I N T E R O F F I C E M E M O R A N D U M

Date: 10-Nov-1994 02:09pm CST
From: Marvin Krout
KROUT_M
Dept: Planning
Tel No: 268-4425

TO: See Below

Subject: RE: Cowskin Fill, Mik

I'll be there at 9 on Monday. But MAPD staff is recommending denial of the use exception for the auto use, and I understand that there was substantial opposition at last night's CPO hearing, and the CPO has recommended denial. And I'm not sure how much Doug would let the BZA tack onto an approval, if they are inclined to vote approval....

Distribution:

TO:	Kurt Schroeder	(SCHROEDER_K)
CC:	Steve Lackey	(LACKEY_S)
CC:	Mike Lindebak	(LINDEBAK_M)
CC:	Suzanne Loomis	(LOOMIS_S)
CC:	Douglas J. Moshier	(MOSHIER_D)
CC:	Jim Cranford	(PAPER MAIL)
CC:	Paul Steinbrenner	(STEINBRENNER)

I N T E R O F F I C E M E M O R A N D U M

Date: 10-Nov-1994 01:06pm CST
From: Kurt Schroeder
SCHROEDER_K
Dept: OCI
Tel No: 268-4481

TO: See Below

Subject: Cowskin Fill, Mik

I've scheduled the OCI large conference room for 9:00 on Monday, 11/14 for us all to meet and discuss the floodplain fill issue for the site at the Cowskin Creek north of Kellogg.

Let me know as soon as possible if you cannot attend. Marvin, we need for you to be there, so we will try to work around your schedule as much as possible.

Marvin, the rest of us met today with Mitch Mitchell who is representing Gene Miles in trying to obtain approval from DRW and the City to keep the illegally-placed fill in this area and to continue to add fill up to or above the BFE. He provided information relative to his survey of the floodway boundary, as well as information on the type of fill that has been placed on the parcel of land known as part of Lot 2, Block 1, Miles Lakewood Village, Tracts 1 and 2. He also presented an soils engineer's report (based on the excavation and analysis of seven pits on Tracts 1 and 2) on the type of fill placed in this area.

Based on the soils testing, he also provided a draft "Land Use Restriction" that could be recorded with the land which placed restrictions on development and construction on areas which had inappropriate fill.

After Mitch left, concerns were raised as to how effective a recorded instrument such as he proposed would practically control and assure that unauthorized development occurred on this inappropriate fill in the future. A concern was also raised about possible future removal of some of this fill at the City's expense for Kellogg and/or other City Street projects in this area. The possibility of requiring repatting of this area to add the restrictions to address the above concerns was discussed.

Mitch has made application to State DWR for a permit to fill the floodplain fringe in these areas, and the comment period expires on 11/24. We intend to make a comment to DRW.

There is, as you know, a BZA request pending (BZA 35-94, with BZA hearing scheduled for 11/22) for Davis/Moore car dealership on this property. We thought that the BZA may be an opportune time

to also discuss these issues, obtain restrictions, replat, etc.

Marvin, we need to make sure you are at our meeting, so let me know if you cannot attend..

Thanks.

Distribution:

TO:	Marvin Krout	(KROUT_M)
TO:	Steve Lackey	(LACKEY_S)
TO:	Mike Lindebak	(LINDEBAK_M)
TO:	Suzanne Loomis	(LOOMIS_S)
TO:	Douglas J. Moshier	(MOSHIER_D)
TO:	Jim Cranford	(PAPER MAIL)
CC:	Paul Steinbrenner	(STEINBRENNER)

THE CITY OF WICHITA

December 22, 1994

DEPARTMENT OF
PUBLIC WORKS
STORM WATER MANAGEMENT DIVISION
CITY HALL — EIGHTH FLOOR
455 NORTH MAIN STREET
WICHITA, KANSAS 67202
(316) 268-4498

Mr. Steve Herman
Allied Laboratories
305 S. Washington
Wichita, KS 67202

Re: Miles Lakewood Village 2nd Addition Levee

Dear Mr. Herman:

After speaking with Mr. Mike Berry today, he suggested I contact you regarding the referenced subject. I am in need of an estimate for services to perform some soil analysis on the levee bordering the referenced addition, west of Seville St., north of US-54, and east of Cowskin Creek (see attachment A).

This levee system is currently unrecognized by FEMA as protection for the 100 year flood. Since this levee system was constructed when this area was in the County, outside the City corporate limits, we do not know if this system will meet FEMA's standards. In order to determine the actual structural integrity of the levee, we need the appropriate tests performed according to the FEMA requirements seen on the attached 44 CFR Sect. 65.10. Once we receive these results, if favorable, we will attempt to gain FEMA's acceptance of the levee system.

Please examine the requirements on attachment B and provide me with a detailed list of your estimated cost of services to perform the tests needed to meet those requirements.

I would appreciate it if you could send me your estimate by January 6, 1995. If you have any questions, please feel free to call me at 316-268-4498.

Sincerely,

Suzanne C. S. Loomis

Suzanne C. S. Loomis
Acting Storm Water Engineer

attachments

cc: Mike Berry, PEC

§ 65.9 Review and response by the Administrator.

If any questions or problems arise during review, FEMA will consult the Chief Executive Officer of the community (CEO), the community official designated by the CEO, and/or the requester for resolution. Upon receipt of a revision request, the Administrator shall mail an acknowledgment of receipt of such request to the CEO. Within 90 days of receiving the request with all necessary information, the Administrator shall notify the CEO of one or more of the following:

(a) The effective map(s) shall not be modified;

(b) The base flood elevations on the effective FIRM shall be modified and new base flood elevations shall be established under the provisions of Part 67 of this subchapter;

(c) The changes requested are approved and the map(s) amended by Letter of Map Revision (LOMR);

(d) The changes requested are approved and a revised map(s) will be printed and distributed;

(e) The changes requested are not of such a significant nature as to warrant a reissuance or revision of the flood insurance study or maps and will be deferred until such time as a significant change occurs;

(f) An additional 90 days is required to evaluate the scientific or technical data submitted; or

(g) Additional data are required to support the revision request.

[51 FR 30315, Aug. 25, 1986]

§ 65.10 Mapping of areas protected by levee systems.

(a) *General.* For purposes of the NFIP, FEMA will only recognize in its flood hazard and risk mapping effort those levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with the level of protection sought through the comprehensive flood plain management criteria established by § 60.3 of this subchapter. Accordingly, this section describes the types of information FEMA needs to recognize, on NFIP maps, that a levee system provides protection from the base flood. This information must be supplied to FEMA by the community or other party seeking recognition of such a levee system at the time a flood risk study or restudy is conducted, when a map revision under the provisions of Part 65 of this subchapter is sought based on a levee system, and upon request by the Administrator during the review of previously recognized structures. The FEMA review will be for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and shall not constitute a determination by FEMA as to how a structure or system will perform in a flood event.

(b) *Design criteria.* For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided. The following requirements must be met:

(1) *Freeboard.* (i) Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.

(ii) Occasionally, exceptions to the minimum riverine freeboard requirement described in paragraph (b)(1)(i) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood elevation profile and include, but not necessarily be limited to an assessment of statistical confidence limits of the 100-year discharge; changes in stage-discharge relationships; and the sources, potential, and magnitude of debris, sediment, and ice accumulation. It must be also shown that the levee will remain structurally stable during the base flood when

ATTACHMENT B

such additional loading considerations are imposed. Under no circumstances will freeboard of less than two feet be accepted.

(iii) For coastal levees, the freeboard must be established at one foot above the height of the one percent wave or the maximum wave runup (whichever is greater) associated with the 100-year stillwater surge elevation at the site.

(iv) Occasionally, exceptions to the minimum coastal levee freeboard requirement described in paragraph (b)(1)(iii) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood loading conditions. Particular emphasis must be placed on the effects of wave attack and overtopping on the stability of the levee. Under no circumstances, however, will a freeboard of less than two feet above the 100-year stillwater surge elevation be accepted.

(2) *Closures.* All openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.

(3) *Embankment protection.* Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability. The factors to be addressed in such analyses include, but are not limited to: Expected flow velocities (especially in constricted areas); expected wind and wave action; ice loading; impact of debris; slope protection techniques; duration of flooding at various stages and velocities; embankment and foundation materials; levee alignment, bends, and transitions; and levee side slopes.

(4) *Embankment and foundation stability.* Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the U.S. Army Corps of Engineers (COE) manual, "Design and Construction of Levees" (EM 1110-2-1913, Chapter 6, Section II), may be used. The factors that shall be addressed in the analyses include: Depth of flooding, duration of flooding, embankment geometry and length of seepage path at critical locations, embankment and foundation materials, embankment compaction, penetrations, other design factors affecting seepage (such as drainage layers), and other design factors affecting embankment and foundation stability (such as berms).

(5) *Settlement.* Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum standards set forth in paragraph (b)(1) of this section. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in the COE manual, "Soil Mechanics Design—Settlement Analysis" (EM 1100-2-1904) must be submitted.

(6) *Interior drainage.* An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.

(7) *Other design criteria.* In unique situations, such as those where the

levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, sound engineering practice will be the standard on which FEMA will base its determinations. FEMA will also provide the rationale for requiring this additional information.

(c) *Operation plans and criteria.* For a levee system to be recognized, the operational criteria must be as described below. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP.

(1) *Closures.* Operation plans for closures must include the following:

(i) Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.

(ii) A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

(iii) Provisions for periodic operation, at not less than one-year intervals, of the closure structure for testing and training purposes.

(2) *Interior drainage systems.* Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan:

(i) Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system.

(ii) A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

(iii) Provision for manual backup for the activation of automatic systems.

(iv) Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than one year shall elapse between either the inspections or the operations.

(3) *Other operation plans and criteria.* Other operating plans and criteria may be required by FEMA to ensure that adequate protection is provided in specific situations. In such cases, sound emergency management practice will be the standard upon which FEMA determinations will be based.

(d) *Maintenance plans and criteria.* For levee systems to be recognized as providing protection from the base flood, the maintenance criteria must be as described herein. Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner. All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

(e) *Certification requirements.* Data submitted to support that a given levee system complies with the structural requirements set forth in paragraphs (b)(1) through (7) of this section must be certified by a registered professional engineer. Also, certified as-built plans of the levee must be submitted. Certifications are subject to the definition given at § 65.2 of this subchapter. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood.

[51 FR 30316, Aug. 25, 1986]

§ 65.11 Evaluation of sand dunes in mapping coastal flood hazard areas.

(a) *General conditions.* For purposes of the NFIP, FEMA will consider storm-induced dune erosion potential in its determination of coastal flood hazards and risk mapping efforts. The criterion to be used in the evaluation of dune erosion will apply to primary frontal dunes as defined in § 59.1, but does not apply to artificially designed and constructed dunes that are not well-established with long-standing vegetative cover, such as the placement of sand materials in a dune-like formation.

(b) *Evaluation criterion.* Primary frontal dunes will not be considered as effective barriers to base flood storm surges and associated wave action where the cross-sectional area of the primary frontal dune, as measured perpendicular to the shoreline and above the 100-year stillwater flood elevation and seaward of the dune crest, is equal to, or less than, 540 square feet.

(c) *Exceptions.* Exceptions to the evaluation criterion may be granted where it can be demonstrated through authoritative historical documentation that the primary frontal dunes at a specific site withstood previous base flood storm surges and associated wave action.

[53 FR 16279, May 6, 1988]

§ 65.12 Revision of flood insurance rate maps to reflect base flood elevations caused by proposed encroachments.

(a) When a community proposes to permit encroachments upon the flood plain when a regulatory floodway has not been adopted or to permit encroachments upon an adopted regulatory floodway which will cause base flood elevation increases in excess of those permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter, the community shall apply to the Administrator for conditional approval of such action prior to permitting the encroachments to occur and shall submit the following as part of its application:

(1) A request for conditional approval of map change and the appropriate initial fee as specified by § 72.3 of this subchapter or a request for exemption from fees as specified by § 72.5 of this subchapter, whichever is appropriate;

(2) An evaluation of alternatives which would not result in a base flood elevation increase above that permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter demonstrating why these alternatives are not feasible;

(3) Documentation of individual legal notice to all impacted property owners within and outside of the community, explaining the impact of the proposed action on their property.

(4) Concurrence of the Chief Executive Officer of any other communities impacted by the proposed actions;

(5) Certification that no structures are located in areas which would be impacted by the increased base flood elevation;

(6) A request for revision of base flood elevation determination according to the provisions of § 65.6 of this part;

(7) A request for floodway revision in accordance with the provisions of § 65.7 of this part;

(b) Upon receipt of the Administrator's conditional approval of map change and prior to approving the proposed encroachments, a community shall provide evidence to the Administrator of the adoption of flood plain management ordinances incorporating the increased base flood elevations

A 8

CITY OF WICHITA

RECEIVED
OCT 16 1995

DEPARTMENT OF
PUBLIC WORKS
STORM WATER MANAGEMENT DIVISION
CITY HALL — EIGHTH FLOOR
455 NORTH MAIN STREET
WICHITA, KANSAS 67202
(316) 268-4498

October 3, 1995

FEMA
REGION VII

Mr. Albert Schultz
FEMA, Region VII
911 Walnut Street, Room #200
Kansas City, MO 64106

Re: Miles Lakewood Village Addition Levee

Dear Al,

Enclosed you will find a geotechnical study performed on the referenced levee located north of US54 Highway just west of Cowskin Creek in Wichita, Kansas.

This study was performed to evaluate the compaction of the existing levee fill. The average apparent compaction for the eight different borings done on the levee was determined to be 99.13%. Therefore, the levee meets the compaction requirement set forth by FEMA.

Due to the facts stated above, the City would like to have the homes within Miles Lakewood Village Addition considered out of the FEMA 100 year flood plain. The changes to the FEMA FIRM panel 200328-0020-B should be considered when new maps are submitted upon completion of our on-going remapping of the Cowskin Creek.

If you recall, City staff and our consultant, Professional Engineering Consultants, met with you and Black & Veatch engineers to discuss the remapping project in your office on December 9, 1994. At that time, you stated approved compaction data would be needed in order for the levee to be recognized by FEMA and the homes to be taken out of the 100 year flood plain due to the levee protection.

Please review this information and comment regarding its use in the remapping project. If you have any questions, please do not hesitate to call me at 316-268-4498.

Sincerely,

Suzanne C. S. Loomis

Suzanne C. S. Loomis
Acting Storm Water Engineer

SCSL/bn

enclosure

cc: Ron Pletcher, Professional Engineering Consultants
Mike Berry, Professional Engineering Consultants
Steve Herman, Allied Laboratories
Chris Breitenstein, City of Wichita, Civil Engineer

GEOTECHNICAL REPORT

ALLIED
LABORATORIES
A DEPARTMENT OF PROFESSIONAL
ENGINEERING CONSULTANTS, P.A.

MILES LAKEWOOD VILLAGE

2ND ADDITION LEVEE

WICHITA, KANSAS

PREPARED FOR

CITY OF WICHITA

JULY 1995

ALLIED LABORATORIES PROJECT NO: 72-95398-42

ALLIED LABORATORIES
(316) 262-6457 • 350 S. Washington • Wichita, Kansas 67202

GEOTECHNICAL REPORT

MILES LAKEWOOD VILLAGE

2ND ADDITION LEVEE

WICHITA, KANSAS

PREPARED FOR

CITY OF WICHITA

JULY 1995

ALLIED LABORATORIES PROJECT NO: 72-95398-42

TABLE OF CONTENTS

1. SCOPE OF STUDY

This report presents the results of a geotechnical study of the existing levee for the Miles Lakewood 2nd Addition, Wichita, Kansas. The study was conducted to explore the subsurface and existing levee conditions according to our proposal to the City of Wichita on January 12, 1995.

A field exploration program was conducted to obtain information on the subsurface conditions. Samples obtained during the field investigation were tested in the laboratory to determine physical and engineering characteristics of the in-situ soils. Field exploration and laboratory test results were analyzed to develop conclusions regarding fill types, levee consolidation and foundation settlement. Results of the field exploration, laboratory testing and our conclusions are presented herein.

2. EXISTING SITE CONDITIONS

The project site is located in the west portion of Wichita, Kansas as shown on Figure A-1. The existing levee is located near the Cowskin Creek. This levee was constructed in 1975. Approximately 2 feet of fill was added to the levee in 1986. The existing levee appeared to be stable with no evidence of slope erosion. The ground surface was grass covered.

Subsurface conditions in the existing levee consisted of lean clay and sandy lean clay fill. The natural soils below the fill consisted of lean clay, fat clay and sand. Free water was encountered in exploratory boring B-4 during drilling.

3. FIELD EXPLORATION

The field exploration was conducted on June 22, 1995. Eight (8) exploratory borings were drilled in the existing levee to explore subsurface conditions and obtain samples for laboratory testing. Exploratory borings were located referencing existing site features as shown on the Boring Location Plan, Figure A-2. Ground elevations at the boring locations were determined by a level survey referencing the benchmark, "Top Bolt of Fire Hydrant at 9832 Dubon Street, Elevation = 1000, assumed".

Exploratory borings were advanced through the overburden soils with a Mobile Drill B-31 drill rig utilizing 4-inch diameter continuous flight augers. The borings were logged in the field by a representative of Allied Laboratories based on visual procedures. All field and laboratory testing was performed under the direction of a Professional Engineer registered in the State of Kansas.

Undisturbed samples of the subsurface materials were obtained by hydraulically pushing 3 inch diameter seamless Shelby Tubes into the in-situ soils according to ASTM D-1587. Disturbed samples were obtained with a 2-inch O.D. splitspoon sampler. The sampler was driven into the various strata using a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler three successive six-inch increments is recorded. The total number of blows required to advance the sampler the second and third six 6-inch increments is the penetration resistance (N-Value). Penetration resistance values indicate the relative density of cohesionless soils and consistency of cohesive soils. Standard Penetration tests were performed in according to ASTM D-1586.

Measurements of the water levels were attempted in the borings shortly after completion of drilling and 24 hours after drilling in Boring B-4. All borings were backfilled with auger cuttings and tamped upon completion of drilling or water level measurements.

4. LABORATORY TESTING

Soil samples obtained during the field exploration were observed and visually classified according to ASTM D-2488 "Soil Classification for Engineering Purposes" which is based on the Unified Soil Classification System. Selected samples were tested to determine engineering and physical properties (ASTM D-2487). Tests performed included; Moisture Content, Dry Unit Weight, Liquid and Plastic Limits, One Dimensional Consolidation, and Moisture-Density Relationship. Laboratory test results are summarized on the attached figures and exploratory boring logs.

5. SUBSURFACE CONDITIONS

The subsurface profile encountered in the borings generally consisted of existing fill overlying clay and sand. Bedrock was not encountered. Brief descriptions of the soils encountered follow. The attached Boring Logs should be reviewed for actual subsurface conditions at each boring location.

5.1 EXISTING FILL

The existing fill in the levee varied from lean clay to lean clay with sand to sandy lean clay. Fill depths varied from 4 to 6 feet. The fill did not appear to contain debris or deleterious materials. This fill was visually characterized as moist to very moist with a firm consistency. Moisture contents of the fill varied from 12.0 to 23.6 percent with dry unit weights ranging from 98.7 to 119.1 pcf.

5.2 NATURAL SOILS

The natural soils below the levee ranged from lean clay to sand. The clay soils were generally characterized as medium stiff to stiff and the sand soils as medium dense. Color of the soils varied from dark grey to reddish-brown to brown. Moisture contents varied from 13.9 to 28.4 percent with dry unit weights ranging from 90.8 to 106.4 pcf.

5.3 GROUNDWATER

Free water was encountered in the exploratory boring B-4 at the time of drilling. The groundwater level during the field exploration does not necessarily denote a static groundwater level. Groundwater levels can vary depending on climatic conditions, time of year, surface runoff and other factors beyond the scope of this report.

6. CONCLUSIONS

Considering the results of the field exploration and laboratory testing, the following conclusions are presented.

6.1 LEVEE FILL

Field exploration results indicate the fill in the existing levee varied from lean clay to sandy clay with the majority of the soils classifying as lean clay with sand. The compaction of the existing levee fill was evaluated by comparing dry unit weights obtained from undisturbed Shelby tube samples to the Standard Proctor values. Standard Proctor tests were performed on two combined samples of the subsurface soils as shown in figures B-7 and B-8. The apparent compaction results are as follow.

BORING NO.	DEPTH (Feet)	STANDARD PROCTOR (pcf)	DRY UNIT WEIGHT (pcf)	APPARENT COMPACTION (%)
B-1	3.0 - 5.0	103.9	104.5	101
B-2	3.0 - 5.0	103.9	98.7	95
B-3	3.0 - 5.0	106.9	101.0	94
B-4	3.0 - 5.0	106.9	106.6	100
B-5	3.0 - 5.0	106.9	109.9	103
B-6	3.0 - 5.0	106.9	100.4	94
B-7	1.0 - 3.0	106.9	119.1	112
B-8	5.0 - 7.0	106.9	99.8	94

6.2 FILL CONSOLIDATION

The fill in the existing levee generally consisted of lean clay with sand. Consolidation characteristics of levee fill was analyzed by one-dimensional consolidation testing as shown in figure B-6. Considering the age of the fill and these test results, the majority of fill consolidation has occurred. Additional consolidation is estimated to be minimal (less than 1/4 inch).

6.3 EMBANKMENT FOUNDATION SETTLEMENT

The embankment foundation soils consisted mainly of medium stiff to stiff lean clay and sandy lean clay. Settlement characteristics of the foundation soils were analyzed by one dimensional consolidation testing and correlation with standard penetration testing. Considering the age of the embankment and the consolidation characteristics of the foundation soils, future settlement will be negligible unless additional fill is added to the levee.

7. LIMITATIONS

This report has been prepared according to generally accepted soil and foundation engineering practices in this area. The conclusions are based on the subsurface conditions at the exploratory boring locations at the time of drilling. The conclusions are intended for the exclusive use of the client. Individual portions should not be taken out of the report context for this project or used for other projects. The conclusions presented are based on the data obtained from eight (8) exploratory borings at the locations indicated on the Boring Location Plan. If subsurface conditions vary significantly across the project site, the conclusions presented may not be valid.

Prepared By:
ALLIED LABORATORIES

STEVEN M. HERMAN LICENSED 12585 PROFESSIONAL ENGINEER ARKANSAS

Steven M. Herman, P.E.
Geotechnical Division Manager

Reviewed By

John B. McDaniel, Jr.
Construction Division Manager

Allied Laboratories
350 South Washington
Wichita, KS 67202
(316) 262-6457

APPENDIX A

FIELD EXPLORATION RESULTS

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE
WICHITA, KANSAS

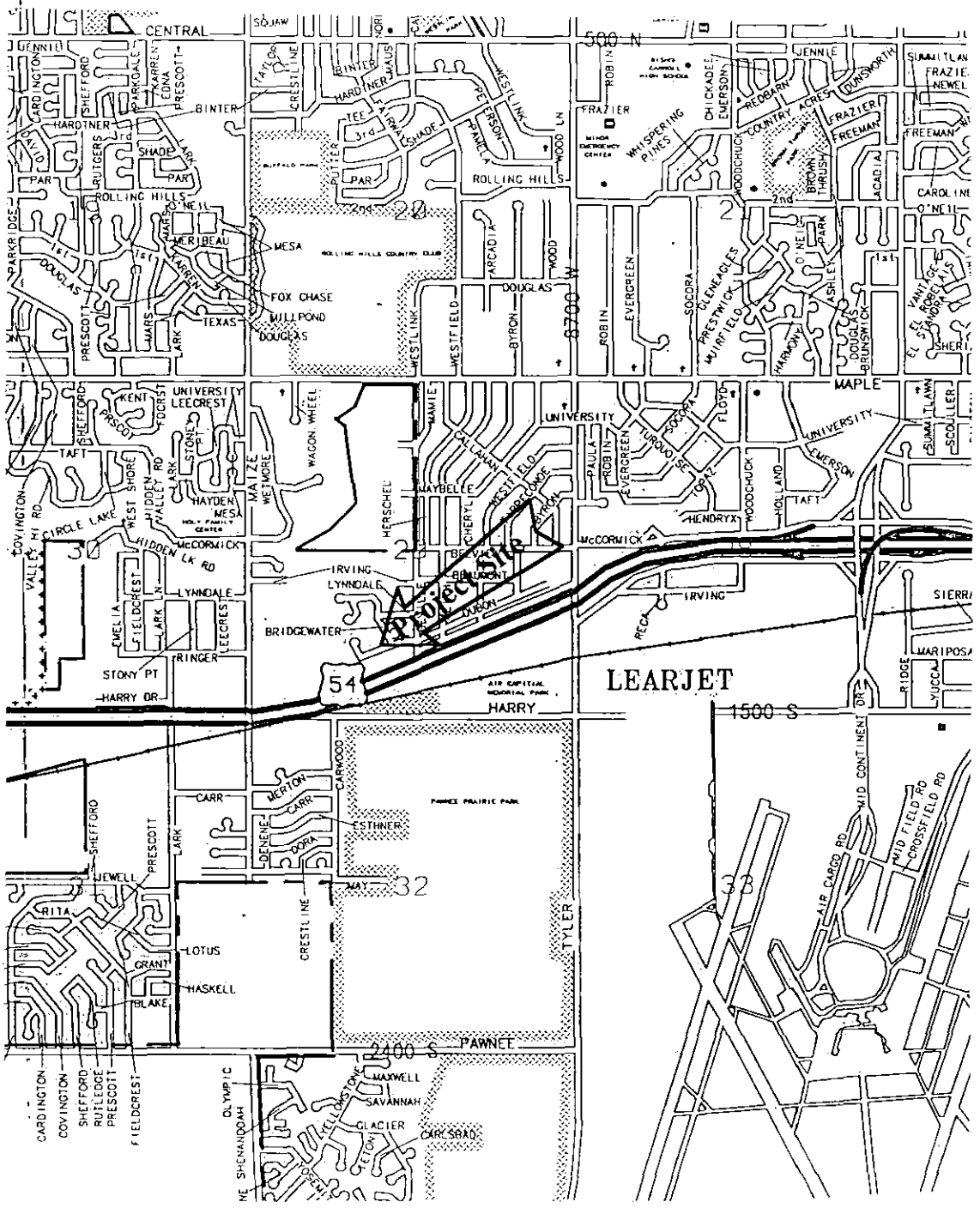
ALLIED PROJECT NO: 72-95398-42

Allied Laboratories
350 South Washington
Wichita, KS 67202
(316) 262-6457

SITE LOCATION MAP

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE - WICHITA, KS

Allied Project No: 72-95398-42



Prepared By: SMH

No Scale

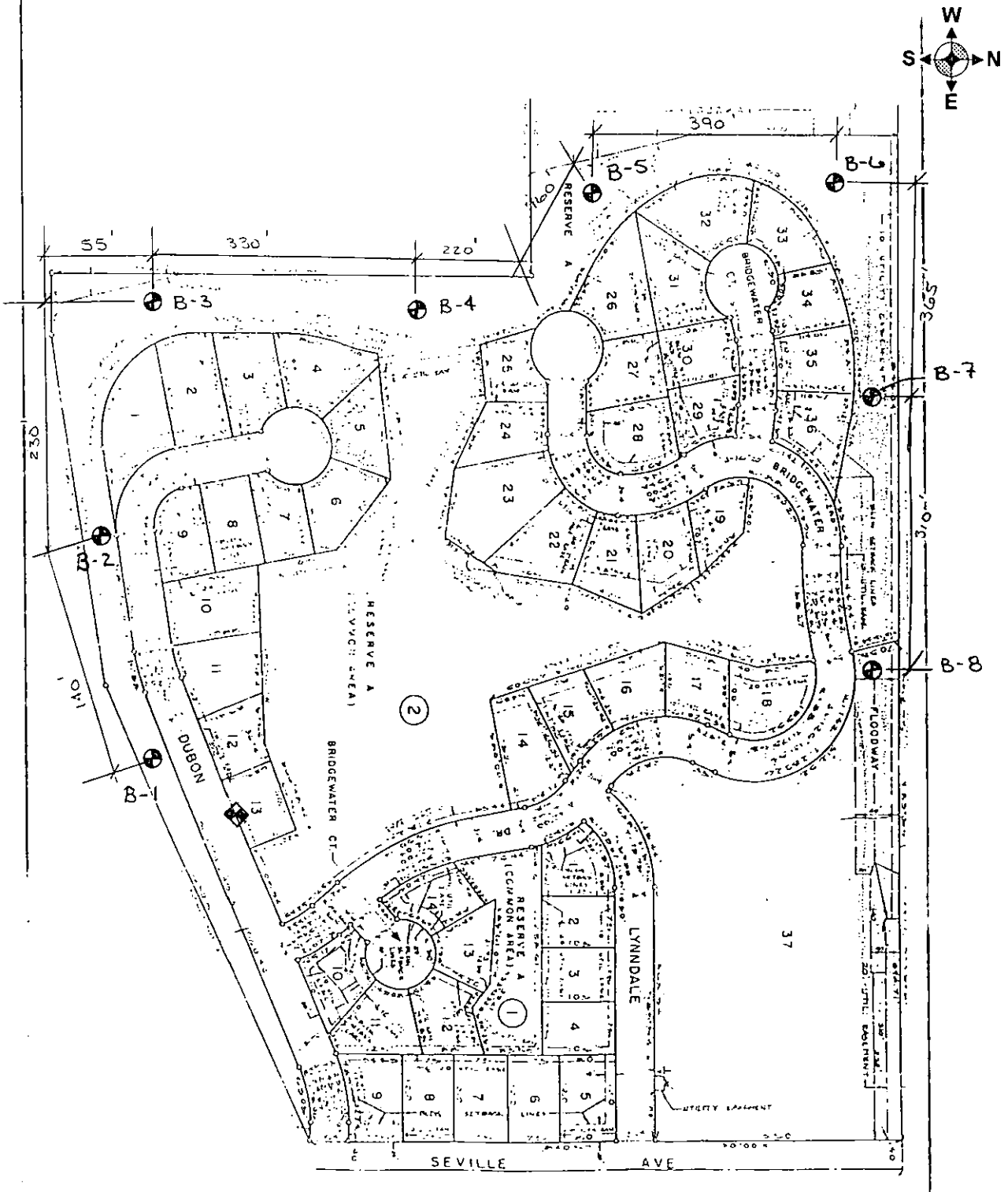
Figure A-1

Allied Laboratories
1350 South Washington
Wichita, KS 67202
(316) 262-6457

BORING LOCATION PLAN

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE - WICHITA, KS

Allied Project No: 72-95398-42



LEGEND:

- Exploratory Boring
- Benchmark

Prepared By: SMH

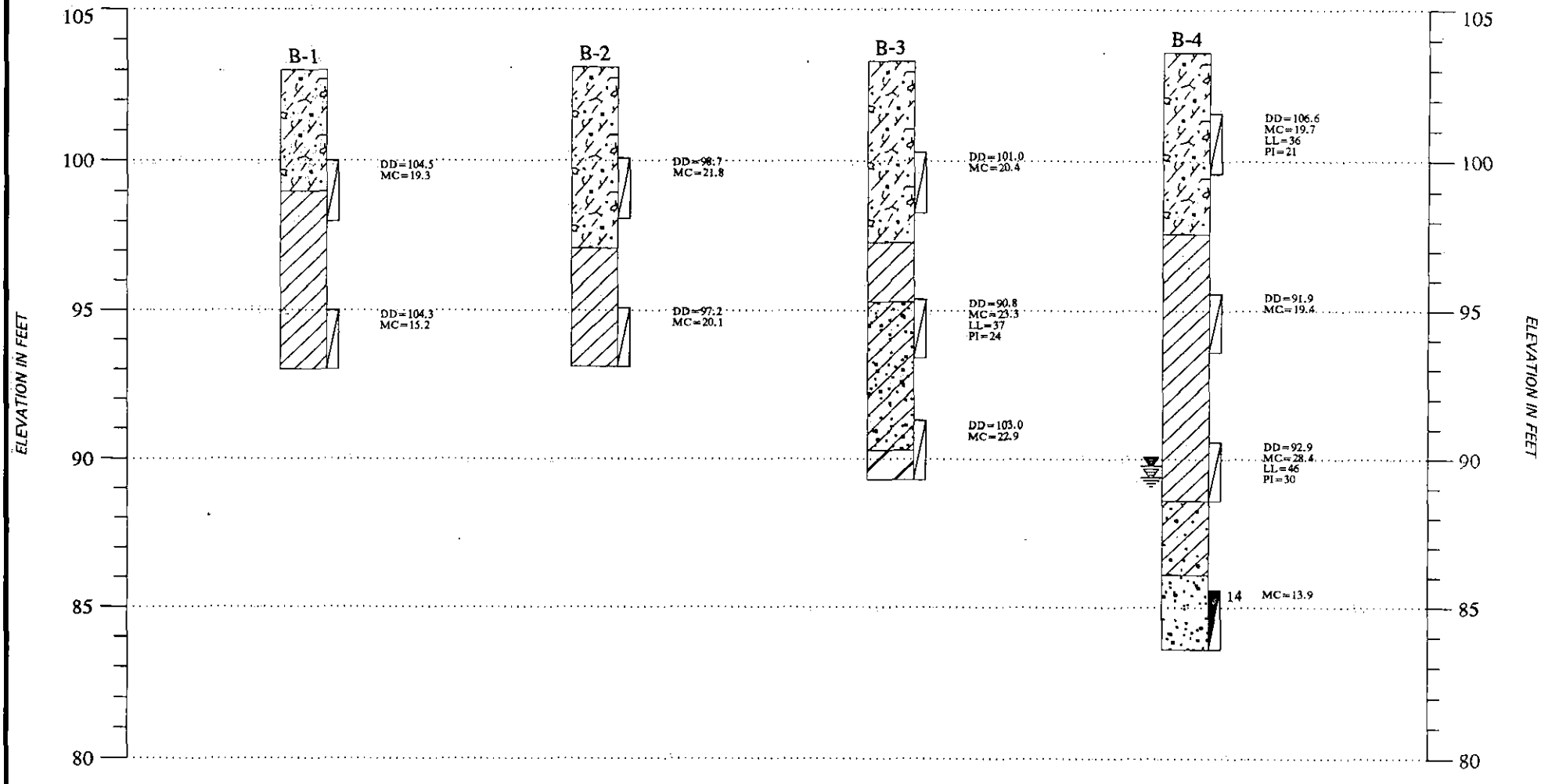
No Scale

Figure A-2

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

PROFILE OF EXPLORATORY BORINGS

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE



Strata symbols

- Fill, clay
- Lean clay low plasticity
- Lean Clay with Sand
- Fat clay, High plasticity
- Clayey sand
- Poorly graded sand

Misc. Symbols

- Water table 24 hrs after completion
- Water table during drilling

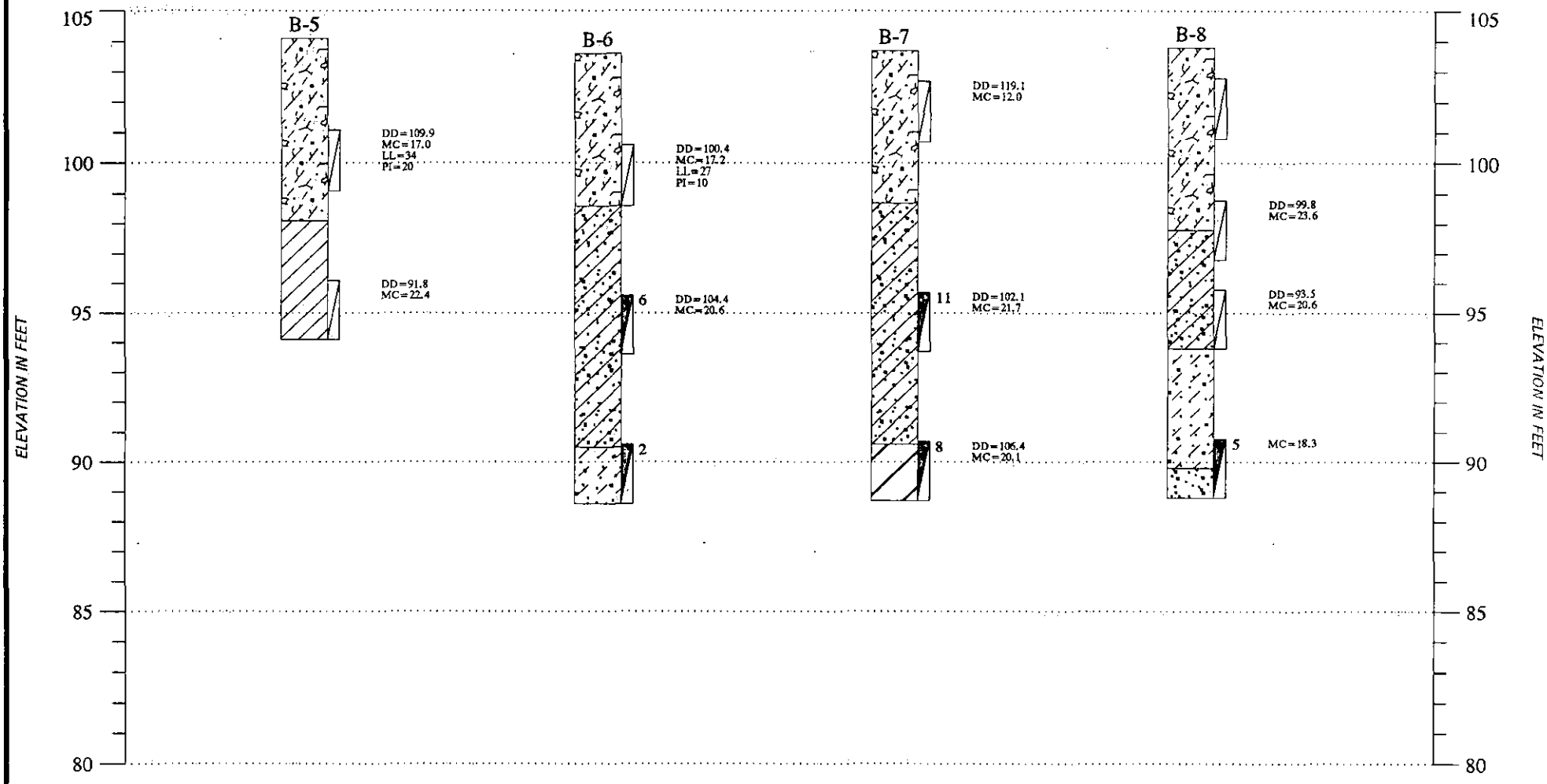
NOTE: Profiles are not proportional and may not present a cross section of the site.

FIGURE A-3

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

PROFILE OF EXPLORATORY BORINGS

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE



Strata symbols

- Fill, clay
- Lean clay low plasticity
- Lean Clay with Sand
- Silty sand
- Fat clay, High plasticity
- Poorly graded sand

Soil Samplers

- Undisturbed thin-wall Shelby tube
- Standard penetration test

NOTE: Profiles are not proportional and may not present a cross section of the site.

FIGURE A-4

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

B-1

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PROJECT NO: **72-95398-42** | BORING LOCATION: **See Boring Location Plan**

SCALE: 1 IN = 5 FT. | BORING DATE **6/22/95** | DRILLER **KJP** | LOGGED BY **RBB** | CHECKED BY **SMH**

WATER LEVEL @ DRILL **Dry** | DATE **6/22/95** | WATER LEVEL AFTER DRILL | DATE

LOG	ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
0	103	*FILL: lean clay, reddish brown to grey to brown, moist, firm*										
			1-1	S		19.3	104.5					
5	99	*LEAN CLAY: brown to dark brown, moist to very moist, medium stiff*										
			1-2	S		15.2	104.3					
10	93	End of boring at 10 feet.										
15												
20												
25												
30												
35												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-5

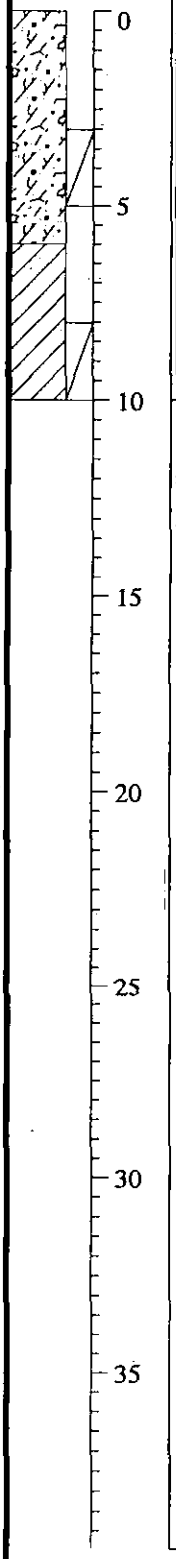
Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

B-2

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

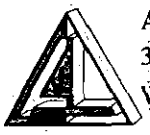
PROJECT NO: **72-95398-42**	BORING LOCATION: **See Boring Location Plan**			
SCALE: 1 IN = 5 FT.	BORING DATE **6/22/95**	DRILLER **KJP**	LOGGED BY **RBB**	CHECKED BY **SMH**
WATER LEVEL @ DRILL **Dry**	DATE **6/22/95**	WATER LEVEL AFTER DRILL		DATE



ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
103.1	*FILL: lean clay, brown to grey, lightly moist to moist, firm*	2-1	S		21.8	98.7					
97.1	*LEAN CLAY: dark grey to brown, very moist, medium stiff*	2-2	S		20.1	97.2					
93.1	End of boring at 10 feet.										

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-6



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350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

B-3

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PROJECT NO: **72-95398-42** | BORING LOCATION: **See Boring Location Plan**

SCALE: 1 IN = 5 FT. | BORING DATE **6/22/95** | DRILLER **KJP** | LOGGED BY **RBB** | CHECKED BY **SMH**

WATER LEVEL @ DRILL **Dry** | DATE **6/22/95** | WATER LEVEL AFTER DRILL | DATE

LOG	ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
	103.3	*FILL: lean clay to sandy lean clay, reddish-brown to dark grey to brown, lightly moist to very moist, firm*	3-1	S		20.4	101.0					
	97.3	*LEAN CLAY: dark grey to brown, very moist, firm*	3-2	S		23.3	90.8		3	97	37	24
	95.3	*LEAN CLAY WITH SAND: dark grey to brown, very moist, medium stiff, thin sand seams*	3-3	S		22.9	103.0					
	90.3	*FAT CLAY: grey, very moist, stiff, caliche*										
	89.3	End of boring at 14 feet.										

0 5 10 15 20 25 30 35

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-7

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

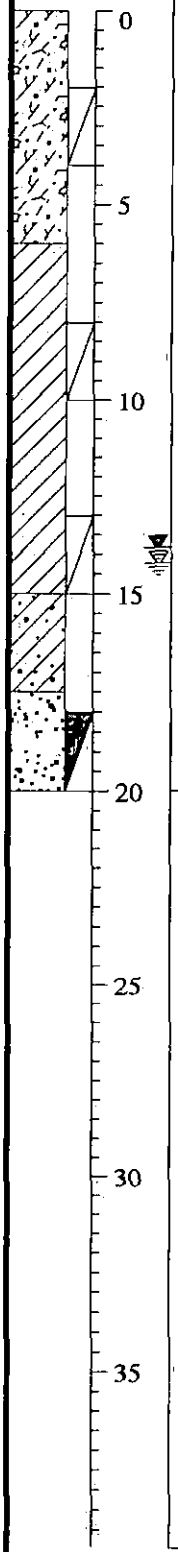
B-4

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PROJECT NO: **72-95398-42** | BORING LOCATION: **See Boring Location Plan**

SCALE: 1 IN = 5 FT. | BORING DATE **6/22/95** | DRILLER **KJP** | LOGGED BY **RBB** | CHECKED BY **SMH**

WATER LEVEL @ DRILL **14.2** | DATE **6/22/95** | WATER LEVEL AFTER DRILL **13.8** | DATE **6/23/95**



ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
103.6	*FILL: lean clay to sandy lean clay, reddish brown to dark grey, lightly moist to very moist, firm*	4-1	S		19.7	106.6		20	80	36	21
97.6	*LEAN CLAY: dark grey to brown, very moist, soft to medium stiff*	4-2	S		19.4	91.9					
	... very moist to wet, soft	4-3	S		28.4	92.9		9	91	46	30
88.6	*SANDY LEAN CLAY: grey to brown, very moist, medium stiff to soft*										
86.1	*SAND: grey to brown, saturated, medium dense, fine to medium grained*	4-4	P	14	13.9						
83.6	End of boring at 20 feet.										

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-8

Allied Laboratories 350 South Washington Wichita, Kansas 67202	**EXPLORATORY BORING LOG**	**B-5**
	MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE	
PROJECT NO: **72-95398-42**	BORING LOCATION: **See Boring Location Plan**	
SCALE: 1 IN = 5 FT.	BORING DATE **6/22/95**	DRILLER **KJP**	LOGGED BY **RBB**	CHECKED BY **SMH**
WATER LEVEL @ DRILL **Dry**	DATE **6/22/95**	WATER LEVEL AFTER DRILL	DATE

LOG	ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
0	104.1	*FILL: lean clay with sand, dark brown to brown, moist, firm*										
			5-1	S		17.0	109.9		24	76	34	20
5	98.1	*LEAN CLAY: dark grey to brown, very moist, medium stiff*										
			5-2	S		22.4	91.8					
10	94.1	End of boring at 10 feet.										
15												
20												
25												
30												
35												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-9

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

B-6

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PROJECT NO: **72-95398-42** | BORING LOCATION: **See Boring Location Plan**

SCALE: 1 IN = 5 FT. | BORING DATE **6/22/95** | DRILLER **KJP** | LOGGED BY **RBB** | CHECKED BY **SMH**

WATER LEVEL @ DRILL **Dry** | DATE **6/22/95** | WATER LEVEL AFTER DRILL | DATE

LOG	ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
0	103.6	*FILL: lean clay to sandy lean clay, reddish-brown to brown, moist to very moist, firm*	6-1	S		17.2	100.4		33	67	27	10
5	98.6	*LEAN CLAY WITH SAND: dark grey to brown, very moist, medium stiff*	6-2	P	6	20.6	104.4					
10		*... with thin sand streamers, very moist to wet*										
15	90.5	*SILTY SAND: grey to brown, saturated, very moist to wet*	6-3	P	2							
20	88.6	End of boring at 15 feet.										
25												
30												
35												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-10

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

B-7

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PROJECT NO: **72-95398-42** | BORING LOCATION: **See Boring Location Plan**

SCALE: 1 IN = 5 FT. | BORING DATE **6/22/95** | DRILLER **KJP** | LOGGED BY **RBB** | CHECKED BY **SMH**

WATER LEVEL @ DRILL **Dry** | DATE **6/22/95** | WATER LEVEL AFTER DRILL | DATE

LOG	ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
0	103.7	*FILL: sandy lean clay and lean clay, reddish-brown to grey to brown, lightly moist to moist, firm*	7-1	S		12.0	119.1					
5	98.7	*LEAN CLAY WITH SAND: dark grey to brown, moist, stiff*	7-2	P	11	21.7	102.1					
10	90.6	*FAT CLAY: grey, moist, stiff, sandy*	7-3	P	8	20.1	106.4					
15	88.7	End of boring at 15 feet.										
20												
25												
30												
35												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-11

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LOG

B-8

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PROJECT NO.: **72-95398-42** | BORING LOCATION: **See Boring Location Plan**

SCALE: 1 IN = 5 FT. | BORING DATE **6/22/95** | DRILLER **KJP** | LOGGED BY **RBB** | CHECKED BY **SMH**

WATER LEVEL @ DRILL **Dry** | DATE **6/22/95** | WATER LEVEL AFTER DRILL | DATE

LOG	ELEVATION	SOIL DESCRIPTION	S No.	TOOL	BPF	% Moist.	Dry Unit Wt. (pcf)	Qu (psf)	% Sand	% Fines	LL	PI
0	103.8	*FILL: lean clay to sandy lean clay, reddish-brown to brown, lightly moist to moist, firm*	8-1	S								
5			8-2	S		23.6	99.8					
	97.8	*LEAN CLAY WITH SAND: dark grey, very moist, soft to medium stiff*	8-3	S		20.6	93.5		26	74		
10	93.8	*SILTY SAND: brown, very moist to wet, medium dense, fine grained* … *saturated*	8-4	P	5	18.3						
15	89.8	*SAND: light brown, saturated, loose, medium grained*										
	88.8	End of boring at 15 feet.										
20												
25												
30												
35												

NOTE: This information only pertains to this boring at the time of drilling and may not be indicative of entire site.

FIGURE A-12

Allied Laboratories
350 South Washington
Wichita, Kansas 67202

EXPLORATORY BORING LEGEND

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

Strata symbols

- Fill, clay
- Lean clay low plasticity
- Lean Clay with Sand
- Fat clay, High plasticity
- Clayey sand
- Poorly graded sand
- Silty sand

Misc. Symbols

- Water table 24 hrs after completion
- Water table during drilling

Soil Samplers

- Undisturbed thin wall Shelby tube
- Standard penetration test

Notes:

1. Exploratory borings were drilled on 6/22/95 with a Mobil Drill B-31 drill rig utilizing 4 inch diameter continuous flight auger.
2. Groundwater was encountered in boring B-4 at the time of drilling and at 24 hour measurement.
3. Borings were located referencing existing site features. Elevations were determined by a level survey referencing a benchmark established as, "Top Bolt of Fire Hydrant at 9832 Dubon Street, Elevation = 100.0 assumed".
4. The exploratory logs are subject to the limitations, conclusions, and recommendations included in the Geotechnical Report.
5. Depths to transitions between soil types presented on the exploratory boring logs are approximate within the limits of this investigation.

FIGURE A-13

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GENERAL GEOTECHNICAL NOTES

SOIL CLASSIFICATION TERMINOLOGY

Soil classification is based on ASTM D-2487 "Soil Classification for Engineering Purposes" which is based on the Unified Soil Classification System. Fine grained soils have less than 50 percent of their particles retained on the No. 200 sieve. These soils are classified as silts if they are nonplastic to slightly plastic and as clays if they classify as plastic. Coarse grained soils have more than 50 percent of their particles retained on the No. 200 sieve and are classified as sands, gravels, cobbles and boulders depending on the grain size. Minor and major constituents may be added as modifiers depending on the proportions of the soil types. Additionally, fine grained soils are described based on their consistency and coarse grained soils are deliniated by their relative density. Examples: Fat clay with sand (CH) and Silty sand (SM).

WATER LEVEL MEASUREMENTS

Water level measurements presented on the test boring logs are for the times indicated. These measurements may not necessarily represent the actual groundwater levels at the site. Fine grained soils of low permeabilty may require measurements for extended periods to accurately reflect free water levels. Coarse grained soils will generally reflect true groundwater levels after short periods. Groundwater levels and seepage water can vary depending on time of year, climatic conditions and other factors beyond the scope of normal geotechnical explorations. Typical water level abbreviations follows:

WD - Water level during drilling
WA - Water level after drilling
W24 - Water level 24 hours after drilling
W48 - Water level 48 hours after drilling
CW - Depth to wet cave of boring
CD - Depth to dry cave of boring

SAMPLING AND DRILLING ABBREVIATIONS

Drilling and sampling procedures are typically performed in accordance with ASTM standards unless otherwise noted. Typical sampling and drilling abbreviations follows:

P - Standard Penetration sampler (1-3/8 in. ID split-spoon)
S - 3 in. diameter thin walled Shelby Tube
D - Denison Barrel Sampler
B - Bulk/grab sample
SB - Sawtooth bit barrel sampler
CF4 - 4 in. diameter continuous flight auger
CF6 - 6 in. diameter continuous flight auger
HS - 7-1/4 in. diameter hollow stem auger
NX - Diamond bit coring

CONSISTENCY OF COARSE GRAINED SOILS

Relative Density (D_R)	Percent D_R	Approximate N - Value (blows/foot)
Very Loose	less than 15	0 to 4
Loose	15 to 35	4 to 10
Medium Dense	35 to 65	10 to 30
Dense	65 to 85	30 to 50
Very Dense	85 to 100	over 50

CONSISTENCY OF FINE GRAINED SOILS

Consistency	Unconfined Compressive Strength (Q_u) psf	Approximate N - Value (blows/foot)
Very Soft	Less than 500	0 to 2
Soft	500 to 1000	2 to 4
Medium Stiff	1000 to 2000	4 to 8
Stiff	2000 to 4000	8 to 16
Very Stiff	4000 to 8000	16 to 30
Hard	Over 8000	Over 30

BEDROCK HARDNESS DESCRIPTIONS

Hardness	Approximate N - Value (blows/foot)
Weathered (Soft)	Less than 20
Firm	20 to 30
Medium Hard	30 to 50
Hard	50 to 80
Very Hard	Over 80

PROPORTIONING OF CONSTITUENTS

Constituant Description	Percent
Trace	Less than 5
With	5 to 12
Modifier	More than 12

GRAIN SIZE DESCRIPTIONS

Constituant Description	Particle Size
Silt or Clay	Passing No. 200 Sieve (0.075 mm)
Sand	No. 200 to No. 4 Sieve (0.075 to 4.75 mm)
Gravel	No. 4 to 3 inch Sieve (4.75 to 75 mm)
Cobbles	3 to 12 inch Sieve (75 to 300 mm)
Boulders	Over 12 inch Sieve (300 mm)

Figure A-14

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APPENDIX B

LABORATORY TEST RESULTS

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE
WICHITA, KANSAS

Allied Project No: 72-95398-42

Allied Laboratories
350 South Washington
Wichita, KS 67202
(316) 262-6457

SUMMARY OF LABORATORY TEST RESULTS

—MILES-LAKEWOOD-VILLAGE-2ND-ADDITION-LEVEE--WICHITA-KANSAS—

Allied Project No. 72-95398-42

Boring No.	Sample No.	Depth (feet)	% Moist. Content	Dry Unit Wt. (pcf)	Qu (psf)	Atterberg Limits			Grain Size (%)			Soil Classification
						LL	PL	PI	Gravel	Sand	Silt/Clay	
B-1	1-1	3.0-5.0	19.3	104.5								Lean Clay (FILL)
B-1	1-2	8.0-10.0	15.2	104.3								Lean Clay
B-2	2-1	3.0-5.0	21.8	98.7								Lean Clay (FILL)
B-2	2-2	8.0-10.0	20.1	97.2								Lean Clay
B-3	3-1	3.0-5.0	20.4	101.0								Lean Clay with Sand (FILL - CL)
B-3	3-2	8.0-10.0	23.3	90.8		37	13	24		3	97	Lean Clay (CL)
B-3	3-3	13.0-15.0	22.9	103.0								Fat Clay
B-4	4-1	3.0-5.0	19.7	106.6		36	15	21		20	80	Lean Clay with Sand (FILL - CL)
B-4	4-2	8.0-10.0	19.4	91.9								Lean Clay
B-4	4-3	13.0-15.0	28.4	92.9		46	16	30		9	91	Lean Clay (CL)
B-4	4-4	18.0-20.0	13.9									Sand
B-5	5-1	3.0-5.0	17.0	109.9		34	14	20		24	76	Lean Clay with Sand (FILL - CL)
B-5	5-2	8.0-10.0	22.4	91.8								Lean Clay
B-6	6-1	3.0-5.0	17.4	100.4		27	17	10		33	67	Sandy Lean Clay (FILL - CL)
B-6	6-2	8.0-10.0	20.6	104.4								Lean Clay

Figure B-1

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SUMMARY OF LABORATORY TEST RESULTS

—MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE – WICHITA KANSAS—

Allied Project No. 72-95398-42

Boring No.	Sample No.	Depth (feet)	% Moist. Content	Dry Unit Wt. (pcf)	Qu (psf)	Atterberg Limits			Grain Size (%)			Soil Classification
						LL	PL	PI	Gravel	Sand	Silt/Clay	
B-7	7-1	1.0-3.0	12.0	119.1								Lean Clay with Sand (FILL)
B-7	7-2	8.0-10.0	21.7	102.1								Lean Clay
B-7	7-3	13.0-15.0	20.1	106.5								Fat Clay
B-8	8-1	1.0-3.0										Sandy Lean Clay (FILL)
B-8	8-2	5.0-7.0	23.6	99.8								Lean Clay with Sand (FILL)
B-8	8-3	8.0-10.0	20.6	93.5						26	74	Lean Clay with Sand
B-8	8-4	13.0-15.0	18.3									Sand
Bulk 1	combined	0.0-5.0				39	15	24		28	72	Lean Clay with Sand (CL)
Bulk 2	combined	6.0-10.0				44	18	26		11	89	Lean Clay (CL)

Figure B-2

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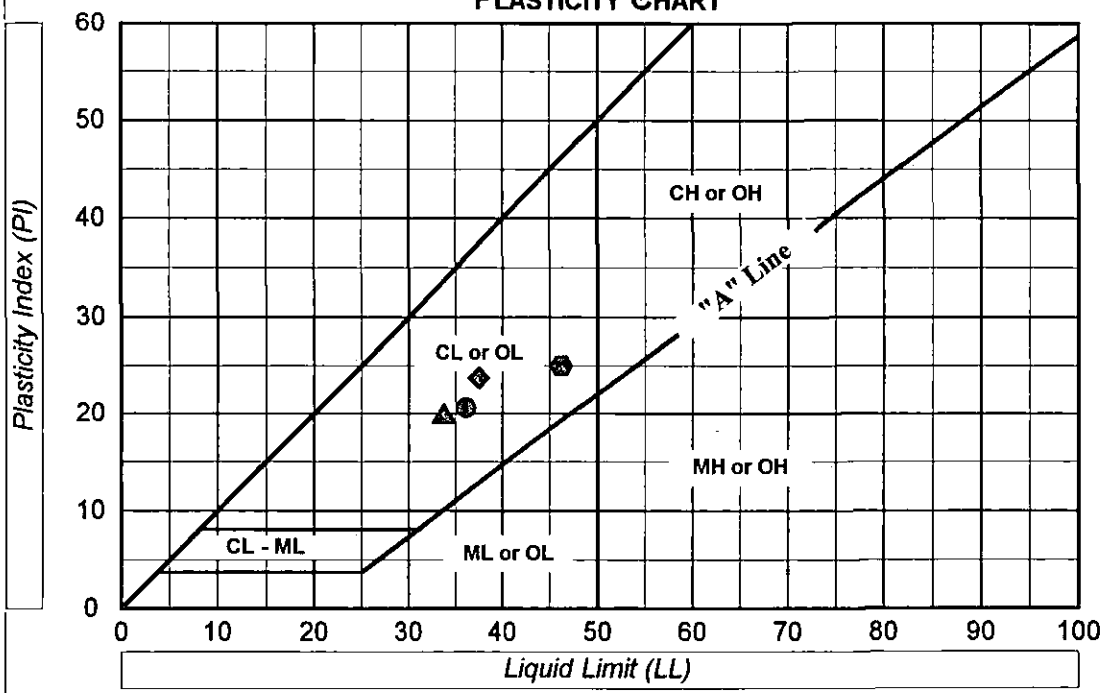
LIQUID AND PLASTIC LIMITS TEST REPORT

ASTM D-4318

Project No. 72-95398-42

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PLASTICITY CHART



TEST RESULTS

	Location/Description	LL	PL	PI	% Fines	ASTM D - 2487
◆	Boring B-3, Sample 3-2 Depth: 8.0-10.0 feet	37	13	24	97	Lean Clay (CL)
●	Boring B-4, Sample 4-1 Depth: 2.0-4.0 feet	36	15	21	80	Lean Clay with Sand (CL)
⬢	Boring B-4, Sample 4-3 Depth: 13.0-15.0 feet	46	16	30	91	Lean Clay (CL)
▲	Boring B-5, Sample 5-1 Depth: 3.0-5.0 feet	34	14	20	76	Lean Clay with Sand (CL)
■						

Figure B-3

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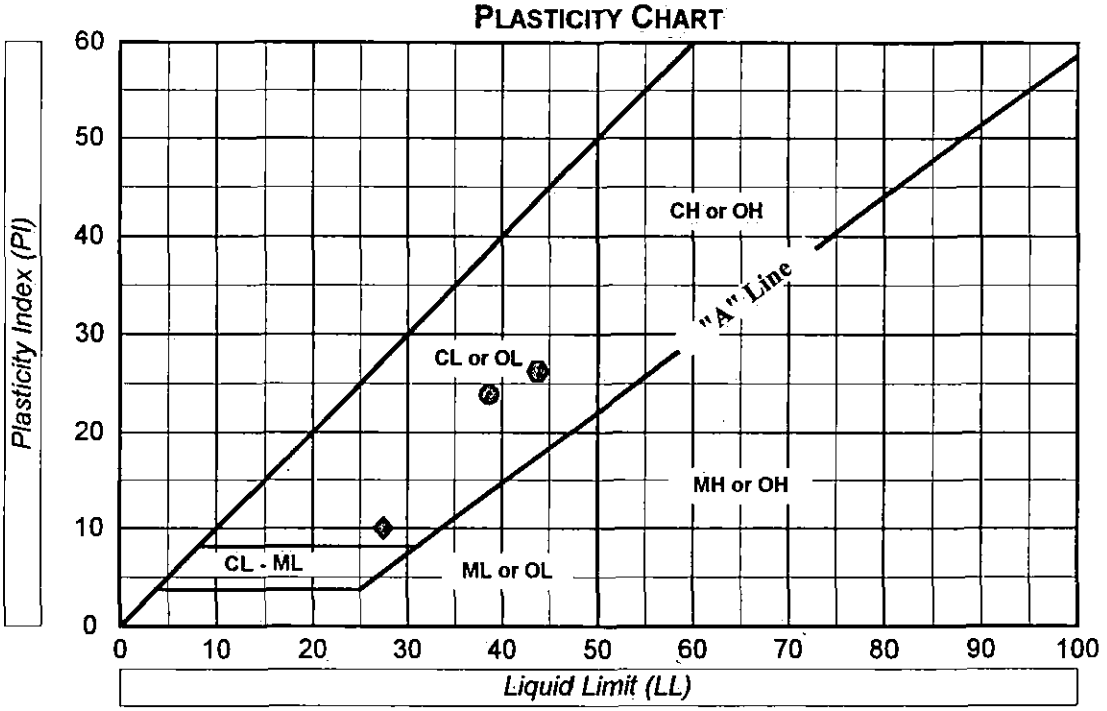
LIQUID AND PLASTIC LIMITS TEST REPORT

ASTM D-4318

Project No. 72-95398-42

MILES LAKEWOOD VILLAGE 2ND ADDITION LEVEE

PLASTICITY CHART



TEST RESULTS

	Location/Description	LL	PL	PI	% Fines	ASTM D - 2487
◆	Boring B-6, Sample 6-1 Depth: 3.0-5.0 feet	27	17	24	67	Sandy Lean Clay (CL)
●	Combined Bulk 1 Depth: 0.0-5.0 feet	39	15	24	72	Lean Clay with Sand (CL)
⬢	Combined Bulk 2 Depth: 5.0-10.0 feet	44	18	26	89	Lean Clay (CL)
▲						
■						

Figure B-4

Allied Laboratories
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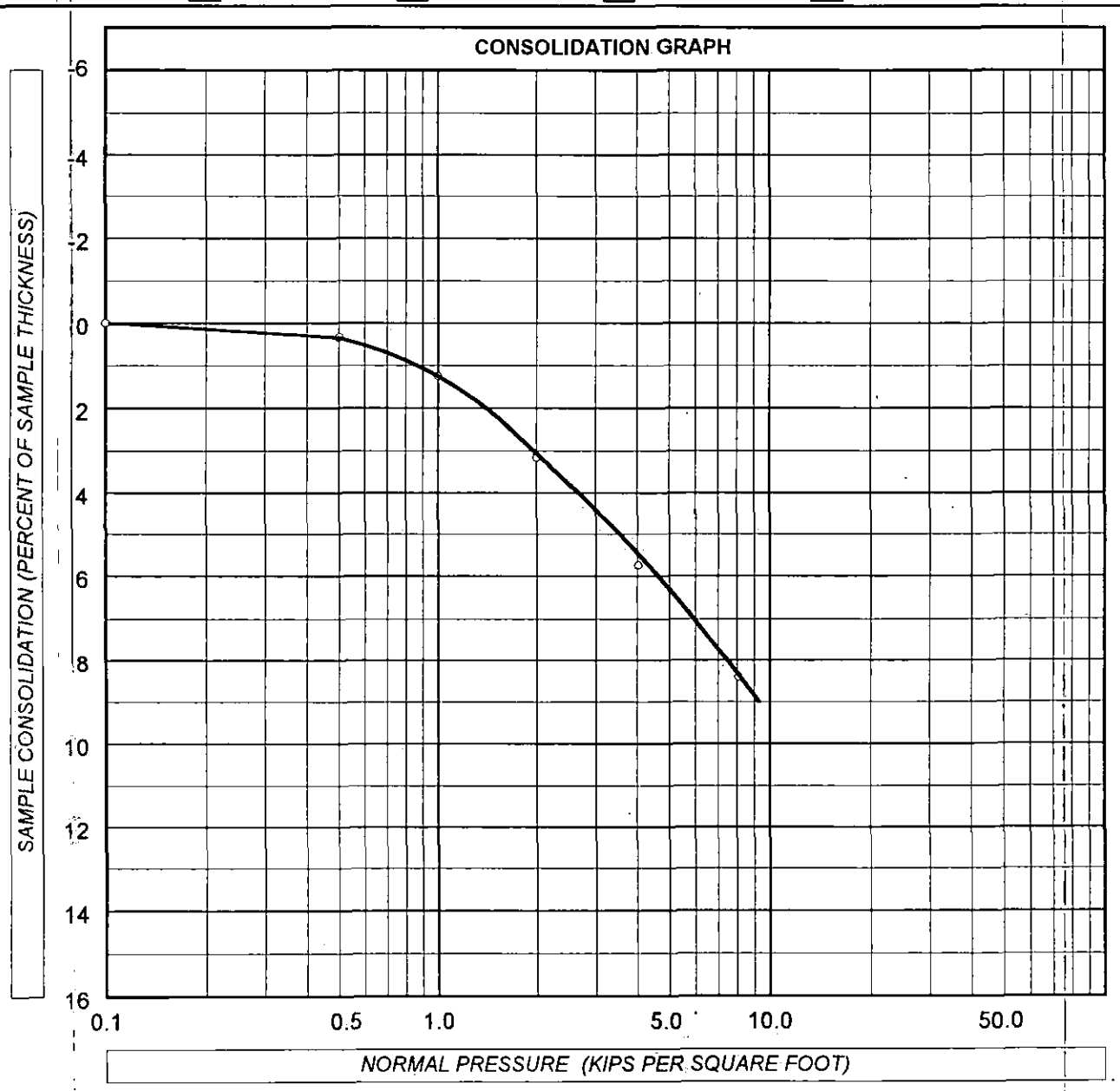
CONSOLIDATION TEST RESULTS

ASTM D-4546, Method B

Project No: 72-95398-42	Project Name: Miles Lakewood Village 2nd Addition Levee		Date: 7/1/95
Boring No: B-4	Sample No: 4-3		Depth 13.0-15.0 feet
Soil Description: Lean Clay: dark brown, slightly sandy			Classification: CL
Liquid Limit: 46	Plastic Limit: 16	Plasticity Index: 30	Specific Gravity: 2.65 assumed
Initial Moisture Content (%): 28.2	Initial Dry Density (pcf): 94.9		Saturation (%): 99.6
Final Moisture Content (%): 22.2	Final Dry Density (pcf): 105.2		Silt/Clay (percent): 91
Sample Length (inch): 1.00	Sample Diameter (inch): 2.50		Height of Solids (inch): 0.5696

Specimen Condition: [X] Undisturbed [ ] Remolded [ ] Compacted [ ] Other _____



Checked By: SMH

Figure B-5

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350 South Washington
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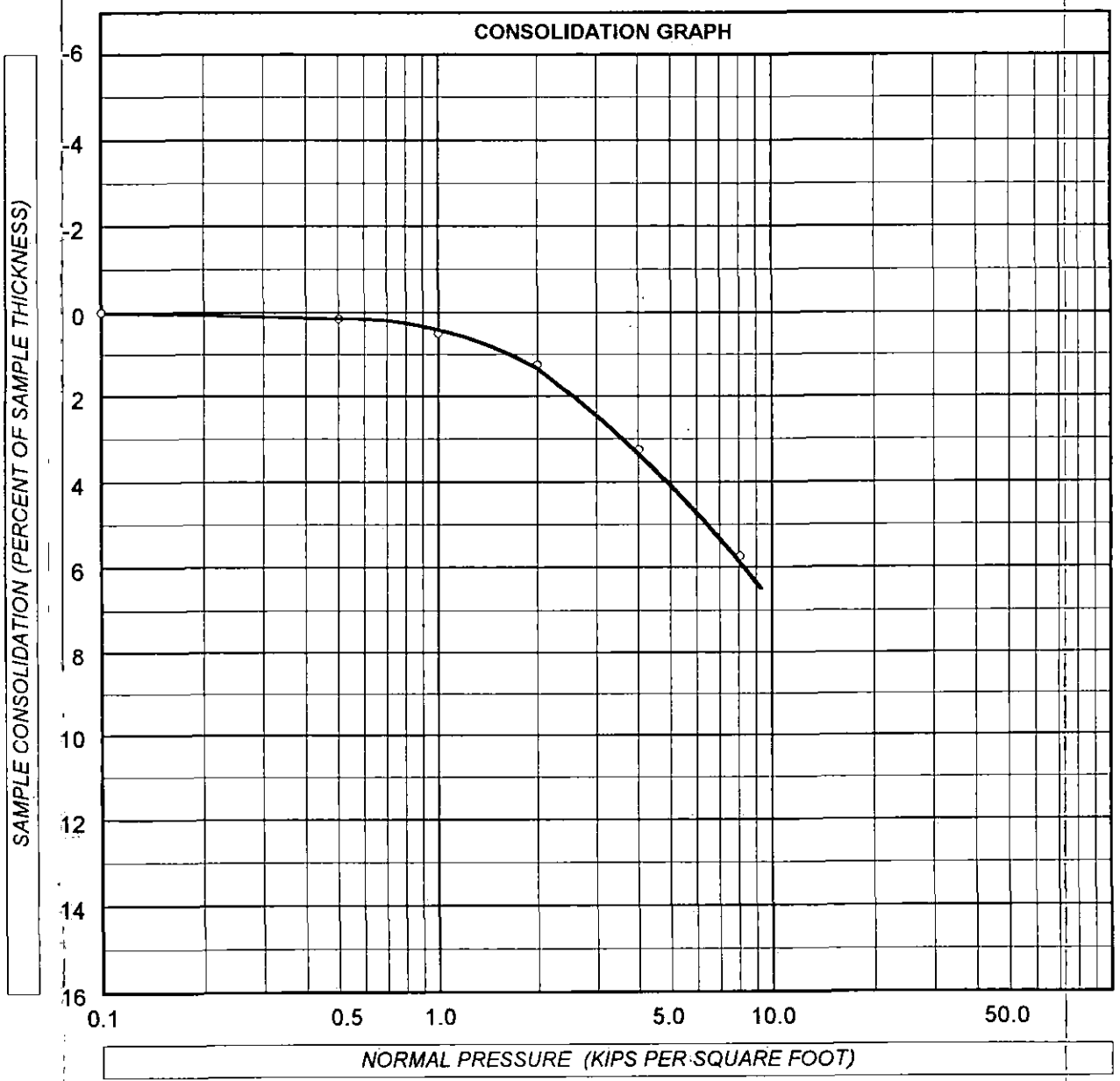
(316) 262-6457

CONSOLIDATION TEST RESULTS

ASTM D-4546, Method B

Project No: 72-95398-42	Project Name: Miles Lakewood Village 2nd Addition Levee		Date: 7/1/95
Boring No: B-5	Sample No: 5-1		Depth 3.0-5.0 feet
Soil Description: Lean Clay with Sand: brown			Classification: CL
Liquid Limit: 34	Plastic Limit: 13	Plasticity Index: 24	Specific Gravity: 2.65 assumed
Initial Moisture Content (%): 18.8	Initial Dry Density (pcf): 108.8		Saturation (%): 94.5
Final Moisture Content (%): 17.4	Final Dry Density (pcf): 116.7		Silt/Clay (percent): 76
Sample Length (inch): 1.00	Sample Diameter (inch): 2.50		Height of Solids (inch): 0.653

Specimen Condition: [X] Undisturbed [ ] Remolded [ ] Compacted [ ] Other _____



Checked By: SMH

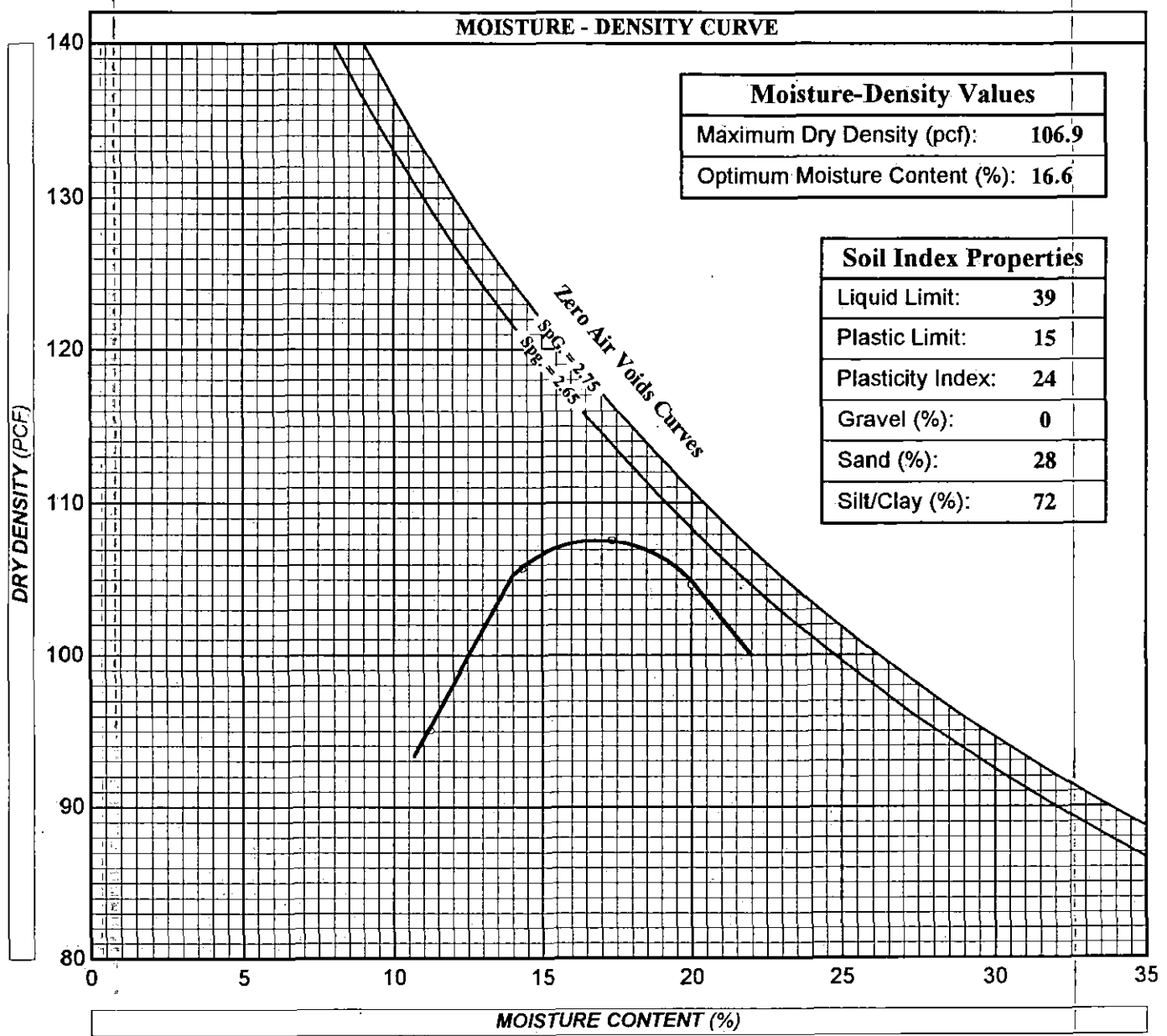
Figure B-6

Allied Laboratories
350 South Washington
Wichita, KS 67202
(316) 262-6457

MOISTURE - DENSITY RELATIONSHIP

Curve No.: na

Project Name: **Miles Lakewood Village 2nd Addition Levee**	Project No: **72-95398-42**	Date: **6/30/95**
Soil Description: **Lean Clay with Sand: FILL**		Classification: **CL**
Sample Location: **Combined Bulk 0.0-5.0 feet**	Sampled By: **Allied**	Date: **6/22/95**



Moisture-Density Values	
Maximum Dry Density (pcf):	106.9
Optimum Moisture Content (%):	16.6

Soil Index Properties	
Liquid Limit:	39
Plastic Limit:	15
Plasticity Index:	24
Gravel (%):	0
Sand (%):	28
Silt/Clay (%):	72

AASHTO Designation:	T-99	ASTM Designation:	D-698		
Weight of Hammer (lbs):	5.5	Height of Drop (inch):	12	Number of Lifts:	3
Blows per Lift:	25	Diameter of Cylinder:	4 in	Volume of Cylinder:	0.0333 ft^3

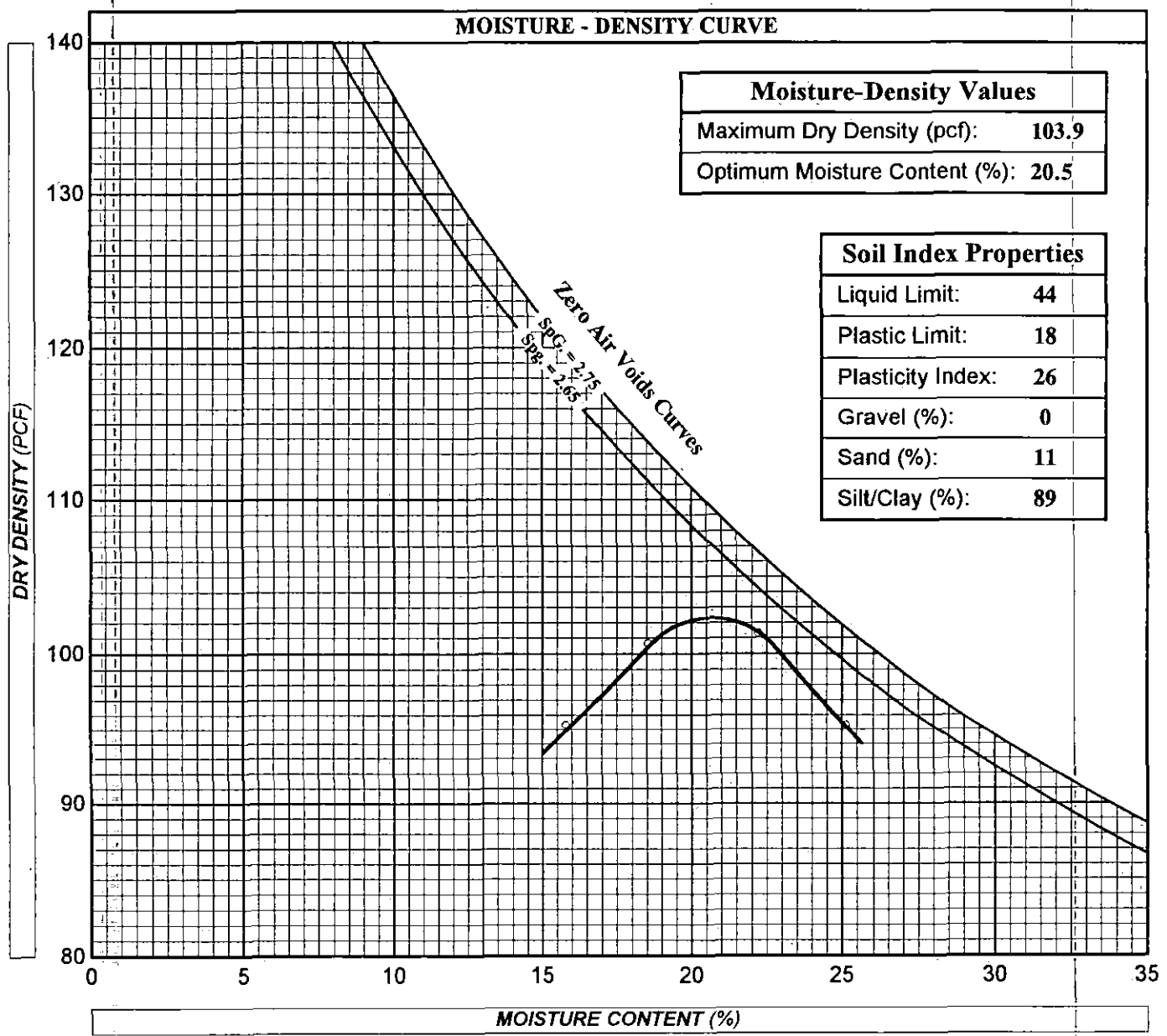
Figure B-7

Allied Laboratories
350 South Washington
Wichita, KS 67202
(316) 262-6457

MOISTURE - DENSITY RELATIONSHIP

Curve No.: na

Project Name: **Miles Lakewood Village 2nd Addition Levee**	Project No: **72-95398-42**	Date: **6/30/95**
Soil Description: **Lean Clay: FILL**		Classification: **CL**
Sample Location: **Combined Bulk 2: 5.0 - 10.0 feet**	Sampled By: **Allied**	Date: **6/22/95**



Moisture-Density Values	
Maximum Dry Density (pcf):	103.9
Optimum Moisture Content (%):	20.5

Soil Index Properties	
Liquid Limit:	44
Plastic Limit:	18
Plasticity Index:	26
Gravel (%):	0
Sand (%):	11
Silt/Clay (%):	89

AASHTO Designation:	T-99		ASTM Designation:	D-698	
Weight of Hammer (lbs):	5.5	Height of Drop (inch):	12	Number of Lifts:	3
Blows per Lift:	25	Diameter of Cylinder:	4 in	Volume of Cylinder:	0.0333 ft^3

Figure B-8

Allied Laboratories
350 South Washington
Wichita, KS 67202
(316) 262-6457

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487

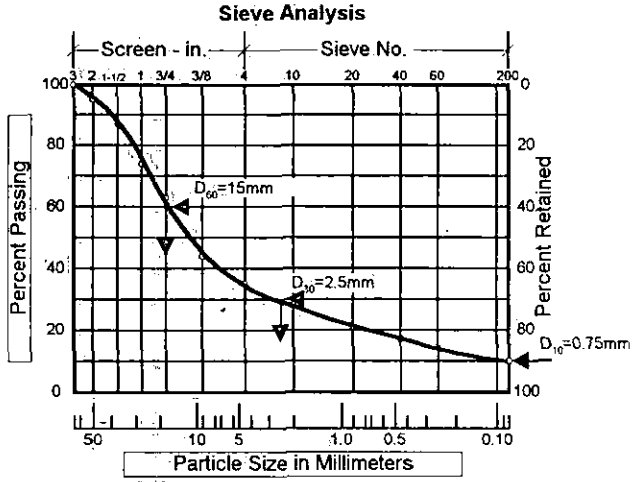
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	**Gravels** More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	**GW**	Well graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	**GP**	Poorly graded gravel [F]
		Gravels with fines More than 12% fines[C]	Fines Classify as ML or MH	**GM**	Silty gravel [F,G,H]
			Fines Classify as CL or CH	**GC**	Clayey gravel [F,G,H]
	Sands 50% or more passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	**SW**	Well graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	**SP**	Poorly graded sand [I]
		Sands with Fines More than 12% fines[D]	Fines Classify as ML and MH	**SM**	Silty sand [G,H,I]
			Fines Classify as CL and CH	**SC**	Clayey sand [G,H,I]
Fine Gained Soils 50% or more passes the No. 200 Sieve	**Silts and Clays** Liquid limit less than 50.	Inorganic	PI>7 and plots on or above "A" line [J]	**CL**	Lean clay [K,L,M]
			PI<4 and plots on or below "A" line [J]	**ML**	Silt [K,L,M]
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} \leq 0.75$	**OL**	Organic clay [K,L,M,N]
					Organic silt [K,L,M]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" Line	**CH**	Fat clay [K,L,M]
			PI plots below "A" Line	**MH**	Elastic silt [K,L,M]
		Organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} \leq 0.75$	**OH**	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			**Pt**	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM Well graded gravel with silt.
GW-GC Well graded gravel with clay.
GP-GM Poorly graded gravel with silt.
GP-GC Poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols:
SW-SM Well graded sand with silt.
SW-SC Well graded sand with clay.
SP-SM Poorly graded sand with silt.
SP-SC Poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$; $Cc = (D_{30})2 / (D_{10} \times D_{60})$.
[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to goup name.
[I] If soil contains $\geq$ 15% gravel, add "with gravel" to goup name.
[J] If Atterberg limits plot in hatched area, soil is a CL-ML silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel" to goup name.
[L] If soil contains $\geq$ 30% plus No. 200, predominately sand, add "sandy" to group name.
[M] If soil contains $\geq$ 30% plus No. 4, predominately gravel, add "gravelly" to group name.
[N] PI $\geq$ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

Sieve Analysis



$C_u = D_{60}/D_{10} = 15/0.075 = 200$ $C_c = (D_{30})^2/(D_{10} \times D_{60}) = (2.5)^2/(0.075 \times 15) = 5.6$

Plasticity Chart

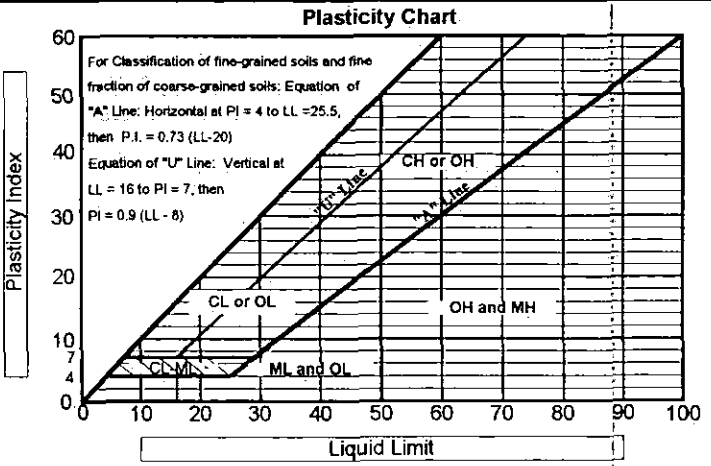


Figure B-9