GREAT PLAINS

SEWER CONTRACT

THIS SEWER CONTRACT, Made and entered into this 13 day of March, 1971,

BY AND BETWEEN BEL AIRE IMPROVEMENT DISTRICT OF SEDGWICK COUNTY, KANSAS, hereinafter referred to as FIRST PARTY;

JESS L. GRAHAM and LUIS A. CASADO, jointly hereinafter referred to as SECOND PARTY;

AND RICHLAND HEIGHTS, INC., a Kansas Corporation, hereinafter referred to as THIRD PARTY.

WHEREAS, the First Party is constructing an outfall sewer which runs along the east side of Oliver Street from 29th Street North to 37th Street North being originally planned to be constructed of ten (10) and eight (8) inch diameter sewer pipe; and

WHEREAS, the said sewer will be constructed in such a location that it could be utilitized to furnish sewer service to the following described real estate:

> South Half of the Northwest Quarter,
> Section 36, Township 26 South, Range 1 East
> Sedgwick County, Kansas,

such tract being owned by the Second Party; and

WHEREAS, such sewer is planned to be constructed in such a location that it can be utilized to furnish sewer service to the following described real property:

> North Half of the Northwest Quarter,
> Section 36, Township 26 South, Range 1 East,
> Sedgwick County, Kansas,

such tract being owned by the Third Party; and

WHEREAS, the parties desire to enter into a contract allowing the Second Party and the Third Party to utilize such sewer to serve the above described tracts with sewer service and to increase the size and style of the proposed sewer so that it can be so used.

WITNESSETH IT THEN, that the First Party does hereby contract and agree that it will cause to be constructed along the east side of Oliver Street from 29th Street North to 37th Street North in Sedgwick County, Kansas, a sanitary sewer outfall sewer; that the size of such sanitary sewer outfall will be increased so that it will be constructed of ten (10) inch and twelve (12) inch diameter sewer pipe and will be designed in such a manner that it will handle anticipated sewage from the two tracts above described at the rate of three and one-half (3 1/2) residences per acre or the equivalent thereto in addition to the sanitary sewer flow from Aurora Park Addition in Sedgwick County, Kansas.

It is further contracted and agreed that sewer connections from the above described tracts of land shall be limited to lateral sewer connections to the outfall sewer manholes which will be constructed along such sewer.

It is further contracted and agreed between the parties that such outfall sewer and all lateral sewer lines connecting thereto shall be constructed in accordance with the City of Wichita specifications and approved by the proper authorities of the City of Wichita.

It is further contracted and agreed between the parties hereto that the Second Party not only must meet the requirements of the City of Wichita but must secure permits from the City of Wichita for each connection they make to the said sewer system.

A federal grant in aid on construction of the said outfall sewer to serve Aurora Park has been obtained. The First Party contracts and agrees it will request from the federal government an increase in such grant in aid of construction, such increase to be based upon the increased cost of construction of the larger sewer line in order to serve the tracts above described.

First Party further contracts and agrees that it will expeditiously cause such outfall sewer to be constructed as above set out. In consideration for the same the Second Party and Third Party agree to pay jointly in cash to the First Part the sum of $30,000 if an increase in the federal grant is obtained, or the sum of $35,000 if no increase in the federal grant is obtained, such sum to be paid at the time that the First Party enters into a contract for the construction of such outfall sewer line.

IN TESTIMONY WHEREOF the parties hereto have signed this contract the day and year first above written.

BEL AIRE IMPROVEMENT DISTRICT
OF SEDGWICK COUNTY, KANSAS

ATTEST:

Secretary

By
Vice President

FIRST PARTY

Jesse L. Graham

Luis A. Casado

SECOND PARTY

RICHLAND HEIGHTS, INC., a Kansas Corporation

ATTEST:

Secretary

By

President

THIRD PARTY

N-128 as per Hilton
1-29-75

No conn. outside city (3300 blk No.) <u>unless</u> $500 spec. fee pd. & approved by City Commission. We can send application for sewer <u>service</u> to property owner to complete & return. The Commission must then approve it & proper signatures must be on it. The property owner must contact Bel-Air Impr. District & get approval from them & pay any fee they might charge.

~~OK for~~ N# ~~tap~~ or to tap the line

SOIL TESTING SERVICES OF KANSAS, INC.
3601 W. Harry St. Suite 8
Wichita, Kansas 67213 (316) 942-0171

September 27, 1979

Great Plain Industries, Inc.
1711 Longfellow Lane
Wichita, Kansas 67207

Attn: Mr. Larry Dean

Re: Subsurface Exploration for the
Great Plains Industries Warehouse
Oliver and 37th Street
Wichita, Kansas
STSK Job No. 179561

Gentlemen:

We are submitting, herewith, the subsurface exploration report performed for the referenced project.

Should you have any questions regarding the enclosed information, or if we can be of service in any other way, please do not hesitate to contact us.

Yours very truly,

SOIL TESTING SERVICES OF KANSAS, INC.

C. Fred Schoell
Registered Professional Engineer
Kansas No 7095

CFS/fg

Enclosure
cc: Poe & Associates of Kansas

SUBSURFACE EXPLORATION REPORT FOR THE PROPOSED

GREAT PLAINS INDUSTRIES WAREHOUSE

OLIVER & 37TH STREET NORTH, WICHITA, KANSAS

WICHITA, KANSAS

STSK JOB NO. 179561

SEPTEMBER 27, 1979

INTRODUCTION

The subsurface exploration for the proposed warehouse for Great Plains Industries in Wichita, Kansas, has been completed. Nine soil borings were performed at the site, 6 in the building area and 3 along a roadway, and the results of those borings along with a location diagram are included with this report.

It is our understanding that the proposed warehouse will have plan dimensions of 200 by 400 feet. The warehouse will be a steel framed single story, slab-on-grade, nonbasement structure. Foundation loads for the warehouse will be light to moderate with maximum column loads on the order of 100 kips, and maximum continuous wall loads of less than 4 kips per lineal foot. Floor loads for the structure will be less than 500 psf.

We understand that the floor surface will be elevation 184, requiring as much as 4 feet of fill and 2 or 3 feet of cut to develop final grade.

The purpose of this report is to describe the subsurface conditions encountered in the borings, analyze all data obtained and submit recommendations regarding foundation design and construction.

SUBSURFACE EXPLORATION PROCEDURES

The soil borings were performed with a truck mounted rotary type drill rig equipped with a hydraulic head employed in drilling and sampling operations. The borings were advanced using 4 inches diameter continuous flight augers. Representative soil samples were obtained by means of the shelby tube sampling procedure in accordance with ASTM Specification D-1587. In the shelby tube sampling procedure, thin wall seamless steel tubes with sharp cutting edges were pushed hydraulically into the soil and relatively undisturbed samples obtained. All samples obtained in the field were sealed and returned to the laboratory for further examination, classification and testing.

TESTING PROGRAM

The testing program consisted of performing unconfined compression and/or calibrated penetrometer, moisture content and density tests on representative samples recovered from the shelby tubes, where possible. In the calibrated penetrometer test, the approximate unconfined compressive strength of a cohesive or moderately cohesive soil was estimated, to a maximum value of 9,000 psf, by measuring the samples resistance to penetration of a small spring calibrated cylinder. Atterberg Limits tests were performed on representative samples to more accurately establish the soil's plasticity and to provide information for approximating the soils tendency to change volume with variation in moisture content. The results of all tests performed are shown on the boring logs.

As part of the testing program, all samples were examined in the laboratory by an engineer and classified in accordance with the attached General Notes and the Unfied Soil Classification System based on the material's texture, plasticity and the results of the Atterberg Limits tests. The estimated group symbol for the Unified Soil Classification System is shown in the appropriate column on the boring logs, and a brief description of the Unified System is included with this report.

SOIL CONDITIONS

The ground surface elevations as shown on the boring logs were taken from a topographic map of the site performed by others which had a contour interval of one foot. Based on this reference, ground elevations at the borings ranged from 179 to 184 in the building area, and from 185 to 177 along the proposed roadway. The site drains to the south, southwest.

The site is located in a terrace area along the east edge of the Arkansas River Valley. Soils of apparent alluvial deposition were encountered in all borings and continued to the bottom of the borings in except in borings #4 and #5.

Six to 10 inches of surface vegetation and topsoil was encountered throughout the building and roadway area. The alluvial soils were predominately cohesive soils consisting of silty clay with various amounts of sand, and clayey silt. Typically, the color of the alluvial soils were brown to red-brown. The upper 4 to 7 feet of the alluvial soils generally had a consistency of very stiff. Beneath approximately 4 to 7 feet the consistency of the silty clay and clayey silt soils was medium to stiff. Sand seams were frequently encountered within the cohesive soils, and boring #1 a layer of medium dense silty sand with clayey zones was encountered at 11 feet. All boring except #4 and #5 were terminated in the apparent alluvial material at depths of 3 to 13 feet.

In borings #4 and #5 very stiff, brown to red-brown, sandy silty clay or silty clay with sand zones continued to depths of 7 and 5 feet, respectively. Below those depths, silty clay (highly weathered shale) with a color of yellow-brown to olive and a consistency of very stiff to hard was encountered. Borings #4 and #5 were terminated in the highly weathered shale at a depth of 13 feet.

The stratification lines shown on the boring logs represent the approximate boundary between soil types; in situ, the transition may be gradual.

GROUNDWATER OBSERVATIONS

Groundwater levels observed while drilling and after completion of the borings are shown on the boring logs. Groundwater was observed only in borings #1, #2 and #3 at depths of approximately 6 to 9 feet beneath existing grades. These depths corresponded to approximately elevations 173 to 176. In addition to the groundwater observed, we feel it is probable that perched or trapped water may occur in the more permeable sand seams contained at other locations during various time of the year.

Fluctuations in the location of the groundwater level, and in the level and amount of perched or trapped water, should be anticipated throughout the years depending upon variations in precipitation, evaporation and surface runoff.

ANALYSIS AND RECOMMENDATIONS

Footing foundations are feasible for the support of the proposed warehouse. We recommend that footings extend below all existing surface vegetation and topsoil and be supported on the very stiff, brown to red-brown, silty clay, sandy silty clay and clayey silt encountered immediately beneath the surface vegetation and topsoil at the boring locations. For the design of footing foundations supported on the very stiff cohesive soils, we recommend using a net allowable total load soil bearing pressure not to exceed 3,500 psf. The net allowable total load soil bearing pressure refers to pressure at foundation level in excess of the minimum surrounding overburden pressure.

With the thickness of fill required in the southeast area of the warehouse it may be desirable to support foundations on compacted fill. To support foundations on compacted fill, all surface vegetation and topsoil should be removed from beneath the building area and for a minimum distance of 5 feet beyond the building area. Fill used below foundations should consist of approved materials, free of organic matter and debris, placed in loose lifts not to exceed 9 inches in thickness and compacted to a minimum of 95% of maximum dry density as determined in accordance with ASTM Specification D-1557, the modified Proctor procedure. The fill should be placed and compacted at a minimum moisture level equal to or greater than optimum moisture as determined by ASTM Specification D-1557. Such fill should extend beyond the outside building edge a minimum of 5 feet.

Foundations supported on properly compacted backfill as defined above can be designed using a net allowable total load soil bearing pressure not to exceed 3,500 psf.

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We recommend that exterior foundations and foundations in nonheated areas be located a minimum distance of 3 feet below final exterior grade to provide adequate frost cover protection and to minimize moisture variations in cohesive bearing materials during wet and dry periods of the year. We recommend using a minimum size of 2.5 feet by 2.5 feet for column footings. Trench footings would be feasible in the native cohesive soils or in compacted fill assuming the fill was essentially cohesive type materials. If trench footings are used, they should have a minimum width sufficient to observe and hand clean the bearing material, and to allow proper placement of reinforcing steel and foundation concrete.

Based on the soil and groundwater conditions encountered at the boring locations, no unusual problems are anticipated in completing the excavations required for the construction of footings. The cohesive soils encountered at the site were moderately plastic and care should be taken to minimize wetting or drying of the bearing materials during construction. Any water accumulating in the foundation excavations should be promptly removed. Based on the soil and groundwater conditions observed normal sump pit and pump procedures should be adequate. Any loosened or disturbed materials in the foundation excavations should be removed prior to placing reinforcing steel and foundation concrete.

Long term settlement of footing foundations designed and constructed as recommended above on suitable native soils or properly compacted fill should be relatively small, less than 3/4 inch.

Floor Slabs

All surface vegetation and topsoil should be removed from beneath floor slabs. The strength and compressibility of the native soils encountered at the boring locations are satisfactory for the support of the slab. Based on the results of the Atterberg Limit tests the cohesive soils generally encountered at the site would be described as moderately plastic. Some highly plastic materials were observed, but these materials occurred several feet below the ground surface and should not have a significant effect on the slab performance. By maintaining the in situ moisture of the native soils prior to construction of the floor slab, and maintaining the moisture levels in the fill required beneath the slab as recommended below, in our opinion, significant volume changes in the slab subgrade would not be anticipated as a result of moisture variations in the native soils.

Where fill is required beneath the floor slab, it should consist of an approved material free of organic matter and debris, placed in loose lifts not to exceed 9 inches in thickness and be compacted to a minimum of 90% of maximum dry density as determined in accordance with ASTM Specification D-1557. We recommend that cohesive fill used beneath the floor slab be placed at a minimum moisture level equal to or greater than 1% above optimum moisture as deter-

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mined in accordance with ASTM Specification D-1557. The moisture level in the cohesive subgrade materials should be maintained up to construction of the floor slab.

Long term settlement of floor slabs supported on native soils or properly compacted fill as described above should be minimal.

Paved Areas

All surface vegetation and topsoil should be removed from beneath paved areas. In cut areas, we recommend that the native soils be scarified for a minimum depth of 6 inches and compacted to a minimum of 90% of maximum dry density as previously defined. The materials should be densified and maintained at a minimum moisture level equal to or greater than optimum moisture as previously defined.

In fill areas, we recommend that fill be placed and compacted as previously recommended for fill beneath floor slab except for the minimum moisture level. We recommend that the minimum moisture level of fill beneath pavements be equal to or greater than optimum moisture as previously defined.

The on site soils generally consisted of cohesive soils although some sand seams were encountered. In fill or cut areas, we recommend that the sand seams be thoroughly blended with the cohesive soils so as not to create potential seepage zones in the subgrade. The native soils encountered at the site are suitable for use as fill on the project providing the minimum moisture levels are maintained.

Based on a pavement subgrade consisting of densified native materials as recommended above for cut areas, or properly compacted fill consisting of the on site cohesive soils, in our opinion a CBR value of 5 would be appropriate for the design of pavement sections. Using a CBR value of 5 and based on approximately 30, 30,000 gross weight trucks using the roadway per day, we recommend using the pavement thicknesses shown in the below table. In addition, all paved areas should be adequately sloped to provide rapid surface runoff in order to minimize softening of the subgrade.

ROADWAY PAVEMENT

PAVEMENT TYPE	TOTAL INCHES
Portland Cement Concrete, plain	7 (4,000 psi, 6 sack, min.)
Full Depth Asphalt	8½ (3 min. surface course)

GENERAL

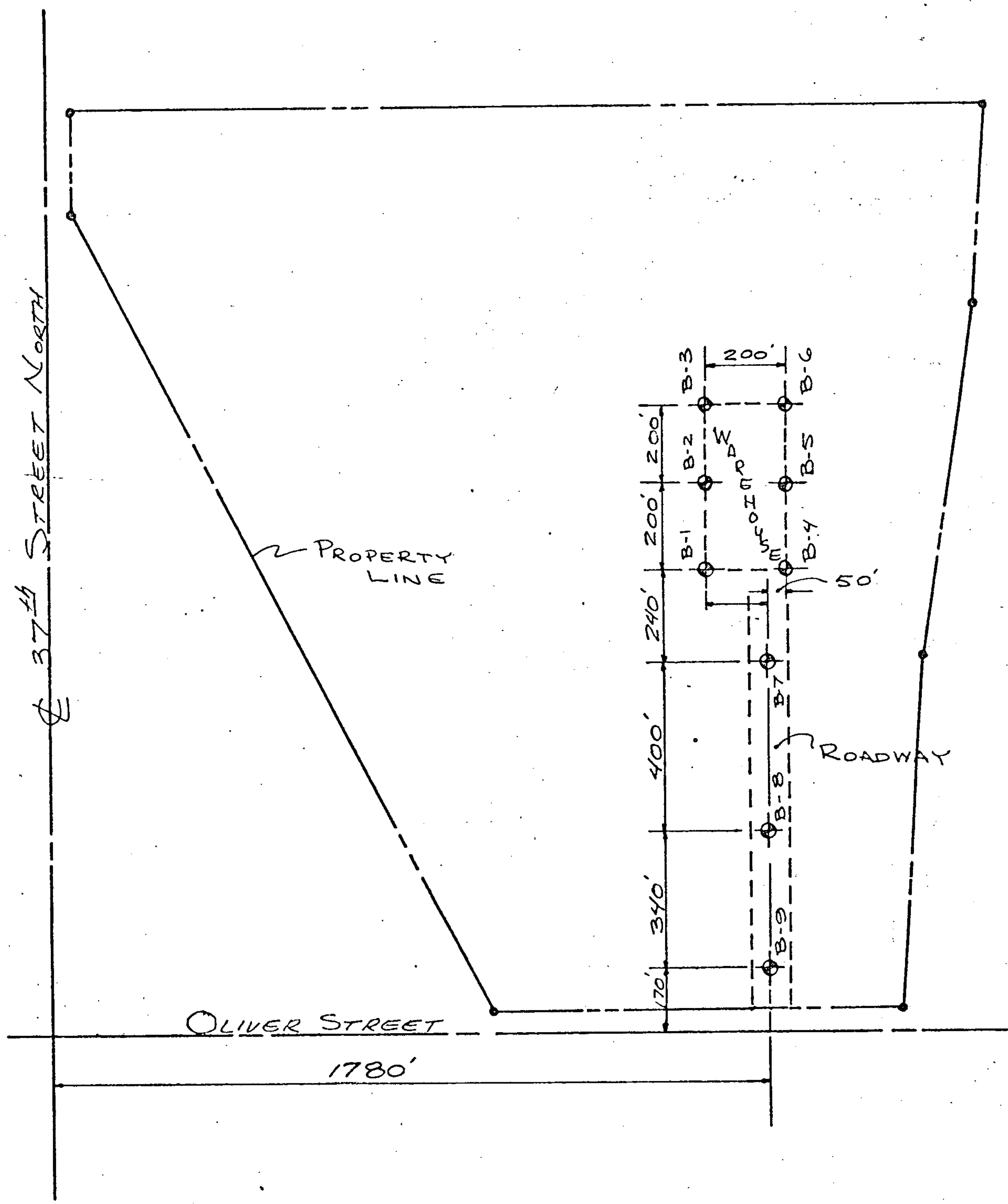
The analysis and recommendations presented in this report are based upon the data obtained from the soil borings performed at the locations indicated on

September 27, 1979

the location diagram and from any other information discussed in this report. This report does not reflect any variations which may occur between the borings. Variations in soil and rock conditions exist on most sites between boring locations and also other conditions such as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations of this report after performing on site observations during the construction period and noting the characteristics of any variations.

It is recommended that all construction operations dealing with earthwork and foundations be observed and tested by an experienced soil engineer or technician to help assure that the design requirements are fulfilled in the actual construction. It is also suggested the soil engineer be given the opportunity to review the plans and specifications when they have been prepared so comments can be made regarding the effect of soil conditions on the design and specifications.

This report has been prepared in order to aid in the evaluation of this property and to assist the architect and/or engineer in the design of this project. The scope is limited to the specific project and location described herein and our description of the project represents our understanding of the significant aspects relevant to soil and foundation characteristics. In the event that any changes in the design or location of the warehouse as outlined in this report are planned, we should be informed so the changes can be reviewed and, where appropriate, the conclusions of this report modified or approved in writing by the soil and foundation engineer.



BORING LOCATION DIAGRAM GREAT PLAINS INDUSTRIES WAREHOUSE		SOIL TESTING SERVICES OF KANSAS, INC. KANSAS CITY · WICHITA
Wichita Kansas		CFS NTS Sept. 79 179561

Lifetime Addition 3-27-80

Composite runoff factor determination

Use 0.5 for existing residential development north of 37th Street. (37. acres)

Use 0.90 for proposed heavy industrial use in North Oliver Industrial Addition (58 acres)

$$\text{Composite } c = \frac{(37. \times 0.5) + (58 \times 0.9)}{95} = 0.74$$ @ North line of Lifetime Addition.

Drainage Area at North line Lifetime Addn = 95 Acres

Length of channel from upper end to North line of Lifetime Addn is 4780 feet.

Fall, H, thru drainage area is 218.1 − 173.4 = 44.7 feet

$$Tc = \left(\frac{11.9}{H} L^3\right)^{.385} = \left[\frac{11.9}{44.7}\left(\frac{4780}{5280}\right)^3\right]^{.385} = .54 \times 60 = 32 \text{ minutes}$$

for duration of 32 minutes, I_{100} = 6.45 inches/hour

$$Q = CiA = 0.74 \times 6.45 \times 95 = 453 \text{ cfs}$$

Drainage area thru Lifetime Addition is 15 acres of mobile home residential land use w/c = 0.5

Composite runoff factor for 37 acres of residental north of 37th (c = 0.5), 58 acres of industrial (C = 0.9) and 15 acres of mobile home residental (C = 0.5) is

$$\text{Composite } c = \frac{(37 \times .5) + (58 \times .9) + (15 \times .5)}{110} = 0.71$$

Lifetime Addn 4-1-80

Drainage Area at South line of Lifetime Addition = 110 Acre
Length of channel from north line to south line is (25+60) - (19+60) = 600 feet. Total length of channel to south line Lifetime Addition is 4780 + 600 = 5380 feet
Fall, H, thru drainage area to south line of Lifetime Addition is 218.1 − 168.0 = 50.1 feet

$$Tc = \left(\frac{11.9 L^3}{H}\right)^{.385} = \left[\frac{11.9}{50.1}\left(\frac{5380}{5280}\right)^3\right]^{.385} = .59 \times 60 = 35 \text{ minutes}$$

@ 2.5 fps

for duration of 35 minutes I_{100} = 6.02 inches/hour

$Q = CiA = 0.71 \times 6.02 \times 110 = \underline{470}$ cfs @ South line of Lifetime Addition.

Drainage Area at Dam south of Lifetime Addn is 123 Acre
Length of channel from south line to dam is (19+60) - (11+40) = 820 feet
Total length of channel to dam is 5380 + 820 = 6200 feet
Fall, H, thru drainage area above dam is 218.1 − 166.5 = 51.6'

$$Tc = \left[\frac{11.9 L^3}{H}\right]^{.385} = \left[\frac{11.9}{51.6} \times \left(\frac{6200}{5280}\right)^3\right]^{.385} = .68 \times 60 = 41 \text{ minutes @ 2.5 fps}$$

I_{100} for 41 min = 5.32 in/hr

Composite runoff factor 'c' for 52 acres residential (c = .5), 58 acres industrial (c = 0.9) and 13 acres grassland (c = 0.2) is

$$\text{Composite 'C'} = \frac{(52 \times .5) + (58 \times .9) + (13 \times .2)}{123} = 0.66$$

Q_{100} @ Dam = CiA = $0.66 \times 5.32 \times 123$ = 432 cfs

NORTH OLIVER INDUSTRIAL PARK 4-1-80

Drainage Area above 37th Street
planimeter survey

Area # 1, North of 38th Street

4213	6393		
2047	4213		
2166	2180	> 21.73 ×	19.95

Area # 2 Between 37th St & 38th Street

10820	2667		
8953	0820		
1867	1847	> 18.57 ×	16.96

A = 36.91 Acres

See Max Greene 10-8-7…

L = 2280 feet from upper end of drainage area to 37th Street.

Fall, H, from upper end of drainage area to 37th Street = 218.1 − 190.0 = 28.1 feet

$T_c = \left(\frac{11.9\ L^3}{H}\right)^{.385}$ $\left[\frac{11.9}{28.1}\times\left(\frac{2280}{5280}\right)^3\right]^{.385} = .27 \times 60 = 16$ minutes.

V = 2.4 fps

* Note: Differs from Greene 10-8…

for 16 minute duration, I_{100} = 8.76

C = 0.5 for single family residential

$Q = C\,i\,A = 0.5 \times 8.76 \times 37 = 162$ cfs **

@ North line of North Oliver Industrial Addn.

** Differs from Greene 10-8-76

North Oliver Industrial Park (2) 4-1-80

Drainage Area of North Industrial Park = **58** Acres
C for industrial land use = 0.9

Composite 'c' for 37 acres of single family residential w/c = 0.5 and 58 acres of industrial w/c = 0.9

$$\frac{(37 \times .5) + (58 \times .9)}{95} = 0.74$$

Length of channel from 37th Street to south line of NOIP is (50+60) - (25+60) = 2500 feet
Total length of channel from upper end to south line of NOIP is 2280 + 2500 = 4780 feet
Total fall, H, thru drainage area to south line of NOIP = 218.1 - 173.4 = 44.7 feet $S = \frac{44.7}{47.80} = .94\%$

$$T_c = \left(\frac{11.9}{H} L^3\right)^{.385} = \left[\frac{11.9}{44.7}\left(\frac{4780}{5280}\right)^3\right]^{.385} = .54 \times 60 = 32 \text{ mi}$$

@ 2.5 fps
$I_{100} = 6.45$ in/hr

Q = CiA = 0.74 × 6.45 × 95 = **453** cfs

Estimates made 5-22-81 MSM

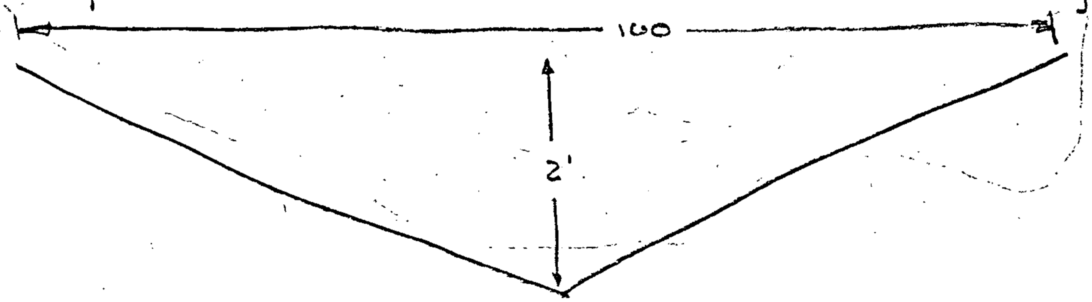
See Pg 6 follow 4-16-80 in Lifetime file

$$\frac{95 \text{ Acres} \times 4.32 \text{ inch/acre runoff}}{12} =$$ 34.2 Acre feet Runoff

S = (453 - 250) 1920 = 9 Acre-feet
Choose average depth of storage = 2', Volume of storage
S = 10 acre-feet ; peak outflow = 250 cfs
60" pipe

North Oliver Industrial Park 4-14-80

Design section for 100 feet Floodway



Area of waterway = $\frac{100 \times 2}{2}$ = 100 square feet.

$WP = \sqrt{(50)^2 + (2)^2} \times 2 = 100.08$

$R = \frac{100}{100.08} = 1$; $R^{2/3} = 1$

w/ n = 0.035

$Q = \frac{1.486}{.035} \times A R^{2/3} S^{1/2}$

$\frac{Q}{S^{1/2}} = 42.46 \times 100 \times 1 = 4246$

w/ S = .01 , Q = 424.6 cfs

w/ S = .008 , Q = 380 cfs

April 16, 1980

To: Jack Galbraith

From: M. S. Mitchell

Re: North Industrial Park Addition--
Proposed Replat of Lot 2.

On April 15, Paul Johnston, Flood Control Director, and I came to an agreement on the effect comments contained in his memorandum of March 13, 1980 to Phil Dietrich might have on the proposed "Replat of Lot 2, North Oliver Industrial Park Addition" dated March 13, 1980 by Poe & Associates:

Based on my presentation of computations to support the ability of the 100 foot wide Floodway to handle the 100 year frequency flood discharge in its natural condition, as modified by maximum encroachment into the floodplain and with a stylized "design channel" section, Mr. Johnston concurs in my recommendation that the 100 foot wide "Floodway" across the aforementioned replat is adequate, reasonable and appropriate.

Please convey this position in your staff comments to the applicant, its engineer, the Planning Commission and other agencies advisory to the Sub-Division Committee of the Metropolitan Area Planning Commission. If we can be of further assistance in this matter, please advise.

M. S. Mitchell

Paul Johnston, Acting Director
Flood Control & Landfill Division

cc: Paul Johnston
Phil Dietrich, Sedgwick
Mike Thompson, Poe & Assoc.
Larry Dean, Great Plains Ind.,Inc.

Exhibit 1 Pg 6

BACKWATER COMPUTATION WORK SHEET

Project: Tolerville Tributary to East Branch Chisholm Creek w/surveyed X-sections in southern portion of Great Plains Business Park Addition - Natural Sections

Page 1 of 1

Computed by: MSM Date Oct 1981

Checked by: ✓ Date

Q = 470 cfs to Sta 26, 450 cfs to sta 29, 370 cfs to 35 n = 0.035 c = 0.4246 x .01 = .4246

Mile or Sec. No.	Reach Length	Est. W.S. Elev.	Area	2/3 r	WEIGHTED S1/2 = 0.01 W	Q W	S	Mean S	hf	TRUE V	TRUE Q	V^2Q	h_v	h_v Diff	H	Comp. Elev.
Using	broad	-crested	weir	@	dam	spillw	ays @	Sta 11+40			W.S. 15					168.0
* 15+90	450	168.7	476	1.75	0.74	354	.0002	.0013	.61	.98	468		.02	.11	.72	168.72
* 18+55	255	169.5	170	.78	.33	56	.007	.0036	.95	2.75	468		.12	-.05	.90	169.62
* 19+50	95	170.9	103	.72	.31	31	.0224	.0147	1.39	4.64	477		.30	-.09	1.3	170.92
* 20+17	67	172.0	208	.85	.36	75	.0039	.0131	.88	2.24	467		.08	.22	1.10	172.02
* 21+25	108	172.8	152	.71	.30	46	.0104	.0072	.77	3.07	466		.15	-.03	.74	172.76
* 23+25	200	174.4	139	.99	.42	58	.0065	.0085	1.69	3.39	472		.18	-.01	1.68	174.44
* 25+20	195	175.5	235	1.17	.50	117	.0016	.0041	.79	2.0	472		.06	.12	.91	175.35
* 29+90	470	178.35	76	1.0	.43	33	.0124	.007	3.29	4.82	366		.36	-.15	3.14	178.49
* 34+10	420	181.8	260	.80	.34	88	.0018	.0071	2.98	1.42	372		.03	.33	3.31	181.80
* 39+50	540	184.0	130	.87	.37	48	.0059	.0039	2.09	2.85	371		.13	-.05	2.04	183.84

$V_1 = C r^{2/3} S^{1/2}$ $C = \frac{1.486}{n}$ $S = (0.01 \frac{Q}{Q_1})^2$ $V = V_1 \frac{Q}{Q_1}$ $h_v = \frac{V^2 Q}{64.4 Q}$ $H = h_v \text{ Diff.} + h_f$

SWT Form 49-C
Rev 18 Dec 61

* Surveyed X-Sections 7-29-80 ** Sections from Flood Control topographic map.

BACKWATER COMPUTATION WORK SHEET

GREAT PLAINS BUSINESS PARK ADDITION

Project: Tolerville Tributary to East Branch of Chisholm Creek
Natural sections on Kraft property to improved channel
channel to RCBC to improved channel to natural section

Page 1 of 2

Computed by: MSM Date Oct 1981

Checked by: ______ Date ______

Q = 470 cfs Sta 11 to Sta 26; 450 cfs Sta 26 to Sta 29; 370 cfs Sta 29 to Sta 40   n = .035   c = 42.46 X .01 = .4246

Mile or Sec. No.	Reach Length	Est. W.S. Elev.	Area	$r^{2/3}$	WEIGHTED $S^{1/2} = 0.01$ V_1	Q_1	S	Mean S	hf	TRUE V	Q	V^2Q	h_v	h_v Diff.	H	Comp. Elev.
							.0070									
19+50	95	170.9	103	.72	.31	31	.0224	.0147	1.39	4.64	477		.30	-.09	1.3	170.92
20+17	67	172.0	208	.85	.36	75	.0039	.0131	.88	2.42	467		.08	.22	1.10	172.02
21+25	108	172.8	152	.71	.30	46	.0104	.0072	.77	3.07	466		.15	-.03	.74	172.76
	TRANS	ITION	FROM	NATU	RAL	SECTION	TO 35'	bottom	w/4	:1 S	ide Slop	es				
23+25	200	174.3	158	.99	.42	67	.005	.0077	1.54	2.97	469		.14	.01	1.55	174.31
23+75	50	174.5	178	1.07	.46	81	.0034	.0042	.21	2.66	473		.11	.03	.24	174.55
	TRAN	SITION	FROM	35'	bottom	w/	4:1 Sid	e Slope	s	to	2-10x	4 RCB	C			
	FRom	Sta	23+85	to	Sta	24+65	usa	2-10x	4 R	CBC	w/D.S.	Flowlin	e 171.	7 & U.	S. Flo	wline 172.5
			D= 4'		DWS	= 176	.5	V=5.9	fps				.54			
	TRAN	SITION	FROM	RC	BC	to 20	' bottom									
24+75	10	176.7	155	2.0	.85	132	.0013	.0006	—	3.03	470		.14	.40	.40	176.9
25+20	45	176.9	160	2.03	.86	138	.0012	.0012	.05	2.93	470		.13	.01	.06	176.96
26+00	80	177.0	144	1.95	.83	119	.0016	.0014	.11	3.27	471		.16	-.02	.09	177.05
27+15	115	177.2	134	1.9	.81	108	.0019	.0017	.19	3.37	452		.18	-.01	.18	177.23

$V_1 = Cr^{2/3}S^{1/2}$ $C = \frac{1.486}{n}$ $S = (0.01 \frac{Q}{Q_1})^2$ $V = V_1 \frac{Q}{Q_1}$ $h_v = \frac{V^2 Q}{64.4 Q}$ H = h_v Diff. + h_f

SWT Form 49-C
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BACKWATER COMPUTATION WORK SHEET

GREAT PLAINS BUSINESS PARK ADDITION

Project: Tolerville Tributary to East Branch of Chisholm Creek
Improved channel to natural section @
North line of plat

Computed by: MSM Date Oct 1981

Checked by: ______ Date ______

Q = 450 cfs to Sta 29; 370 to Sta 40 n = .035 WEIGHTED c = 42.46 X.01 = .4246

Mile or Sec. No.	Reach Length	Est. W.S. Elev.	Area	2/3 r	$S^{1/2}$ = 0.01 V 1	Q 1	S	Mean S	hf	TRUE V	Q	V^2Q	h_v	h_v Diff.	H	Comp. Elev.
							.0017						.18			177.23
28+35	120	177.4	114	1.78	.76	86	.0027	.0022	.26	3.97	453		.24	-.03	.23	177.46
	TRANSITION FROM TRAPEZOIDAL 20' bottom w/4:1 side slopes to TRIANGULAR SECTION															
		D = 2.2	T = 100													
29+90	155	178.0	110	1.06	.45	50	.0056	.0041	.64	3.36	370		.18	.06	.70	178.16
		D = 1.9	T = 100													
32+00	210	179.7	90	.96	.41	37	.0102	.0079	1.66	4.14	372		.27	-.05	1.61	179.77
		D = 2.0	T = 100													
34+00	200	181.5	100	1	.42	42	.0076	.0089	1.78	3.66	366		.21	.06	1.84	181.61
35+00	100	182.5	100	1	.42	42	.0076	.0076	.76	3.66	366		.21	—	.76	182.37
		TRANSITION TO NATURAL SECTION														
39+50 *	450	184.5	259	1	.42	110	.0011	.0044	1.96	1.41	366		.03	.18	2.14	184.51

$V_1 = C r^{2/3} S^{1/2}$ $C = \frac{1.486}{n}$ $S = (0.01 \frac{Q}{Q_1})^2$ $V = V_1 \frac{Q}{Q_1}$ $h_v = \frac{V^2 Q}{64.4 Q}$ $H = h_v$ Diff. + h_f

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* * Section from Flood Control topographic map