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# DESIGN REPORT

FOR

***THE HUNTLEY ADDITION TO TOWNCENTER***

***WATER AND SEWER EXTENSION LOOP***

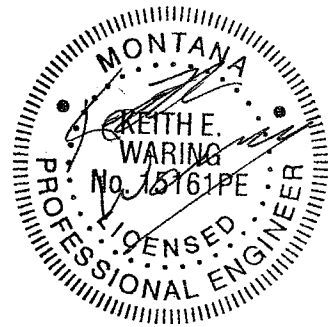
***BIG SKY, MONTANA***

PREPARED BY:

**THOMAS, DEAN & HOSKINS, INC  
GREAT FALLS, KALISPELL & BOZEMAN, MONTANA  
SPOKANE, WASHINGTON & LEWISTON, IDAHO**

MAY 2006

**JOB #B03-047-016**



**Huntley Addition of Big Sky Town Center  
Water Loop and Sanitary Sewer Extension  
Engineering Design Report  
May 2006**

**General**

In January 2001, an Engineering Design Report was submitted and approved for the Big Sky Town Center, a Planned Unit Development within the boundaries of the Big Sky County Water & Sewer District. The Town Center is located in the NW ¼ of Section 1, Township 7 South, Range 3 East and the SW ¼ of Section 36, Township 6 South, Range 3 East, P.M.M. Gallatin County, Montana.

This report is an addendum to the February 2006 Engineering Design Report and discusses the design of the water distribution and sanitary sewer system extensions in the Huntley Addition. The purpose of this extension is to create more available water for fire flow in the Huntley Addition. This planning for future phases will allow for larger buildings in the Huntley Addition. This evaluation shows that the alignment and sizes of the water and sewer system are adequate for the proposed population and usage. Calculations for this design are included in the applicable section.

**Water Distribution System**

The water distribution system has been designed in accordance with the Montana Department of Environmental Quality Circular DEQ 1 and the requirements of the Big Sky Water and Sewer District (BSWSD). The BSWSD will supply the potable water and storage for the Town Center. As such, only the distribution mains in the proposed extension loop within the Huntley Addition are evaluated in this report.

The proposed extension to the Huntley Addition of the Big Sky Town Center includes 1,252 lineal feet of 8" ductile iron to the existing distribution system. This brings the total length of the Huntley Addition distribution system to 3,823 lineal feet. The water main is proposed to connect with the existing distribution system at an 8" gate valve located at the south end of the current line on Huntley Drive. From that point, the line continues to extend southward down Huntley

Drive to the intersection with Aspen Leaf Drive. At that point the line heads west on the north side of Aspen Leaf Drive, crosses the road, and connects with the existing main near the intersection of Aspen Leaf Drive and Simkins Drive on the south side of the road.

Fire hydrant spacing is such that a hydrant is provided every 350 to 500 feet depending on the area being served. All hydrants have pumper connections allowing them to withdraw over 1,500 gpm in the event of a fire. The Gallatin Canyon Volunteer Fire Department responds to fires in this area. The fire hydrants in the Big Sky Town Center as well as the Huntley Addition are compatible with the Fire Department's equipment and comply with BSWSD Standard Drawing #BS-201.

Water meters that comply with the standards of the BSWSD will be required during the land use permit process for all residential and commercial users in Town Center. Metering water encourages conservation and can provide water use information that can be a good indicator of leaks in the system. Metering also allows the BSWSD to keep accurate records of demand.

Water valves provide flexibility in a distribution system and permit portions of the system to be removed from service without shutting down the entire system. Valves have been placed to minimize inconvenience to users in the event that a section of main is taken out of service.

#### Water Use Data

Water service is to be provided to the Huntley Addition through connections to the existing public water system owned and operated by the BSWSD. The BSWSD has established a set schedule that equates specific land uses to a specific number of Single Family Equivalents (SFE). The SFE system allows the District to relate usage to the total number of SFE's and provides a basis for estimating water service requirements. The Owner of the Town Center Development is allowed to develop up to 1,435 SFE's. The proposed water loop will use an estimated 252.8 SFE's, bringing the total SFE count in the Huntley Addition to 498. Calculations of the SFE's are included in Appendix A.

The actual water use per SFE was discussed in the January 2001 Engineering Report and is used to estimate water usage for the Town Center and Huntley Addition. Regardless of the revised subdivision layout, the overall usage remains similar to that of the original layout and will be

capped at 1,435 SFE's. A multiplier of 2.3 was used to calculate maximum day demands. This is the same as the maximum day multiplier used in the January 2001 Design Report. A multiplier of 7.0 was used for peak hour demands. Irrigation uses contribute significantly to peak hour demands. Depending on the precipitation for a given year, these demands can change greatly. The peak hour factor of 7.0 used in this analysis is conservative. In small communities such as Town Center, the controlling demands are typically maximum day plus fire flow. The following summarizes the average day, maximum day and peak hour demands for this subdivision.

Huntley Addition (Extended Loop)

Total SFE's	252.2
gpd/SFE	258
Total Use	$252.8 \times 258 = 65,222.4$ gpd
Average Day Flow	45.29 gpm
Maximum Day Flow	104.17 gpm
Peak Hour Flow	317.03 gpm
Maximum Day Flow plus Fire Flow	$104.17 + 1,500 = 1,604.17$ gpm

Flow Requirements

The Gallatin Canyon Fire Department requires that all commercial buildings as well as residences larger than 3,600 square feet have automatic fire sprinklers. Fire sprinklers shall be required for all buildings in the Huntley Addition. In addition to fire sprinklers, fire hydrants within the Town Center must have a minimum capacity of 1,500 gpm for two hours.

Hydraulic analyses for the water distribution system were performed with computer modeling software, WaterCAD by Haestads Methods, Inc. The analysis evaluated average day and maximum day demands plus 1,500 gpm fire flows while maintaining minimum zone pressures of 20 psi throughout the system. The system is also capable of delivering peak hourly domestic demands while maintaining a minimum zone pressure of 35 psi. Data from these computer analyses is included in Appendix B.

### Water Services

A water service has been installed to the property line of each lot. It is the responsibility of each lot owner/developer to size the service to meet the lots requirements. Eight-inch service lines have been provided to each lot. Sprinkler systems are required for commercial buildings. Multi-family housing will also require four-inch service lines thus being able to serve both the combined fire and domestic demands. The multi-family housing units are proposed to have a maximum of 15 units/acre, the maximum density allowed by zoning for this subdivision. The calculations in this report are based on the maximum density allowed by zoning so the design is not limited later by changes in flow.

All commercial and multi-family lots will typically have one water service line per building group. This service line will deliver fire plus domestic demands to each building group.

### Design Criteria

The standards and criteria for construction of the water system include the following:

- Montana Public Works Standard Specifications, 4<sup>th</sup> edition
- Big Sky Water and Sewer District Special Provisions

### **Sanitary Sewer System**

The sanitary sewer system has been designed in accordance with the Montana Department of Environmental Quality Circular DEQ 2 and the requirements of the Big Sky Water and Sewer District. Wastewater treatment will be provided through the existing public wastewater system for the BSWSD.

### Flow Requirements.

The BSWSD is legally obligated to accept a total of 43,000,000 gallons of wastewater per year from the Big Sky Town Center Development. As discussed in the January 2001 Design Report, a unit flow of 82 gpd/SFE is used in the BSWSD. Sewer SFE calculations can be found in Appendix C. The following shows the average day and peak hour flow rates for the Huntley Addition sewer extension loop.

Huntley Addition (Extended Loop)

Total SFE's	252.8
gpd/SFE	82
Total Daily Use	$252.8 \times 82 = 20,729.6$ gpd
Average Daily Flow	14.40 gpm
Peaking Factor*	4.2
Peak Hour Flow	60.46 gpm

\* Peak hour factor was determined from Circular DEQ 2, Figure 1.

The proposed sewer extension in the Huntley Addition of the Big Sky Town Center Development will include extending the existing 8" PVC sewer main by approximately 840.6 lineal feet. At a minimum grade of 0.4%, 8" PVC has a capacity of 370 gpm. The maximum flow for the entire Big Sky Town Center Development is 81.8 gpm based on the January 2001 Design Report. This indicates the proposed sewer collection system can accommodate sewer demand from the Huntley Addition as well as all other phases of the Big Sky Town Center Development. Sewer flow calculations have been included in Appendix D, which include previous calculations that still apply from the design report submitted in February 2006.

Sewer service line sizes comply with the requirements of the Uniform Plumbing Code (UPC). Generally, one service line has been installed for each building group. Fixture unit totals were estimated based on the proposed building uses for each lot and have not changed from the original design report.

Design Criteria

The standards and criteria for construction of the wastewater system include the following:

- Montana Public Works Standard Specifications, 4<sup>th</sup> edition
- Big Sky Water and Sewer District Special Provisions

Wastewater Treatment

Wastewater from this proposed loop will connect to the existing BSWSD collection system at the south end of Huntley Drive. Wastewater treatment is provided through an existing public wastewater treatment system owned by the BSWSD.

## References

1. Draft Engineering Design Report, Town Center – A Planned Unit Development, January 2001, prepared by Thomas, Dean & Hoskins, Inc.
2. Montana Department of Environmental Quality, Circular DEQ 1 Standards for Water Works.
3. Montana Department of Environmental Quality, Circular DEQ 2 Design Standards for Wastewater Facilities, 1999 edition.
4. Montana Department of Environmental Quality, Circular DEQ 8 Design Standards for Subdivision Storm Drainage, 2002 edition

APPENDIX A

WATER SFE CALCULATIONS



Maximum Single Family Equivalent (SFE's) are 15 units per acre and 1.6 SFE's per unit

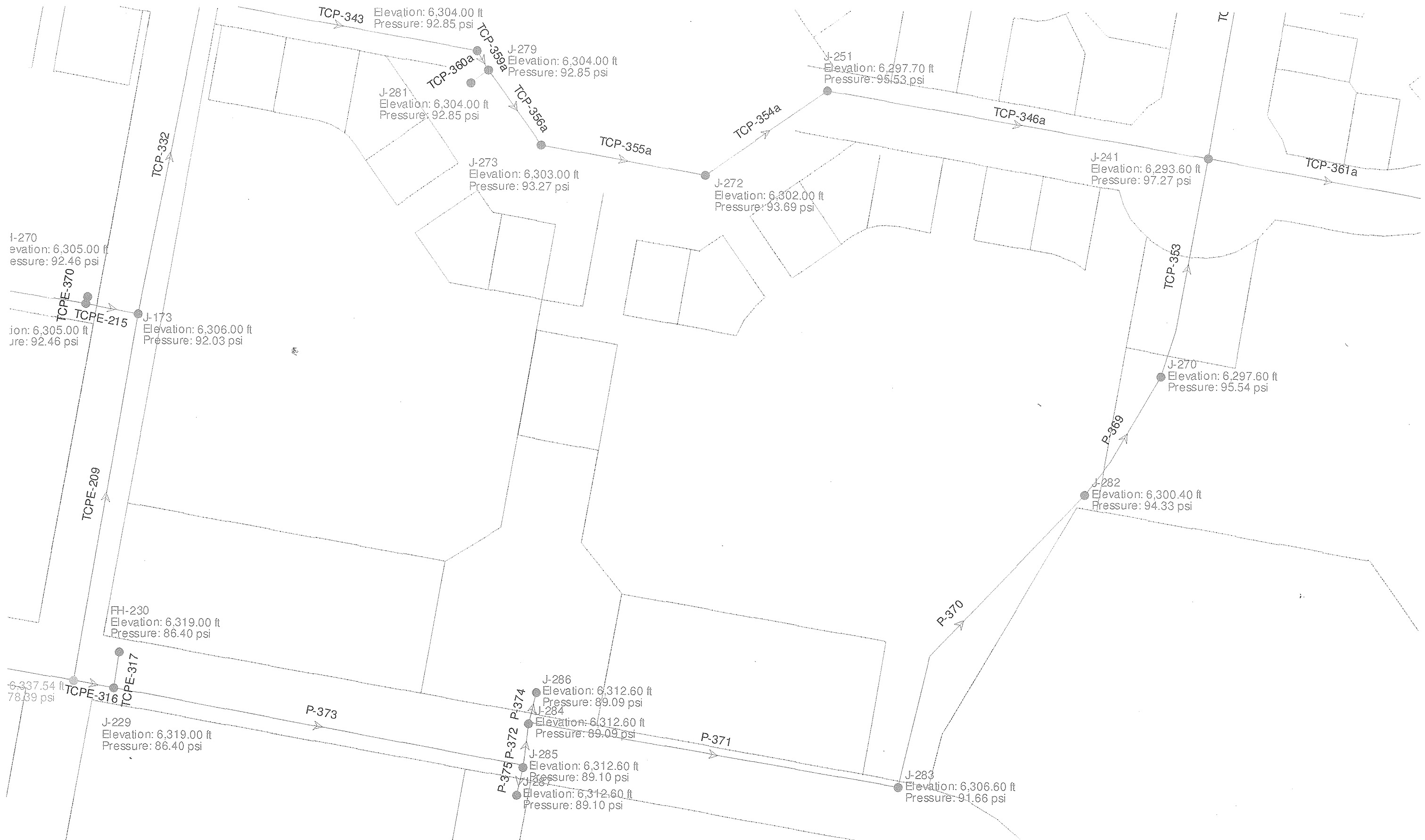
**Water**

Junction	Lot	Acres	Units	SFE's	Ave GPD	Peak hr. (gpm)	Max. day (gpm)	Avg. day (gpm)
270	13	2.661	30.00	48.00	12384.00	60.20	19.78	8.60
282	14	3.440	40.00	64.00	16512.00	80.27	26.37	11.47
283	6	1.957	20.00	32.00	8256.00	40.13	13.19	5.73
284	No service							
285	No service							
286	20	0.930	12.00	19.20	4953.60	24.08	7.91	3.44
	21	0.796	12.00	19.20	4953.60	24.08	7.91	3.44
287	5	1.675	20.00	32.00	8256.00	40.13	13.19	5.73
	2	1.241	12.00	19.20	4953.60	24.08	7.91	3.44
229	1	1.241	12.00	19.20	4953.60	24.08	7.91	3.44
<b>Totals</b>		<b>13.94</b>	<b>158.00</b>	<b>252.80</b>	<b>65222.40</b>	<b>317.05</b>	<b>104.17</b>	<b>45.29</b>

Previous SFE use in Huntley Addition = 245.2

Total SFE use in Huntley Addition = 245.2 + 252.8 = 498

Scenario: Max Day



Scenario: Max Day



**Scenario: Average Day  
Fire Flow Analysis  
Junction Report**

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-241	6,293.60	TC-Huntley	Demand	7.27	Fixed	7.27	6,521.95	98.80
J-248	6,286.60	TC-Huntley	Demand	7.27	Fixed	7.27	6,521.95	101.83
J-250	6,304.00	TC-Huntley	Demand	3.11	Fixed	3.11	6,521.99	94.32
J-251	6,297.70	TC-Huntley	Demand	3.11	Fixed	3.11	6,521.97	97.03
J-268	6,291.00	TC-Huntley	Demand	7.27	Fixed	7.27	6,521.95	99.92
J-270	6,297.60	TC-Huntley	Demand	11.44	Fixed	11.44	6,521.95	97.07
J-272	6,302.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,521.98	95.17
J-273	6,303.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,521.99	94.75
J-277	6,281.50	TC-Huntley	Demand	7.27	Fixed	7.27	6,521.95	104.03
J-278	6,280.75	TC-Huntley	Demand	7.27	Fixed	7.27	6,521.95	104.36
J-279	6,304.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,521.99	94.32
J-280	6,282.20	TC-Huntley	Demand	7.27	Fixed	7.27	6,521.95	103.73
J-281	6,304.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,521.99	94.32
J-282	6,300.40	TC-HWL	Demand	14.79	Fixed	14.79	6,521.96	95.86
J-283	6,306.60	TC-HWL	Demand	8.42	Fixed	8.42	6,521.96	93.18
J-284	6,312.60	TC-HWL	Demand	0.00	Fixed	0.00	6,521.98	90.59
J-285	6,312.60	TC-HWL	Demand	0.00	Fixed	0.00	6,521.98	90.59
J-286	6,312.60	TC-HWL	Demand	7.42	Fixed	7.42	6,521.98	90.59
J-287	6,312.60	TC-HWL	Demand	12.54	Fixed	12.54	6,521.98	90.59

**Scenario: Max Day  
Fire Flow Analysis  
Junction Report**

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-241	6,293.60	TC-Huntley	Demand	16.83	Fixed	16.83	6,518.42	97.27
J-248	6,286.60	TC-Huntley	Demand	16.83	Fixed	16.83	6,518.40	100.29
J-250	6,304.00	TC-Huntley	Demand	7.15	Fixed	7.15	6,518.61	92.85
J-251	6,297.70	TC-Huntley	Demand	7.15	Fixed	7.15	6,518.50	95.53
J-268	6,291.00	TC-Huntley	Demand	16.83	Fixed	16.83	6,518.41	98.39
J-270	6,297.60	TC-Huntley	Demand	26.32	Fixed	26.32	6,518.42	95.54
J-272	6,302.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,518.54	93.69
J-273	6,303.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,518.58	93.27
J-277	6,281.50	TC-Huntley	Demand	16.83	Fixed	16.83	6,518.39	102.49
J-278	6,280.75	TC-Huntley	Demand	16.83	Fixed	16.83	6,518.39	102.82
J-279	6,304.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,518.60	92.85
J-280	6,282.20	TC-Huntley	Demand	16.83	Fixed	16.83	6,518.40	102.19
J-281	6,304.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,518.60	92.85
J-282	6,300.40	TC-HWL	Demand	34.02	Fixed	34.02	6,518.42	94.33
J-283	6,306.60	TC-HWL	Demand	19.37	Fixed	19.37	6,518.46	91.66
J-284	6,312.60	TC-HWL	Demand	0.00	Fixed	0.00	6,518.53	89.09
J-285	6,312.60	TC-HWL	Demand	0.00	Fixed	0.00	6,518.54	89.10
J-286	6,312.60	TC-HWL	Demand	17.07	Fixed	17.07	6,518.53	89.09
J-287	6,312.60	TC-HWL	Demand	28.84	Fixed	28.84	6,518.54	89.10

**Scenario: Peak Hour  
Fire Flow Analysis  
Junction Report**

Label	Elevation (ft)	Zone	Type	Base Flow (gpm)	Pattern	Demand Calculated (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
J-241	6,293.60	TC-Huntley	Demand	51.25	Fixed	51.25	6,458.24	71.23
J-248	6,286.60	TC-Huntley	Demand	51.25	Fixed	51.25	6,458.13	74.21
J-250	6,304.00	TC-Huntley	Demand	21.76	Fixed	21.76	6,459.71	67.37
J-251	6,297.70	TC-Huntley	Demand	21.76	Fixed	21.76	6,458.88	69.74
J-268	6,291.00	TC-Huntley	Demand	51.25	Fixed	51.25	6,458.14	72.31
J-270	6,297.60	TC-Huntley	Demand	80.10	Fixed	80.10	6,458.24	69.33
J-272	6,302.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,459.17	68.00
J-273	6,303.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,459.49	67.70
J-277	6,281.50	TC-Huntley	Demand	51.25	Fixed	51.25	6,458.05	76.39
J-278	6,280.75	TC-Huntley	Demand	51.25	Fixed	51.25	6,458.05	76.71
J-279	6,304.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,459.66	67.35
J-280	6,282.20	TC-Huntley	Demand	51.25	Fixed	51.25	6,458.06	76.09
J-281	6,304.00	TC-Huntley	Demand	0.00	Fixed	0.00	6,459.66	67.35
J-282	6,300.40	TC-HWL	Demand	103.54	Fixed	103.54	6,458.27	68.78
J-283	6,306.60	TC-HWL	Demand	58.91	Fixed	58.91	6,458.58	65.75
J-284	6,312.60	TC-HWL	Demand	0.00	Fixed	0.00	6,459.10	62.82
J-285	6,312.60	TC-HWL	Demand	0.00	Fixed	0.00	6,459.19	62.77
J-286	6,312.60	TC-HWL	Demand	51.95	Fixed	51.95	6,459.09	62.90
J-287	6,312.60	TC-HWL	Demand	87.77	Fixed	87.77	6,459.17	62.59

**Scenario: Max Day  
Fire Flow Analysis  
Fire Flow Report**

Label	Fire Flow Iterations	Fire Flow Balanced?	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Junction	Minimum Zone Pressure (psi)	Zone
J-279	16	true	true	1,500.00	2,184.13	2,184.13	20.00	20.00	20.00	J-281	20.00	TC-Huntle
J-281	16	true	true	1,500.00	2,135.61	2,135.61	20.00	22.49	20.00	J-279	20.00	TC-Huntle
J-270	14	true	true	1,500.00	2,125.31	2,151.63	20.00	23.49	20.00	J-241	20.00	TC-Huntle
J-277	13	true	true	1,500.00	2,110.96	2,127.79	20.00	20.33	20.00	J-278	20.00	TC-Huntle
J-251	16	true	true	1,500.00	2,162.46	2,169.61	20.00	20.22	20.00	J-272	20.00	TC-Huntle
J-241	16	true	true	1,500.00	2,157.42	2,174.25	20.00	20.00	20.13	J-270	20.00	TC-Huntle
J-248	17	true	true	1,500.00	2,128.32	2,145.15	20.00	21.57	20.00	J-270	20.00	TC-Huntle
J-250	12	true	true	1,500.00	2,189.70	2,196.85	20.00	20.05	20.00	J-279	20.00	TC-Huntle
J-280	16	true	true	1,500.00	2,129.96	2,146.79	20.00	20.28	20.00	J-268	20.00	TC-Huntle
J-273	13	true	true	1,500.00	2,172.00	2,172.00	20.00	20.87	20.00	J-272	20.00	TC-Huntle
J-278	15	true	true	1,500.00	2,095.86	2,112.69	20.00	20.94	20.00	J-277	20.00	TC-Huntle
J-268	16	true	true	1,500.00	2,107.83	2,124.66	20.00	22.65	20.00	J-270	20.00	TC-Huntle
J-272	16	true	true	1,500.00	2,149.49	2,149.49	20.00	22.08	20.00	J-273	20.00	TC-Huntle
J-285	16	true	true	1,500.00	2,094.10	2,094.10	20.00	20.00	20.00	J-287	20.00	TC-HWL
J-286	16	true	true	1,500.00	2,067.09	2,084.16	20.00	20.90	20.00	J-284	20.00	TC-HWL
J-287	16	true	true	1,500.00	2,078.69	2,107.53	20.00	20.79	20.00	J-285	20.00	TC-HWL
J-284	16	true	true	1,500.00	2,085.40	2,085.40	20.00	20.00	20.00	J-286	20.00	TC-HWL
J-282	16	true	true	1,500.00	2,105.85	2,139.87	20.00	20.80	20.00	J-283	20.00	TC-HWL
J-283	16	true	true	1,500.00	2,080.98	2,100.35	20.00	21.96	20.00	J-286	20.00	TC-HWL

APPENDIX C

SEWER SFE CALCULATIONS



**Sewer**

Junction	Lot	Acres	Units	SFE's
270	13	2.661	30.00	48.00
282	14	3.440	40.00	64.00
283	6	1.957	20.00	32.00
284	No Service			
285	No Service			
286	21	0.796	12.00	19.20
	20	0.930	12.00	19.20
287	5	1.675	20.00	32.00
	2	1.241	12.00	19.20
229	1	1.241	12.00	19.20
Totals			158.00	252.80

APPENDIX D

SEWER FLOW CALCULATIONS

**Thomas Dean & Hoskins, Inc**  
 215 West Mendenhall, Suite C-1  
 Bozeman, MT 59715  
 406-586-0277

TITLE: **Huntley Addition of the Big Sky Town Center**  
 PROJ NO: **B03-047-016**  
 DATE: **1/19/2006**  
 BY: **KLS**  
 CK:

## MANNING'S EQUATION

**Manning's Equation**  
 $Q = 1.49/n \cdot A R^{2/3} S^{1/2}$

d =	8" Pipe	ft	Minimum Slope per DEQ Circular 2
S =	0.00	ft/ft	Minimum Required Flow for Pipe
Q =	117,670	gpd	
n =	0.013		

**EQUATIONS**

$A = \frac{D^2(\theta - \sin\theta)}{8}$	<b>At optimum flow</b>
$R = \frac{D(\theta - \sin\theta)}{4\theta}$	$y = 0.938D$
$Q = (1.49/n) \cdot (A \cdot R^{2/3} \cdot S^{1/2})$	$\theta = 302.5$
$V = Q / A$	

**\*Note**     $\theta$  in radians

y (depth) at Optimum Flow	$\theta$ (Degrees)	A	R
0.63	302.3	0.340	0.193

SLOPE	$\theta$ (Deg.)	A (ft <sup>2</sup> )	R (ft)	Q (cfs)	Q (gpm)	Q (gpd)	V (ft/s)
0.004	302.3	0.340	0.193	0.82	370.0	532,748	2.42

\* The largest wastewater flow for the Big Sky Town Center Development is 117,670 gpd. 8" PVC sewer main installed at minimum grade has a capacity of 532,748 gpd, which is greater than the entire flow for the development. Therefore, the sewer collection system for the Huntley Addition has the capacity to accommodate all sewer demands created by this phase of the development and future/existing phases.