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File 1993-0047 Name: Guardian Storage - SPR - 2260 I-70 Business Loop

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		A few items are denoted with an asterisk (*), which means they are to be scanned for permanent record on the ISYS retrieval system. In some instances, items are found on the list but are not present in the scanned electronic development file because they are already scanned elsewhere on the system. These scanned documents are denoted with (**) and will be found on the ISYS query system in their designated categories. Documents specific to certain files, not found in the standard checklist materials, are listed at the bottom of the page. Remaining items, (not selected for scanning), will be listed and marked present. This index can serve as a quick guide for the contents of each file.
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		Public notice cards
		Record of certified mail
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		Other bound or non-bound reports
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X	X	***Review Comments**
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DOCUMENT DESCRIPTION:

X	X	Sign Permit - issued 7/1/593 - **			
X	X	Development Improvements/w release - to be scanned - **			
X	X	Modifications, Hydrologic Analysis			
X	X	Correspondence			
X		E-mails			
X	X	Modification in Size of Orifice Plates, Drainage Plan			
X		State Highway Access Permit - Colorado Dept. of Transportation - 4/21/93 - # 393049			
X	X	Certificate of Occupancy			
X	X	Landscape Plan			
X	X	Drainage Plan			
X	X	Site Plan			
X		Foundation Plan			
X		Elevation Plan			
X		Sections Map			

Lincoln DeVore, Inc.
Geotechnical Consultants
1000 West Fillmore St.
Colorado Springs, CO 80907

TEL: (719) 632-3593
FAX: (719) 632-2648

April 1, 1993

Kelco General Contractors
584 25 Road
Grand Junction, CO 81505

Attn: Mr. Kelly Ford

Re: Modifications, Hydrologic Analysis, Guardian Storage Facility, 2260 E. Main Street, Grand Junction, Colorado

Dear Mr. Ford:

We have been informed that you would like to make two minor changes in the Guardian Storage Site which might change the runoff calculations to a degree. These changes have been reviewed, and are the subject of this letter.

1. You wish to have the option to change the pavement from asphalt to concrete. It is true that the surface friction factors of these materials are slightly different, being 0.015 for concrete and 0.018 for asphalt. The time of concentration will be a bit shorter and the velocity and maximum runoff a bit higher on concrete than on asphalt.

   However, the paved area is only about 300 feet and the grades are relatively low. A spot check of the figures showed a few seconds difference in time. In our opinion, the change is not significant over such a short area.

2. You wish to replace the concrete trench drain which we show with a dipped gutter section similar to a street pan. The hydraulic radius of such a section varies from that of a vertical sided trench drain, and will change the velocity and flow in a manner similar to that noted in (1) above.

   Again, in our opinion, the change in timing and flow will not be significant over the short distances involved.

In our opinion, either or both of the proposed changes can be used on this site. Minor differences in timing and flow amounts will not be significantly changed. Please let us know which of

the construction details you are going to use so that we can note them in our files.

This opportunity to be of professional service is sincerely appreciated. If you have any questions or require additional information, please feel free to contact the undersigned engineer at your convenience.

Respectfully submitted,

LINCOLN DeVORE, INC.

By: George D. Morris, P.E. 4/6/93

GEORGE D. MORRIS REGISTERED 2051 PROFESSIONAL ENGINEER STATE OF COLORADO

GDM/lab
LD Job No. 77461-J
Enclosures
cc: Lincoln DeVore, Grand Junction

Lincoln DeVore, Inc.
Geotechnical Consultants
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March 30, 1993

Kelco General Contractors
584 25 Road
Grand Junction, CO 81505

Attn: Mr. Kelly Ford

Re: Hydrologic Analysis, Guardian Storage Facility,
2260 E. Main Street, Grand Junction, Colorado

Dear Mr. Ford:

As requested, Lincoln DeVore has investigated runoff conditions at the proposed Guardian Storage site on the U. S. Highway 50 Frontage Road at approximately the extension of 23rd Street, in Grand Junction, Colorado. This analysis was completed in March, 1993, and consisted of analyzing the historic 2-year and 100-year runoff at the site outlet, together with the developed 2-year and 100-year runoff at the site outfall. The proposed internal drainage and paving area storage was computed to determine the holding capacity and means to allow developed runoff from the site which will not exceed historic rates.

Scope and Sources:

The purpose of the analysis was to size outlets from the site which restrict outflow runoff to the equivalent historic rates. The analysis was based on the "Interim Outline of Grading and Drainage Criteria" obtained from the City Engineering Office of Grand Junction, Colorado. We understand that the copy obtained is not yet in its final form, but the basic outline of procedure appears to be complete.

The results obtained following the Grand Junction criteria were checked using methods outlined in CUHP, Vols. 1 and 2. Information concerning soil drainage characteristics was taken from Soil Conservation Service and U. S. Geological Survey publications, and was corroborated by information from geotechnical work performed in the area by Lincoln DeVore.

Coefficients for the Rational Method, n values and Intensity, Duration, Frequency Values used herein were taken from Appendices attached to the Interim Grading and Drainage Criteria, Grand Junction, Colorado. We understand that the Criteria requires design of outlets for the 2-year runoff and the 100-year runoff

so that the equivalent "historic" flow is not exceeded through this range. The project site and contributing basin areas are very small. Therefore, the modified Rational Formula method was used for these calculations.

Site Description:

The project site is located on the north side of the U. S. Highway 6 and 50 Frontage Road, at approximately the line of 23rd Street extended southerly, in the southeasterly portion of Grand Junction, Colorado. The site has the address of 2260 East Main Street in Grand Junction. The area around the project site consists of a very low gradient slope down toward the southwest. Construction of the City Bypass of U. S. Highway 6 and 50 altered the drainage pattern "downstream" from the project site, so that drainage became controlled by the street. Most runoff north of the Frontage Road is sheetflow controlled to some degree by the street system.

The project site was found to be elevated one to three feet above the surrounding area. We understand that the site has been higher than the surrounding slope for some time. Due to this elevation difference, the calculations for both historic flow and developed flow were completed based on the area of the project site only. The "historic" flow is thus quite small. The generally low gradient of approximately 0.4% forced the time of concentration for historic flow to be relatively slow.

The proposed development of the area has changed the direction of flow from southwest to due south. The proposed buildings are to be long and narrow, with paved driveways on each side of each building. The shape of the buildings and pavement force drainage to move south parallel with the buildings to the front (south portion) of the lot, which will be the primary storage area for runoff. The maximum elevation for storage is set and controlled by the entry driveway from the Frontage Road to the site. This elevation is set by the existing curb and sidewalk which cannot be changed. For all practical purposes, developed runoff consists only of that precipitation falling directly onto the site.

The City of Grand Junction has constructed a storm sewer along the Frontage Road which serves as the outfall for surface runoff in the area. This project site will utilize this storm sewer as an outfall also. Runoff from the site will be temporarily stored over a relatively large, shallow area and allowed to flow into the storm sewer via two metered manhole outlet and pipe systems. This metered outfall is intended not to exceed the historic flow

into the storm sewer, and to prevent water overflowing the sidewalk and moving into the street.

Soil Conditions:

The soils on the site are described by the U.S.G.S. as residually weathered clays derived from the Mancos Shale, occasionally covered with local colluvium consisting of clayey sands. The Soil Conservation Service describes the soils as being variations of the Billings Silty Clay, 0 to 3% slopes. Their classification shows these site soils as being in Hydrologic Group C. Coefficients for use in both the "historic" analysis and in the developed analysis were taken from the Grand Junction Criteria based on the S.C.S Hydrologic Classification of "C". Development on site will cover most of the site with roof areas, paved areas and two small landscaped areas at the south entry to the site. Runoff coefficients for each of these conditions were taken from the Grand Junction Criteria.

Historic Runoff:

The time of concentration for each of the subbasins was calculated based on overland flow not to exceed 300 feet. Since the project site is approximately 300 feet along the direction of runoff, the time of concentration for "historic" flow was found by formula without the use of ditch flow. Examination of the project site and surrounding area indicated that most runoff was either sheetflow (overland) or concentrated in shallow, relatively wide swales southwest of the project site. Therefore, the time of concentration for "historic" flow was relatively long to the point of outfall. The historic peak flow found by the modified Rational Formula varied from 0.152 cfs for the 2-year runoff to 0.76 cfs for the 100-year runoff.

Developed Runoff:

The time of concentration for the project site runoff in the developed condition is relatively short, since nearly all of the area will be building roof area or asphalt pavement area. Although the overall surface gradient has been slightly reduced, the use of paved swales and concrete trench drains increase velocity considerably. The coefficients for the formula were increased to fit the paved and small area landscaped conditions. The developed peak flows found by the modified Rational Formula varied from 1.10 cfs for the 2-year runoff to 3.16 cfs for the 100-year runoff.

The site plan design was utilized without change except in gradient of pavement. The buildings were left in the position shown on the plan given to Lincoln DeVore, as were the concrete trench drains and landscaped areas. The grades were modified to provide adequate storage volume for runoff water on the site without overtopping the front sidewalk elevations. Other than this elevation change in the paved area, the plan for the site is the same as that provided to us.

The small landscaped areas at the front (south end) of the site have little effect on developed runoff other than to slow the velocity of flow from the paved areas along the east and west boundaries of the project site into the storage area. A runoff time lag therefore exists between the time of peak flow from the central paved area and the time of peak flows from the paved areas adjacent to the east and west boundaries of the site. The east, north and west boundaries of the site require raising and placement of a concrete curb in these areas to contain the runoff within the project site. Flow in these exterior areas will not be deep, so that a low curb will be adequate. From a practical standpoint, however, we recommend that the City standard height curb be used.

As designed, the paved areas is to be constructed as a series of swales leading into a shallow basin near the entry. Two outlets will be required. The first of these consists of a catch basin at the lowest level of the ponding area. The outlet pipe is recommended to be a 6-inch PVC pipe leading to the manhole on the City storm sewer marked #1 on the attached plan. This pipe is to be metered by means of a metal orifice to accept no more than the historic 2-year flow at the maximum storage elevation of the 2-year runoff. At the maximum storage elevation of the 2-year runoff, a second grated outlet is proposed. The outlet pipe from this second outlet will also consist of a 6-inch PVC pipe leading to Manhole #1 in the City storm sewer. This pipe is to be metered to accept no more than the historic 100-year flow by means of a metal orifice. We recommend that both these outlets be constructed as standard collection manholes with a City standard, street strength, grated cover set at the proper elevation.

The volumetric capacity of the holding pond area was computed at ascending elevations of 0.2 feet from the low grate elevation of 99.28 to the sidewalk overflow point at elevation 100.40. The computations show that this system will hold the developed runoff and restrict outflow from the system to the historic 2-year and 100-year runoff.

The required sizes of plate orifices to cover each of the pipe ends in the outlet boxes was calculated. In the low outlet, the orifice required to restrict flow to the 2-year historic runoff

was found to be a round orifice with a diameter of 1.65 inches. The orifice required in the second outlet to restrict flow to the 100-year historic runoff was found to be a round orifice with a diameter of 3.63 inches.

Conclusions:

The geometry of the site restricts the locations possible for the two manhole outlets to be used. This geometry also restricts the possible depth of water storage on the site by requiring that it be spread over a relatively large area. The grated concrete channels will help deliver runoff to the storage area under conditions of precipitation ranging from 2-year frequency to approximately 40-year frequency. They will have little or no effect on runoff during 100-year frequency storms.

In our opinion, the proposed system described in this report will maintain the historic runoff from the site from the 2-year to the 100-year runoff without overflowing the front sidewalk. The 100-year runoff will pond water approximately one foot in depth at the lowest outlet point.

This opportunity to be of professional service is sincerely appreciated. If you have any questions or require additional information, please feel free to contact the undersigned engineer at your convenience.

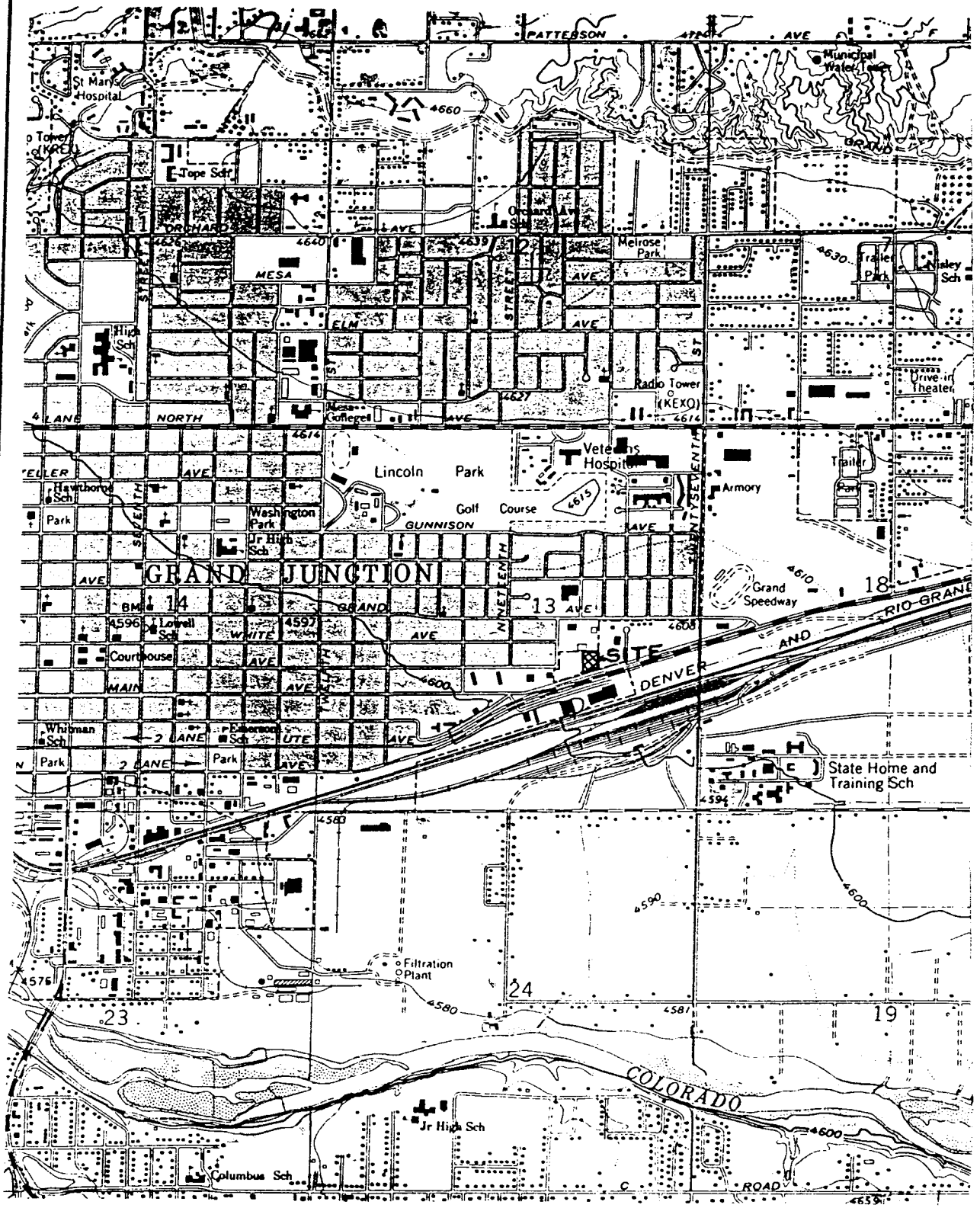
Respectfully submitted,

LINCOLN DeVORE, INC.

4/1/93

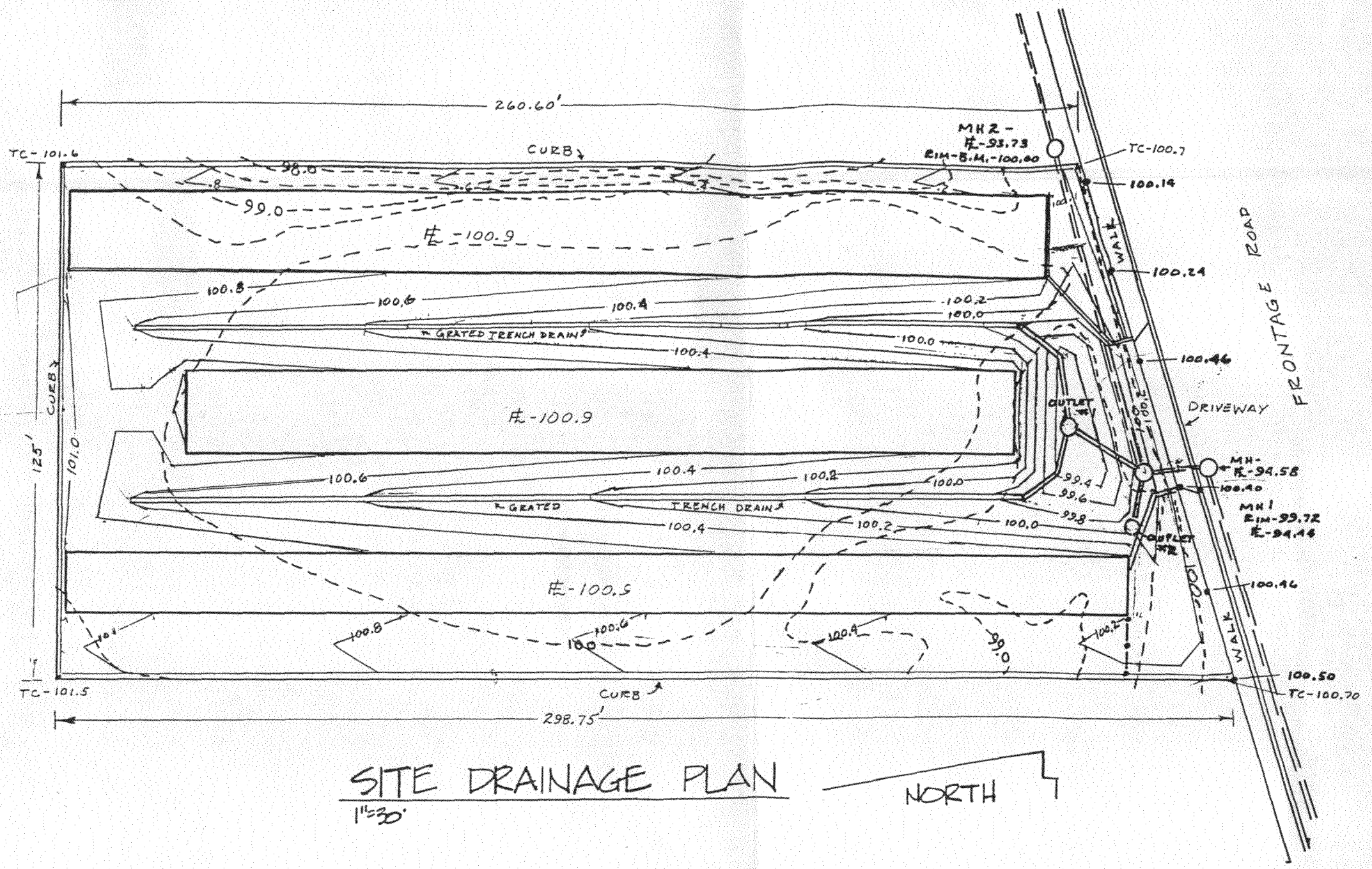
By: George D. Morris, P.E.

GDM/lab
LD Job No. 77461-J
Enclosures
cc: Lincoln DeVore, Grand Junction



SCALE: 1"=2000'

Lincoln DeVore, Inc. Geotechnical Consultants	VICINITY MAP	
	Kelco General Contractors	DATE 3/93
	JOB NO. 77461-J / DRAWN GDM	



SITE DRAINAGE PLAN

1"=30'

NORTH

LINCOLN DEVORE INCORPORATED

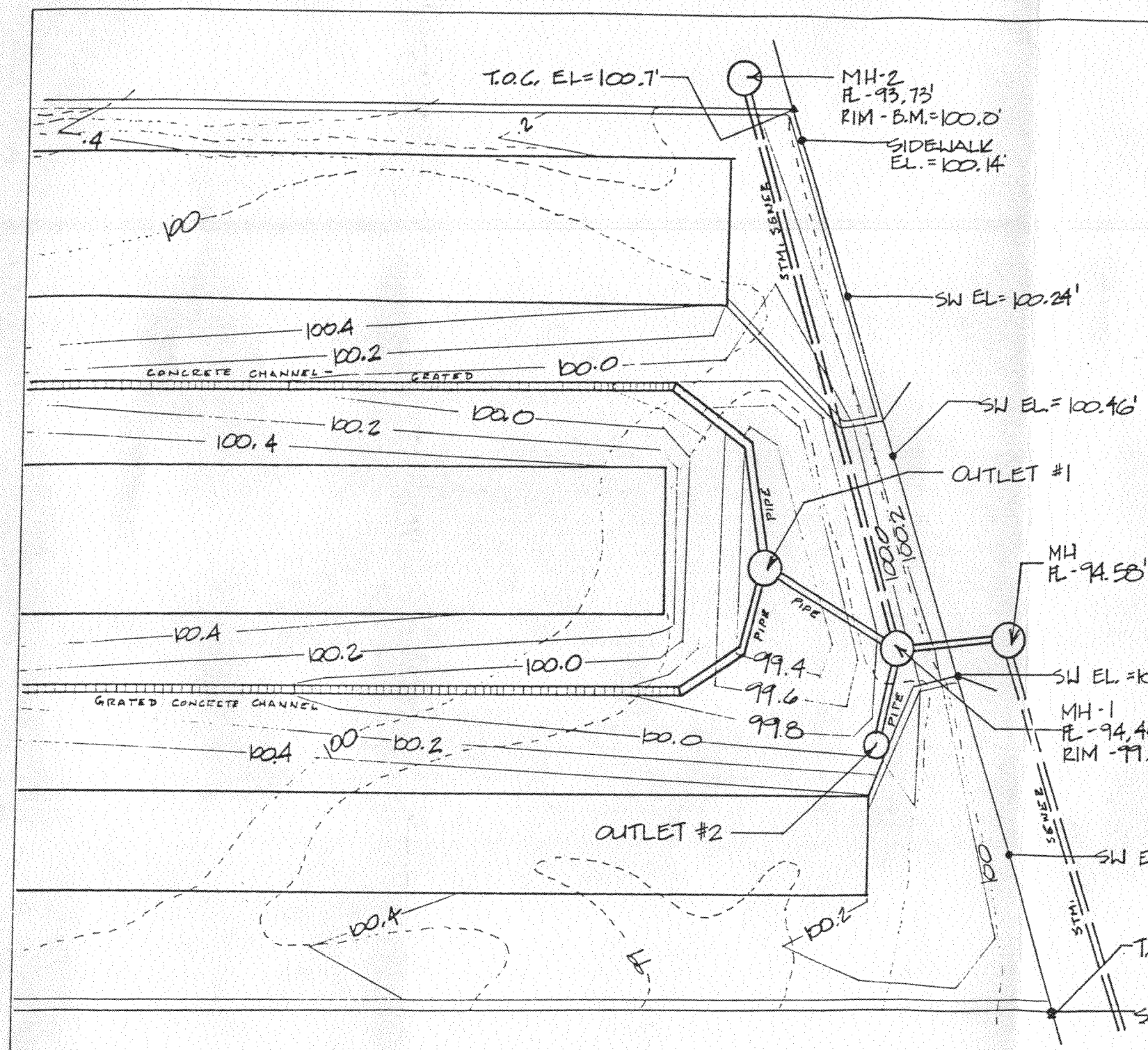
GEORGE D. MORRIS REGISTERED 2051 PROFESSIONAL ENGINEER STATE OF COLORADO

BY: 4.1.93

DESIGNED BY: GEORGE MORRIS

PAGE OF

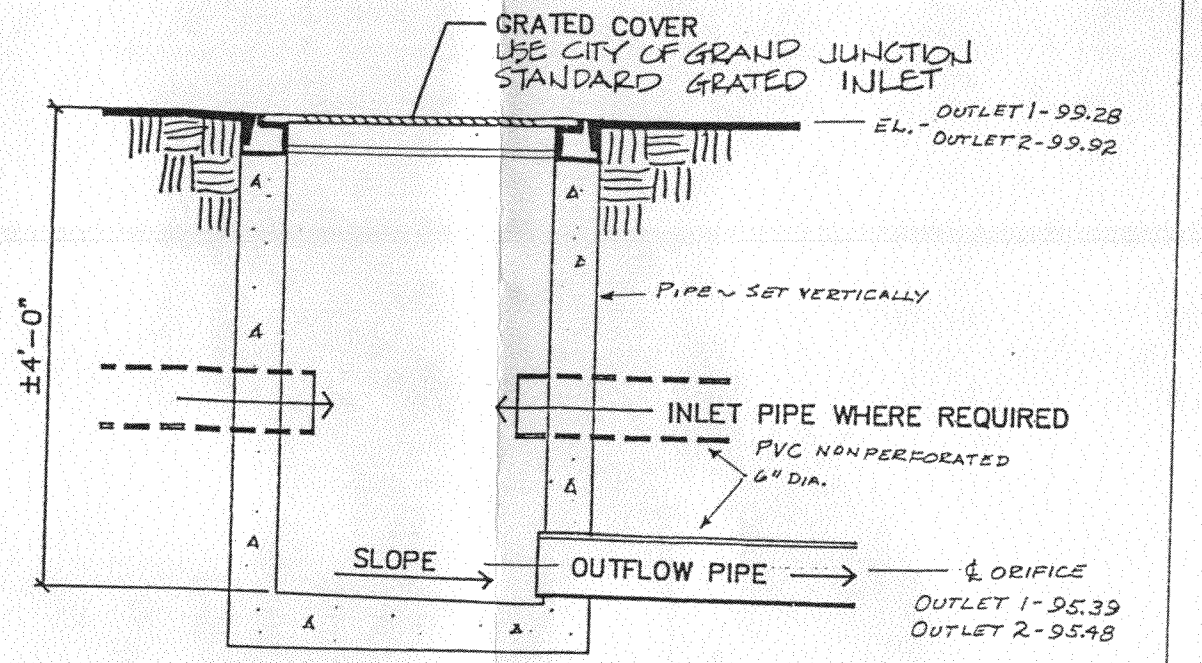
SITE DRAINAGE DESIGN LD#77461-J 2260 E. MAIN ST. KELCO GENERAL CONTRACTORS		
LINCOLN DeVORE	COLORADO SPRINGS PUEBLO, GRAND JUNCTION, CASTLE ROCK	
DRAWN BY: GDM	SCALE: SHOWN	DATE: 3/29/93
CHECKED BY:	CONT. INT.	REV.



SOUTH PORTION - SITE PLAN

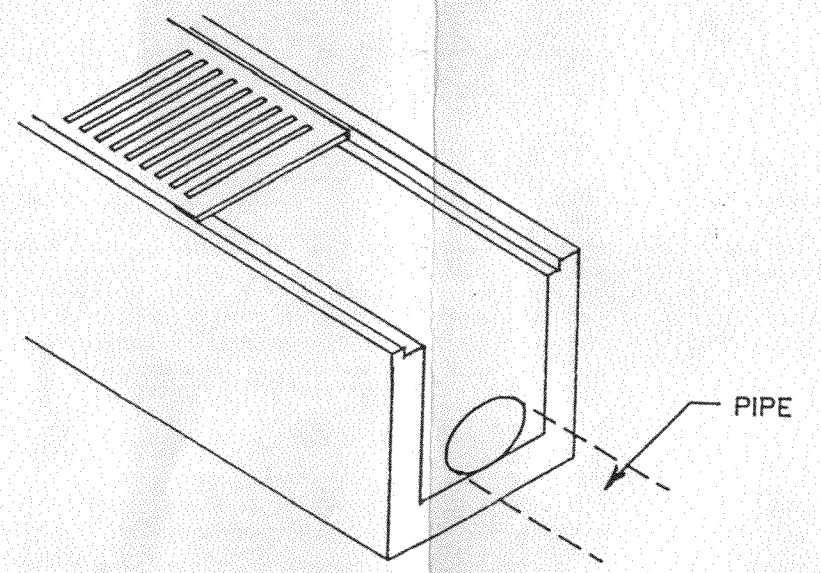
0 10 20 30

NORTH



CATCH BASIN

1/2"=1'-0'



GRATED TRENCH DRAIN

DESIGNED BY: GEORGE MORRIS

LINCOLN DEVORE-INCORPORATED

GEORGE MORRIS REGISTERED 2051 PROFESSIONAL ENGINEER STATE OF COLORADO

BY: 4/1/93

PAGE OF

SITE DRAINAGE DESIGN LD#77461-J
2260 E. MAIN ST.
KELCO GENERAL CONTRACTORS

LINCOLN DeVORE	COLORADO SPRINGS PUEBLO, GRAND JUNCTION, CASTLE ROCK	
DRAWN BY: GDM	SCALE: SHOWN	DATE: 3/29/93
CHECKED BY:	CONT. INT.	REV.

APPENDIX

Soils Data:

1978 SCS Grand Junction area soils and 1958 SCS for inside City Limits:
Site listed as Ba in 1958, Bs in 1978.
Billings Silty Clay, 0-3% - moderate alkalinity, CL, deep water level, low permeability, moderate expansion, piping prone, frost susceptible, Hydro Class C at best. None of these soils are listed as hydric.

Runoff Notes:

We have been informed that the site has been higher than surrounding land for some time. It is to be left higher than surrounding land and streets. Final elevation tion of site will be based on driveway elevation at the frontage road south of the site.

Historic flow across the site appears to be consisting of rainfall falling on the tract only. No exterior drain entry appears to have taken place. Since the site is to be shielded from outside flow entry, the site only runoff will control historic flow anyway.

At this time, it does not appear that north-south streets north of the site will not be extended south through the area, so drainage is basically sheetflow across the site collected by the frontage road drainage. At one time, collection was via borrow ditch. Storm sewer now exists on site.

Due to confining rainfall/runoff to the project site only, both historic runoff and developed runoff will be relatively low. Developed area is mostly roofs and pavement which will produce considerably more runoff than historic.

Long, narrow buildings on site will force a split in runoff, therefore basin (original site) is split into these units to find Time of Concentration for maximum flow under developed conditions. The entire basin must be used to determine historic flow.

Flow:

Grand Junction rules limit the standard T_c form to 300 feet. The entire site is approximately 300 feet in length north to south. Direction of flow is slightly west of south.

Have to make one assumption for ditch flow--ordinary pavement flow will be 2-3% side slopes and rounded bottom. However, they want to use a square grated concrete channel to deep pavement clear and avoid asphalt erosion. Assume standard 14½" continigrate with a concrete channel 12" width, vertical sides and ±12" deep av.

Rainfall Area:

Site Area (for rainfall) - $\frac{298.75 + 260.60}{2} \times 125 = 34{,}960\ ft^2 = 0.803\ ac.$

A (east) - $\frac{260.60 + 265.79}{2} \times 17 = 4{,}974\ ft^2 = 0.103\ ac.$

B (east center) - $\frac{265.79 + 279.22}{2} \times 44 = 11{,}990\ ft^2 = 0.275\ ac.$

C (west center) - $\frac{279.22 + 289.60}{2} \times 34 = 9{,}670\ ft^2 = 0.222\ ac.$

D (west) - $\frac{289.60 + 298.75}{2} \times 30 = 8{,}826\ ft^2 = 0.203\ ac.$

Composite Present C:

Roof = 0.304 ac., $C_2 = 0.90$, $C_{100} = 0.95$
Pavement = 0.472 ac., $C_2 = 0.90$, $C_{100} = 0.95$
Landscape = 0.027 ac., $C_2 = 0.15$, $C_{100} = 0.30$

Composite C_2 = (0.90x0.304+0.90x0.472+0.15x0.027)/0.803 = 0.87
Composite C_{100} = (0.95x0.304+0.95x0.472+0.30x0.027)/0.803 = 0.93

Use composites for fin. areas as req. (A&D) (Not B&C)

eg - A = (.007 x 15 + .096 x 90)/.103 = 85 = C_2
A = (.007 x 30 + .096 x 95)/.103 = 91 = C_{100}
and D = (.020 x 15 + .183 x 90)/.203 = 83 = C_2
D = (.020 x 30 + .183 x 95)/.203 = 89 = C_{100}

B & C - C_2 = 0.90 C_{100} = 0.95

Drainage-Holding Area:

Total Basin:

Elevation	Area
100.4	8127
100.2	5130
100.0	2322
99.8	1296
99.6	684
99.4	279

Soil Data:

SCS (1978) B_s - Billings Series - silty clay loam, 0 to 3%, alkaline - moderate, erosion - moderate, very poor wetland, CL, water level > 6', AASHTO A -6, PI - 11 to 20, permeability - .06-.2 in/hr, moderate expansion, high corrosive - steel and concrete, severe absorption, frost susceptible, piping, Hydro Classification - C at beat, possibly D.

LD Classification - CL - silty clay - matches classification - verify C/D condition

Historic Flow:

Site: A = 0.803 ac., total L = 296', H = 1.3', S = 0.0044, 2-yr. storm, C_2 = 0.20 C or D soil) C_{100} = 0.35

(No real ditch or erosion known in area, assume sheetflow and Tc form. OK.

2-year Storm:

Tc_2 = overland = $1.87\ (1.1-0.20)\ 296^{.5} \times 0.44^{-.33}$ = 38 min.

Alt.:

Tc_2 = overland = $1.87\ (1.1-0.20)\ 99^{.5} \times 0.44^{-.33}$ = 21.9 min.

Swale (see B_2) V = 0.66 fps ≈ (197/.66)/60 = 5.0 min.

Tc_2 at outfall = 26.9 min.

(use 27 min.)

Q_2 = 0.20 x 0.95 x 0.803 = 0.152 cfs

100-year Storm:

Tc_{100} = overland = $1.87\ (1.1-0.35) \times 99^{.5} \times 0.44^{-.33}$ = 18.3 min.

Swale (see B_{100}) V = 1.02 ≈ (197/1.02)/60 = 3.2 min.

Tc_{100} at outfall = 21.5 min. - use 22 min.

Q_{100} = 0.35 x 2.7 x 0.803 = 0.759 cfs

Paved Storage Area:

Manhole #1, Flow line = 94.44', Outlet #1 for site is near center of front, 23' away from #1; 23 x .0086 = .20', put pipe from outlet into storm sewer at least 6" above ℄. Then flow line at outlet = 94.44 + 0.20 = 94.64 + 6" = 95.14'.
Top of outlet grate = 99.28. ℄ pipe = 95.39. Outlet CB formed with 30" pipe - av. depth above ℄ orifice = 99.28 - 95.39 = 3.89'

So:

Comment	Elev.	Form = $[Ag+Ag+1+(AgxAg+1)^{.5}]\ h/3$	Cum. Volume
Flow Line, Outlet	95.14	--	--
℄ Pipe & Orifice	95.39	--	--
Top outlet & grate	99.28	start with volume of C.B. #1	19 $ft.^3$
	99.40	$.12/3\ [5 + 279 + (5 \times 279)^{.5}]$	32 $ft.^3$
	99.60	$.2/3\ [279+684 + (279 \times 684)^{.5}]$	125 $ft.^3$
	99.80	$.2/3\ [684+1296+ (684x1296)^{.5}]$	320 $ft.^3$
	100.00	$.2/3\ [1296+2322+(1296x2322)^{.5}]$	677 $ft.^3$
	100.20	$.2/3\ [2322+5130+(2322x5130)^{.5}]$	1404 $ft.^3$
Top of Lowest Sidewalk Level	100.40	$.2/3\ [5130+8127+(5130x4816)^{.5}]$	2718 $ft.^3$

Summary:

		Historic Flow						Developed Flow					
		2-year			100-year								
Basin	Area	Tc_2	qp_2	C_2	Tc_{100}	qp_{100}	C_{100}	Tc_2	qp2	C_2	Tc_{100}	qp100	C_{100}
B/C	.497 ac.							4 min.	0.89 cfs	.90	3 min.	2.46 cfs	0.95
A	.103 ac.							11 min.	0.13 cfs	.85	9 min.	0.15 cfs	0.91
D	.203 ac.							11 min.	0.24 cfs	.83	9 min.	0.72 cfs	0.89
Total Site	.803 ac.	27 min.	0.152 cfs	0.2	22 min.	0.76 cfs	0.35	10 min.	1.10 cfs	.87	8 min.	3.16 cfs	0.93

Developed Site:

2-year Storm: $Qo = .80 \times .152 = .122$ av.

$Td_2 = [633.4x.87x.803/(.122-.122^2x10/(81.2x.87x.803)]^{.5} - 15.6 = 45.28$ min.
$Id_2 = 40.6/60.88 = .667"/hr.$
$Qd_2 = .87 \times .803 \times .667 = .466$ cfs
$K_2 = 27/10 = 2.70$
$V_2 = 66[.466x45.28-.122x45.28-.122x10+2.70x.122x10/2+.122^2x10/(2x.466)]$
$= 1067\ ft.^3$ (El = 99.92)

Outlet (MH) - center line of orifice = 95.39 Max. 2 yr. water level = 99.92.
99.92-95.39 = 4.53'

$Q = C\ A\ (2gH)^{.5} - .152 = .6 \times A \times 17.080$

$A = 0.0148\ ft^2 = 2.14\ in^2$ d = 1.65"

Developed Site (cont'd):

100-year Storm: $Qo = .80 \times .760 = .608$

$Td_{100} = [2925x.93x.803/(.608-.608^2x8/(234x.93x.803)]^{.5} - 25 = 35.79$ min.
$Id_{100} = 117/60.79 = 1.925$"/hr.
$Qd_{100} = .93 \times .803 \times 1.925 = 1.438$"/hr (use 1.44)
$K_{100} = 22/8 = 2.75$
$V_{100} = 66[1.44x35.79-.608x35.79-.608x8+2.75x.608x8/2+.608^2x8/(2x1.44]$
$= 2153$ ft.^{3} (El = 100.31)

Set rim of Outlet #2 at 99.92 and pipe directly to MH1. Flow line MH1 = 94.44, Outlet is 14' away - Set flow line of pipe 8" above flow line of manhole and grade at 0.84%. Then: 94.44 + 0.67 = 95.11 14' x .0084 = .12', so flow line of outlet = 95.11 + 0.12 = 95.23, use 6" pipe - C pipe = 95.23 + 95.48.

Theoretical high water = 100.31' - 95.48 = 4.83' head.

Then:

$Q = C\ A\ (2gh)^{.5} - .760 = .6 \times A \times 17.637$, and

$A = 0.07182$ ft^2 $= 10.342$ in^2 d = 3.63"

Background Data:

Developed Flow by Subbasins:

Subbasin A
Overland L = 50' Swale L = 202' Asphalt, 28' dirt
(asphalt n = 0.018, clay n = 0.044)
A = .103 ac., L = 280' H = 0.94' S = 0.0034

2-year storm:
Overland $Tc_2 = 1.87\ (1.1-.90) \times 50^{.5} \times .34^{-.33} =$ 3.8 min.
Asphalt Swale (See AA_2) V = .61 ≈ (202/.61)/60 = 5.5 min.
Earth Swale (See AS_2) V = .30 ≈ (28/.30)/60 = 1.6 min.
10.9 min.

Composite C_2 for A = 0.85

$Q_2 = 0.85 \times 1.48 \times 0.103 = 0.13$ cfs

100-year storm:
Overland $Tc_{100} = 1.87\ (1.1-.95) \times 50^{.5} \times .34^{-.33} =$ 2.8 min.
Asphalt Swale (See AA_{100}) V = .65 ≈ (202/.65)/60 = 5.2 min.
Earth Swale (See AS_{100}) V = .33 ≈ (28/.33)/60 = 1.4 min.
9.4 min.
(use 9 min.)

Composite C_{100} for A = 0.91

$Q_{100} = 0.91 \times 1.58 \times 0.103 = 0.15$ cfs

Subbasin B and C

Note: Actually, the length of channel is slightly different in Subbasins B and C, but the grade is the same--street grade S = .0034, ditch grade .0036-- In fact, they will act as a single, split basin, flooding at the same rate. Therefore, I will treat these as one basin with the shortest length by a few feet.

So: B + C: A = .275 ac. + .222 = 0.497 ac.
L = overland = 30', grated ditch = 260', Total = 290' (to Basin MH)
n = 0.018 asphalt and 0.015 concrete, entire area is paved.
C_2 = 0.90, C_{100} = 0.95 - Overland S = 0.017

2-year storm:
Overland $Tc_2 = 1.87\ (1.1-.90) \times 30^{.5} \times 1.72^{-.33}$ = 1.7 min.
Concrete Channel (See B/C_2) V = 2.02 ≈ (260/2.16)/60 = 2.0 min.
3.7 min. (use 4 min)

$Q_2 = 0.90 \times 2.0 \times 0.497 = 0.89$ cfs

100-year storm:
Overland $Tc_{100} = 1.87\ (1.1-.95) \times 30^{.5} \times 1.72^{-.33}$ = 1.3 min.
Concrete Channel (See B/C_{100}) V = 2.75 ≈ (260/2.75)/60 = 1.6 min.
2.9 min. (use 3 min)

$Q_{100} = 0.95 \times 5.20 \times 0.497 = 2.46$ cfs

Subbasin D

Overland L = 50' Asphalt Swale L = 224' 30' Earth Swale -
Total L = 304', n Asphalt = 0.018, n earth = 0.044,
A = .203 ac., H = 0.97' S = 0.0032 Composite C_2 = 83, C_{100} = 89

2-year storm:
Overland $Tc_2 = 1.87\ (1.1-.90) \times 50^{.5} \times .32^{-.33}$ = 3.9 min.
Asphalt Swale (See DA_2) V = .68 fps ≈ (224/.68)/60 = 5.5 min.
Earth Swale (See DS_2) V = .35 fps ≈ (30/.35)/60 = 1.4 min.
10.8 min. (use 11 min)

$Q_2 = 0.83 \times 1.45 \times 0.203 = 0.24$ cfs

100-year storm:
Overland $Tc_{100} = 1.87\ (1.1-.95) \times 50^{.5} \times .32^{-.33}$ = 2.9 min.
Asphalt Swale (See DA_{100}) V = .78 fps ≈ (224/.78)/60 = 4.8 min.
Earth Swale (See DS_{100}) V = .72 fps ≈ (50/.72)/60 = 0.7 min.
8.4 min. (use 9 min)

$Q_{100} = 0.89 \times 4.0 \times 0.203 = 0.72$ cfs

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ STORAGE

Comment: GRAND JUNCTION STORAGE SITE

Solve For Discharge

Given Input Data:

Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n.....	0.032
Channel Slope....	0.0044 ft/ft
Depth.....	0.20 ft

Computed Results:

Discharge.....	0.13 cfs
Velocity.....	0.66 fps
Flow Area.....	0.20 sf
Flow Top Width...	2.00 ft
Wetted Perimeter.	2.04 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0378 ft/ft
Froude Number....	0.37 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ STORAGE

Comment: GRAND JUNCTION STORAGE SITE

Solve For Discharge

Given Input Data:

Left Side Slope..	5.00:1 (H:V)
Right Side Slope.	5.00:1 (H:V)
Manning's n.....	0.032
Channel Slope....	0.0044 ft/ft
Depth.....	0.39 ft

Computed Results:

Discharge.....	0.78 cfs
Velocity.....	1.02 fps
Flow Area.....	0.76 sf
Flow Top Width...	3.90 ft
Wetted Perimeter.	3.98 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0298 ft/ft
Froude Number....	0.41 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ STORAGE

Comment: GRAND JUNCTION STORAGE SITE

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.018
Channel Slope....	0.0034 ft/ft
Depth.....	0.09 ft

Computed Results:

Discharge.....	0.15 cfs
Velocity.....	0.61 fps
Flow Area.....	0.24 sf
Flow Top Width...	5.40 ft
Wetted Perimeter.	5.40 ft
Critical Depth...	0.07 ft
Critical Slope...	0.0146 ft/ft
Froude Number....	0.51 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ STORAGE

Comment: GRAND JUNCTION STORAGE SITE

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.044
Channel Slope....	0.0034 ft/ft
Depth.....	0.12 ft

Computed Results:

Discharge.....	0.13 cfs
Velocity.....	0.30 fps
Flow Area.....	0.43 sf
Flow Top Width...	7.20 ft
Wetted Perimeter.	7.20 ft
Critical Depth...	0.07 ft
Critical Slope...	0.0885 ft/ft
Froude Number....	0.22 (flow is Subcritical)

AH100

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ STORAGE

Comment: GRAND JUNCTION STORAGE SITE

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.018
Channel Slope....	0.0034 ft/ft
Depth.....	0.10 ft

Computed Results:

Discharge.....	0.20 cfs
Velocity.....	0.65 fps
Flow Area.....	0.30 sf
Flow Top Width...	6.00 ft
Wetted Perimeter.	6.00 ft
Critical Depth...	0.08 ft
Critical Slope...	0.0140 ft/ft
Froude Number....	0.51 (flow is Subcritical)

AS100

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ STORAGE

Comment: GRAND JUNCTION STORAGE SITE

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.044
Channel Slope....	0.0034 ft/ft
Depth.....	0.14 ft

Computed Results:

Discharge.....	0.20 cfs
Velocity.....	0.33 fps
Flow Area.....	0.59 sf
Flow Top Width...	8.40 ft
Wetted Perimeter.	8.40 ft
Critical Depth...	0.08 ft
Critical Slope...	0.0837 ft/ft
Froude Number....	0.22 (flow is Subcritical)

BAC 1a

Rectangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ BC

Comment: GRAND JUNCTION STORAGE B & C CONC.CHANNEL

Solve For Discharge

Given Input Data:

Bottom Width.....	1.00 ft
Manning's n.....	0.015
Channel Slope....	0.0036 ft/ft
Depth.....	0.39 ft

Computed Results:

Discharge.....	0.84 cfs
Velocity.....	2.16 fps
Flow Area.....	0.39 sf
Flow Top Width...	1.00 ft
Wetted Perimeter.	1.78 ft
Critical Depth...	0.28 ft
Critical Slope...	0.0091 ft/ft
Froude Number....	0.61 (flow is Subcritical)

B/C,00

Rectangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ BC

Comment: GRAND JUNCTION STORAGE B & C CONC.CHANNEL

Solve For Discharge

Given Input Data:

Bottom Width.....	1.00 ft
Manning's n.....	0.015
Channel Slope....	0.0036 ft/ft
Depth.....	0.85 ft

Computed Results:

Discharge.....	2.34 cfs
Velocity.....	2.75 fps
Flow Area.....	0.85 sf
Flow Top Width...	1.00 ft
Wetted Perimeter.	2.70 ft
Critical Depth...	0.55 ft
Critical Slope...	0.0108 ft/ft
Froude Number....	0.53 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ/SU

Comment: GRAND JUNCTION STORAGE UNIT D

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.044
Channel Slope....	0.0032 ft/ft
Depth.....	0.16 ft

Computed Results:

Discharge.....	0.27 cfs
Velocity.....	0.35 fps
Flow Area.....	0.77 sf
Flow Top Width...	9.60 ft
Wetted Perimeter.	9.61 ft
Critical Depth...	0.09 ft
Critical Slope...	0.0802 ft/ft
Froude Number....	0.22 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ/SU

Comment: GRAND JUNCTION STORAGE UNIT D

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.018
Channel Slope....	0.0032 ft/ft
Depth.....	0.11 ft

Computed Results:

Discharge.....	0.25 cfs
Velocity.....	0.68 fps
Flow Area.....	0.36 sf
Flow Top Width...	6.60 ft
Wetted Perimeter.	6.60 ft
Critical Depth...	0.08 ft
Critical Slope...	0.0136 ft/ft
Froude Number....	0.51 (flow is Subcritical)

DA100

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ/SU

Comment: GRAND JUNCTION STORAGE UNIT D

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.018
Channel Slope....	0.0032 ft/ft
Depth.....	0.17 ft

Computed Results:

Discharge.....	0.78 cfs
Velocity.....	0.90 fps
Flow Area.....	0.87 sf
Flow Top Width...	10.20 ft
Wetted Perimeter.	10.21 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0117 ft/ft
Froude Number....	0.55 (flow is Subcritical)

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: GJ/SU

Comment: GRAND JUNCTION STORAGE UNIT D

Solve For Discharge

Given Input Data:

Left Side Slope..	30.00:1 (H:V)
Right Side Slope.	30.00:1 (H:V)
Manning's n.....	0.044
Channel Slope....	0.0032 ft/ft
Depth.....	0.23 ft

Computed Results:

Discharge.....	0.72 cfs
Velocity.....	0.45 fps
Flow Area.....	1.59 sf
Flow Top Width...	13.80 ft
Wetted Perimeter.	13.81 ft
Critical Depth...	0.13 ft
Critical Slope...	0.0705 ft/ft
Froude Number....	0.23 (flow is Subcritical)

REVIEW COMMENTS

FILE NO. #47-93 **TITLE HEADING:** Site Plan Review
Mini-Storage Units

LOCATION: 2260 ~~East Main Street~~ I-70 Business

PETITIONER: Timmerwilke Properties

PETITIONER'S ADDRESS/TELEPHONE: c/o Kelco
Grand Junction, CO
245-6464

PETITIONER'S REPRESENTATIVE: Kelly Ford
245-9343

STAFF REPRESENTATIVE: David Thornton

POLICE DEPARTMENT **4/14/93**
Mark Angelo **244-3587**

What type, if any, security lighting are you proposing in front or at the entrance to the compound? What type of lock assembly are you installing on the garage doors and on the entrance gate?

What type of "shrubs" are you using? Recommend dwarf bushes and shrubs for visibility for drive-by viewing. On the southwest corner, nothing to obstruct view along the west end of the storage units as you drive by on the frontage road. North side - storage units too close to the fence - even with barbed wire, existing barbed wire extends into proposed site, therefore will be resting against units. Someone can still climb the fence and get on top of the storage units. Fence 6' tall; units approximately 9'6" tall.

CITY DEVELOPMENT ENGINEER **4/16/93**
Gerald Williams **244-1591**

SITE PLAN

1. Provide curbing to contain/direct runoff as shown on the Drainage Plan. Also, curbing or berming is required between the driveway and the SE corner of the property to a minimum elevation of 100.4.
2. Replace broken monolithic curb/gutter/sidewalk.

DRAINAGE PLAN

1. Information provided in the Drainage Report was not transferred to the plans as it must be. Also provide orifice sizes, once corrected by Lincoln-DeVore.
2. Add berming or curbing along the sidewalk.

DRAINAGE REPORT

Revised ponding elevation and orifice sizes must be resubmitted as discussed with George Morris

on April 16, 1993.

CITY UTILITIES ENGINEER **4/19/93**
Bill Cheney **244-1590**

Sewer and water available in East Main if required for project. No other comments.

COMMUNITY DEVELOPMENT DEPARTMENT **4/20/93**
David Thornton **244-1447**

The address for this property is 2260 I-70 Business Loop, not 2260 East Main.

KELCO
General Contractors
P.O. Box 55065, Grand Junction, Colorado 81505 (303) 245-9343 Fax (303) 245-5090

April 20, 1993

REVIEW COMMENTS RESPONSE

FILE NO. #47-93 TITLE HEADING: Site Plan Review
Comments Response
Mini-Storage Units

LOCATION: 2260 I-70 Business Loop (2260 East Main St.)

PETITIONER: Timmerwilke Properties, Inc.
245-6464

PETITIONER'S ADDRESS/TELEPHONE: c/o Kelco
P.O. Box 55065
Grand Junction, CO 81505
245-9343

PETITIONER'S REPRESENTATIVE: Mr. Kelly Ford
Kelco
245-9343

POLICE DEPARTMENT
Mark Angelo 244-3587

There are (8) wall mounted high pressure sodium security light fixtures distributed evenly throughout the driveways and on both ends of the buildings. There should be ample lighting at the entrance and entire project for security purposes. The type of lock assembly installed on the overhead coiling doors is the standard mini storage type. It is a heavy duty steel slide bolt mechanism with places for (2) locks. The tenant padlock is then installed. The gate entrance will have a heavy duty master lock on a commercial chain link fence and gate latching detail. The mini storage units will be patrolled by Western Colorado Security and will be locked by Western Colorado Security at 10:00 p.m. each evening.

The type of shrubs that will be used along the front landscape are called out on the landscape plan of record. There will be a mixture of Yucca plants, low ground cover shrubs, and some 1-1/2" caliper Juniper trees. The owner has chosen Zero Scape Landscaping Theme as it requires the minimum water and maintenance requirements of any options that the City's mandated

landscaping ordinance requires. We will therefore not be able to minimize the plant size further for visibility for drive by viewing as we are following minimum requirements mandated.

The north side of the storage units are within 2' of the chain link fence with barb wire. Thank you for your making us aware of this situation.

CITY DEVELOPMENT ENGINEER
Gerald Williams 244-1591

SITE PLAN

1. We are currently bringing together cost estimates to provide curbing on the east and west property boundaries which would contain all site water to a minimum elevation of 100.4. An alternative plan to change the roof slope of Buildings A and C to drain toward the center of the project and alleviate drain water from being discharged into the east and west landscape areas is seriously being considered at this point, however. Either the curbing/berming at the perimeter or a roof pitch change to the interior will be acceptable to the owner. The owner, however, would like to reserve the right to make the final decision. A berm shall be installed in the landscape area on the south east corner of the lot along the sidewalk and returning to the building to a minimum elevation of 100.4 to detain water in the center basin.

2. All broken monolithic curb/gutter/sidewalk and the new curb cut shall be removed and replaced per city specifications.

DRAINAGE PLAN

1. Additional information has been transferred to the plans per review comments.

2. Berming has been added along the sidewalk and southeast corner as described above.

DRAINAGE REPORT

As of the time of this transmittal the revised drainage report with orifice sizes have not been received by Kelco from Lincoln Devore. We will forward this revised drainage report under separate cover to you promptly upon it's receipt.

CITY UTILITIES ENGINEER
Bill Cheney 244-1590

We will require a 3/4" water tap and meter pit for the mandatory landscaping requirements for this project. A city specification fire hydrant has also been required to be installed per the Grand

Junction Fire Dept. Both of these items will be the financial responsibility of Kelco and we will schedule with your department for their installation.

COMMUNITY DEVELOPMENT DEPARTMENT
David Thornton 244-1447

The proper address for this property is so noted.

The contact person for the Colorado Department of Transportation for the highway access permit is Rose Burditt at 248-2708. It is our understanding that the permit has been granted and that Rose is processing the paperwork at present.

Thank you,

Kelly Ford

Kelly Ford
Owner

KF/cp

Lincoln DeVore, Inc.
Geotechnical Consultants
1000 West Fillmore St.
Colorado Springs, CO 80907
TEL: (719) 632-3593
FAX: (719) 632-2648

May 10, 1993

Kelco General Contractors
584 25 Road
Grand Junction, CO 81505

Attn: Mr. Kelly Ford

Re: Proposed Modifications, Hydrologic Analysis, Guardian Storage Facility, 2260 E. Main Street, Grand Junction, Colorado

Dear Mr. Ford:

As requested, the sketch showing a triangular ditch along the easterly side of the above referenced property has been reviewed. We understand that you intend to place a triangular ditch along this property line, formed by a filled slope along the east side of the property, eventually intersected by the slope along the building. We further understand that you will riprap the side slope extending downward to the adjoining property for erosion protection. In addition, we understand that you intend to pave the resulting triangular ditch with asphalt, or possibly concrete, pavement as shown on the sketch you sent to me.

We are not sufficiently familiar with Grand Junction regulations concerning slopes onto adjacent property, so will not comment on this condition. From the standpoint of ditch and gradient, the triangular ditch will carry the runoff anticipated in this area insofar as quantity is concerned. The time of flow to the storm sewer at the front of the building is such that the timing and storage for the site previously calculated will not change sufficiently to change the previously submitted calculations. We understand that you have planned to change the roof slope along this building. Our analysis assumes that the roof change has been made, and that the triangular ditch is to be paved.

In our opinion, the change shown can be used on this site without changing the calculated drainage and flow conditions on the property.

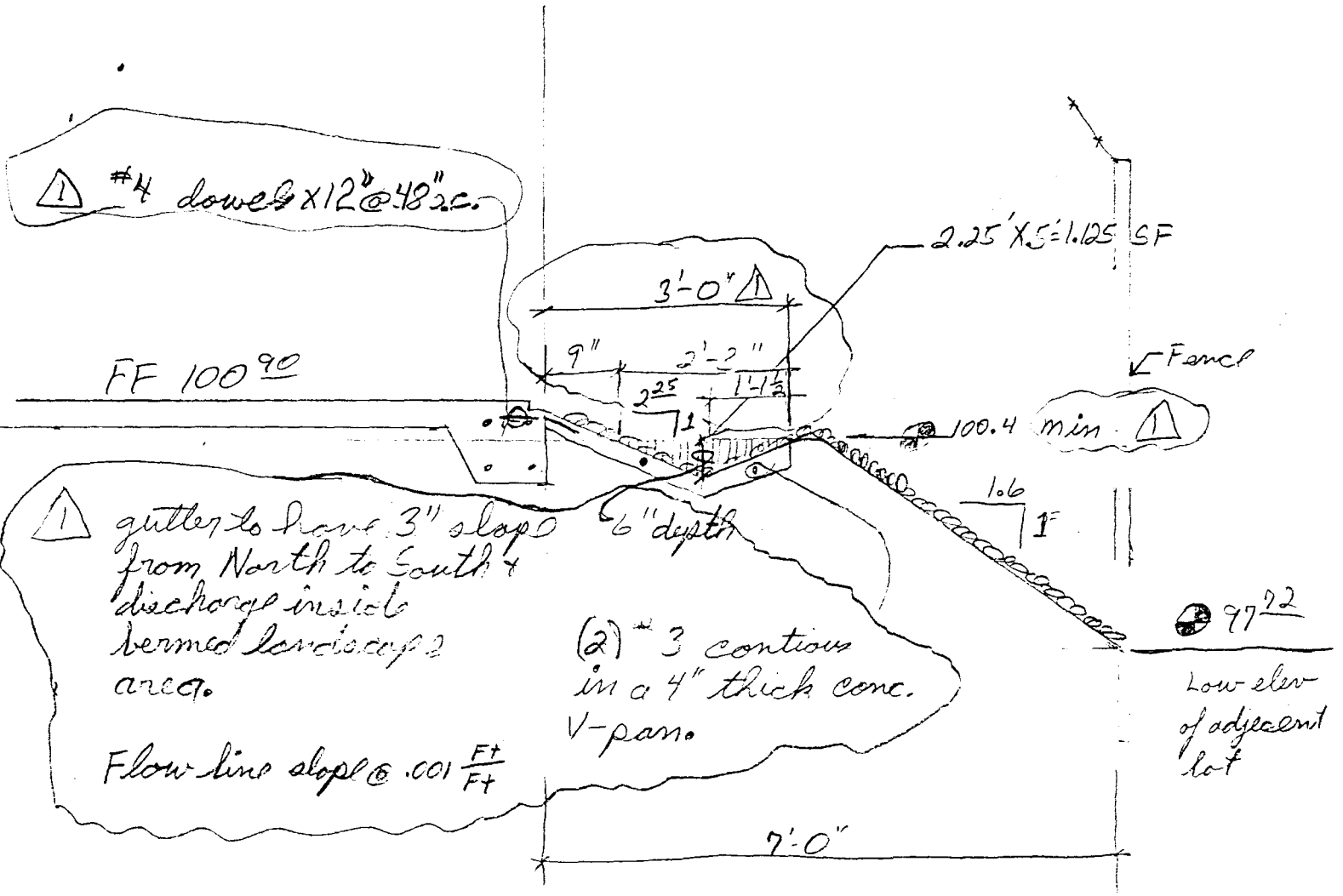
This opportunity to be of professional service is sincerely appreciated. If you have any questions or require additional information, please feel free to contact the undersigned engineer at your convenience.

Respectfully submitted,

LINCOLN DeVORE, INC.

By: George D. Morris, P.E.

GDM/lab
LD Job No. 77461-J
cc: Lincoln DeVore, Grand Junction



4-20-93
Guardian Storage
2660 E Main
Kelly Ford
1 5-11-93

scale = 1/2" = 1'

CERTIFICATE OF OCCUPANCY

BUILDING DEPARTMENT
CITY OF GRAND JUNCTION
(OR MESA COUNTY)

PERMIT # 44728 *DATE* 7-27-93

PERMISSION IS HEREBY GRANTED TO Kelco General Contractors *TO OCCUPY THE*

BUILDING SITUATED AT 2260 ~~East Main~~ I-70 B Building #A

LOT _____ *BLOCK* _____ *FILING* _____ *SUBDIVISION* _____

TAX SCHEDULE NUMBER 2945-134-03-018

FOR THE FOLLOWING PURPOSE: mini storage building #A

THIS CERTIFICATE ISSUED IN CONFORMITY TO SECTION 307, UNIFORM BUILDING CODE

INSPECTOR _____

City Planning _____
9-20-93

CERTIFICATE OF OCCUPANCY

BUILDING DEPARTMENT
CITY OF GRAND JUNCTION
(OR MESA COUNTY)

PERMIT # 44729 *DATE* 7-27-93

PERMISSION IS HEREBY GRANTED TO Kelco General *TO OCCUPY THE*

BUILDING SITUATED AT 2260 ~~East Main St.~~ I-70 B Building #C

LOT _____ *BLOCK* _____ *FILING* _____ *SUBDIVISION* _____

TAX SCHEDULE NUMBER 2945-134-03-018

FOR THE FOLLOWING PURPOSE: mini storage building #C

THIS CERTIFICATE ISSUED IN CONFORMITY TO SECTION 307, UNIFORM BUILDING CODE

INSPECTOR _____

City Planning _____
9-20-93

CERTIFICATE OF OCCUPANCY

BUILDING DEPARTMENT
CITY OF GRAND JUNCTION
(OR MESA COUNTY)

PERMIT # 44730 *DATE* 7-27-93

PERMISSION IS HEREBY GRANTED TO Kelco general *TO OCCUPY THE*

BUILDING SITUATED AT 2260 ~~East Main~~ I-70 B Building #B

LOT _____ *BLOCK* _____ *FILING* _____ *SUBDIVISION* _____

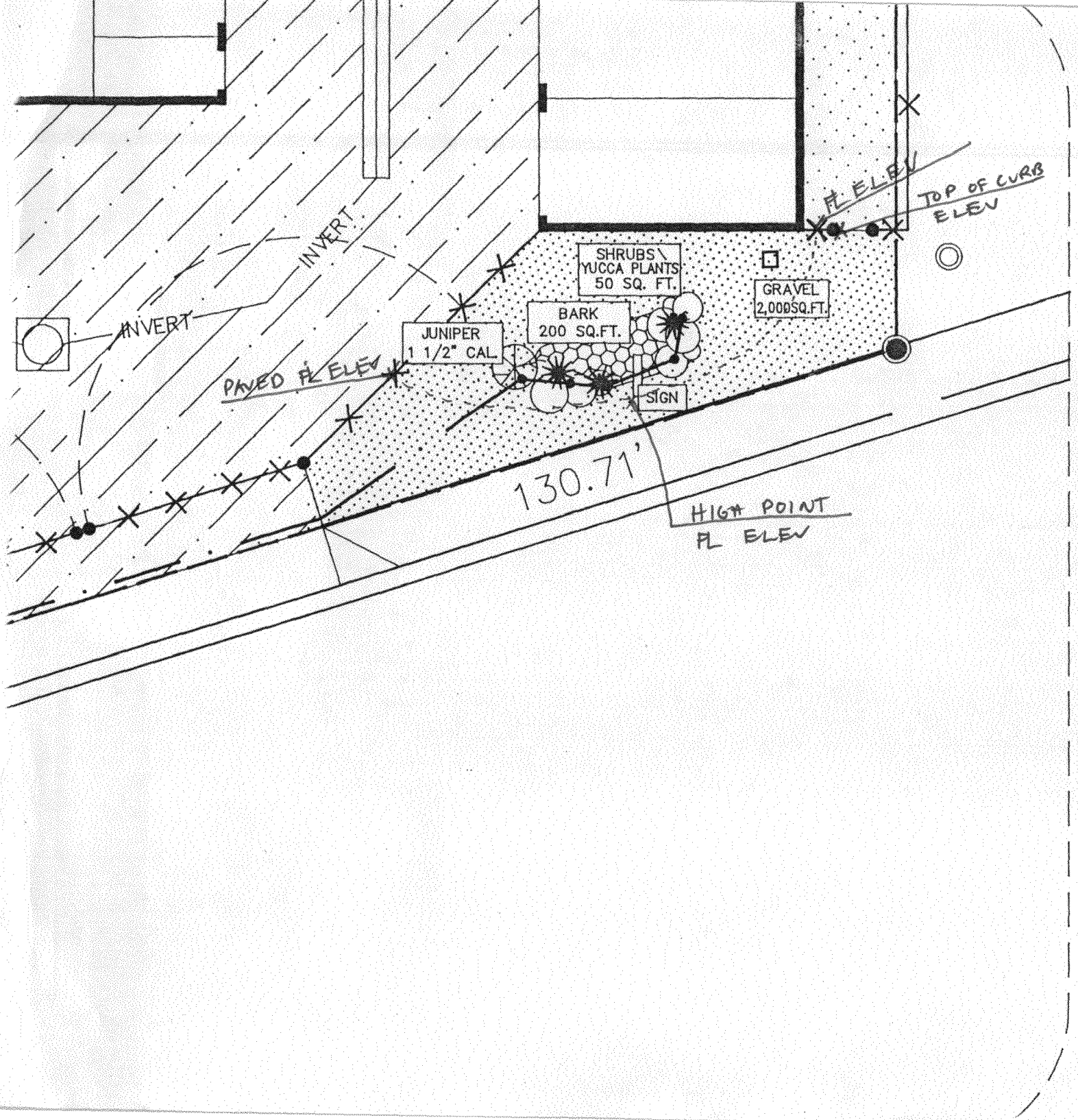
TAX SCHEDULE NUMBER 2945-134-03-018

FOR THE FOLLOWING PURPOSE: ~~mini storage bldg. #B~~

THIS CERTIFICATE ISSUED IN CONFORMITY TO SECTION 307, UNIFORM BUILDING CODE

INSPECTOR _____

City Planning _____
9-20-93


INVERT
INVERT
PAVED FL ELEV
JUNIPER
1 1/2" CAL
SHRUBS \
YUCCA PLANTS
50 SQ. FT.
BARK
200 SQ.FT.
GRAVEL
2,000SQ.FT.
SIGN
FL ELEV
TOP OF CURB
ELEV
130.71'
HIGH POINT
FL ELEV

To: Randy Booth
Cc: Don Newton, Gerald Williams
From: David Thornton
Subject: Release Imp Agree - 2260 E Main
Date: 9/21/93 Time: 10:55a

Randy,

Please release the entire amount ($2,740.00) of the improvements guarantee minus our accounting and transaction costs for the Guardian Storage development at 2260 (1-70 B) East Main Street developed by Kelco. The development has passed final inspection and a certificate of occupancy has been issued.

Dave