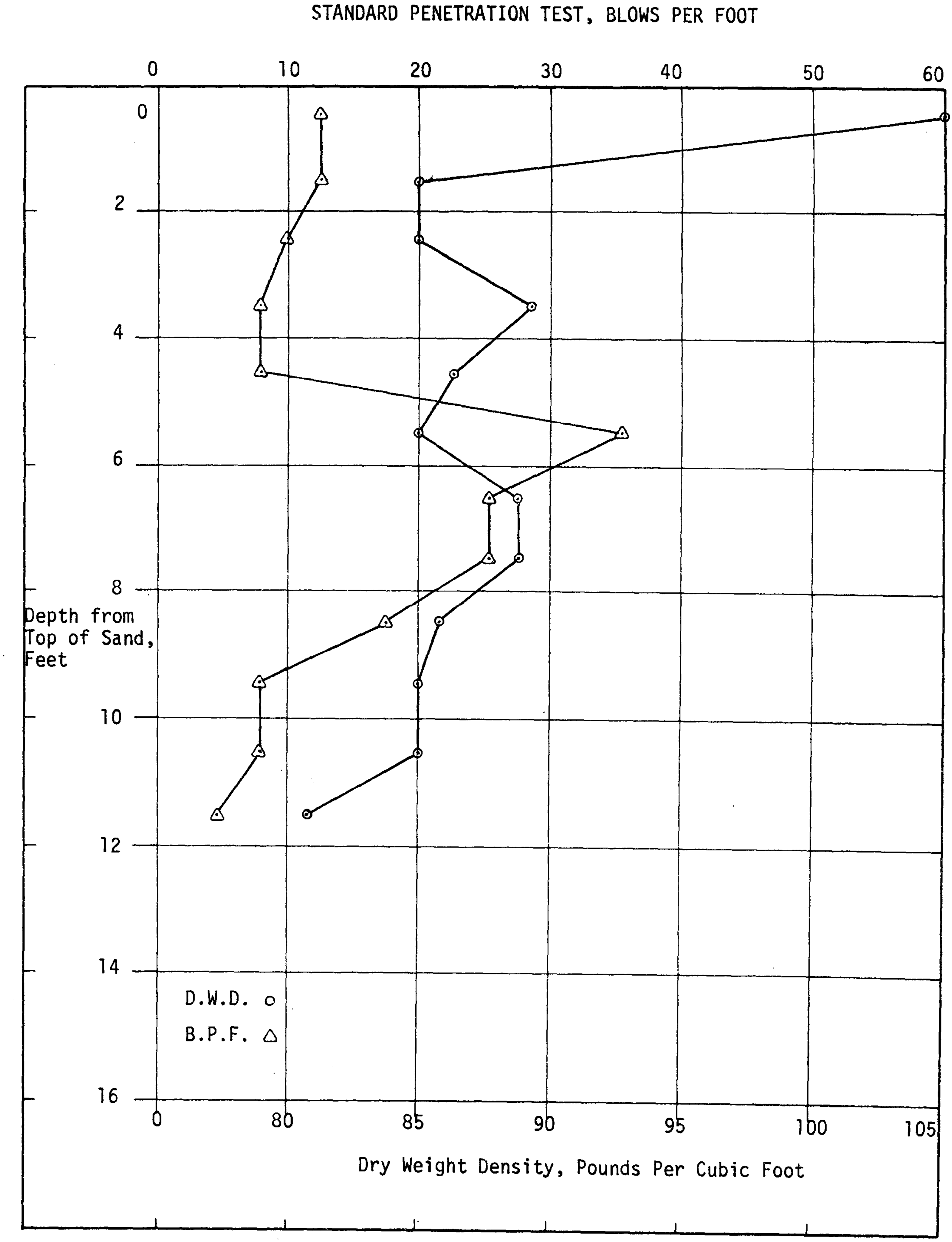
(b.) Depressions in the black base occurred primarily between the centerline of the roadway and the outside edge of the black base. Similarly, vibration effected greater density changes along the outside lane of the test strip.

2. Williams Boulevard - Veterans Memorial Highway, Route I-10.

This project is 1.5 miles in length and the typical section called for eight inches of continuously reinforced concrete pavement, six inches of cement stabilized sand shell base, and (per test borings) approximately 13 feet of trucked sand fill. Now in service for 4 1/2 years, this is the second oldest C.R.C.P. in the state.

Table 5 (Appendix) and Figure 3 illustrate the relations of dry weight density and standard penetration test blows per foot with depth of sand fill. One's initial observation might well be the non-uniformity of density and penetration values versus depth. The decrease in density and penetration values at depths below seven and one-half feet is also noteworthy, as one might expect density values to increase with depth. The fill is quite moist even at the upper levels. Again the most significant factor seems to be the variation in density and penetration values through the fill.

Hole Number 2 of Table 5 (Appendix) is presented as additional information. Excavation of muck was limited to the confines of the roadway. An attempt to establish hole number 2 at the outside edge of the shoulder apparently resulted in intersection of only a portion of the sand fill and then penetration of in-place organic deposits. Data from hole number 2 does provide a review of the characteristics of the in-place material immediately adjacent to the sand fill. What small lateral restraint (at the backfill-muck interface) must be afforded by a saturated soil with dry weight density of only 29.7 pounds per cubic foot! Extending the limits of excavation past the boundaries of the roadway would seemingly provide a factor of safety against lateral movement of the sand fill.



Density and Standard Penetration Values Versus Depth of Sand Fill
Williams Boulevard - Veterans Memorial Highway
Route I-10
(Hole No. 1)
FIGURE 3

Table 6* (Appendix) gives a thorough performance evaluation of this project since construction in 1968. An average Dynaflect deflection of 0.57 milli-inches and an average Mays Ride Meter roughness value of 63 inches per mile are quite good. In fact, these values are excellent in light of the 242,317 equivalent 18-kip wheel loads (both directions) which the pavement has experienced since opening 4 1/2 years ago. However, one cannot help but wonder what phenomenon is occurring within the 20 foot long test section E where the average deflection is 1.02 milli-inches and the maximum deflection is 1.68 milli-inches. Such deflections would be significant even for jointed portland cement concrete pavement. Further investigation should be initiated within the area of test section E to minimize possible future maintenance. The performance evaluation test sections as well as the sand fill test holes are depicted in Figure 14 of the Appendix.

3. Joffre Road - Paris Road Highway, Route I-10.

The typical section is comprised of 10 inches of conventional portland cement concrete, six inches of cement stabilized sand shell, and approximately five feet of sand fill.

Unfortunately, detailed performance data is not available for this project. Moreover, the shallow depths of this fill do not lend themselves to detailed analysis. See Table 7 (Appendix) and Figures 4 and 5. Perhaps of most interest in Table 7 (Appendix) is the low density and high moisture values at certain levels beneath the sand fill. Pavement performance on this project is satisfactory at this time.

The condition of the adjacent Little Woods - Lake Pontchartrain (450-16-37) project on I-10 should not go unmentioned, although that sand fill was not evaluated by nuclear means and Standard Penetration Tests. The section is basically a rigid pavement structure supported by sand fill. Pavement performance is satisfactory although characterized by undulations of the jointed pavement. District maintenance personnel are literally keeping an eye on this project. One maintenance superintendant's technique of spotting waves along this roadway is by observation of oil trails deposited by certain elements of traffic. Sudden disruption of continuous oil trails alerts him to possible differential levels in the roadway.

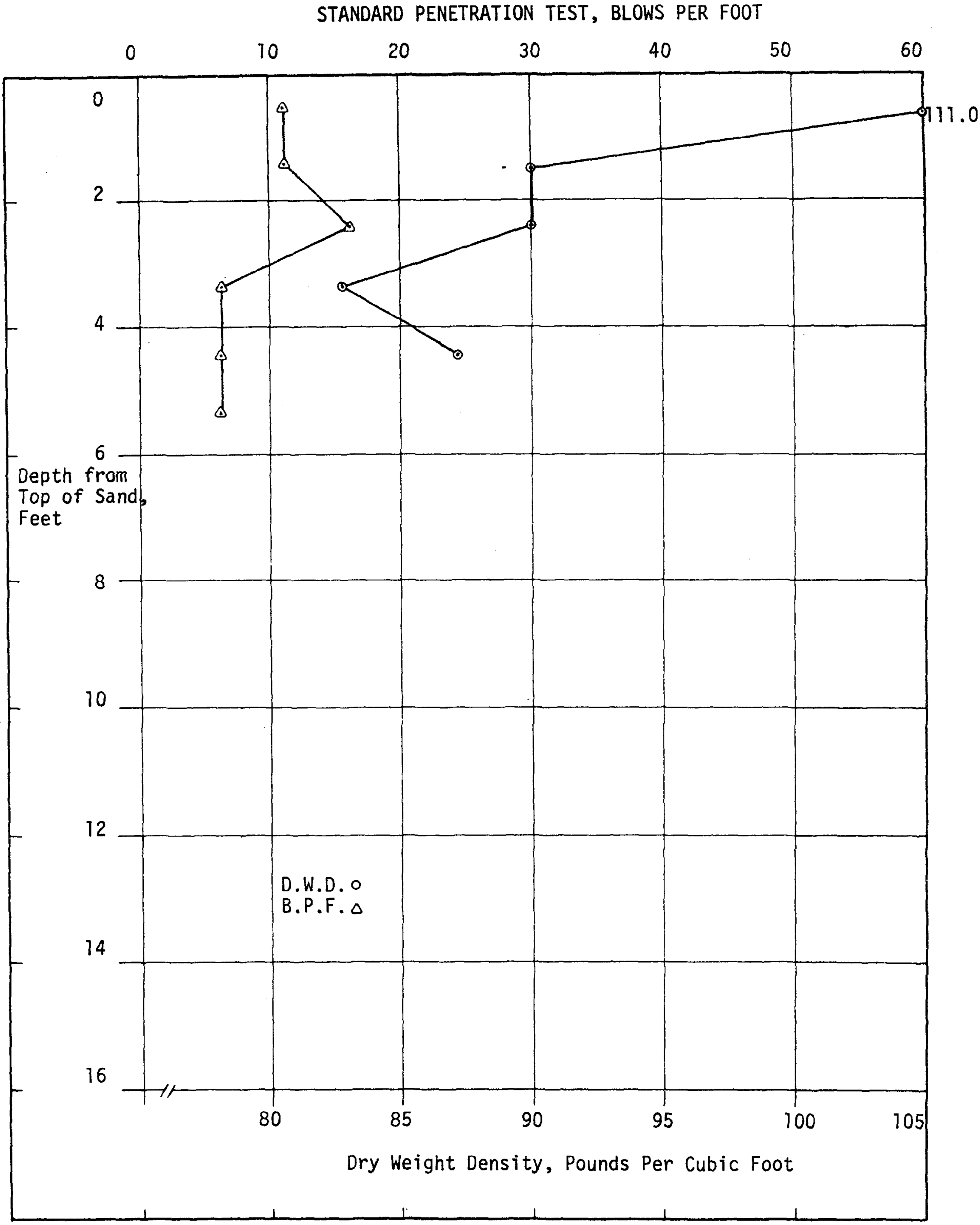
4. Lake Pontchartrain Bridge - Slidell Highway, Route I-10.

The rigid pavement (10 inch PCC with 6 inch cement stablized base) on this project is performing in a very satisfactory manner at this time.

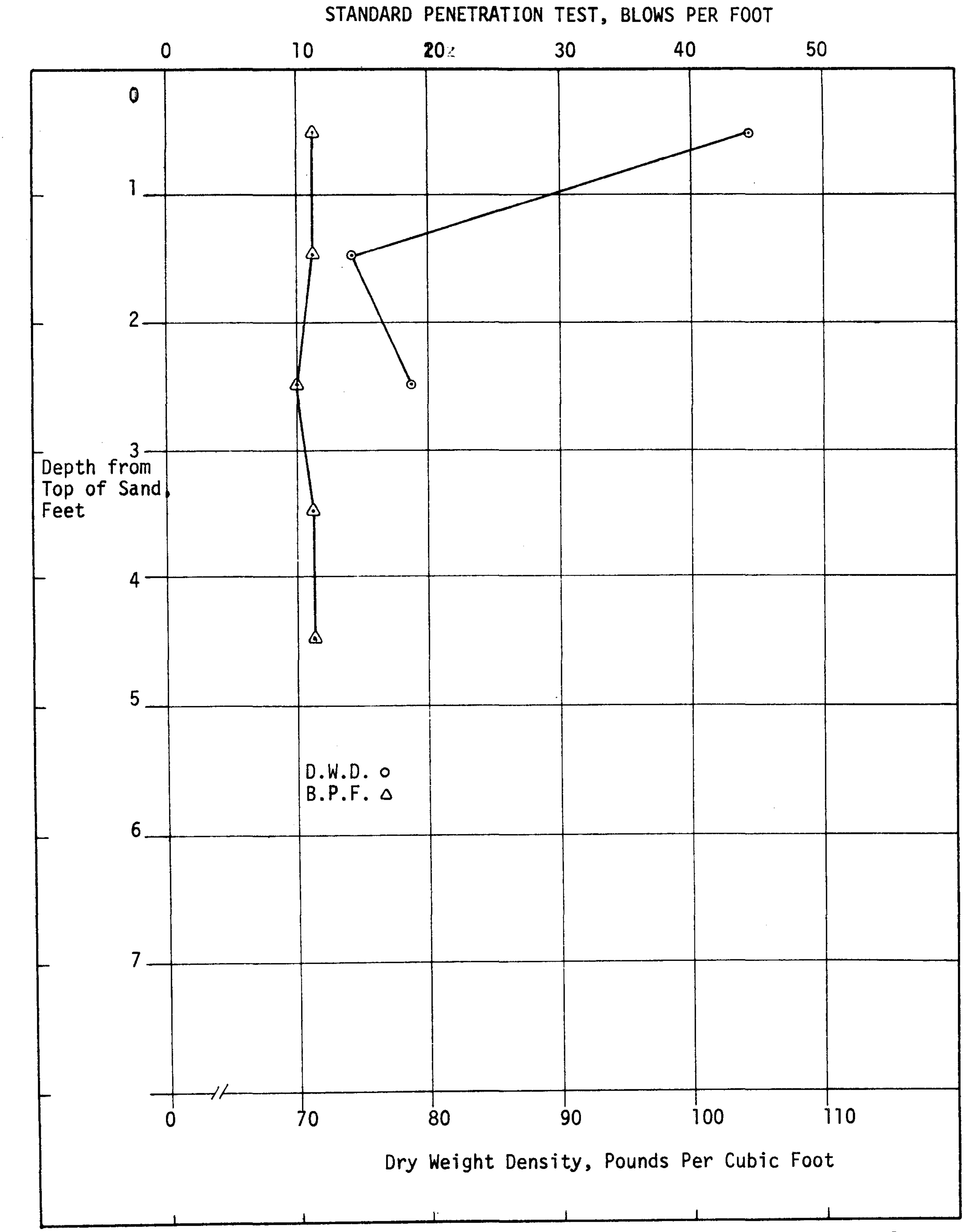
Two sets of nuclear tests were taken, one at 0.1 mile east of the Rigolets Bridge and the second at 0.2 mile east of the bridge. Both were taken on the median centerline very close to the locations of the Standard Penetration Tests.

The plots of the density results and blows per foot of the standard penetration, Figures No. 6 and 7 and Table 8 (Appendix), are very similar. The results of the density tests taken in hole number 1 indicated a non-uniform condition between 4 to 7 feet. This was not indicated by the Standard Penetration Tests. The sand

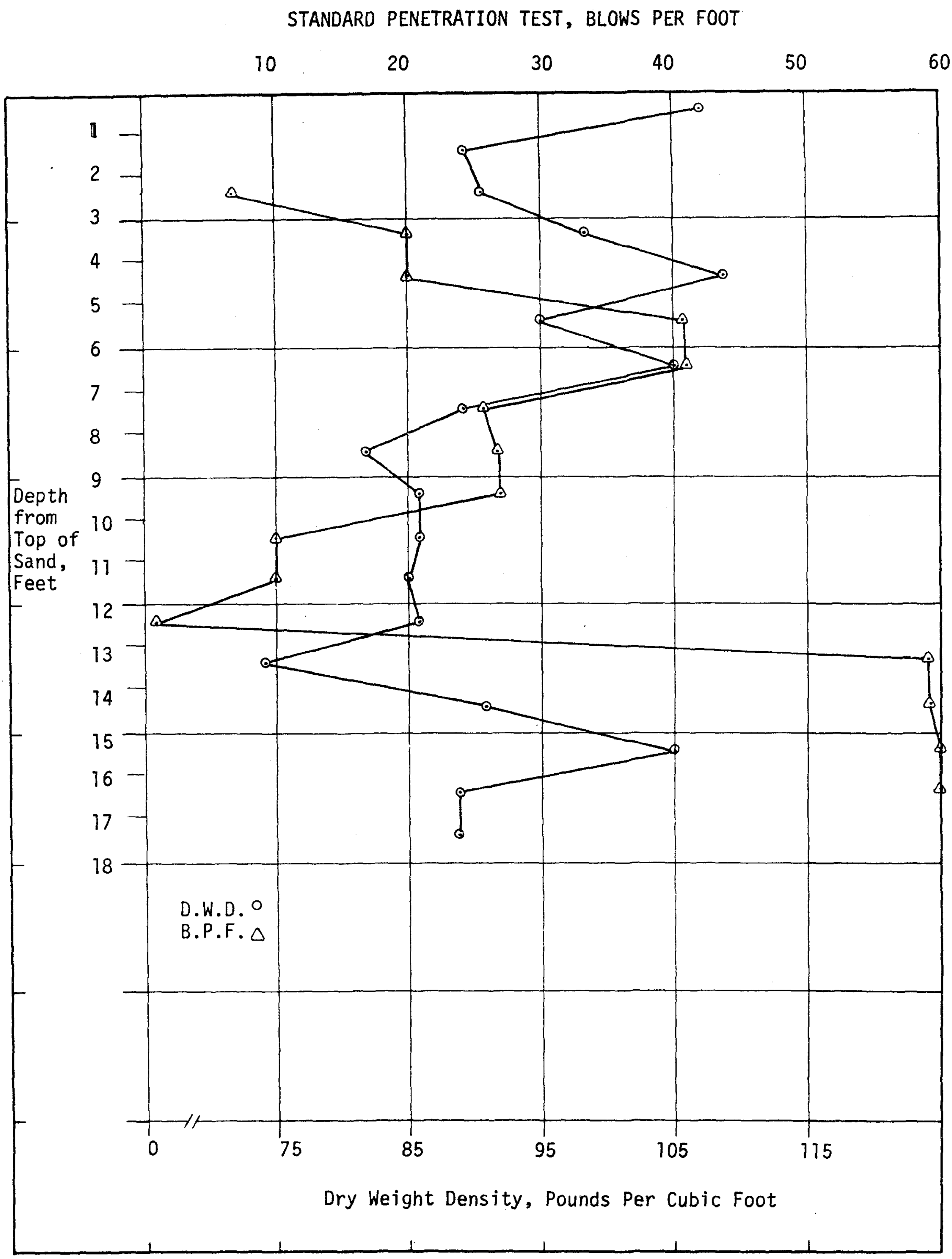
* Extract from "Sixth Evaluation of C.R.C.P.", J. C. Myers and W. H. Temple, Louisiana Department of Highways, November, 1973.



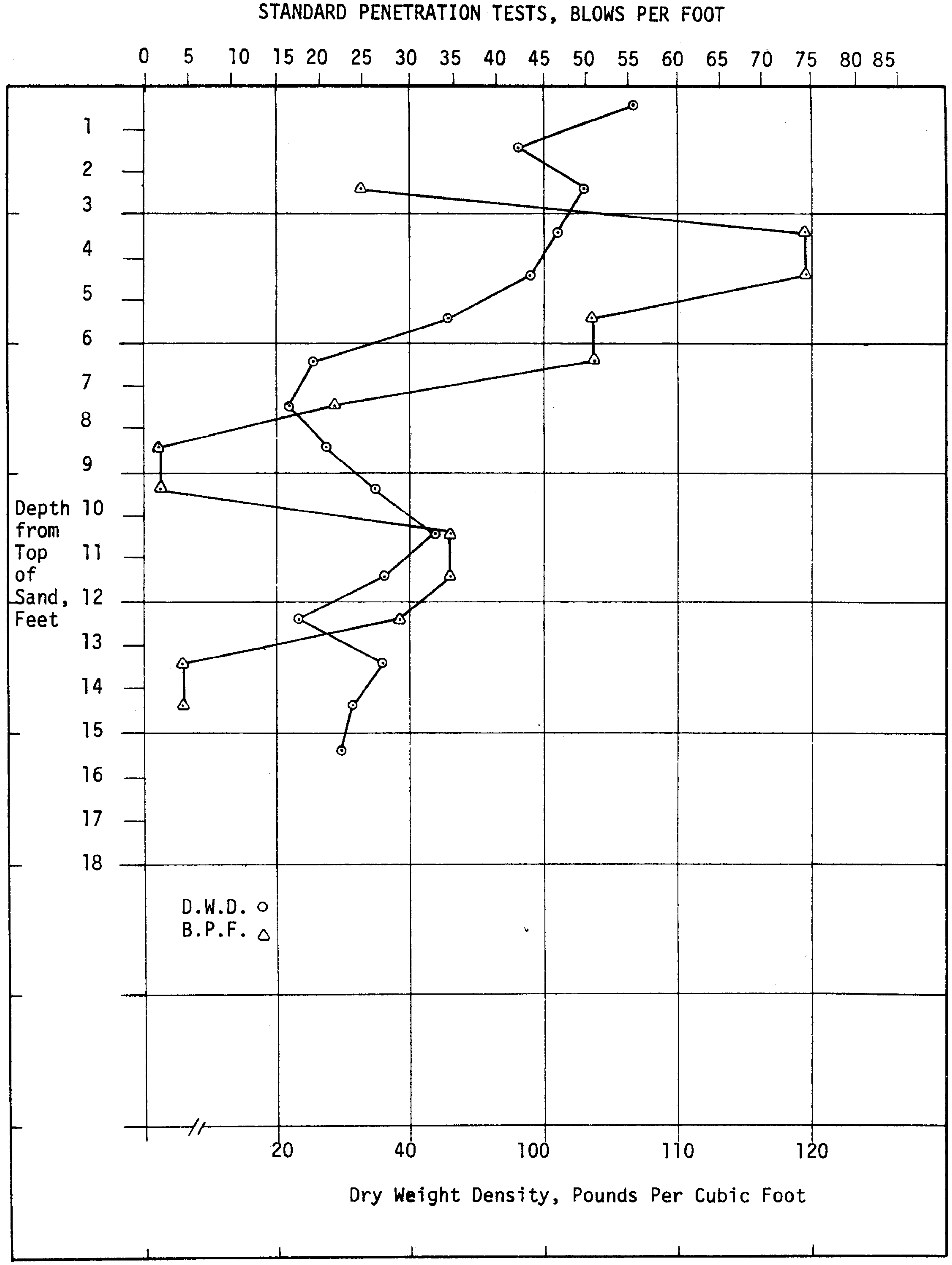
Density and Standard Penetration Values Versus Depth of Sand Fill
JOFFRE ROAD - PARIS ROAD HIGHWAY
Route I-10
Hole No. 1
FIGURE 4



Density and Standard Penetration Values Versus Depth of Sand Fill
Joffre Road - Paris Road Highway
Route I-10
Hole No. 2
FIGURE 5



Density and Standard Penetration Values Versus Depth of Sand Fill
Lake Pontchartrain Bridge - Slidell Highway
Route I-10
Hole No. 1
FIGURE 6



Density and Standard Penetration Values Versus Depth of Sand Fill
Lake Pontchartrain Bridge - Slidell Highway

Route I-10
Hole No. 2
FIGURE 7

at 5 to 6 feet is confined by much denser layers, 10 to 12 pounds per cubic foot greater. If this 4 to 7 foot zone extends for the full width of the roadway, re-adjustment of particles will probably occur with time as a result of being subjected to the vibratory action of traffic.

5. Slidell - Mississippi State Line, Route I-10

The section consists of seven inches of hot mix asphaltic concrete, 12 inches of sand-shell base course, and sand fill in excess of 18 feet (at the station evaluated). The pavement is performing in a very satisfactory manner, although gradual undulations of the surface are beginning to appear in certain areas.

Densities were checked at one location on this project, 0.2 mile west of the west end of the Pearl River Bridge. The test hole was placed 24 feet right of the traveled centerline of the eastbound roadway (outside edge of the shoulder).

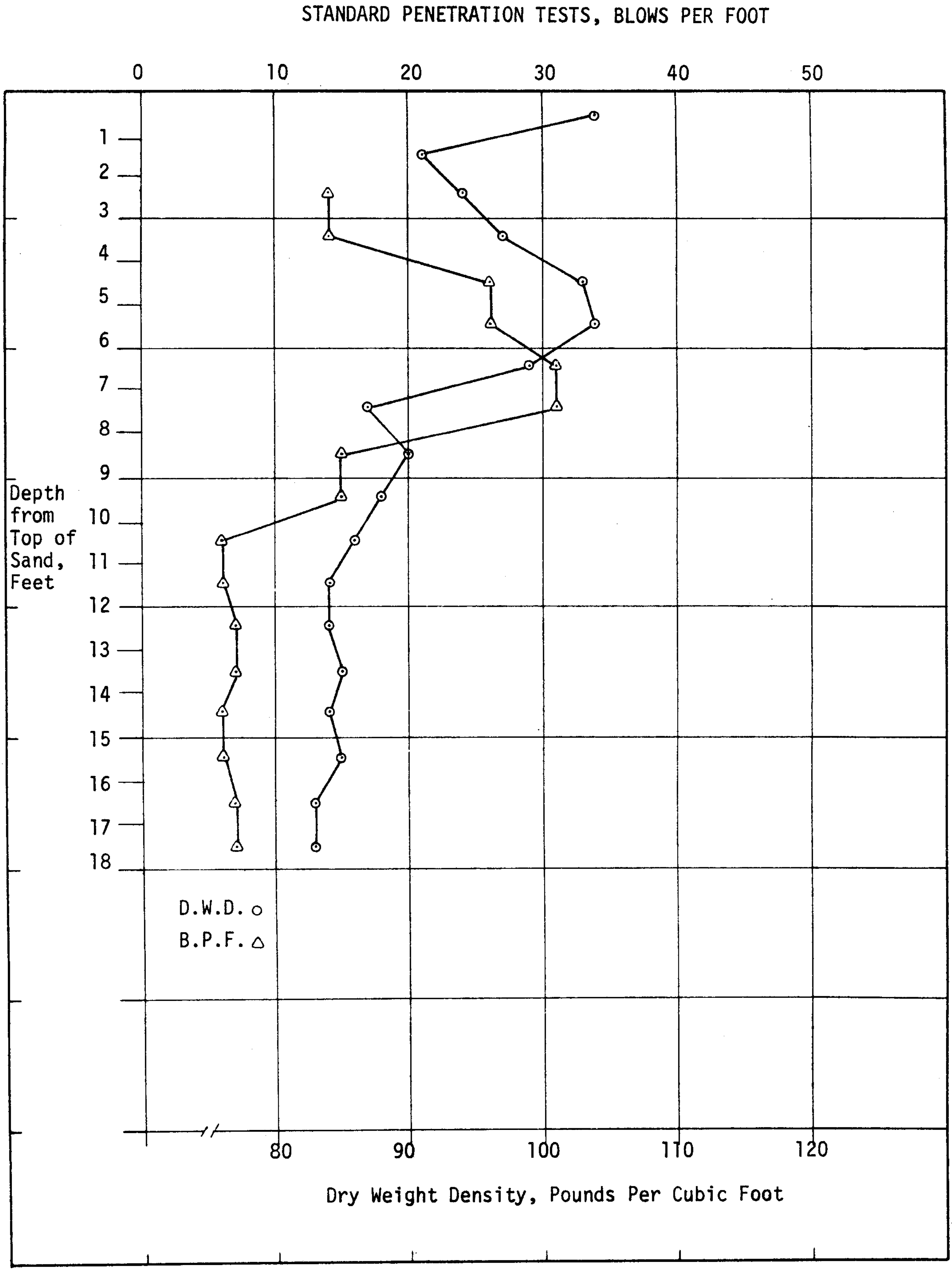
The plots of density per depth and blows per foot of depth of the Standard Penetration Test are very similar from a depth of one foot to the bottom of the density test hole (18 feet). The trend of density for the portion of the fill above the water table is of interest (i.e., increase in density with depth). Please refer to Table 9 (Appendix) and Figure 8.

6. Texas State Line - Toomey Highway, Route I-10.

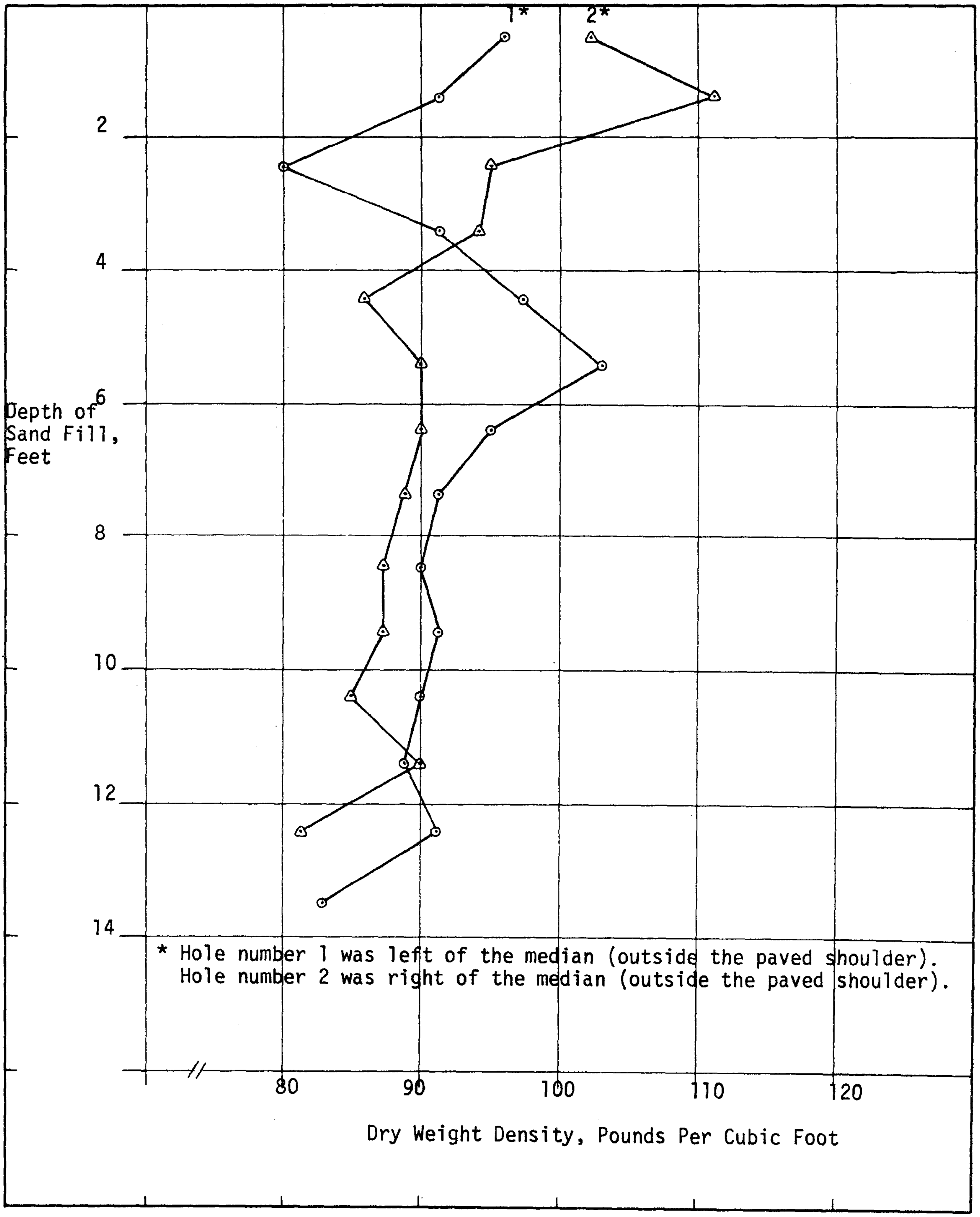
This sand fill is the oldest of all fills investigated, having been built in 1952. In 1965 two feet of sand-shell was placed on the original road surface and overlayed with bituminous hot mix. In the process of reconstruction, approximately four to five feet of the top of the sand fill was removed from the Sabine River Bridge eastward to a distance of about 855 feet in order to achieve a smoother approach onto and off of the bridge.

Several months ago small waves began forming in the bituminous surface which caused very rough riding conditions. Investigation by means of Standard Penetration Tests and sampling of the fill beneath the roadway did not indicate any intrusion of underlying soft soils into the fill, or the presence of any layer of organic or clayey soil within the fill. Since the fill has been in-place for many years, it was concluded that the recent problems were not due to consolidation of the underlying material. It was concluded that the removal of the top portion of the fill subjected a new portion of the fill to the effects of heavy traffic. Then, densification of the sand caused movement in the sand-shell which, in turn, resulted in deterioration of the bituminous hot mix wearing course. It is suspected that overlaying this area with more hot mix may only solve the problem temporarily and that this condition may occur again until the sand in the top of the fill has reached its optimum densification.

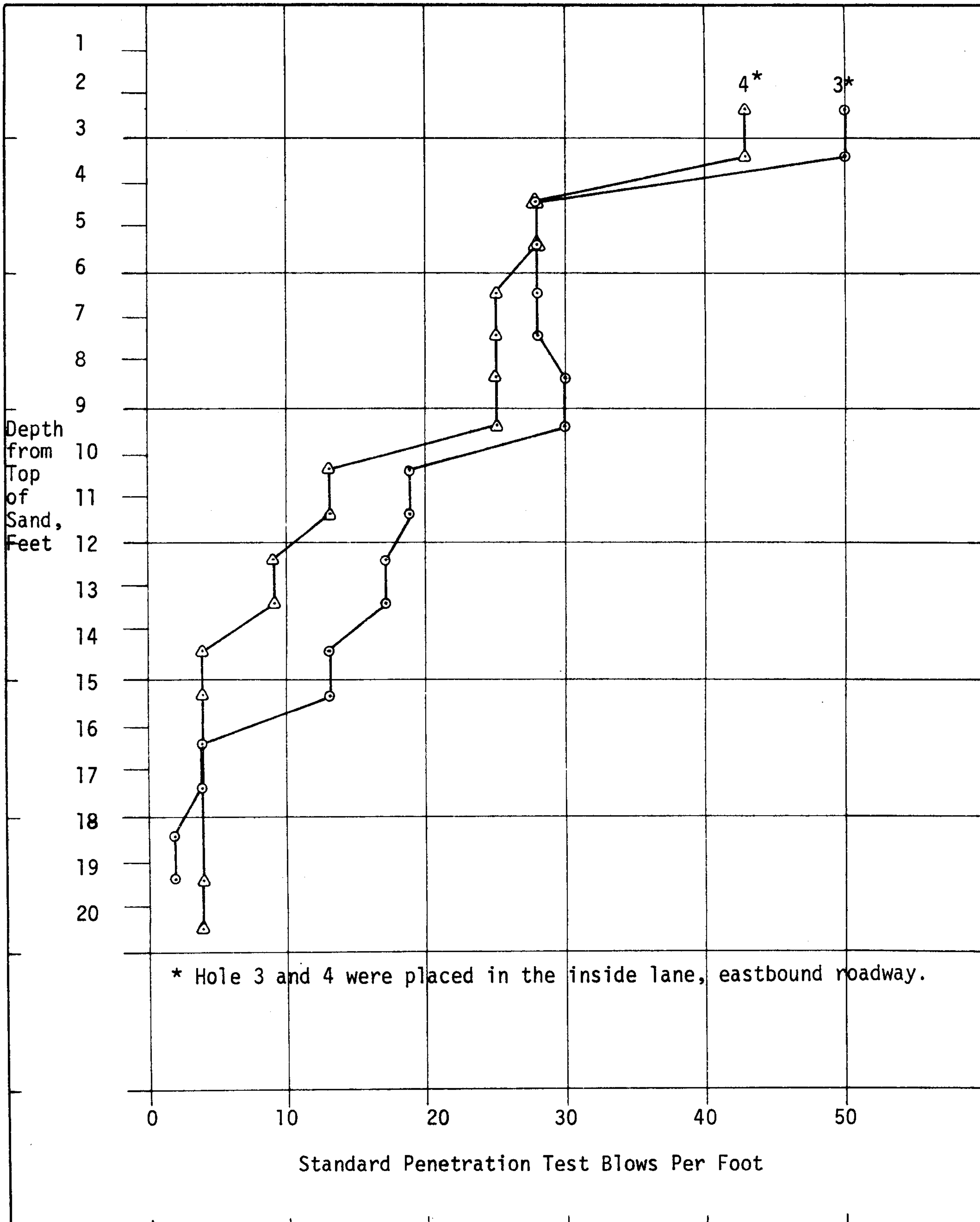
Density results obtained left of the median (outside the shoulder) indicate that the highest value is at 5 to 6 feet below the surface of the sand fill. A very loose and wet layer was observed at 2 to 3 feet. Borings showed this was caused by a thin (6 inch) layer of saturated silty clay. This was not observed in the borings under the roadway or on the opposite side of the roadway in hole number 2. Results of hole number 2 indicate a loose, moist sand zone at 4 to 5 feet. See Table 10 (Appendix) and Figures 9 and 10.



Density and Standard Penetration Values Versus Depth of Sand Fill
Slidell - Mississippi State Line Highway
Route I-10
FIGURE 8



Density Values Versus Depth of Sand Fill
Route I-10 Texas State Line - Toomey Highway
Holes No. 1 and 2
FIGURE 9



Standard Penetration Test Versus Depth of Sand Fill
Texas State Line - Toomey Highway
Route I-10
Holes No. 3 and 4
FIGURE 10

7. Raceland - Des Allemands Highway, Route U. S. 90.

This state route is 6.42 miles in length and rests on sand hauled in by barge and deposited by conveyor belt. The typical section is comprised of 4 1/2 inches of hot mix asphaltic concrete, 12 inches of shell, and varying depths of sand fill (up to 15 feet at the stations evaluated). This project is approximately 12 years old.

Pavement performance may be subjectively described as adequate although marked by undulations (rises and depressions). The major maintenance measure performed along this roadway has been patching. It may or may not be significant to this evaluation of sand fills that patching seems keyed to the outside lanes. Of course, the outside lanes are the heaviest travelled. However, Tables 11 through 14 (Appendix) and Figures 15 through 19 (Appendix) reveal slightly higher density values and greater depths of sand at the middle of the fill than on the outer portions.

Borings taken by the Department in March, 1966, (approximately five years after construction) at three stations along this project indicated that the sand fill had extended the initial limits of mucking both vertically and laterally. Figures 20, 21 and 22 indicate conditions before construction, the general extent of mucking, and the extent to which the sand fill had moved both vertically and laterally. It is likely that much of the movement of the backfill material took place during construction and that such movement was rectified by the addition of sufficient sand to bring the fill to proper grade. Such further movement by this massive fill probably wrought only minor problems for the paved surface. However, determination of "the final resting place of the backfill material"* was considered worth mentioning in this evaluation of sand fills.

* "Removal and Backfill of Material in Louisiana Mucklands," R. M. Allen, Jr., Lemke, C. A., and McLeane, R. W., Louisiana Polytechnic University, April 15, 1967.

CONCLUSIONS

1. Density values vary significantly with depth and with transverse position within sand fills. These values are most uniform near the centerline of sand fills, but vary quite erratically with depth near the outer portions. The greatest density values occur near the centerline of these fills.

2. A vibratory compactor readjusts the particles in a sand fill. Simultaneous tightening of certain levels and loosening of others produce volume changes in sand fills which cannot be predicted as construction proceeds on top of the said fills. Densification is most pronounced at the outer portions of sand fills where the as-placed density values vary the most with depth. This is considered the mechanism which produced the depressions in the black base of the Sorrento-LaPlace highway in St. James Parish.

3. The loose nature of the sand at and below the water table is not considered a serious problem for recently constructed thick sand fills. This phenomenon was observed at the Texas State Line - Toomey project constructed in 1952 and that roadway is performing satisfactorily except for the area wherein several feet of sand were removed in 1965 during a pavement reconstruction operation.

4. Densification within sand fills can be reflected in pavement performance. This occurrence might initially be most pronounced on flexible pavements, since rigid pavements (especially continuously reinforced concrete pavements) may provide a bridging effect which could initially minimize the results of density changes in underlying fills. Continuous action within sand fills will eventually cause a decrease in pavement performance of both rigid and flexible pavements.

5. Dry weight density values (pounds per cubic foot) and Standard Penetration Test values (blows per foot) vary very similarly with depth in sand fills.

RECOMMENDATIONS

1. Consideration should be given to widening the base and/or reducing the side slopes of mucked areas. The effect of adjustments at the backfill-muck interface would seemingly be reduced by this action, and a more stable sand fill platform could result.

2. Vibrations should be applied by means of heavy equipment such as tractors or rollers prior to construction on top of sand fills. If density adjustments are imminent, leveling would best be done with sand than with the more expensive base course or surfacing material.

3. If serious questions still exist concerning the validity of the sand fill concept, controlled long-term research should be conducted to resolve the issue.

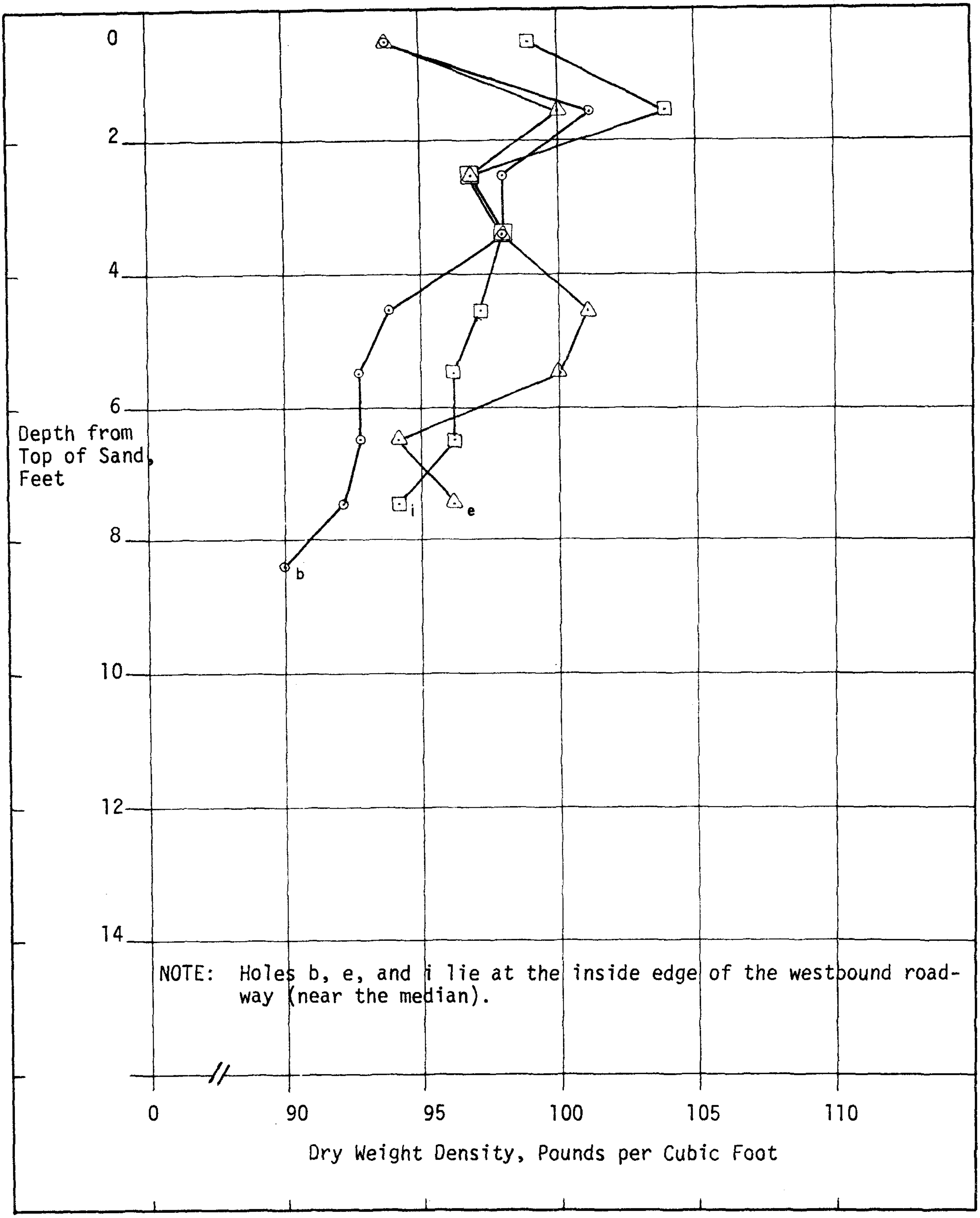
APPENDIX

TABLE 1

NUCLEAR MOISTURE - DENSITY DETERMINATIONS
STATE PROJECT NO. 450-12-02
SORRENTO - LAPLACE HIGHWAY
ST. JAMES PARISH
I-10

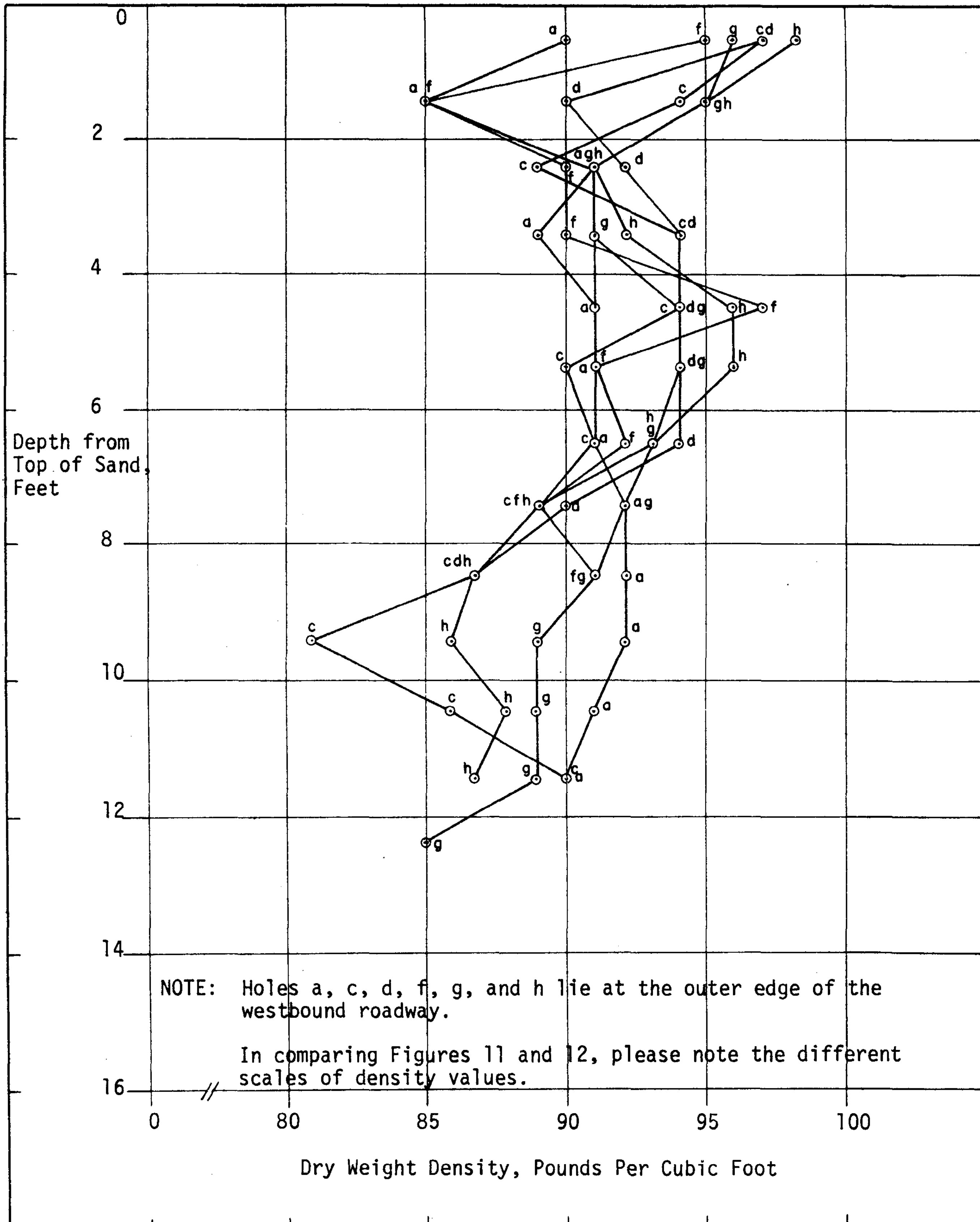
Station Nos.	1483 + 50		1517 + 75	1520 + 75		1520 + 10	1551 + 10	1584 + 00	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Depth from top of sand	12' Lt. c/L* 10' dia. depression	10'Rt. c/L No depression	10'Lt. c/L No depression	12'Lt. c/L No depression	12'Rt. c/L No depression	12'Lt. c/L 4' dia. depression	8'Lt. c/L 6' dia. depression	12'Lt. c/L No depression	13'Rt. c/L No depression
0'-1'	90.3@13.0**	94.2@4.2	96.8@5.9	97.4@5.2	94.0@5.1	95.2@5.0	95.9@7.2	98.9@4.8	99.4@4.8
1'-2'	85.1@30.4	100.7@7.1	93.7@12.2	90.0@20.4	99.7@6.8	85.3@23.3	95.4@7.8	95.4@8.2	104.3@4.7
2'-3'	90.5@29.8	98.2@24.2	89.0@30.0	92.3@28.1	97.2@20.8	90.8@28.1	91.4@27.5	91.6@20.1	97.3@16.3
3'-4'	88.5@32.8	97.9@24.6	93.5@27.4	94.4@30.3	97.8@26.3	89.9@29.9	91.1@29.3	91.8@29.3	97.8@24.2
4'-5'	91.0@34.0	94.3@30.4	93.7@30.1	94.0@31.4	101.4@27.0	97.2@29.1	93.5@31.6	96.4@29.7	97.3@27.5
5'-6'	90.6@34.7	92.9@30.2	89.8@33.6	94.0@31.4	99.8@27.6	91.4@32.8	93.6@31.4	95.5@30.6	95.9@28.9
6'-7'	91.3@33.7	92.9@32.4	90.7@33.7	94.1@31.2	94.0@34.3	91.6@32.5	93.4@31.9	92.5@32.2	95.6@29.2
7'-8'	92.1@33.6	91.9@33.1	89.1@35.2	90.0@34.4	95.7@30.1	89.2@34.3	91.5@33.3	89.0@35.3	93.6@29.9
8'-9'	92.0@33.7	90.3@34.2	87.3@36.5	87.3@35.6		90.6@33.6	90.5@33.9	86.9@36.5	
9'-10'	91.5@33.6		80.7@41.3				88.7@35.9	86.4@37.2	
10'-11'	90.7@34.7		85.6@37.3				89.1@35.2	88.1@35.1	
11'-12'	89.6@35.8		89.5@35.2				89.4@34.8	87.1@36.1	
12'-13'							84.5@38.5		

* Tests locations are referenced with respect to the centerline of the hot mix on the westbound roadway, as all tests were taken in that roadway.
** Dry weight density (pounds per cubic foot) @ moisture content (%).



Dry Weight Density Values Versus Depth of Sand Fill
Route I-10 Sorrento - LaPlace Highway
Adjacent to Median of Fill

FIGURE 11



Dry Weight Density Values Versus Depth of Sand Fill
Route I-10 Sorrento - LaPlace Highway
Outer Edge of Fill

FIGURE 12

LAYOUT OF
SAND FILL TEST SECTION

Sorrento - LaPlace Highway

Route I-10

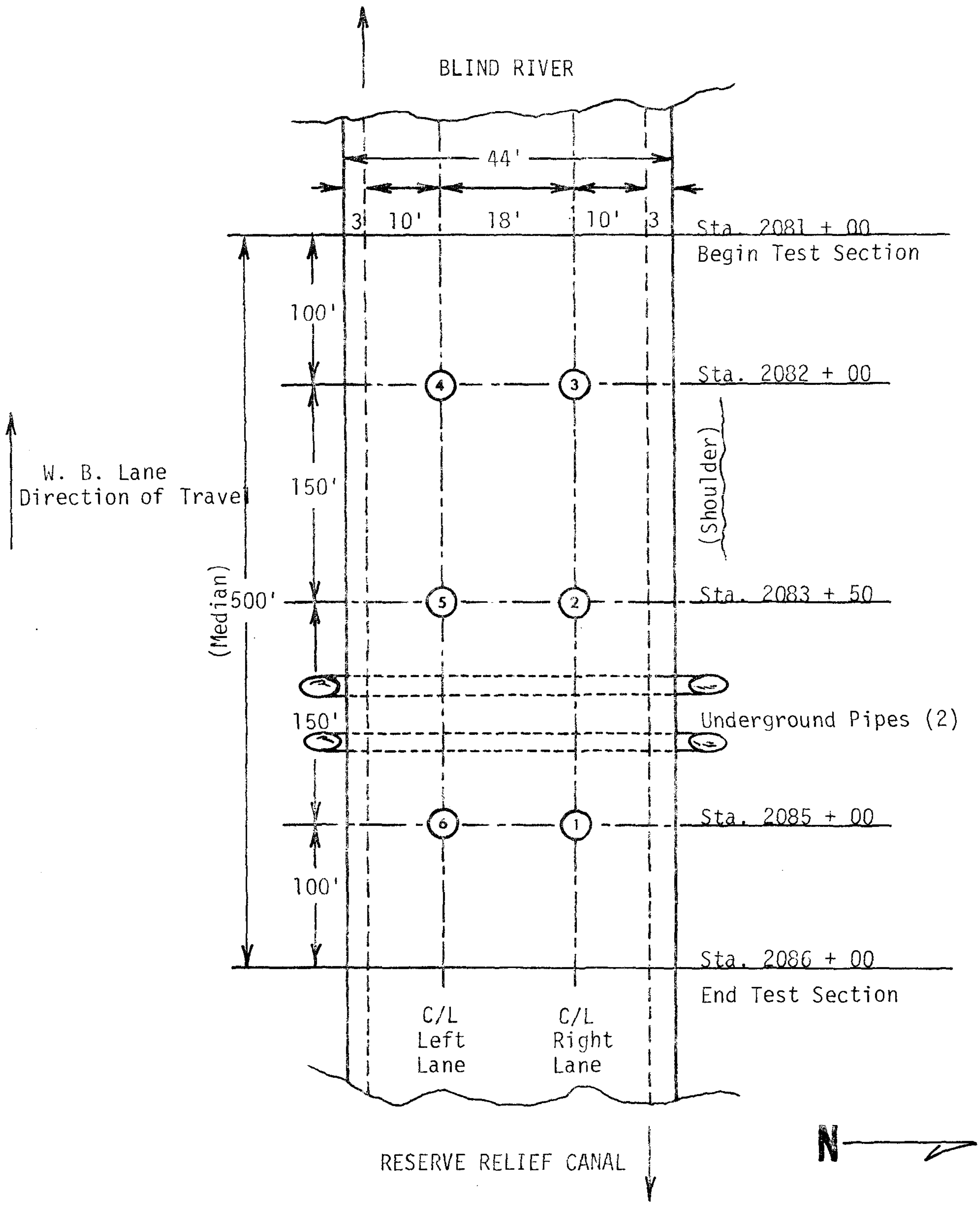


FIGURE 13

TABLE 2

REPEATABILITY OF DENSITY TESTS ON SAND FILL OF SORRENTO-LAPLACE HIGHWAY ROUTE I-10

	Tests Taken 9/28/73		Tests Taken 10/1/73		
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture	Variation of D.W.D.**
			Hole No. 1		
0 - 1	94.6	5.7	93.3	9.3	1.3
1 - 2	96.3	5.6	97.6	9.8	1.3
2 - 3	94.3	14.5	96.7	11.2	1.4
3 - 4	92.5	28.6	93.1	28.5	0.6
4 - 5	93.9	31.0	92.8	31.8	1.1
5 - 6	93.9	31.0	92.9	31.6	1.0
			Hole No. 2		
0 - 1	94.5	7.7	94.5	10.1	0.0
1 - 2	98.6	5.2	97.6	9.6	1.0
2 - 3	95.3	11.8	97.2	12.1	1.9
3 - 4	94.8	26.6	95.1	27.2	0.3
4 - 5	92.7	30.6	93.0	31.2	0.3
5 - 6	93.2	29.8	93.3	30.5	0.1
			Hole No. 3		
0 - 1	90.3	7.8	90.5	7.7	0.2
1 - 2	96.3	8.3	96.0	8.3	0.3
2 - 3	96.4	12.2	95.5	12.4	0.9
3 - 4	94.8	26.6	94.8	26.6	0.0
4 - 5	92.9	31.3	92.9	31.3	0.0
5 - 6	94.3	30.6	94.1	30.7	0.2
			Hole No. 4		
0 - 1	93.0	6.6	93.2	8.9	0.2
1 - 2	99.3	5.1	98.6	9.3	0.7
2 - 3	99.6	6.4	99.2	7.9	0.4
3 - 4	94.2	22.4	93.3	25.9	0.9
4 - 5	93.2	29.8	92.9	30.2	0.3
5 - 6	93.2	31.2	94.8	30.8	1.6
			Hole No. 5		
0 - 1	89.4	8.8	91.4	10.0	2.0
1 - 2	96.5	5.2	96.8	10.3	0.3
2 - 3	98.1	5.7	99.2	7.9	1.1
3 - 4	94.2	22.6	93.8	24.7	0.4
4 - 5	93.2	29.4	94.1	29.6	0.9
5 - 6	91.4	32.7	93.0	32.3	1.6
			Hole No. 6		
0 - 1	91.2	6.4	91.0	10.9	0.2
1 - 2	96.9	5.6	96.4	8.5	0.5
2 - 3	97.6	7.4	99.5	6.5	1.9
3 - 4	91.9	26.8	93.0	26.0	1.1
4 - 5	91.6	31.6	92.2	31.2	0.6
5 - 6	92.5	31.9	93.4	31.6	0.9

* Depth in feet.
** Density, pounds per cubic foot.

TABLE 3

SAND FILL DENSITY RESULTS IN TEST SECTION
STATE PROJECT NO. 450-12-02
SORRENTO - LAPLACE HIGHWAY
ROUTE I-10

	Density Prior to Rolling		Density After 2 Coverages		Density After 4 Coverages	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
			Hole No. 1			
0 - 1	93.3	9.3			98.3	5.2
1 - 2	97.6	9.8			95.8	10.4
2 - 3	96.7	11.2			96.2	12.6
3 - 4	93.1	28.5			93.0	28.6
4 - 5	92.8	31.8			93.6	31.4
5 - 6	92.9	31.6			94.2	31.2
6 - 7	94.2	31.1			94.4	31.1
7 - 8	93.4	31.2			93.8	31.6
8 - 9	94.1	31.7			92.3	32.5
9 - 10	93.9	31.8			93.6	31.8
			Hole No. 2			
0 - 1	94.5	10.1	97.4	9.9	96.3	10.3
1 - 2	97.6	9.6	98.9	8.9	98.2	9.2
2 - 3	97.2	12.1	97.4	11.9	96.9	13.2
3 - 4	95.1	27.2	95.4	27.3	94.9	27.5
4 - 5	93.0	31.2	90.6	32.1	92.5	31.7
5 - 6	93.3	30.5	93.5	30.5	92.7	30.5
6 - 7	92.2	31.3			92.8	30.6
7 - 8	91.1	32.9			91.9	32.8
8 - 9	91.2	33.2			91.6	33.4
9 - 10	90.6	33.6			90.1	34.3
10 - 11	90.1	34.0			89.9	34.4
11 - 12	90.1	34.0			90.2	34.4
			Hole No. 3			
0 - 1	90.5	7.7			95.0	8.0
1 - 2	96.0	8.3			96.9	8.4
2 - 3	95.5	12.4			91.7	15.2
3 - 4	94.8	26.6			94.4	27.1
4 - 5	92.9	31.3			92.9	31.3
5 - 6	94.1	30.7			93.3	31.0
6 - 7	93.2	31.3			92.6	31.5
7 - 8	90.0	33.8			90.3	33.8
8 - 9	86.5	34.5			87.6	36.4
9 - 10	89.2	34.5			90.2	33.9

* Depths are in feet.
** Dry weight density, pounds per cubic foot.

TABLE 3 (CONTINUED)

SAND FILL DENSITY RESULTS IN TEST SECTION
STATE PROJECT NO. 450-12-02
SORRENTO - LAPLACE HIGHWAY
ROUTE I-10

	Density Prior to Rolling		Density After 2 Coverages		Density After 4 Coverages	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
			Hole No. 4			
0 - 1	93.2	8.9	94.3	9.2	93.3	10.1
1 - 2	98.6	9.3	99.8	8.6	98.8	10.3
2 - 3	99.2	7.9	97.6	9.6	98.0	9.7
3 - 4	93.3	25.9	87.7	34.0	91.7	27.6
4 - 5	92.9	30.2	91.7	32.2	92.2	30.7
5 - 6	94.8	30.8	92.7	31.9	94.8	30.8
6 - 7	93.3	32.2			94.6	31.1
7 - 8	92.2	32.5			93.5	32.1
8 - 9	92.5	32.2			93.5	31.9
9 - 10	90.6	33.6			91.8	33.2
			Hole No. 5			
0 - 1	91.4	10.0	94.6	9.5	94.1	10.9
1 - 2	96.8	10.3	97.9	10.0	96.5	10.9
2 - 3	99.2	7.9	98.5	8.1	97.1	9.7
3 - 4	93.8	24.7	94.1	24.9	93.3	25.9
4 - 5	94.1	29.6	92.2	31.7	93.3	30.1
5 - 6	93.0	32.3	91.6	33.2	91.0	33.4
6 - 7	92.3	32.2			93.4	31.7
7 - 8	89.2	34.5			90.3	34.0
8 - 9	89.0	34.8			90.0	34.7
9 - 10	90.0	33.9			90.4	33.8
10 - 11	89.3	34.5			90.2	34.1
11 - 12	88.9	34.9			89.7	34.4
			Hole No. 6			
0 - 1	91.0	10.9			92.4	11.5
1 - 2	96.4	8.5			96.3	10.8
2 - 3	99.5	6.5			99.0	8.1
3 - 4	93.0	26.0			93.1	26.2
4 - 5	92.2	31.2			92.1	30.9
5 - 6	93.4	31.6			92.2	31.9
6 - 7	93.9	31.2			94.4	30.8
7 - 8	92.9	31.9			93.8	31.4
8 - 9	92.0	32.2			93.3	31.7
9 - 10	91.6	33.2			91.2	33.3

* Depths are in feet.
** Dry weight density, pounds per cubic foot.

TABLE 4
CHANGES IN DENSITY IN TEST SECTION AFTER APPLICATION OF VIBRATORY COMPACTOR
SORRENTO - LAPLACE HIGHWAY
ROUTE I-10

Depth*	Variation in Density After Compaction** Two Coverages	Four Coverages
	Hole No. 1	
0 - 1		+5.0
1 - 2		-1.8
2 - 3		-0.5
3 - 4		-0.1
4 - 5		+0.8
5 - 6		+1.3
6 - 7		+0.2
7 - 8		+0.4
8 - 9		-1.8
9 - 10		-0.3
	Hole No. 2	
0 - 1	+2.9	+1.8
1 - 2	+1.3	+0.6
2 - 3	+0.2	-0.3
3 - 4	+0.3	-0.2
4 - 5	-2.4	-0.5
5 - 6	+0.2	-0.6
6 - 7		+0.6
7 - 8		+0.8
8 - 9		+0.4
9 - 10		-0.5
10 - 11		-0.2
11 - 12		+0.5
	Hole No. 3	
0 - 1		+4.5
1 - 2		+0.9
2 - 3		-3.8
3 - 4		-0.4
4 - 5		0.0
5 - 6		-0.8
6 - 7		-0.6
7 - 8		+0.3
8 - 9		+1.1
9 - 10		+1.0

* Depth in feet.
** Variation in density in pounds per cubic feet.

TABLE 4 (CONTINUED)
CHANGES IN DENSITY IN TEST SECTION AFTER APPLICATION OF VIBRATORY COMPACTOR
SORRENTO - LAPLACE HIGHWAY
ROUTE I-10

Depth*	Variation in Density After Compaction**	
	Two Coverages	Four Coverages
	Hole No. 4	
0 - 1	+1.1	+0.1
1 - 2	+1.2	+0.2
2 - 3	-1.6	-1.2
3 - 4	-5.6	-1.6
4 - 5	-1.2	-0.7
5 - 6	-2.1	0.0
6 - 7		+1.3
7 - 8		+1.3
8 - 9		+1.0
9 - 10		+1.2
	Hole No. 5	
0 - 1	+3.2	+2.7
1 - 2	+1.1	-0.3
2 - 3	-0.7	-2.1
3 - 4	+0.3	-0.5
4 - 5	-1.9	-0.8
5 - 6	-1.4	-2.0
6 - 7		+1.1
7 - 8		+1.1
8 - 9		+1.0
9 - 10		+0.4
10 - 11		+0.9
11 - 12		+0.8
	Hole No. 6	
0 - 1		+1.4
1 - 2		-0.1
2 - 3		-0.5
3 - 4		+0.1
4 - 5		-0.1
5 - 6		-1.2
6 - 7		+0.5
7 - 8		+0.9
8 - 9		+1.3
9 - 10		-0.4

* Depth in feet.
** Variation in density in pounds per cubic feet.

TABLE 5
SAND FILL MOISTURE - DENSITY DETERMINATIONS
WILLIAMS BOULEVARD - VETERANS MEMORIAL HIGHWAY
ROUTE I-10

	Hole No. 1		Hole No. 2***	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
0 - 1	105.7	13.2	93.1	16.0
1 - 2	84.7	25.6	76.8	27.6
2 - 3	85.1	32.4	81.8	37.4
3 - 4	89.0	30.4	29.7	151.2
4 - 5	87.0	32.2	27.0	163.0
5 - 6	85.3	31.2	41.5	87.5
6 - 7	88.0	30.0	89.9	34.4
7 - 8	87.7	29.9	69.4	58.8
8 - 9	85.8	31.4	30.5	146.6
9 - 10	84.7	31.1	11.0	443.6
10 - 11	85.1	31.1	8.7	552.9
11 - 12	81.0	37.8	29.3	145.1
12 - 13	62.5	55.2	60.6	59.4
13 - 14	80.6	40.6	71.0	103.9
14 - 15	87.8	33.3	88.2	33.6
15 - 16	92.8	30.5	92.4	30.7
16 - 17	90.3	32.1	87.2	35.4
17 - 18	88.3	35.1	68.3	49.8

The above test sites were located along Route I-10 immediately east of the Route La. 49 (Williams Boulevard) interchange. More specifically:

Hole No. 1 - was at the outside edge of the shoulder of the westbound roadway.

Hole No. 2 - was at the outside edge of the shoulder of the eastbound roadway.

* Depths are in feet.

** Dry weight density, pounds per cubic foot.

*** Apparently, hole number two intersected only a portion of the sand fill prior to penetrating the adjacent muck.

TABLE 6

SUMMARY - CRCP PERFORMANCE
WILLIAMS BOULDEVARD-VETERANS HIGHWAY

	TEST SECTION Year	A	B	C	D	E	F	Project Avg.
Σ - Load (18 Kip)	1968	Constructed but not open to traffic						--
	1969	Open to traffic						44,408
	1970							87,622
	1971							143,584
	1972							192,825
	1973							242,317
	1974							
	1975							
	1976							
	1977							
Age (Years)	1968							1/2
	1969							1 1/2
	1970							2 1/2
	1971							3 1/2
	1972							4 1/2
	1973							5 1/2
	1974							
	1975							
	1976							
	1977							
Average Deflection (Milli-Inches)	1968	0.42	0.38	0.36	0.41	0.48	0.40	0.41
	1969	0.47	0.42	0.47	0.48	0.49	0.48	0.47
	1970	0.42	0.38	0.52	0.46	0.62	0.55	0.49
	1971	0.59	0.44	0.50	0.45	0.76	0.39	0.52
	1972	0.39	0.42	0.57	0.48	0.81	0.42	0.52
	1973	0.46	0.44	0.54	0.50	1.02	0.48	0.57
	1974							
	1975							
	1976							
	1977							
Maximum Deflection (Milli-Inches)	1968	0.42	0.40	0.36	0.41	0.48	0.40	0.41
	1969	0.50	0.44	0.51	0.48	0.53	0.52	0.50
	1970	0.44	0.42	0.59	0.48	0.66	0.61	0.53
	1971	0.61	0.50	0.59	0.56	0.84	0.44	0.59
	1972	0.42	0.48	0.66	0.62	0.96	0.47	0.60
	1973	0.48	0.54	0.67	0.70	1.68	0.55	0.77
	1974							
	1975							
	1976							
	1977							
Minimum Deflection (Milli-Inches)	1968	0.41	0.36	0.34	0.41	0.48	0.40	0.40
	1969	0.43	0.38	0.42	0.47	0.46	0.44	0.43
	1970	0.39	0.34	0.50	0.43	0.58	0.48	0.45
	1971	0.54	0.35	0.37	0.41	0.70	0.32	0.45
	1972	0.37	0.36	0.46	0.42	0.66	0.38	0.44
	1973	0.42	0.37	0.44	0.43	0.62	0.43	0.45
	1974							
	1975							
	1976							
	1977							

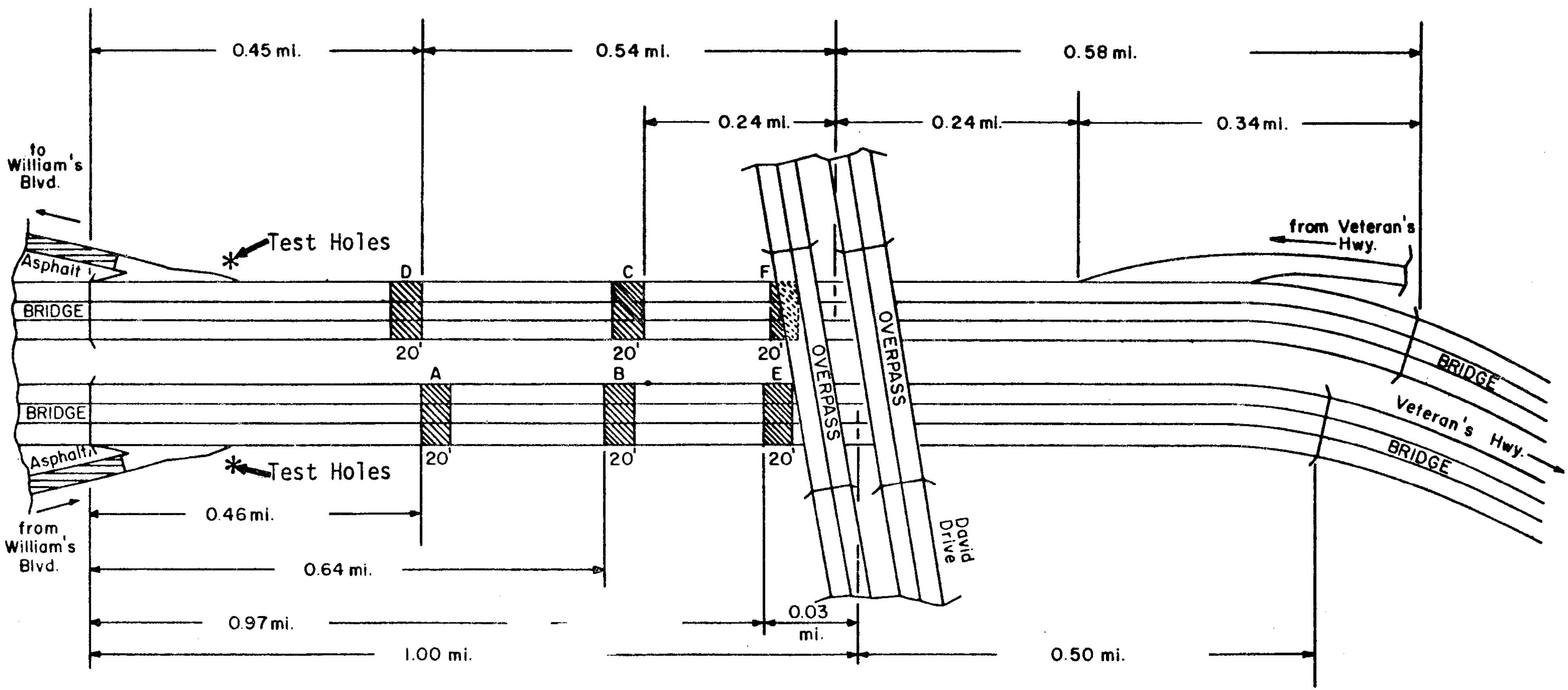
TABLE 6 (CONTINUED)

SUMMARY - CRCP PERFORMANCE

WILLIAMS BOULEVARD-VETERANS HIGHWAY

	TEST SECTION	A	B	C	D	E	F	Project Avg.
	Year							
Average Deflection At Cracks (Milli-Inches)	1968	0.42	0.40	0.36	0.41	-	-	0.40
	1969	0.50	0.43	0.47	0.48	0.50	0.50	0.48
	1970	0.44	0.38	0.54	0.48	0.63	0.56	0.51
	1971	0.60	0.45	0.51	0.43	0.78	0.40	0.53
	1972	0.42	0.43	0.58	0.44	0.80	0.42	0.52
	1973	0.45	0.44	0.55	0.47	0.96	0.44	0.55
	1974							
	1975							
	1976							
	1977							
Average Surface Curvature Index (Milli-Inches)	1968	0	0	0	0	-	-	0.00
	1969	0.04	0.04	0.02	0.02	0.02	0.04	0.03
	1970	0.04	0.04	0.04	0.04	0.05	0.06	0.04
	1971	0.04	0.04	0.04	0.05	0.06	0.04	0.04
	1972	0.04	0.02	0.02	0.04	0.04	0.03	0.03
	1973	0.04	0.04	0.04	0.05	0.06	0.04	0.04
	1974							
	1975							
	1976							
	1977							
Present Serviceability Index	1968	-	-	-	-	-	-	-
	1969	3.53	3.53	3.49	3.49	3.53	3.49	3.51
	1970	3.68	3.68	3.72	3.72	3.68	3.72	3.70
	1971	4.43	4.43	4.32	4.32	4.43	4.32	4.38
	1972	4.37	4.37	4.15	4.15	4.37	4.15	4.26
	1973	4.13	4.13	3.98	3.98	4.13	3.98	4.06
	1974							
	1975							
	1976							
	1977							
Crack Spacing (Feet) 20 Foot Section	1968	8.0	6.1	5.6	8.0	7.2	8.8	7.3
	1969	8.0	4.1	5.6	8.0	4.8	8.8	6.6
	1970	8.0	4.1	5.6	8.0	4.8	8.8	6.6
	1971	8.0	4.1	5.6	5.3	3.6	8.8	5.9
	1972	8.0	4.1	5.6	5.3	3.6	8.8	5.9
	1973	5.3	4.1	5.6	5.3	3.6	8.8	5.4
	1974							
	1975							
	1976							
	1977							
Mays Ride Meter Roughness (In/Mile)	1968	39	39	41	41	39	41	40
	1969	40	40	40	40	40	40	40
	1970	40	40	40	40	40	40	40
	1971	-	-	-	-	-	-	-
	1972	66	66	72	72	66	72	69
	1973	59	59	67	67	59	67	63
	1974							
	1975							
	1976							
	1977							

LAYOUT OF PROJECT NUMBER 450-15-15



Continuously Reinforced Concrete Pavement
450-15-15
Kenner to N. O. I-10
William's Blvd. – Veteran's Hwy.

FIGURE 14

TABLE 7
SAND FILL MOISTURE - DENSITY DETERMINATIONS
JOFFRE ROAD - PARIS ROAD HIGHWAY
ROUTE I-10

	Hole No. 1		Hole No. 2	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
0 - 1	111.0	18.7	104.7	19.4
1 - 2	89.8	29.0	73.5	44.8
2 - 3	90.1	26.4	79.4***	40.6
3 - 4	83.4	36.8	59.9	60.9
4 - 5	87.2***	33.5	61.8	59.1
5 - 6	58.7	64.2	32.8	129.3
6 - 7	26.5	164.2	14.4	325.0
7 - 8	25.8	167.4	54.8	66.1
8 - 9	76.4	40.7	73.7	45.5
9 - 10	71.3	46.4	69.3	49.6
10 - 11	76.7	41.5	65.0	55.1
11 - 12	60.1	59.4	73.2	43.6
12 - 13	70.0	49.4	63.7	53.8
13 - 14	64.5	54.7	63.3	55.6
14 - 15	63.7	55.4	64.3	54.7
15 - 16	64.1	54.4	63.0	56.8
16 - 17	66.2	51.8	67.0	51.9
17 - 18	73.3	44.3	73.0	45.3

The above test sites were located along Route I-10 immediately west of Route La. 47 (Paris Road). More specifically:

Hole No. 1 - at the outside edge of the shoulder in the westbound roadway.

Hole No. 2 - at the outside edge of the shoulder in the eastbound roadway.

* Depths in feet.

** Dry weight density, pounds per cubic foot.

*** Lower limit of sand fill.

TABLE 8
SAND FILL MOISTURE - DENSITY DETERMINATIONS
LAKE PONTCHARTRAIN BRIDGE - SLIDELL HIGHWAY
ROUTE I-10

	Hole No. 1		Hole No. 2	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisutre
0 - 1	107.3	0.7	107.1	0.6
1 - 2	89.1	2.6	98.3	2.5
2 - 3	91.0	7.5	103.2	6.3
3 - 4	97.7	11.3	100.9	6.2
4 - 5	107.9	7.0	99.0	4.9
5 - 6	95.1	8.5	92.7	9.5
6 - 7	105.3	7.0	83.0	33.4
7 - 8	89.4	13.3	81.0	38.4
8 - 9	82.3	35.6	83.7	40.1
9 - 10	86.2	38.1	87.3	37.3
10 - 11	86.1	38.2	92.0	34.6
11 - 12	84.6	39.2	87.7	37.4
12 - 13	86.4	38.1	81.6	46.2
13 - 14	74.0	49.2	87.5	36.7
14 - 15	90.6	34.3	86.3	37.5
15 - 16	105.8	27.6	84.7	39.1
16 - 17	89.2	36.4	81.9	39.7
17 - 18	88.9	36.9	93.5	30.5

The above test sites were located immediately east of the Lake Pontchartrain Bridge near the Rigolets. More specifically:

Hole No. 1 - 0.1 log mile east of east end of Rigolets bridge at centerline of I-10 median.

Hole No. 2 - 0.2 log mile east of east end of Rigolets bridge at centerline of I-10 median.

* Depths in feet.

** Dry weight density, pounds per cubic foot.

TABLE 9
SAND FILL MOISTURE - DENSITY DETERMINATIONS
SLIDELL - MISSISSIPPI STATE LINE HIGHWAY
(WEST PEARL RIVER BRIDGE - PEARL RIVER BRIDGE)
ROUTE I-10

HOLE NO. 1

Depth*	D.W.D.**	Percent Moisture
0 - 1	103.7	1.5
1 - 2	90.7	7.4
2 - 3	93.5	9.9
3 - 4	96.9	10.1
4 - 5	102.6	9.8
5 - 6	103.8	6.6
6 - 7	99.1	13.4
7 - 8	87.3	34.4 ***
8 - 9	89.7	35.7
9 - 10	88.0	36.9
10 - 11	86.0	38.7
11 - 12	84.3	40.8
12 - 13	84.0	41.0
13 - 14	84.8	40.7
14 - 15	83.8	41.3
15 - 16	84.5	40.4
16 - 17	83.3	41.8
17 - 18	83.3	42.5

The above test site was located 0.2 log miles west of the west end of the Pearl River Bridge. The test hole was placed 24 feet right of the traveled centerline of the eastbound roadway (outside edge of the shoulder).

* Depths in feet.

** Dry weight density, pounds per cubic foot.

*** Apparent water table.

TABLE 10
SAND FILL MOISTURE - DENSITY DETERMINATIONS
TEXAS STATE LINE - TOOMEY HIGHWAY
ROUTE I-10

	Hole No. 1		Hole No. 2	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moistu
0 - 1	96.0	6.0	102.4	11.4
1 - 2	90.7	6.3	111.4	7.3
2 - 3	80.0	30.0	94.7	8.8
3 - 4	91.2	8.0	93.5	7.2
4 - 5	96.5	5.4	86.0	27.8
5 - 6	102.8	12.9	90.0	34.6
6 - 7	95.2	30.0	90.2	36.3
7 - 8	91.1	35.5	89.3	37.6
8 - 9	90.2	35.9	87.8	39.0
9 - 10	90.6	36.3	88.2	38.7
10 - 11	90.4	36.0	85.2	41.7
11 - 12	89.4	37.2	90.4	36.0
12 - 13	91.3	36.3	81.1	40.4
13 - 14	83.4	39.2	44.5	99.0
14 - 15	69.4	46.9	42.9	100.9
15 - 16	72.0	56.5	30.6	148.3

Hole No. 1 - 355 feet east of east end of Sabine River bridge at 52 feet left of median centerline.

Hole No. 2 - 355 feet east of east end of Sabine River bridge at 55 feet right of median centerline.

* Depth are in feet.
** Dry weight density, pounds per cubic foot.

TABLE 11
SAND FILL MOISTURE - DENSITY DETERMINATIONS
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U.S. 90

	Hole No. 1		Hole No. 2		Hole No. 3	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
0 - 1	85.2	27.9	85.3	21.8	96.5	18.7
1 - 2	78.5	33.6	84.2	12.6	85.4	30.3
2 - 3	92.6	32.1	84.5	14.3	92.5	31.9
3 - 4	94.4	31.1	88.9	28.3	94.9	30.9
4 - 5	91.0	29.1	93.4	31.3	94.6	31.1
5 - 6	90.2	29.7	95.5	30.3	92.6	29.4
6 - 7	88.9	29.7	95.5	30.3	93.8	30.6
7 - 8	88.9	32.7	94.9	30.8	94.3	31.5
8 - 9	89.2	33.4	94.9	30.8	93.8	32.0
9 - 10	46.4	86.6	94.5	31.0	90.5	33.4
10 - 11	69.5	50.8	93.6	31.6	89.3	34.4
11 - 12	74.6	39.7	93.4	31.9	86.6	36.3
12 - 13	73.4	40.3	93.5	31.8	54.8	59.1
13 - 14	71.1	42.8	92.6	32.4	75.3	48.1
14 - 15	84.3	36.8	90.6	33.7	86.4	35.4
15 - 16	84.5	36.1	77.3	38.3	91.9	31.4
16 - 17	83.7	32.6	71.8	41.4	83.9	37.1
17 - 18	78.3	36.0	85.1	35.7	69.9	51.6

The above test sites were located 0.3 log mile north of an abandoned police sub-station between Raceland and Des Allemands. More specifically:

Hole No. 1 - at 24 feet right of traveled centerline of southbound roadway, on outside edge of the shell shoulder.

Hole No. 2 - at centerline of median.

Hole No. 3 - at 23 feet right of traveled centerline of northbound roadway, on outside edge of the shell shoulder.

* Depths in feet are with respect to the existing ground surface.

** Dry weight density, pounds per cubic foot.

TABLE 12
SAND FILL MOISTURE - DENSITY DETERMINATIONS
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U.S. 90

Hole No. 4

Depth*	D.W.D.**	Percent Moisture
0 - 1	94.9	16.1
1 - 2	87.3	6.8
2 - 3	82.9	13.6
3 - 4	88.2	21.2
4 - 5	94.5	25.9
5 - 6	97.1	22.9
6 - 7	97.8	23.8
7 - 8	94.7	25.7
8 - 9	93.6	31.0
9 - 10	91.3	29.7
10 - 11	89.9	32.0
11 - 12	92.9	32.3
12 - 13	89.9	34.7
13 - 14	92.2	32.3
14 - 15	89.6	35.5
15 - 16	70.4	49.6
16 - 17	74.4	45.2
17 - 18	85.4	34.7

The above test site was located 1.2 log miles south of an abandoned police sub-station between Raceland and Des Allemands. The test hole was at the centerline of the median. The paved surface was level in this area.

* Depths in feet are with respect to the ground surface.

** Dry weight density, pounds per cubic foot.

TABLE 13
SAND FILL MOISTURE - DENSITY DETERMINATIONS
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U.S. 90

	Hole No. 5		Hole No. 6	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
0 - 1	88.4	19.9	93.5	21.7
1 - 2	85.9	14.7	85.6	15.7
2 - 3	89.1	24.8	97.1	20.9
3 - 4	93.0	26.3	96.7	22.5
4 - 5	95.1	23.9	95.7	23.8
5 - 6	96.4	23.4	94.8	25.5
6 - 7	95.2	26.1	93.0	26.2
7 - 8	96.6	21.9	90.7	27.3
8 - 9	96.1	22.6	91.0	27.5
9 - 10	93.0	24.7	91.6	29.4
10 - 11	93.6	24.9	94.0	31.6
11 - 12	91.5	26.8	89.6	34.3
12 - 13	90.3	27.9	87.7	34.6
13 - 14	87.6	29.9	62.0	63.7
14 - 15	84.7	32.0	58.5	65.0
15 - 16	83.7	38.0	50.8	78.2
16 - 17	28.8	158.3	40.1	104.4
17 - 18	26.0	173.1	46.0	88.7

The above test sites were located 2.6 log miles south of an abandoned police sub-station between Raceland and Des Allemands. More specifically:

Hole No. 5 - at centerline of the median (adjacent paved surface was level).

Hole No. 6 - at centerline of the median, 305 feet south of Hole No. 5 (situated on a rise extending across the roadway).

* Depths in feet are with respect to the ground surface.

** Dry weight density, pounds per cubic foot.

TABLE 14
SAND FILL MOISTURE - DENSITY DETERMINATIONS
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U.S. 90

	Hole No. 7		Hole No. 8	
Depth*	D.W.D.**	Percent Moisture	D.W.D.**	Percent Moisture
0 - 1	109.9	15.7	88.0	13.1
1 - 2	92.5	28.3	71.4	26.1
2 - 3	91.1	26.2	76.6	32.9
3 - 4	92.5	27.1	92.7	29.0
4 - 5	92.9	26.8	95.1	23.7
5 - 6	92.6	26.7	96.4	24.1
6 - 7	89.2	29.5	94.3	26.2
7 - 8	88.5	30.8	94.1	25.8
8 - 9	89.8	33.9	95.0	24.9
9 - 10	90.9	32.9	91.2	27.6
10 - 11	93.6	31.9	89.0	29.8
11 - 12	93.6	31.6	89.2	30.8
12 - 13	82.2	36.7	88.1	31.4
13 - 14	26.1	117.6	88.5	31.9
14 - 15	48.6	71.2	89.4	31.4
15 - 16	70.4	47.6	91.2	32.8
16 - 17	63.1	57.9	94.1	31.6
17 - 18	62.9	57.9	89.5	32.6

The above test sites were located 3.4 log miles south of an abandoned police sub-station between Raceland and Des Allemands. More specifically:

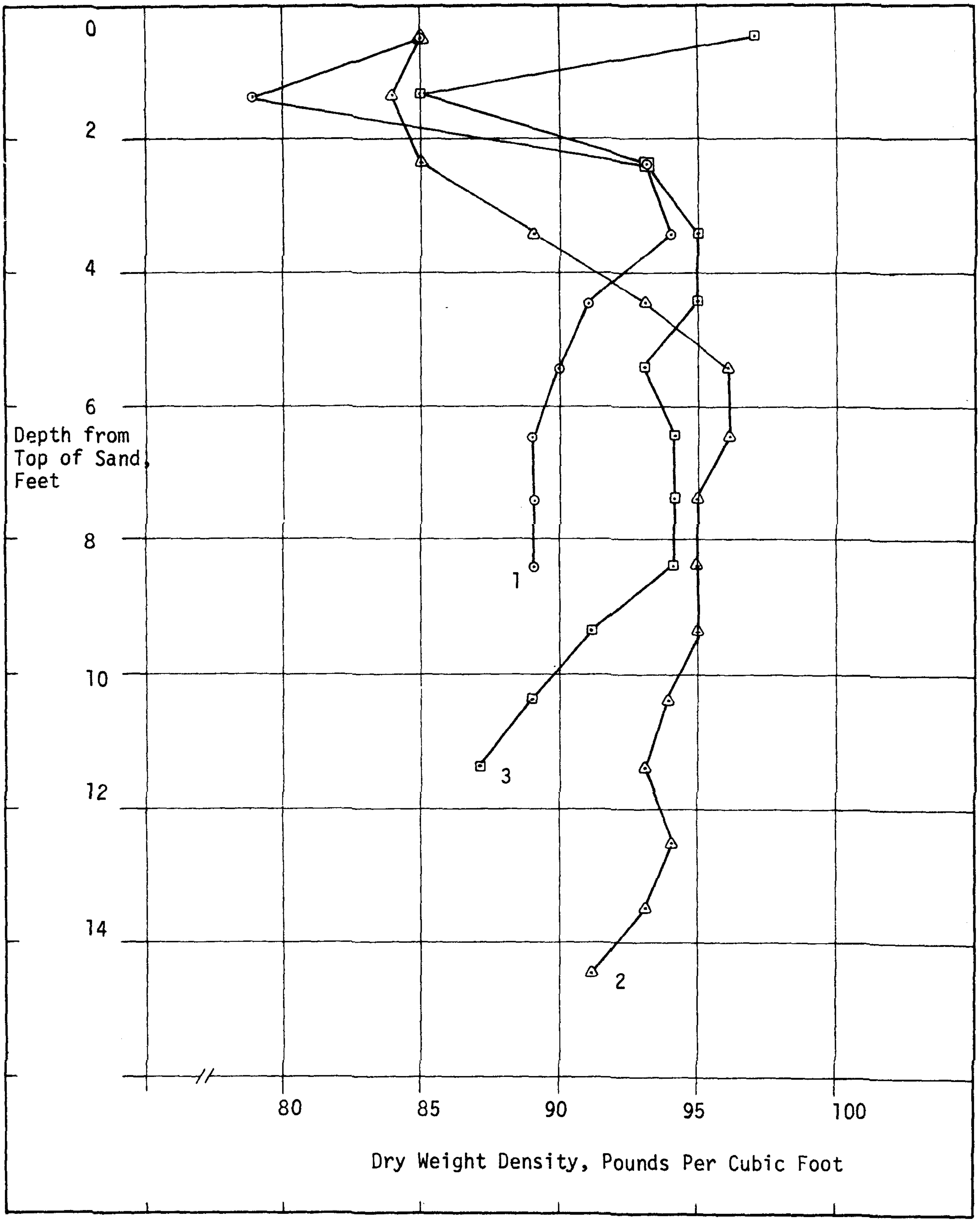
Hole No. 7 - at 23 feet right of the traveled centerline of the southbound roadway, on the outside edge of the shell shoulder.

Hole No. 8 - at the centerline of the median.

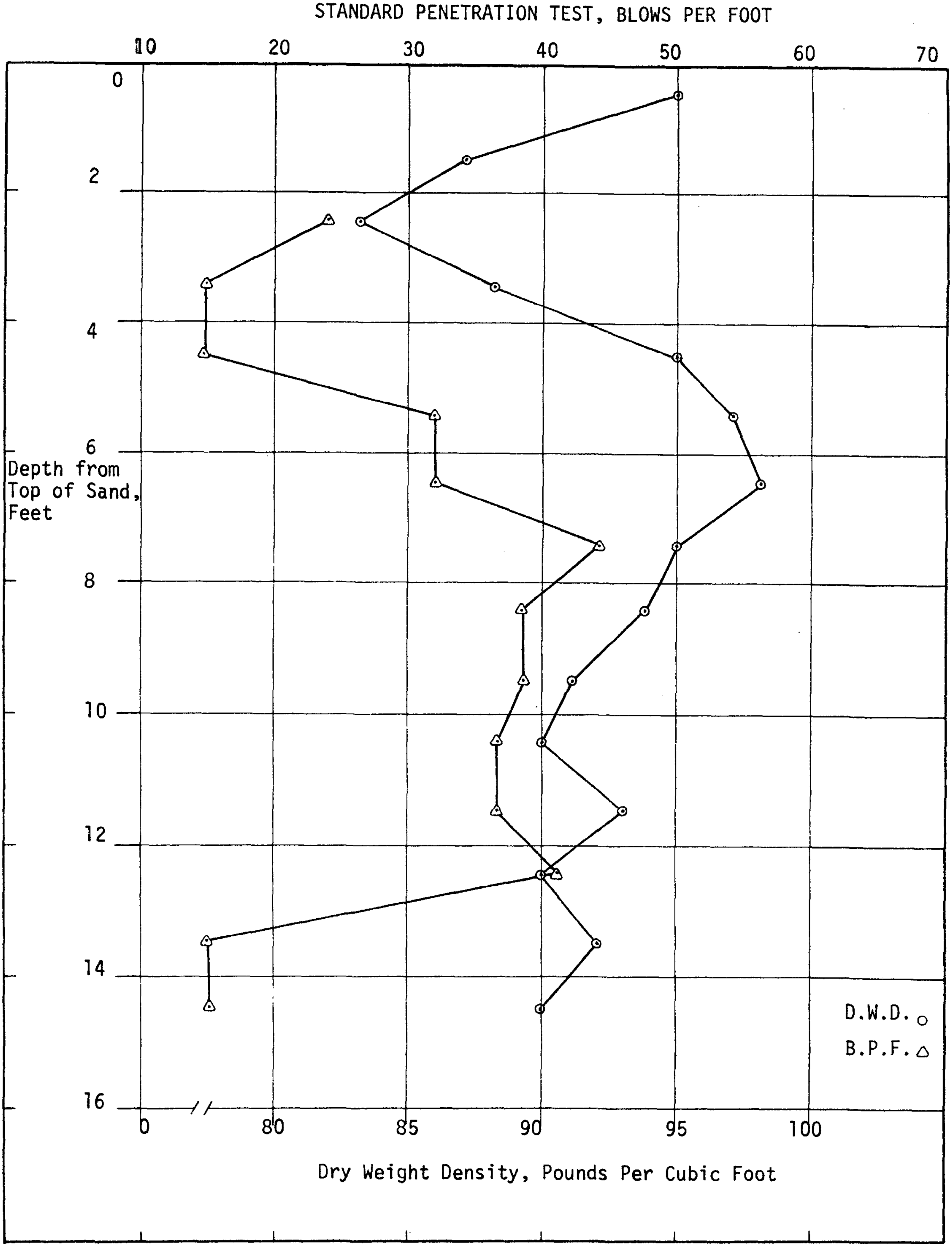
A depression extended across these test sites.

* Depths in feet are with respect to the ground surface.

** Dry weight density, pounds per cubic foot.

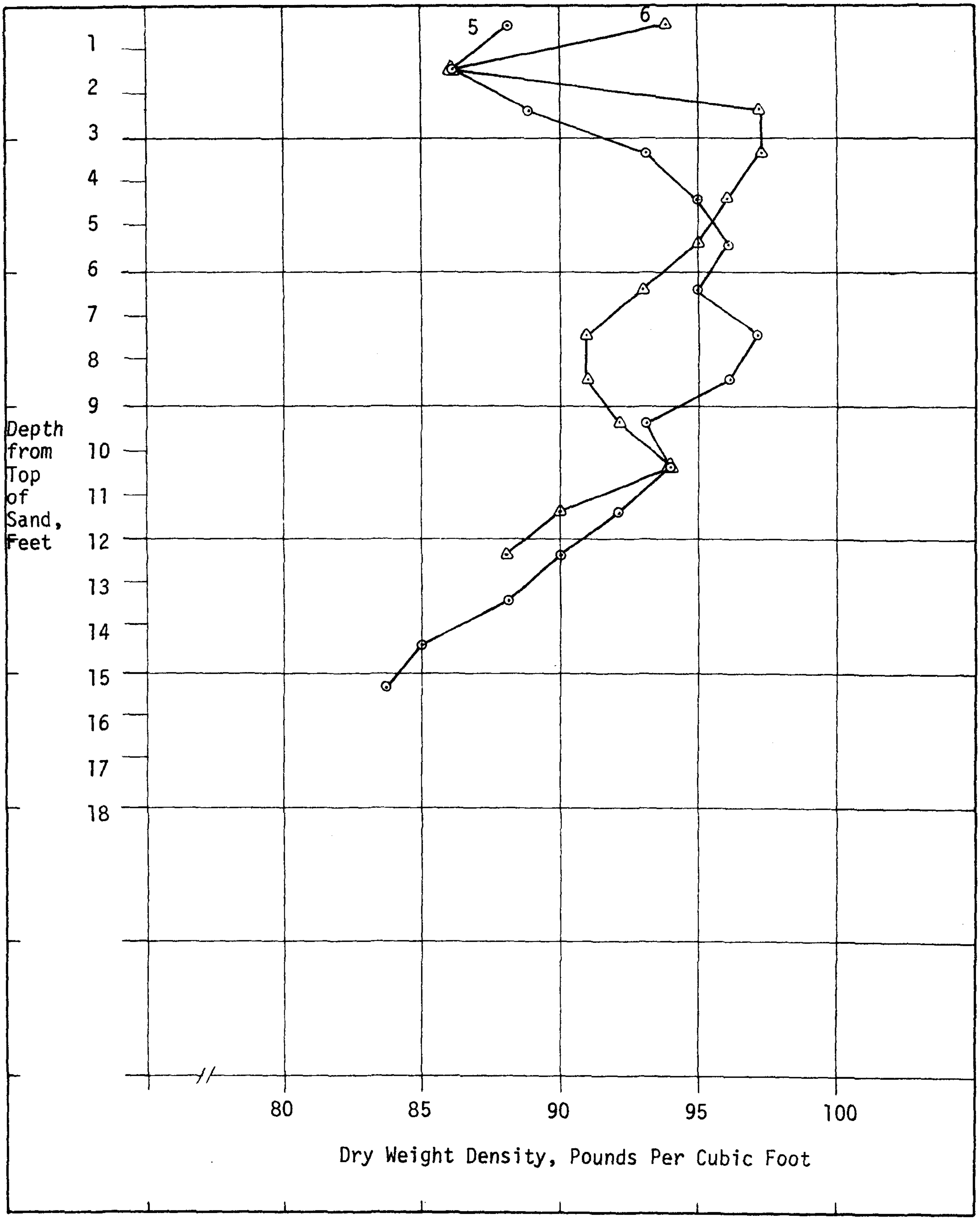


Density Values Versus Depth of Sand Fill
Route U. S. 90 Raceland - Des Allemands Highway
Holes No. 1, 2 and 3
FIGURE 15



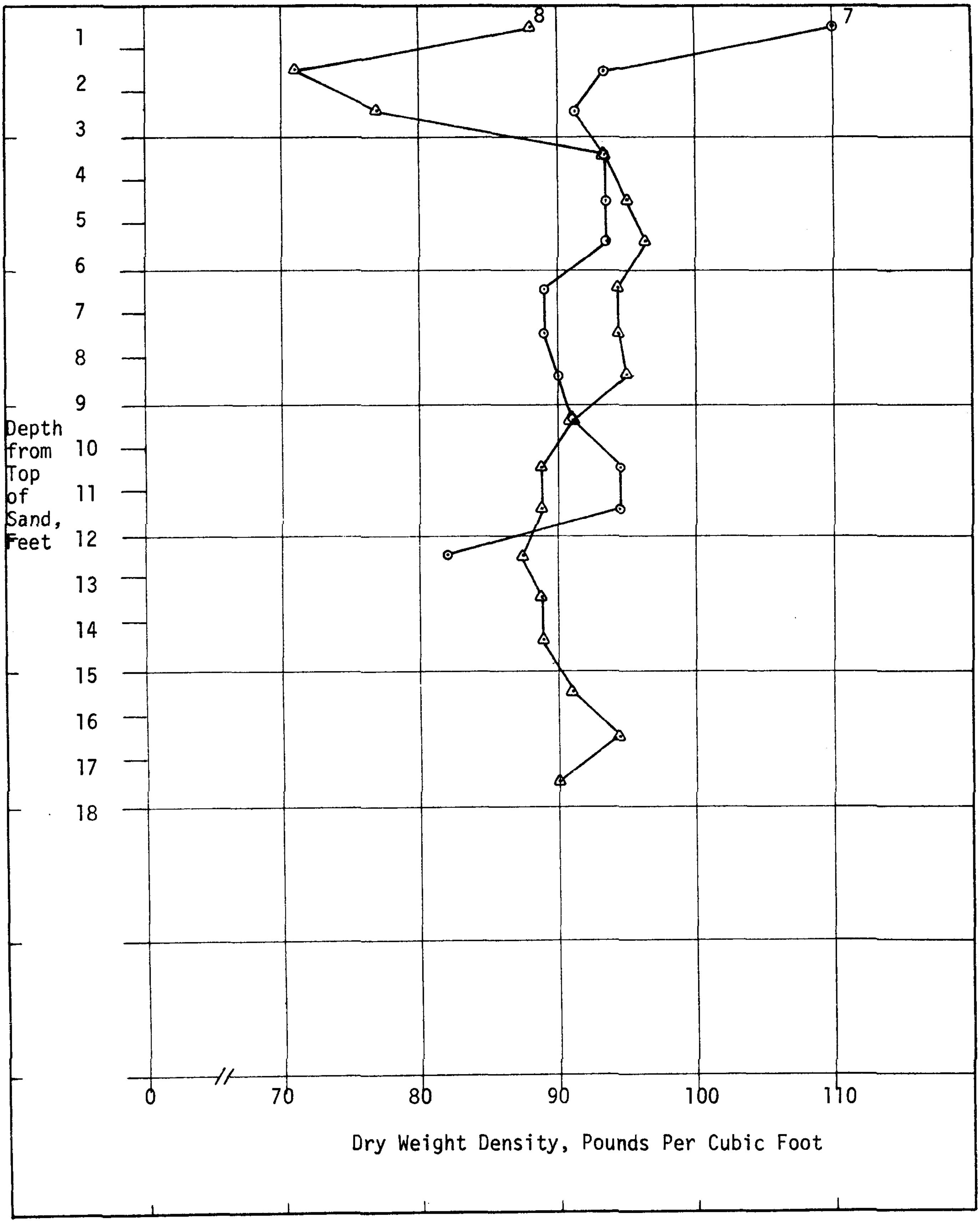
Density and Standard Penetration Values Versus Depth of Sand Fill
Route U. S. 90 Raceland - Des Allemands Highway
Hole No. 4

FIGURE 16

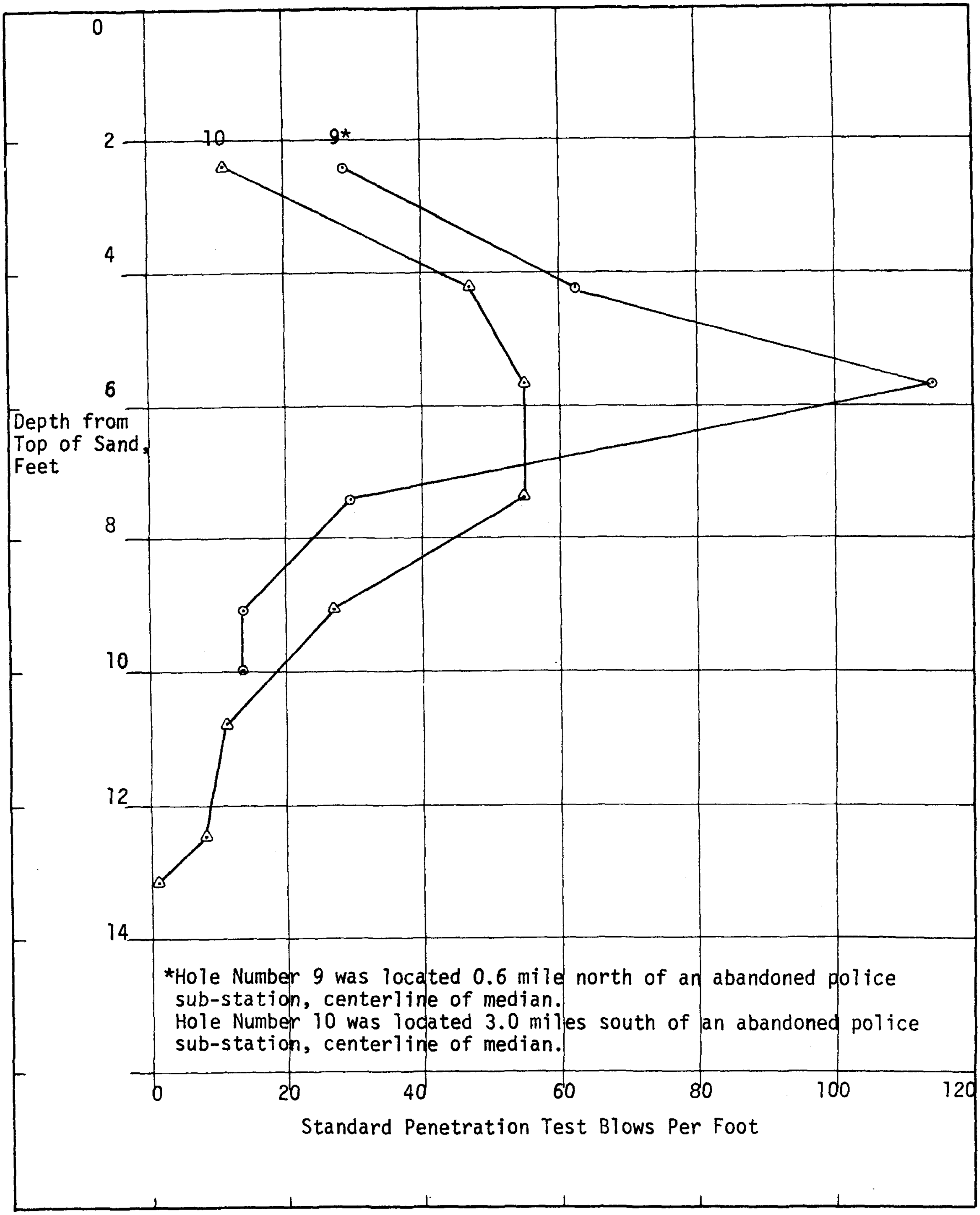


Density Values Versus Depth of Sand Fill
Route U. S. 90 Raceland - Des Allemands Highway
Holes No. 5 and 6

FIGURE 17



Density Values Versus Depth of Sand Fill
Route U. S. 90 Raceland - Des Allemands Highway
Holes No. 7 and 8
FIGURE 18



Standard Penetration Values Versus Depth of Sand Fill
Route U. S. 90 Raceland - Des Allemands Highway
Holes No. 9 and 10
FIGURE 19

MUCK AND SOIL INVESTIGATION CROSS-SECTION
STATION 37+65
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U. S. 90

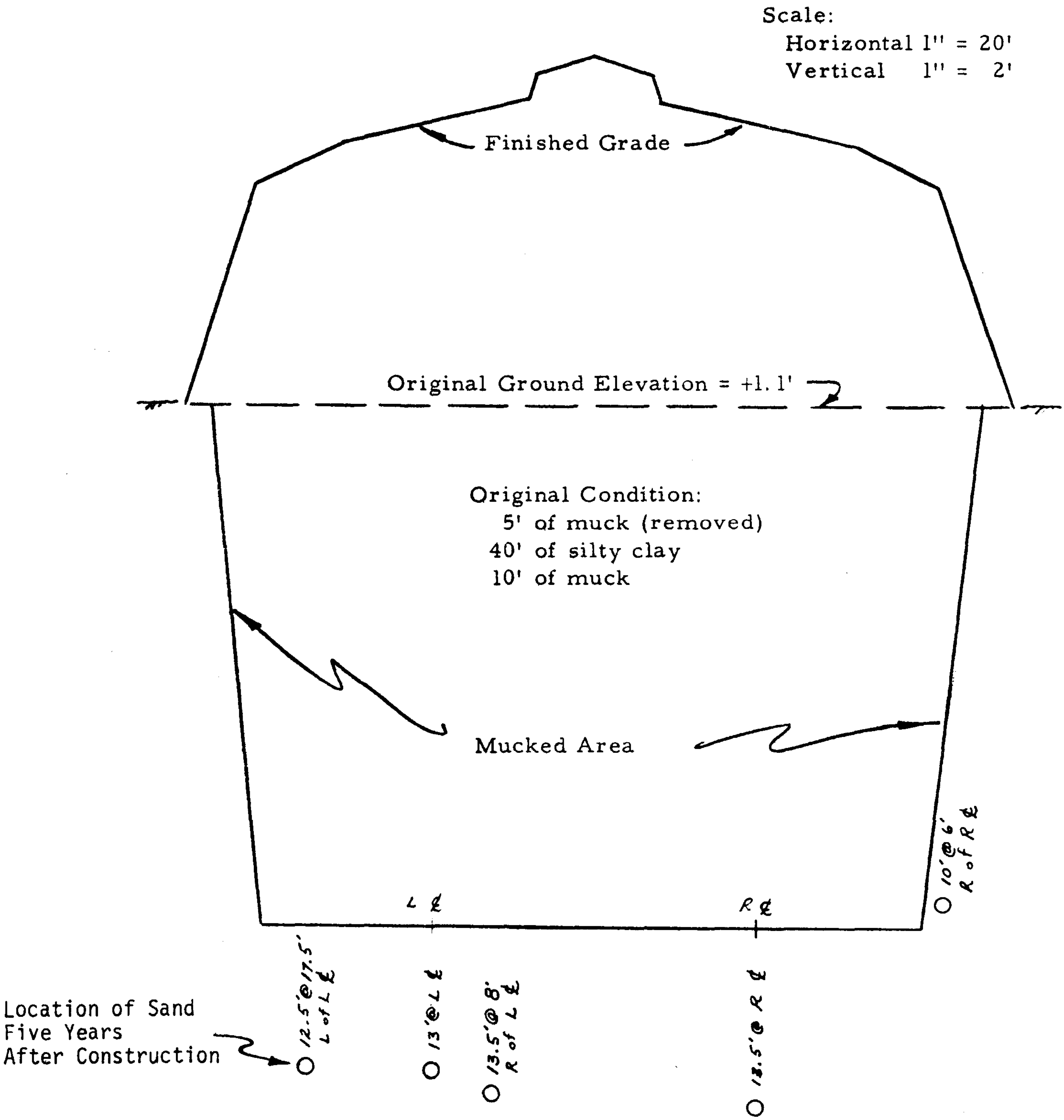


FIGURE 20

MUCK AND SOIL INVESTIGATION CROSS-SECTION
STATION 119+90
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U. S. 90

Scale:
Horizontal 1" = 20'
Vertical 1" = 2'

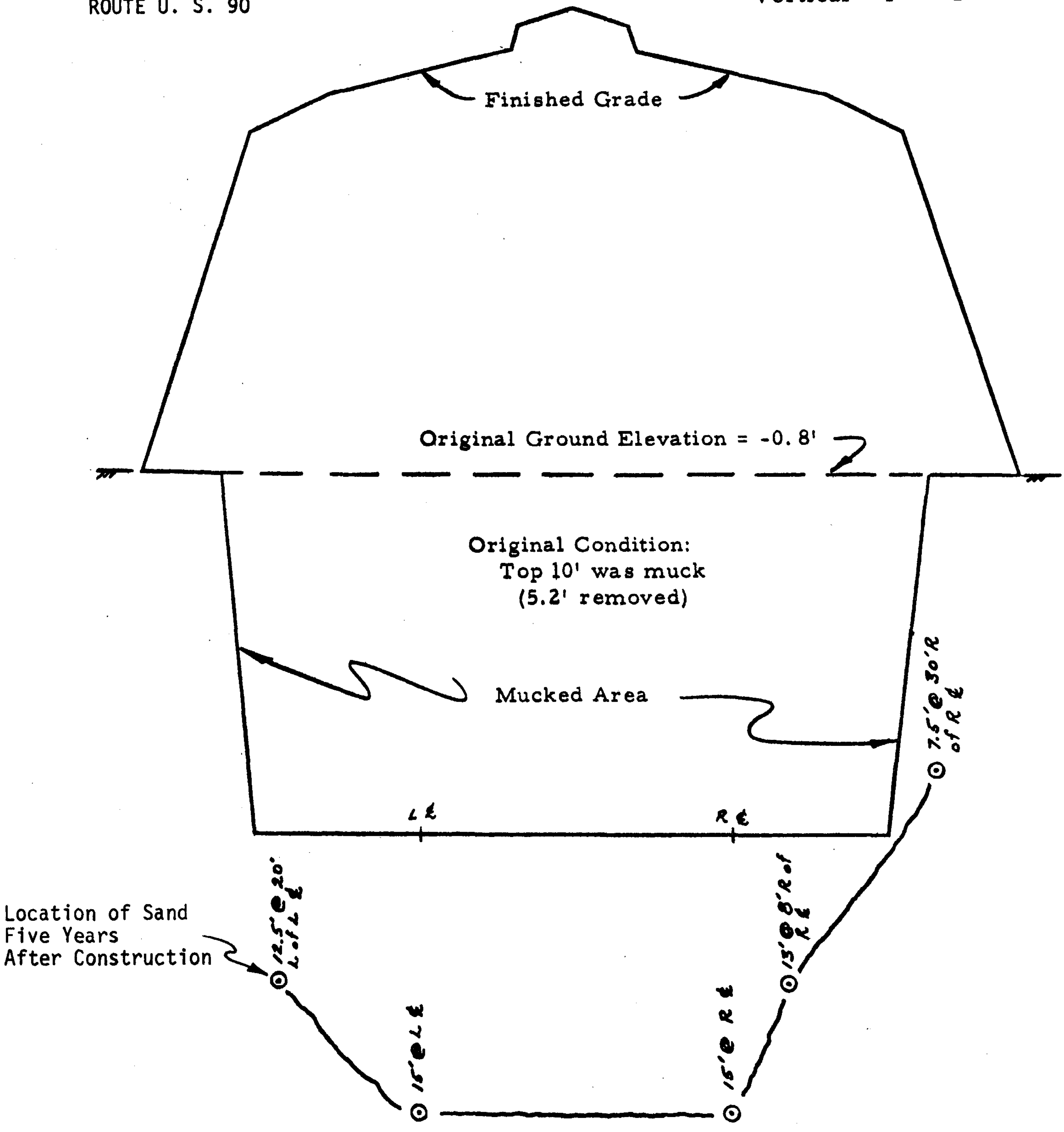


FIGURE 21

MUCK AND SOIL INVESTIGATION CROSS-SECTION
STATION 256+18
RACELAND - DES ALLEMANDS HIGHWAY
ROUTE U. S. 90

Scale:
Horizontal 1" = 20'
Vertical 1" = 2'

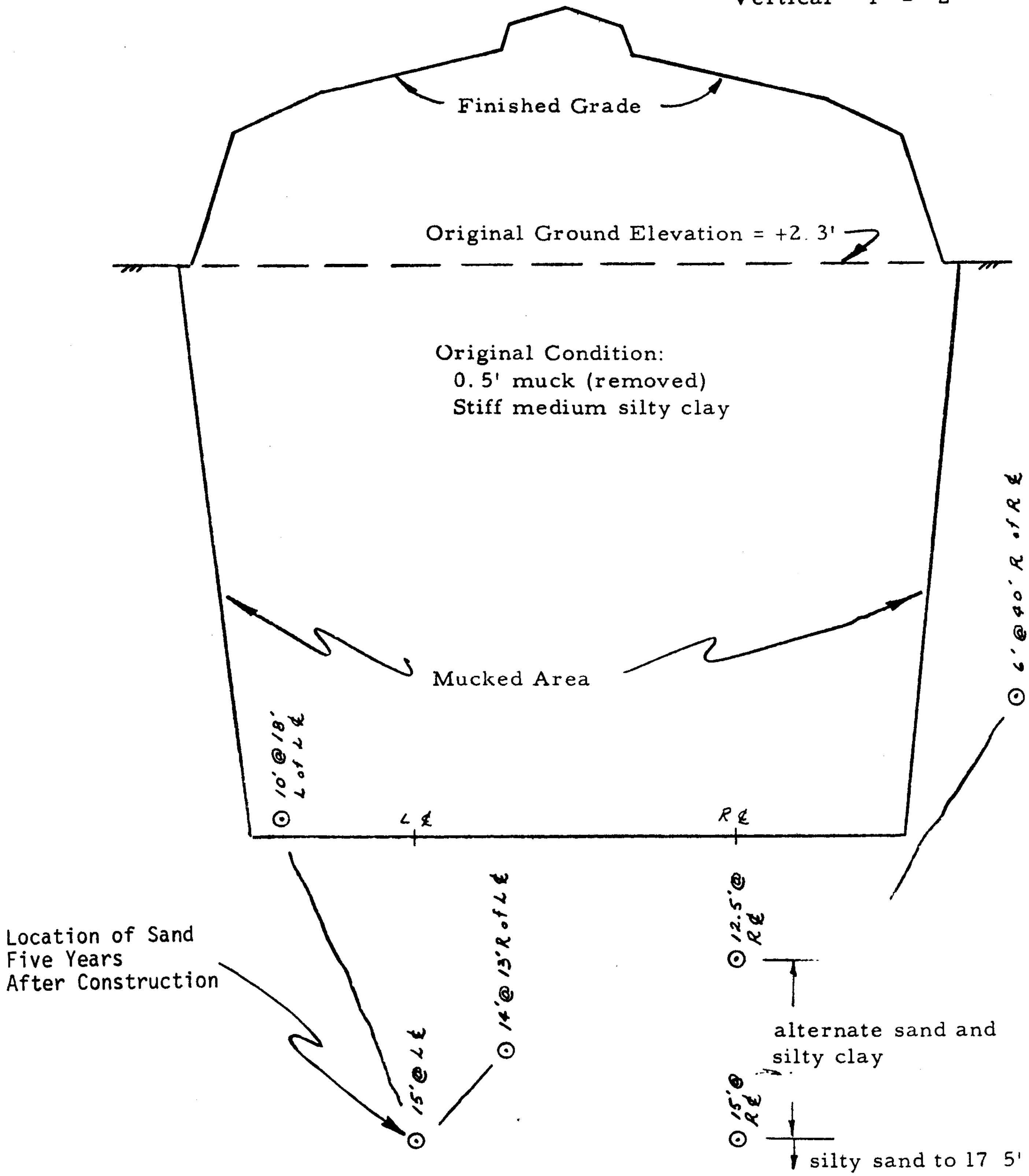


FIGURE 22