CULVERT ANALYSIS

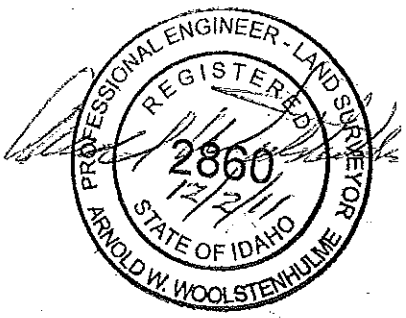
LDS Church, Driggs, Idaho, Stake

Near Victor, Teton County, Idaho

Prepared For:
NBW architects
Idaho Falls, Idaho

Property Blackfoot Farms
500 Huntsman Way
Salt Lake City, Utah
801- 584- 5700

Prepared by:
A-W Engineering
Box 139
Victor, ID 83455
208-787-2952



Nov 24, 2011

reports/ Culvert Pipe, LDS Church.wpd

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I. GENERAL PROJECT INFORMATION

LOCATION:

Part of SE 1/4 SW 1/4 Sec 35, Twp. 4 N, Rng. 45 E.,B.M. Teton County, Idaho.
(see Map M : 1 & 2 in appendix)

DEVELOPER:

LDS Church, Salt Lake City, Utah

PROPERTY OWNER

Blackfoot Farms,
500 Huntsman Way
Salt Lake, City Utah 84108

Client

NPW Architects Phone 208-522 8779, fax 8785
P.O. Box 2212
990 John Adams Parkway
Idaho Falls, Idaho 83403
email

ENGINEER / SURVEYOR:

Arnold W. Woolstenhulme, A-W Engineering, 4 North Main, Victor, Id. 83455.
208-787-2952 email aweng@ida.net

PROPOSAL : The LDS Church of Driggs, Idaho Stake is proposing to construct a new two ward chapel in the Victor, Idaho area. The church has proposed developing a 5.5 acre site with building and parking on it. The plan at this time is to connect the two entrances from the parking lot onto 7000 South County road. This would place all of the traffic onto on County road that accesses onto the State Highway 33 at the 7000's intersection.

No storm water system exists in this rural area. The farm area has natural runoff slope of 1 percent to the north west that would eventually drain into Teton River.
No evidence of drainage is present on the site or through this property. No erosion or channeling exists. The county roads do not have any culverts under them and have not shown previous runoff or water collection in the borrow pits. The county is requiring that culverts be installed in new approaches onto the county roads.

This report discusses and supports the placing of a 18" standard drainage culvert across each approach onto the county road.

II. BACKGROUND AND GUIDELINES

The 5.5 acres have been used by the owners for farm ground for the last 100 years to raise hay, grain and for horse and cattle pasture land. This property is surrounded on three sides by farm land and on the east by the Frontage road, Rails for trails and State Highway 33. Then on to the east side of State Highway 33 is more farm land.

Easements that cross the property are:

1. The prescriptive rights Easement for County Road 7000 South.
2. Power and Telephone prescriptive Rights Easements.

A. PROPOSED PLANNED SITE DEVELOPMENT

Total acres in project::	5.5 acres
Roads in project County Road R-O-W	0.30 acres
Acres improved or hardened surface	3.13 acres
Acres in Farm Parcel Lot Split from	80.0 acres

B. EXISTING CONDITIONS AT BUILDING SITE.

1- Soil is classified as Driggs Gravelly Loam D ra Permeability of 2.5-10"/hr.
2- Percolation of 2.0 to 10 Inches per hour SCS soil Survey
3- Soil tests by AW Engineering in Area. Percolation Rate of 3.0 " / hr
4- Existing Farm ground good condition - No runoff and good ground cover.

III. DESIGN CRITERIA AND DATA

No culverts exist under the county roads or State Highway. Therefore no runoff or drainage from of site areas is channelized into the county borrow pits that the new approaches will cross. The 350 feet of property just east of this proposed new church property is presently farm land and there is no indication of storm water overflow from this property.

A. STORM WATER PRESENT RUNOFF

There is no indication of any storm water run off down the borrow pits at this time. Calculations from the area of borrow pit show that the natural percolation of 1" per 3 minutes would dissipate most rain fall events. With the 100 year storm and a 2 hour rain event in this area of Teton County a rainstorm may produce less than 5 " of rain. This area of pervious and inpervious is at 50 percent for the borrow pit area and therefore this rain storm would be percolated into the ground with in 30 minutes of time.

The adjacent property will not contribute any significant runoff into the culvert area because it is downhill from the approach points. If runoff was to occur is will flow around the curb at the parking area an run to the north west away from the approaches .

B. DEVELOPED SITE :

The developed site calculated runoff would add some improved county road way and the paved approaches to the drainage under the new approaches .

Q = CI A

A 1 = .30 acres paved
C (asphalt) = 0.95
I = 0.80.

A 2 = .30 acres borrow pit area
C grd 0.20

Q asp. = (0.95) x 0.80 x 0.25 = 0. 20 cfs
Q grd = (0.20) x 0.80 x 0.35 = 0.06 cfs
Total of 0.26 cfs flow at 100 yr storm

C. STORM WATER SYSTEM FOR DEVELOPED PROPERTY

The calculated 18" cmp at 3 ft per sec would carry 5.3 cfs of water
Percolation in borrow bit of 1" in 3 minutes = .35 ac x .33 /60 = 6.6 cfs water.

More percolation in Borrow pit than runoff.

Design Culvert pipe at 18" size minimun county size.

IV. IMPACTS ON ADJACENT PROPERTIES

The developed 5.5 acres with 18" culvert in borrow pit would have no effect on neighbor property.

STORM WATER MANAGEMENT

LDS Church Site - Driggs Idaho Stake

Located in: A portion of the E ½ SW1/4 of Section 35, Twp. 4N, Range 45 E.,B.M. Teton County, Idaho

Prepared For:
NBW Architects
Idaho Falls, Idaho

Owner: Blackfoot Farms
500 Huntsman Way
Salt Lake City, Utah
801- 584- 5700

Prepared by:
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Box 139
Victor, ID 83455
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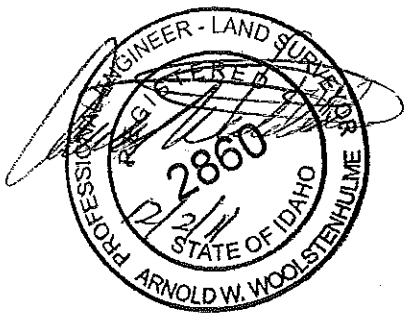

Nov 24, 2011

reports/ Storm water, LDS Church.wpd

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I. GENERAL PROJECT INFORMATION

LOCATION:
Part of SE 1/4 SW 1/4 Section 35, Twp. 4 N, Rng. 45 E.,B.M. Teton County, Idaho.
(see Map M : 1 & 2 in appendix)

DEVELOPER:
LDS Church, Salt Lake City, Utah

PROPERTY OWNER:
Blackfoot Farms LLC
500 Huntsman Way
Salt Lake, City Utah 84108

Client
NPW Architects Phone: 208-522 8779 fax: 522- 8785
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990 John Adams Parkway
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email sln@nbwarchitects.com

ENGINEER / SURVEYOR:
Arnold W. Woolstenhulme, A-W Engineering, 255 South Main, Victor, Id. 83455
208-787-2952 email aweng@ida.net

PROPOSAL : The LDS Church of the Driggs, Idaho Stake is proposing to construct a new two ward chapel in the Victor, Idaho area. The church has proposed developing a 5.5 acre site with building and parking on it. The site is outside of City of Victor limits, but it is situated within the city area of impact. The present plan is to connect into the city of Victor water and sewer systems. The water service is about 1 mile away to connect into a new well the city has created. The Victor -Driggs sewer trunk line is about 400 feet east of this building site. The plan at this time is to connect the two entrances from the parking lot onto 7000 South County road. This would place all of the traffic onto a County road that accesses onto the State Highway 33 at the 7000 South intersection.

This project will consist of two separate wards that meet in overlapping wards' time slots at a three hour block meeting schedule. This means on a typical Sunday two wards will overlap their meeting by one hour. Therefore the peak traffic would be during the period when one ward is meeting and the second ward is starting their meetings.

No storm water system exists in this rural area. The farm area has a natural runoff slope of 1 percent to the west that would eventually drain into the Teton River.
No evidence of drainage is present on the site or through this property. No erosion or channeling exists. The county roads do not have any culverts under them and have not shown previous runoff or water collection in the borrow pits.

Many concerns and problems that will be addressed as this project proceeds are discussed in this report. Oversights or problems which are not apparent at this time neither negate the interest of the Engineer or the developer in addressing all concerned problems in a professional manner, nor their interest in having a quality project of which they are proud to be a part.

II. BACKGROUND AND GUIDELINES

The 5.5 acres have been used by the owners for farm ground for the last 100 years to raise hay, grain and for horse and cattle pasture land. This property is surrounded on three sides by farm land and on the east by the Frontage Road, Rails for Trails and State Highway 33. Then to the east side of State Highway 33 is more farm land.

Easements that cross the property are:

1. The prescriptive rights easement for County Road 7000 South.
2. Power and telephone prescriptive rights easements.

A. PROPOSED PLANNED SITE DEVELOPMENT

Total acres in project:	5.5 acres
Roads in project County road right-of-way	0.30 acres
Acres improved or hardened surface	3.13 acres
Acres in farm parcel from which the church site was split	80.0 acres

B. EXISTING CONDITIONS AT BUILDING SITE.

1- Soil is classified as Driggs Gravelly Loam D ra Permeability of 2.5-10"/hr.
2- Percolation of 2.0 to 10 Inches per hour SCS soil Survey
3- Soil tests by AW Engineering in area. Percolation Rate of 6.0 " / hr
4- Existing farm ground good condition - No runoff and good ground cover.

D. AREAS TO ADDRESS FROM STUDY

1. Existing Storm water runoff conditions.
2. Calculated Storm Water runoff from developed site.
3. Proposed Storm water runoff solution.

III. DESIGN CRITERIA AND DATA

The 5.5 acres have been used by the owners for farm ground for the last 100 years to raise hay, grain and for horse and cattle pasture land. This property is surrounded on three sides by farm land and on the east by the Frontage Road, Rails for Trails and State Highway 33. Then on the east side of State Highway 33 is more farm land. No culverts are under the county roads or State Highway. Therefore no runoff or drainage of site is directed are would come onto this property. The 350 feet just east of this property is in farm land and has no indication of storm overflow from this property. Therefore at this time only the developed property will be evaluated.

A. STORM WATER PRESENT RUNOFF

The calculated runoff of 0.50 cfs (See Worksheet in Appendix) for the undeveloped site would have 3600 cu feet of water for the 100 year frequency storm at 2.2 inches of rain and 2 hour storm. The history of this property shows no runoff from existing farming methods.

The adjacent property will not contribute any significant runoff onto this site from the history of the property and observations by A-W Engineering over the past 40 years.
If runoff was to occur it will easily flow around the curb at the parking area and run in its natural drainage away from this site.

B. DEVELOPED SITE:

The developed site calculated runoff of 1.80 cfs (See Worksheet 4, Developed Site in Appendix) would have 12,960 cubic feet of water for the 100 year frequency storm at 2.2 inches of rain and a 2 hour storm. See Teton County storm water Teton Valley of 1.19 inches of rain for 100 year storm and adding 1.0 inches for rain on snow for worst case scenario would total to 2.20 inches of rain / snow runoff for said 100 year storm. This is the worst case situation and the one used for calculating storm water retention.

C. STORM WATER SYSTEM FOR DEVELOPED PROPERTY

The calculated 12,960 cubic feet of water for peak 100 year storm runoff minus the present 3660 cf of water from present condition runoff.

Percolation of 6" per hour would result in cubi feet of water drained into the ground.
6" / hr x 2 hrs x area (50 ft x 70 ft area) 3500 cubic feet of water.

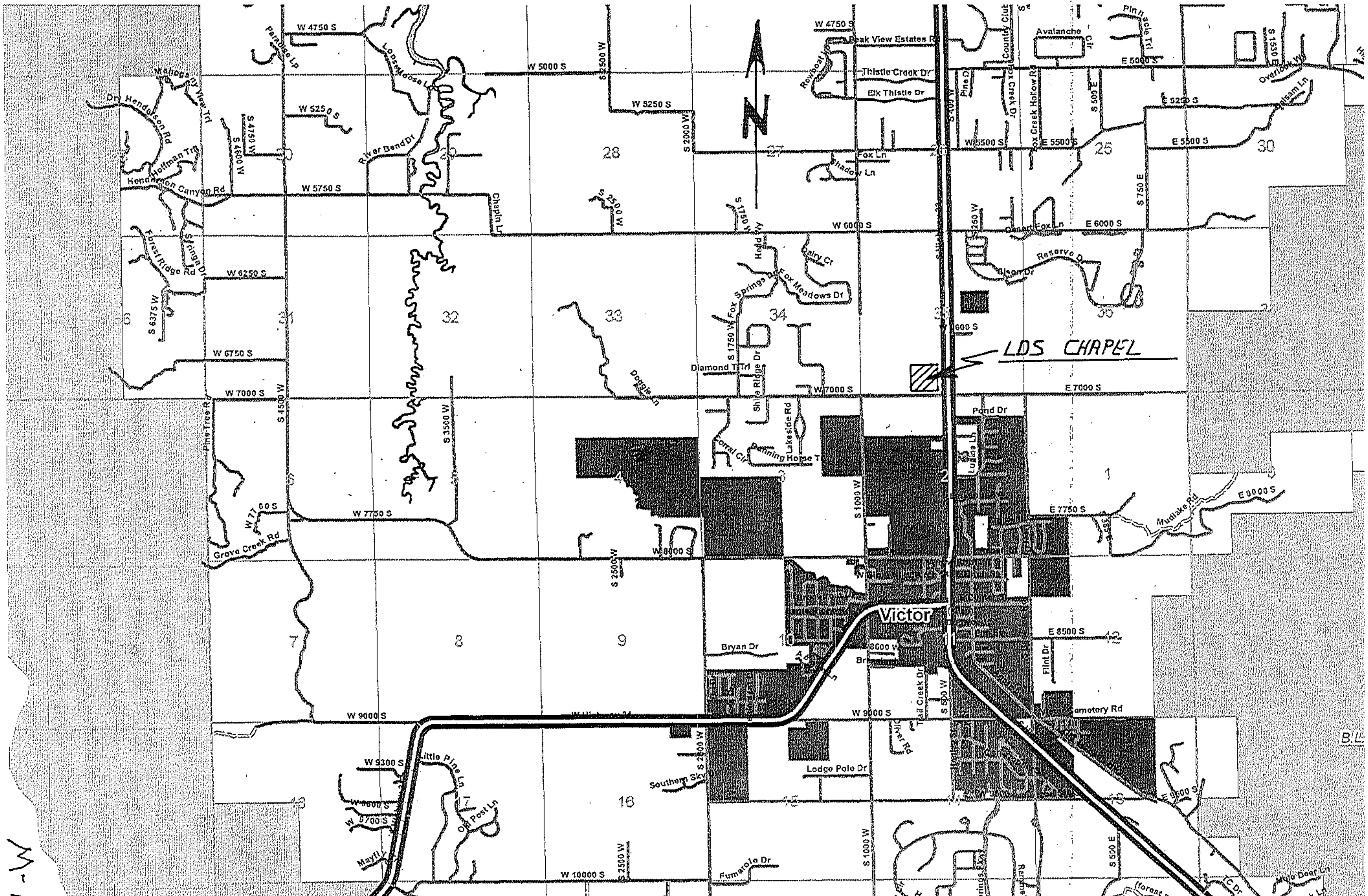
12,960	cu ft design run off
3,660	cu ft of water present condition
3,500	cu ft of percolation into ground
5,800	cu ft retention pond

Design Pond for 6,000 cu feet of water

Pond dimensions 50 feet x 60 feet surface x 4.0 feet depth. = 7300 cu ft.
Pond dimensions 50 feet x 58 feet surface x 3.0 feet depth. = 6000 cu ft.

IV. IMPACTS ON ADJACENT PROPERTIES

The developed 5.5 acres with a 6000 cu feet retention pond would have very little if any impact on the adjacent property. With the percolation rate of 1" in 12 minutes (5" per hour on farm ground) that calculates into 5" /12" x 50 ft x 50 ft would 1040 cu ft of water percolated in take ground per hour. This would require 6 hours hours to percolate out before the next 24 hour storm.
This system is designed to only discharge the 3,660 cu ft of water from the present condition.



LDS CHAPEL
Victor
N
W 4750 S
Peak View Estates Rd
Thistle Creek Dr
Elk Thistle Dr
Avalanche Cir
Country Club
Fox Creek Dr
Fox Creek Hollow Rd
Pinnacle Trl
E 5000 S
E 5250 S
E 5500 S
W 5500 S
Overlook Wy
Balsam Ln
W 5000 S
W 5250 S
W 5750 S
W 6000 S
E 6000 S
W 6250 S
W 6750 S
W 7000 S
E 7000 S
W 7750 S
E 7750 S
W 8000 S
E 8500 S
W 9000 S
E 9000 S
W 9300 S
W 10000 S
Paradise Lp
Loose Moose Ln
River Bend Dr
Henderson Canyon Rd
Hoffman Trl
Henderson Rd
Mahogany View Trl
Forest Ridge Rd
Syringa Dr
Pine Tree Rd
Grove Creek Rd
Chapin Ln
Fox Ln
Shadow Ln
Rowboat Ln
Dairy Ct
Fox Springs Dr
Fox Meadows Dr
Reserve Dr
Bison Dr
Diamond T Trl
Shire Ridge Dr
Lakeside Rd
Running Horse Trl
Corral Cir
Doggie Ln
Pond Dr
Mudlake Rd
Bryan Dr
Flint Dr
Cemetery Rd
Tail Creek Dr
Oliver Rd
Lodge Pole Dr
Southern Sky
Little Pine Ln
Old Post Ln
Fumarole Dr
Mule Deer Ln
S 2500 W
S 2000 W
S 1750 W
S 1000 W
S 500 W
S 750 E
S 550 E
S 3500 W
S 4500 W
S 6375 W
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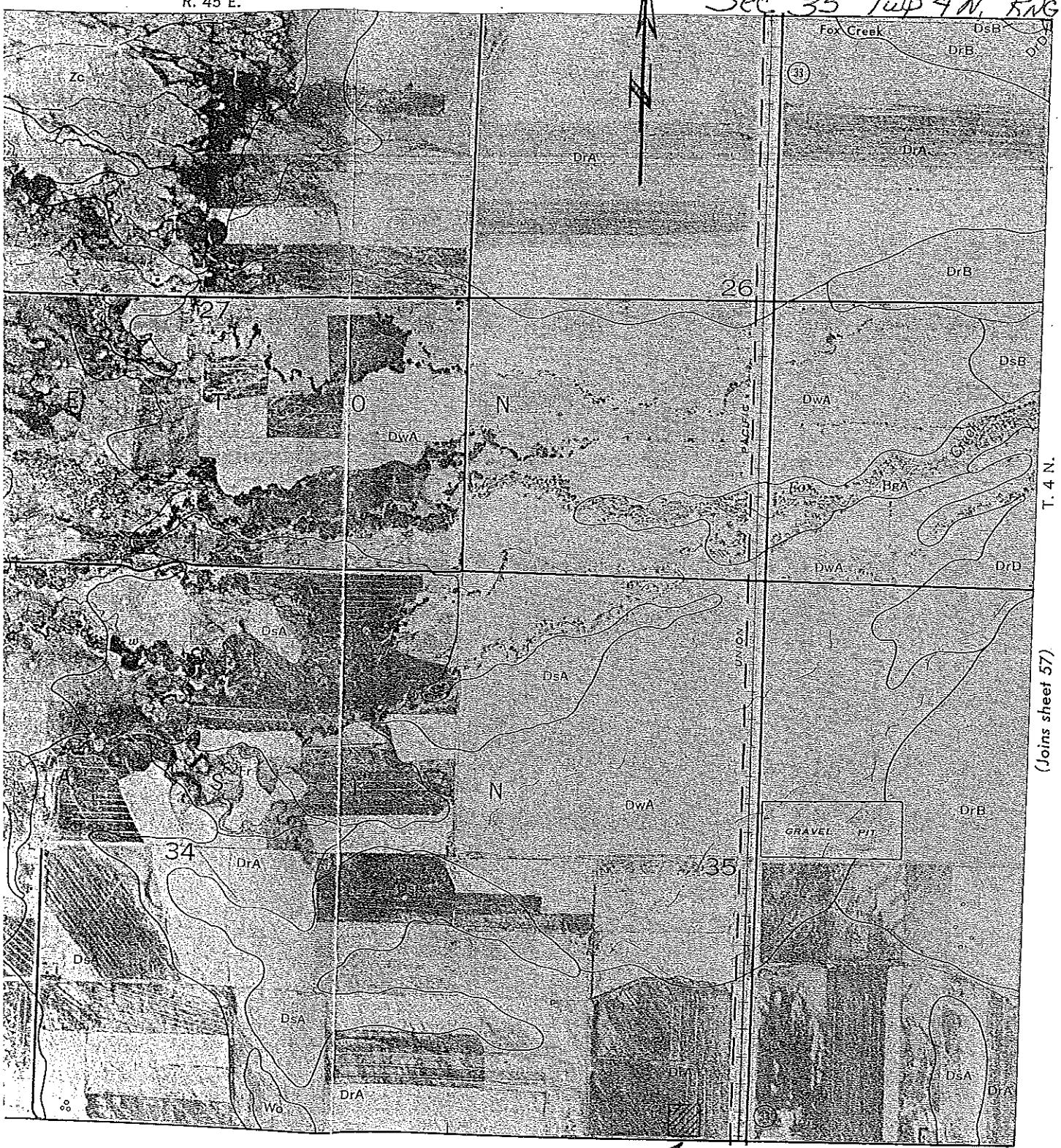
AREA, IDAHO - WYOMING — SHEET NUMBER 56

Teton County, Idaho

Sec. 35 Twp 4N, Rng 45E



Church Proj.

½ Mile

Scale 1:15840

0 3 000 Feet

M-2

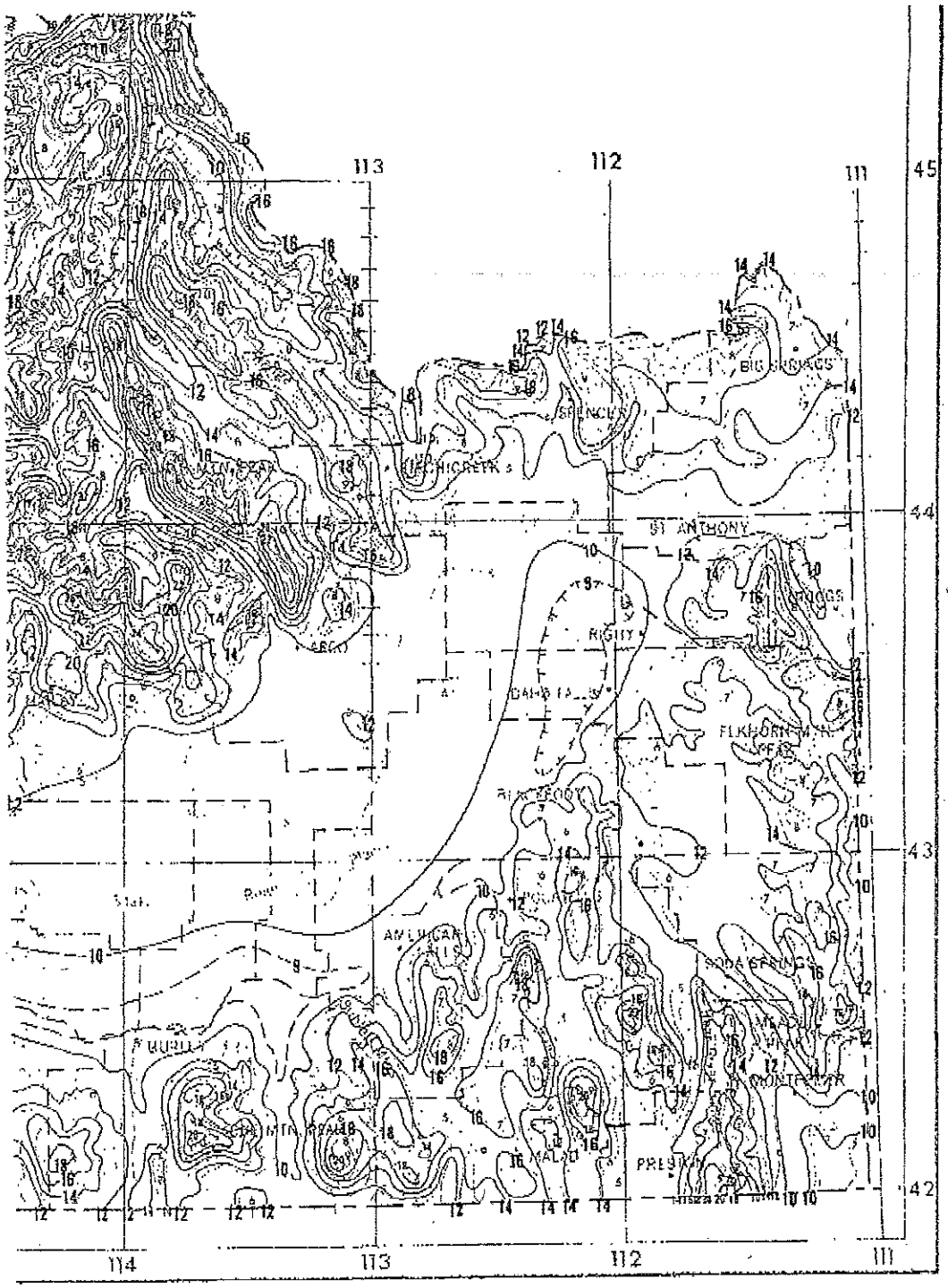
TABLE 4.—*Estimated engineering properties of the soils*—Continued

Soil series and map symbols	Depth from surface	Classification: USDA texture	Classification: Unified
	Inches		
Dranyon (DgG, DgF).	2 to 0	Organic material	Pt
	0 to 47	Stony loam	ML or CL
	47	Fractured sandstone	
Driggs (DsA, DtA, DsB, DsC, DrA, DrB, DrD, DoA, DwA).	0 to 25	Silt loam or gravelly or cobbly loam	SM, ML, or CL
For Wiggleton part of DwA, see Wiggleton series.	25 to 35	Very gravelly coarse sandy loam	GM
	35	Sand and gravel	GW
Felt (FlA, FlB, FlC, FlD, FeD).	0 to 34	Loam or gravelly loam	SM, ML, or CL
	34	Sand and gravel	GP or GW
Feltonia (FnA, FnB, FoB, FoD).	0 to 36	Loam	ML or CL
	36 to 49	Very gravelly loam	GM or SM
	49	Sand and gravel or sand	SW or SM
Foxcreek (Fs, Fr).	0 to 19	Loam or gravelly loam	SM, SC, ML, or CL
	19	Loose sand and gravel	GW, GP, or GM
Foxcreek, shallow variant (Ft, Fu).	0 to 11	Loam or gravelly loam	SM or SC
	11	Sand and gravel	GW
Foxcreek, heavy subsoil variant (Fv).	2 to 0	Organic matter	Pt
	0 to 30	Silty clay loam	MH
	30	Sand and gravel	GP or GM
Furniss (Fx, Fw).	2 to 0	Organic matter	Pt
	0 to 30	Silty clay loam	MH
	30 to 35	Heavy fine sandy loam	SM or SC
	35	Sand and gravel	GP or GM

properties of the soils—Continued

Classification—Continued: AASHO	Percentage passing sieve: No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Shrink-swell potential
				Inches per hour	*Inches per inch of soil*	*pH value*	
				5. 00–10. 00		5. 6–6. 0	
A–4 or A–6	80–90	70–80	50–70	0. 20–0. 80	0. 10–0. 12	5. 6–6. 0	Low.
A–4 or A–6	80–100	60–95	40–85	0. 80–2. 50	0. 10–0. 20	6. 6–7. 3	Low to moderate.
A–1	40–60	20–40	5–15	>10	0. 05–0. 06	6. 6–7. 8	Low.
A–1	25–35	15–25	0–5	>10	0. 04–0. 05	6. 6–7. 8	Low.
A–4 or A–6	80–95	60–95	40–70	0. 80–2. 50	0. 10–0. 14	7. 4–8. 4	Low.
A–1	30–45	25–35	0–5	>10	0. 04–0. 05	7. 4–8. 4	Low.
A–4 or A–6	90–100	95–100	50–60	0. 80–2. 50	0. 14–0. 16	7. 4–8. 4	Low.
A–1 or A–2	50–60	20–50	10–20	5. 0–10. 0	0. 06–0. 10	7. 4–8. 4	Low.
A–1, A–2, or A–3	30–100	25–100	0–25	>10	0. 04–0. 05	7. 5–8. 5	Low.
A–4 or A–6	80–95	60–95	40–70	0. 80–2. 50	0. 10–0. 16	6. 6–7. 3	Low.
A–1	35–50	25–40	0–15	>10	0. 04–0. 05	7. 4–8. 4	Low.
A–4 or A–6	80–95	60–95	40–50	0. 80–2. 50	0. 10–0. 16	7. 4–8. 4	Low.
A–1	20–30	15–25	0–5	>10	0. 04–0. 05	7. 4–8. 4	Low.

59 Weathering shale or sandstone



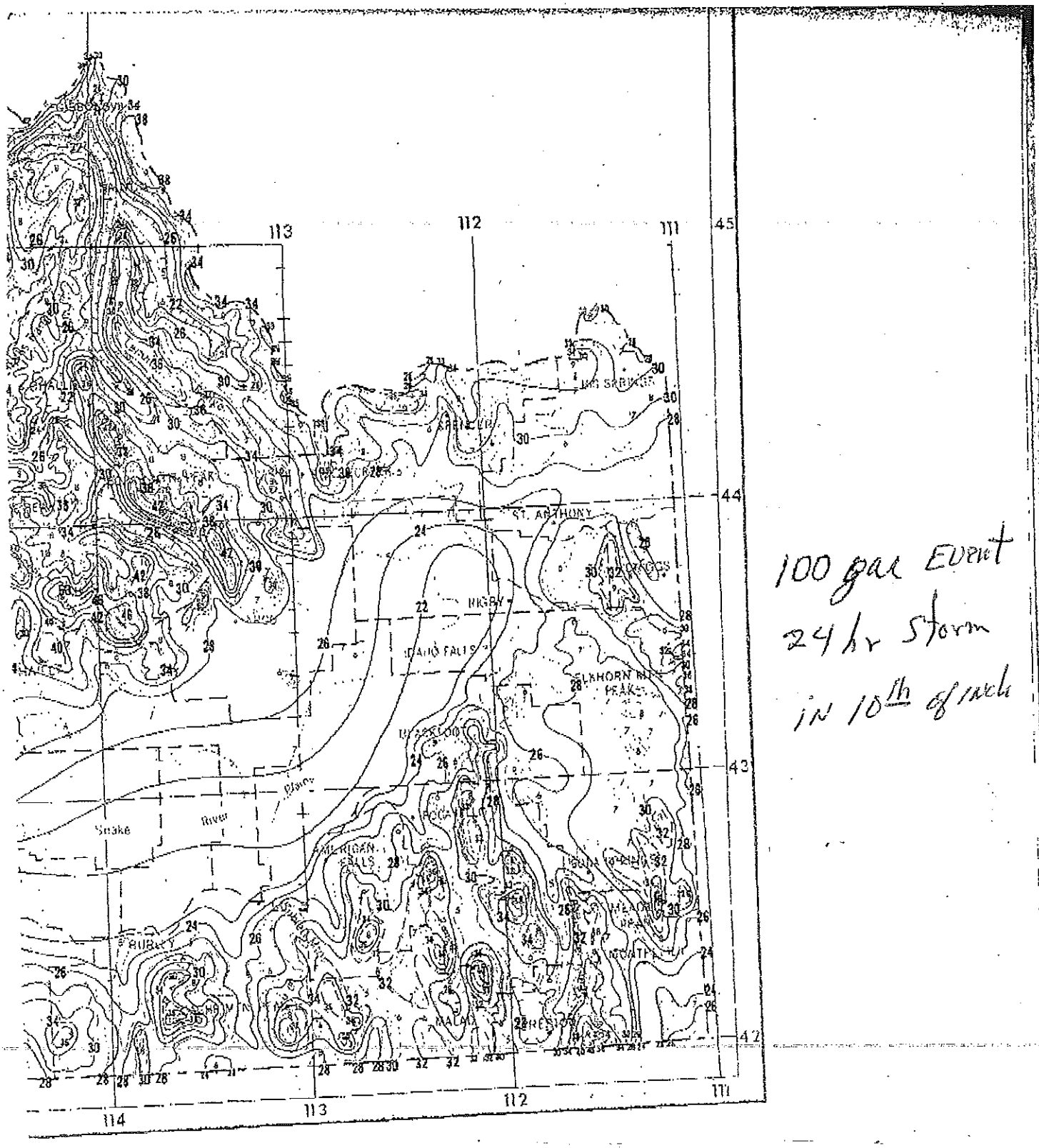
2 year
24 hour
event

1N 10th of inch

0 12" in Victor

Use 1 20" Summer rain fall

P-1

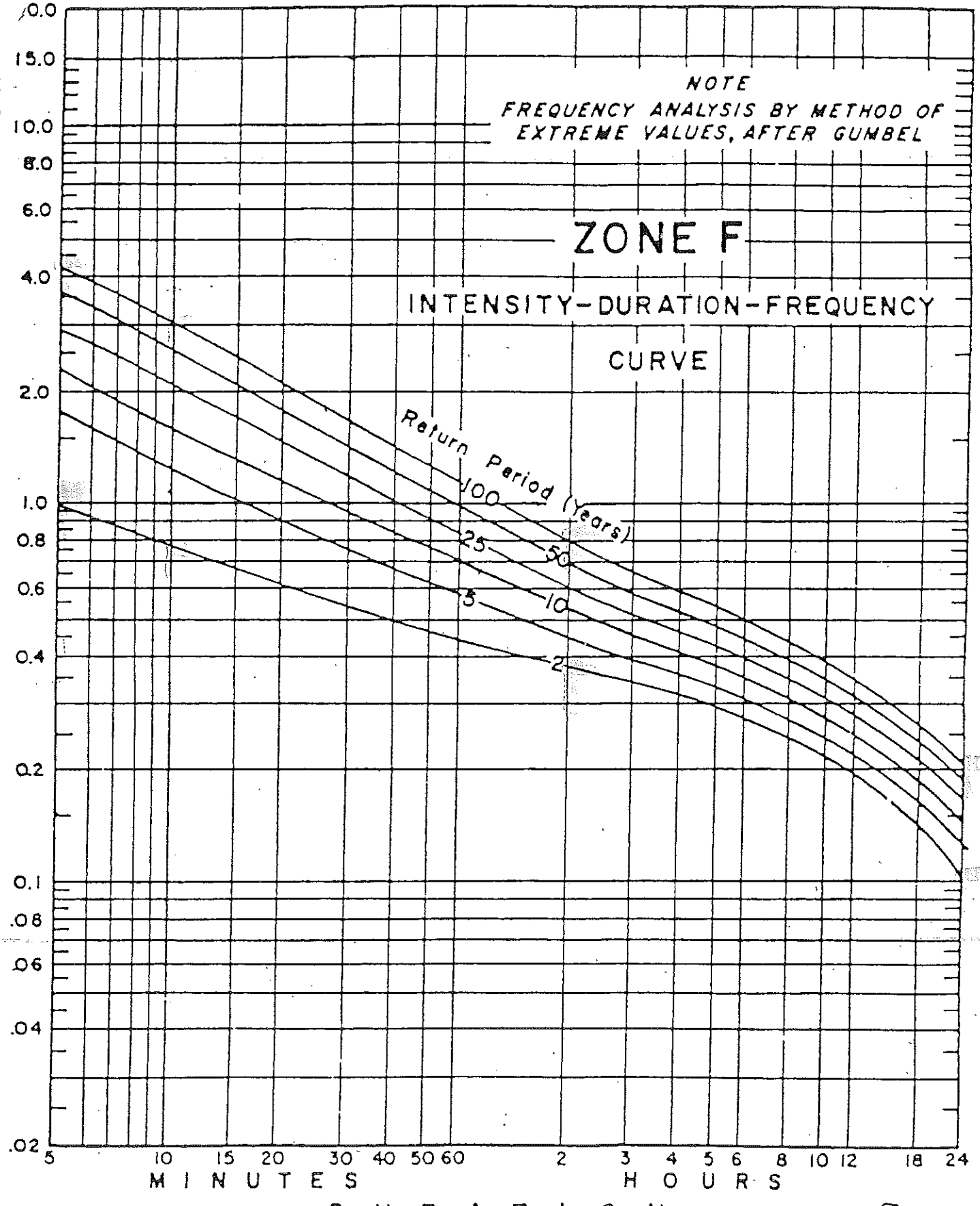


From Records use 2.20"

1.19" + 1.6" snow = 2.20"

P-2

ZONE F, INTENSITY-DURATION-FREQUENCY CURVE
(IDAHO TRANSPORTATION DEPARTMENT)



P-3

5. **Design Runoff** Major channels and outfall facilities, (including culverts, open channels, roadside swales, and curbed street flows less than 1.0' in depth), and also detention and retention basins, shall be designed for the greater of the 100 year rainfall runoff event or the 100 year rainfall-snowmelt event, per procedures explained elsewhere in this document. Curbed street flow below inundation limits, street catch basin inlets, and most local storm drains shall be adequate to handle 25% of the design runoff.

B. HYDROLOGY

1. **Watershed Delineation** Use the entire watershed that drains to and from the Site as noted above.

2. **Precipitation Rates** The NOAA Atlas 2 for Idaho was published in 1973, and is based on limited years of rainfall data before that, and does not reflect better design storm precipitation rates that can be estimated using 36 years worth of data since. Consequently, values out of the NOAA Atlas 2 should not be used except where better information is unavailable.

   a. **Teton Valley Floor** The most complete and longest-running official rain gauge in the Teton Valley is located in Driggs. A 2008 statistical analysis of rainfall resulted in the rainfall amounts shown below.

Teton Valley Floor Precipitation		
Season	**Approximate Months**	**100 Yr Rainfall (Inches)**
Winter	December through February	1.19
Early Spring	March and April	1.14
Late Spring	May and June	1.92
Thundershower	July through October	1.52

   b. **Big Hole Mountains Area** For Teton County areas in the Big Hole Mountains to the west of the valley, the most complete and longest-running official rain gauge that may be representative is located at the

Worksheet 2: Runoff curve number and runoff

Project	By	Date
LDS Church Site, Driggs	A. Woolstenhulme	Nov' 18, 11
Location	**Checked**	**Date**
SW¼ Sec 35 T4N R45E		

Check one: ☐ Present ☒ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Figure 2-3	CN [1/] Figure 2-4	Area ☐ acres ☐ mi² ☐ %	Product of CN x area
Driggs, Good "B"	Co Road - Dirt R-o-W	35			0.16	5.6
	Grassland Open	70			2.22	155.4
	Paved / developed Site	98			3.13	307

[1/] Use only one CN source per line

Totals ➡ 5.51 | 468

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{468}{5.51} = 84.9$; **Use CN** ➡ 85

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	2 Yr	100 yr	
Rainfall, P (24-hour)	in	1.20"	2.20"	
Runoff, Q	in	0.21	0.95	

(Use P and CN with table 2-1, figure 2-1, or equations 2-3 and 2-4)

R-6

Worksheet 3: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
LDS Church Site, Driggs	Arnold Woolstenhulme	Nov 18, 11
Location	**Checked**	**Date**
SW¼ Sec 35, T4N, R45E		

Check one: ☐ Present ☒ Developed

Check one: ☐ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

	Segment ID		
1. Surface description (table 3-1)	Parking		
	Paved		
2. Manning's roughness coefficient, n (table 3-1)	0.11		
3. Flow length, L (total L † 300 ft) ft	150'		
4. Two-year 24-hour rainfall, P_2 in	1.2"		
5. Land slope, s ft/ft	0.01		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.38	+	= 38

Shallow concentrated flow

	Segment ID		
7. Surface description (paved or unpaved)	Parking		
	Paved		
8. Flow length, L ft	200'		
9. Watercourse slope, s ft/ft	0.01		
10. Average velocity, V (figure 3-1) ft/s	1.90		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr	0.29	+	= 0.29

Channel flow

	Segment ID		
	Gutter		
12. Cross sectional flow area, a ft^2	1.60		
13. Wetted perimeter, p_w ft	3.20		
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft	0.5		
15 Channel slope, s ft/ft	0.01		
16. Manning's roughness coefficient, n	0.11		
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s	0.84		
18. Flow length, L ft	200'		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr	0.06	+	= 0.06

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr 0.73

A-5

Worksheet 4: Graphical Peak Discharge method

Project	By	Date
LDS Church Site Drives	A. Wahlstrahulme	Nov 18, 11
Location	**Checked**	**Date**
SW¼ Sec 35, T4N, R45E		

Check one: ☐ Present ☒ Developed

1. Data

Drainage area ..... S.S/A A_m = 0.0086 mi^2 (acres/640)

Runoff curve number ..... CN = 85 (From worksheet 2)

Time of concentration ..... T_c = 0.73 hr (From worksheet 3)

Rainfall distribution ..... = I (I, IA, II III)

Pond and swamp areas sprea throughout watershed ..... = 0 percent of A_m (0 acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	24yr	100yr	
3. Rainfall, P (24-hour)	in	1.2	2.2	
4. Initial abstraction, I_a (Use CN with table 4-1)	in	0.353	0.353	
5. Compute I_a/P		0.29	0.16	
6. Unit peak discharge, q_u (Use T_c and I_a/P with exhibit 4–)	csm/in	153	220	
7. Runoff, Q (From worksheet 2) Figure 2-6	in	0.21	0.95	
8. Pond and swamp adjustment factor, F_p (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond ans swamp area.)		1	1	
9. Peak discharge, q_p	ft^3/s	0.28	1.80	

(Where $q_p = q_u A_m Q F_p$)

cfs 1.8 X 2hrs = 12,960 CF water Runoff developed

R-4

Area Paved

Area	316 x 930	=	133,300
Inlet Cuts	- 55 x 150'	=	- 8,250
Driveway	+ 25 x 170	=	4250
CoRd	+ 15' x 466	=	6900 = 0.16
		=	136,200 / 3.13 Ac
Total 5.57 Ac	- 3.13 paved	=	2.44 Ac

C-1

Present - CN = 73

$$Q = \frac{(P - 0.25)^2}{P + 0.8S}$$

P = 1.2" for 2yr
= 2.2" " 100 yr

$$S = \frac{1000}{CN} - 10 = 3.70$$

2yr $Q = \frac{(1.2 - .2(3.70))^2}{1.2 + .8(3.70)} = \frac{0.21}{4.16} = 0.05$

100yr $Q = \frac{(2.2 - .2(3.70))^2}{2.2 + .8(3.7)} = \frac{2.13}{6.51} = 0.33$ ←

Future Developed CN = 85

S = 1.76

$Q_{2yr} = \frac{(1.2 - .2(1.76))^2}{1.2 + 0.8(1.76)} = \frac{0.72}{2.60} = 0.28$ ←

$Q_{100yr} = \frac{2.2 - .2(1.76)^2}{2.2 + .8(1.76)} = \frac{3.42}{3.60} = 0.95$

$T_T = \frac{.007(nL)^{.8}}{P_2^{1/2} S^{.4}} = \frac{.007(16.5)^{.8}}{(1.2)^{.5}(0.01)^{.4}} = \frac{0.066}{(1.09)(.16)} = 0.38$ ← hr

C-2

T_c = 5 MIN

	IMPERV.	GRASS
EXISTING	19,000	30,206
PROPOSED	30,000	19,200

RUNOFF	Cu. FT Water
5 MIN	1.2 CF
10 MIN	0.8 CF

$Q = C I_T A$ A = .43 A = .70 A = 1.13

STORM DURATION	I IN/HR INTENSITY	Q GRASS C=0.5 ·215	Q IMPER C=0.85 · .6	Q TOT
5 MIN	1.8	.39	1.08	1.47
10 MIN	1.38	.30	0.83	1.13
15 MIN	1.20	.26	0.72	0.98
30 MIN	0.82	.18	0.49	.67
1 HR	0.52	.11	0.31	.042
2 HR	0.32	.07	.19	.26

PREDEVELOPMENT 10 YR STORM - 5MIN DUR

5 MIN	1.8	.61	.66	1.27
5 MIN	1.8	1.8 x 1.13AC X 0.5		1.017