FINAL
DRAINAGE PLAN AND REPORT

FUEL MISSIONS

A PROPOSED CHURCH AT 10695 LINDBERGH ROAD

AS UNPLATTED LOT

EL PASO COUNTY

December 15, 2020

Prepared for

FUEL MISSIONS

Oliver E. Watts, Consulting Engineer, Inc.
Colorado Springs, Colorado

OLIVER E. WATTS, PE-LS
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Celebrating over 41 years in business

December 15, 2020

El Paso County Planning and Community Development
2880 International Circle
Colorado Springs, CO 80910

ATTN: *Jennifer Irvine, P.E.*

SUBJECT: Final Drainage Plan and Report
Church at 10695 Lindbergh Road

Transmitted herewith for your review and approval is the drainage plan and report for the proposed Church at 10695 Lindbergh Road in El Paso County. This report will accompany the development plan submittal.

Please contact me if I may provide any further information.

Oliver E. Watts, Consulting Engineer, Inc.

BY:______________________________
Oliver E. Watts, President

Encl:

Drainage Report 4 pages
Computations, 1 pages
FEMA Panel No. 08041C0259 G
SCS Soils Map and Interpretation Sheet
Backup Information, 4 sheets
Drainage Plan, Dwg 20-5449-06

1. ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Oliver E. Watts, Consulting Engineer, Inc.

____

Oliver E. Watts Colo. PE-LS No. 9853 date

2. OWNERS / DEVELOPER'S STATEMENT:

I the owner / developer have read and will comply with all of the requirements specified in this drainage report and plan.

Fuel Missions, by Dan Crosby

By: ____
P.O. Box 939
Monument, CO 80132-0939

EL PASO COUNTY:

Filed in accordance with the requirements of the El Paso Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

____________________________________ ______________

Jennifer Irvine, P.E., date
County Engineer / ECM Administrator

Conditions:

4. LOCATION AND DESCRIPTION:
The proposed church for Fuel Missions is located at 10965 Lindbergh Road, being the N1/2, N1/2 East of the Road in Section 21, Township 11 South, Range 67 west of the 6th P.M., in El Paso County. The site is 7.333 acres. The details of the proposal are shown on the enclosed drainage plan. The parking area, driveway and sidewalks will be asphalt, and the remaining area outside the building will be landscaped. The property is in an unstudied drainage basin.

5. FLOOD PLAIN STATEMENT:
This subdivision is not within the limits of a flood plain or flood hazard area, according to FEMA map panel number 08041C0259 G, dated December 7, 2018, a copy of which is enclosed for reference.

6. METHOD AND CRITERIA:
The method used for all computations is that specified in the City-County Drainage Criteria Manual, using the rational method for areas of the size of the development. All computations are enclosed for reference and review.

The soils in the subdivision have been mapped by the local USDA/SCS office, and a soils map and interpretation sheet are enclosed for reference. All soils in this area are of the Perrypark complex, being in hydrologic group "B".

7. DESCRIPTION OF RUNOFF:
<u>EXISTING DRAINAGE CONDITIONS</u>

The site is adjacent to and south of the Forest boundary at the bottom of a will timbered side hill. The natural basin consists of basins A and B on the enclosed site that discharges 0.4 cfs (5-year runoff) / 3.2 cfs (100-year runoff) historically

<u>PROPOSED DRAINAGE CONDITIONS</u>

The area will be graded to conform to the existing topography shown on the drainage plan, routing all runoff into a lot area at the southeast portion of the construction site. Very little clearing was necessary within the construction site.

All runoff will be routed to and contained within the private site, terminating at the historic outfall point. Basin A is an area partially within the forest that creates an inflow of 0.3 cfs \ 2.0 cfs that is distributed across the north line of the construction site. No concentrated point flows exist. This will combine with the 2.0 cfs /4.4 cfs from the site to total 1.0/5.2 cfs at the outfall point. This is a relatively minor increase that is easily accommodated by existing conditions downstream.

A private culvert of minimum size and slope is provided at the driveway at Lindbergh Road. No defiled borrow ditch or terrain conditions exist to require separate computations.

<u>FOUR STEP PROCESS</u>
The following process has been followed to minimize adverse impacts of urbanization

<u>Runoff Reduction:</u> The scope of the development has been minimized consistent with zoning

requirements to present the minimum footprint in providing a church in near natural surroundings. The undisturbed portions are to be landscaped to reduce the impervious percent.

Treat and Slowly Release: The total construction site is less that one acre in size and does not require treatment according to County and State regulations.

Channel Stabilizing: The site will be graded to route the runoff over improved parking and driveway installations to provide stabilizing in the natural erosive material over the site. Discharge from the site will be into and across a private driveway to the historic discharge point. Runoff is relatively minor and there will be no adverse affect on downstream developments as a result of this development

Source Controls: This is a church site, so source control problems will be a minimum. During construction, standard site specific state of the art BMP's will be employed to minimize and mitigate erosive problems.

8. COST ESTIMATE:

No drainage structures are required, other that the normal private driveway culvert into the site.

9. FEES:

No subdivision is required, therefore fees are not due.

10. SUMMARY

The proposed church site at this address provides a minimum encroachment in an attractive natural setting in order to aid in a meaningful worship experience.

The drainage analysis has been prepared in accordance with the current City of Colorado Springs Drainage Criteria Manuel. Supporting information and calculations are included in this report.

This report and findings is in general conformance with the MDDP or Preliminary Drainage Report or other pertinent studies

References

1. City of Colorado Springs Drainage Criteria Manuel, Volumes 1 and 2, May, 2014

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc MIN	I in./hr.		SOIL GRP	DEV. TYPE	C		FLOW 5-ry	FLOW 100-yr	RETURN PERIOD -years-	
		PLANIM READ	ACRES	LENGTH -FT.-	HEIGHT -FT.-								qp -CFS-	qp -CFS-		
UNSTUDIED	A	COGO	1.105	300	14.4	19.0	3.0	5.1	B	FOREST	0.08	0.35	0.3	2.0	5	100
HISTORIC	B	COGO	1.183	+180	10.5	+1.8										
		TOTAL	2.288	V=1.64		21	2.3	4.8	B	FOREST	0.08	0.35	0.4	3.2	5	100
DEVELOPED	A	AS	ABOVE													
	B	COGO	1.183	300	18	11.1			B	66%*	0.458	0.596				
			V=2.82	+138	2%	+0.8										
		TOTAL				11.9	8.7	6.5					2.0	4.4	5	100
	A+B	COGO	2.288	+438	17	+2.6										
			V+2.82			21.6	2.9	4.8	B	MIX	0.275	0.477	1.0	5.2	5	100
* % IMP	BUILDG		0.583													
	PARKG.		0.157													
	S/W		0.040													
	IMP		0.782							66%						
	TOTAL		1.183							100%						

HYDROLOGICAL COMPUTATION – BASIC DATA

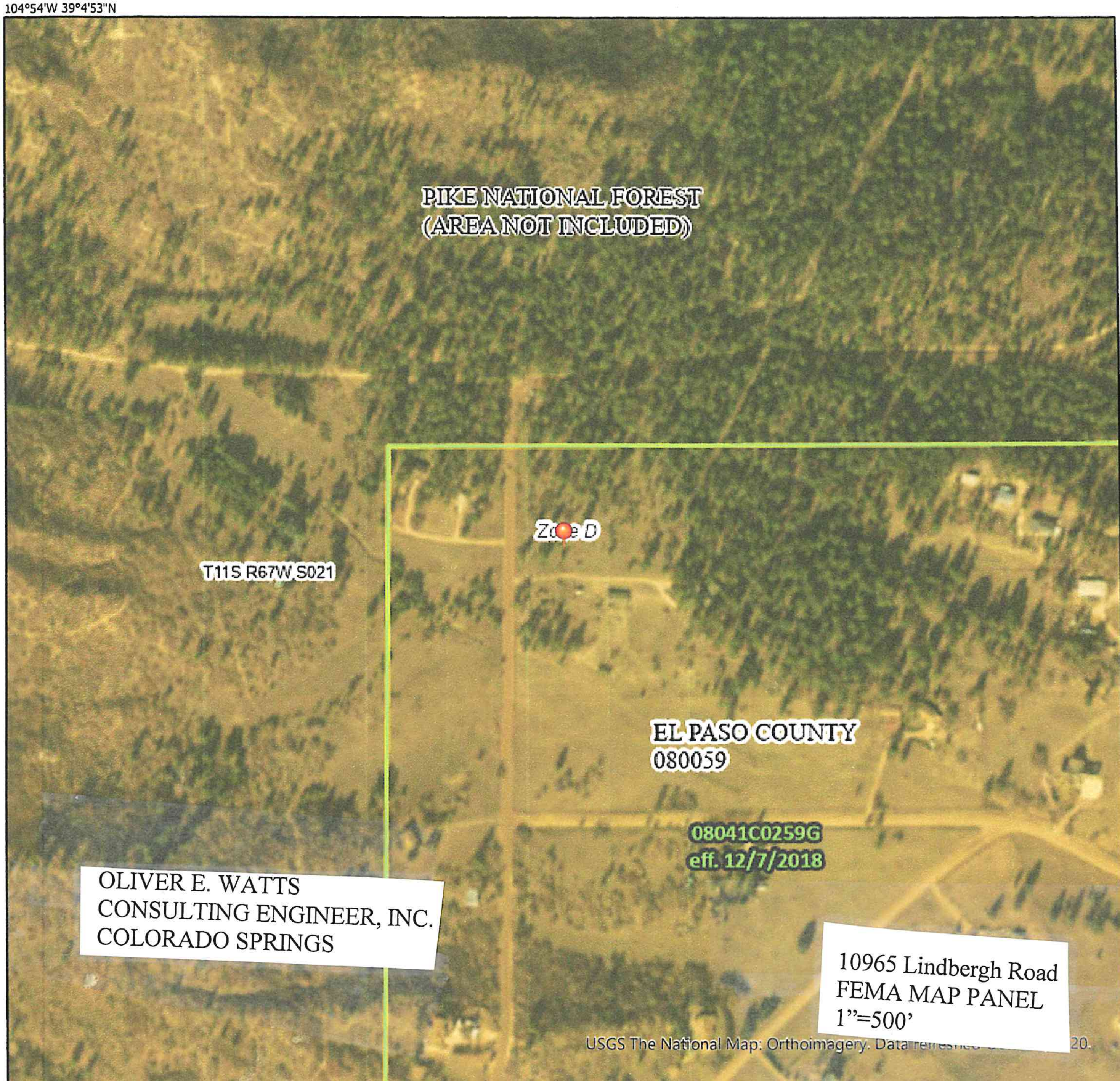
PROJ: BY:

RATIONAL METHOD DATE: December 11, 2020

OLIVER E. WATTS, CONSULTING ENGINEER, INC.
614 ELKTON DRIVE COLORADO SPRINGS, CO 80907

National Flood Hazard Layer FIRMette

104°54'W 39°4'53"N



104°53'22"W 39°4'25"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represen an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/11/2020 at 4:27 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

PIKE NATIONAL FOREST—EASTERN PART, COLORADO
SOIL SURVEY AREA
SHEET NO. 14

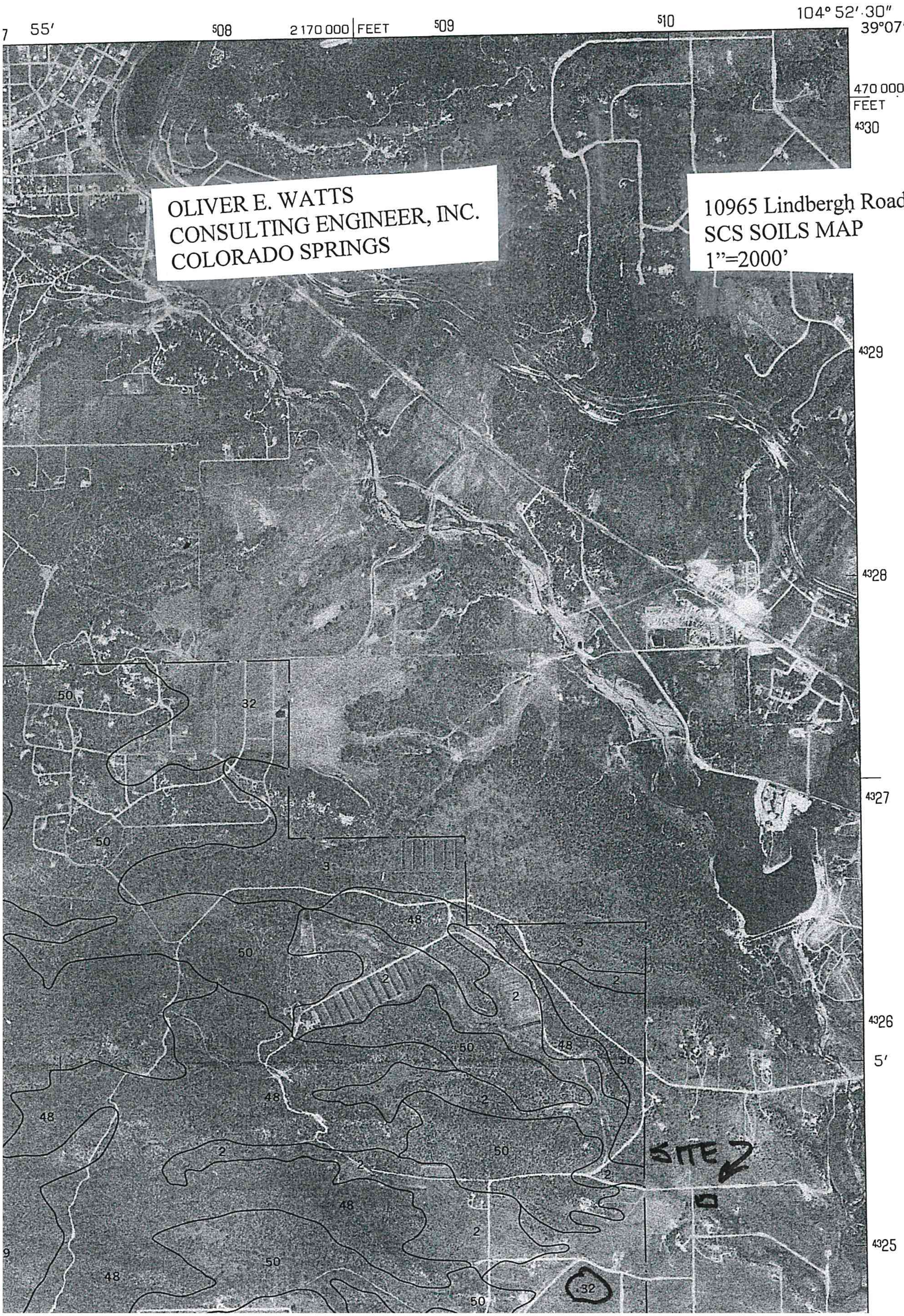


TABLE 11.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Bedrock		Risk of corrosion	
		Depth	Hard-ness	Uncoated steel	Concrete
		In			
22---------------- Kassler	A	>60	---	Moderate	Low.
23---------------- Kutch	C	20-40	Soft	High-----	Moderate.
24, 25------------ Legault	D	5-20	Soft	Moderate	Moderate.
26:					
Legault----------	D	5-20	Soft	Moderate	Moderate.
Rock outcrop-----	D	0	Hard	---	---
27, 28:					
Palboone---------	B	>60	---	Moderate	Moderate.
Security---------	C	20-40	Soft	Moderate	Moderate.
29, 30------------ Pendant	D	7-20	Hard	Moderate	Low.
31:					
Pendant----------	D	7-20	Hard	Moderate	Low.
Rock outcrop-----	D	0	Hard	---	---
32---------------- Perrypark	B	>60	---	Moderate	Low.
33:					
Rock outcrop-----	D	0	Hard	---	---
Catamount--------	D	10-20	Soft	Moderate	Moderate.
34:					
Rock outcrop-----	D	0	Hard	---	---
Security---------	C	20-40	Soft	Moderate	Moderate.
Cathedral--------	D	10-20	Hard	Moderate	Moderate.
35, 36:					
Rock outcrop-----	D	0	Hard	---	---
Sphinx-----------	D	8-20	Soft	Moderate	Low.
37:					
Sachett----------	C	10-20	Soft	High-----	High.
Rock outcrop-----	D	0	Hard	---	---
38, 39------------ Security	C	20-40	Soft	Moderate	Moderate.
40:					
Security---------	C	20-40	Soft	Moderate	Moderate.
Cathedral--------	D	10-20	Hard	Moderate	Moderate.

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.39	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$$t_c = t_i + t_t \qquad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

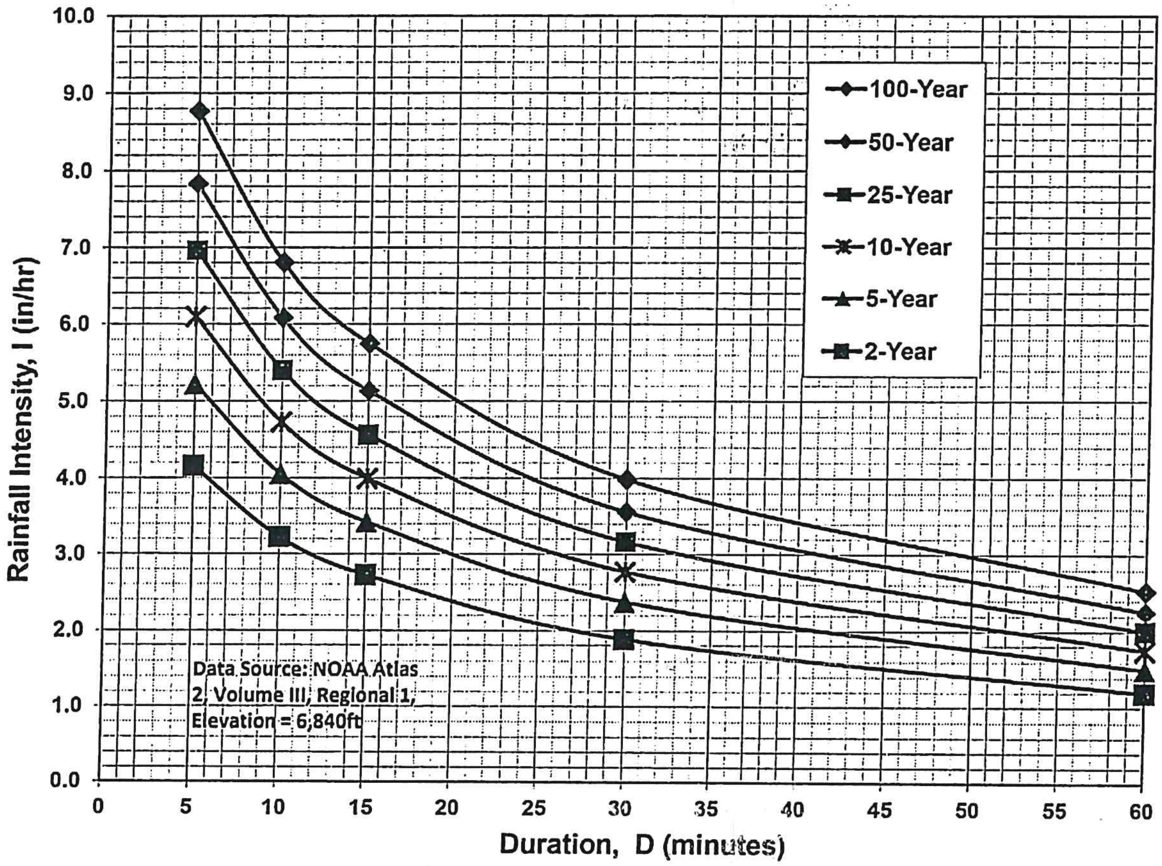
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

DRAWN BY: O.E. WATTS	APPROVED BY:	REVISIONS	OLIVER E. WATTS CONSULTING ENGINEER COLORADO SPRINGS
DATE: 12-9-20	PROJ. NO.		
DWG. NO.: 20-5449 01	DWG.		
TOPOGRAPHY BY: COUNTY LIDAR SURVEYED BY: OEW, ESW, 4-29-20, 12-4-20			

PROJECT: 16965 LINDBERGH ROAD
N1/2, N1/2, NW1/4, SE1/4, SEC. 22, T.11S., R.67W.
EL PASO COUNTY

SHT. NAME:

DRAINAGE PLAN

SHT. NO. 1 OF 1