

CITY OF DEADWOOD – WATER SYSTEM FACILITY PLAN September, 2023

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I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.



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Reg. No. 9254
Expiration Date: 8/31/2023
TDG Project Number: 22-023

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CITY OF DEADWOOD WATER SYSTEM FACILITY PLAN

September of 2023

PROJECT INTRODUCTION

In September of 2022, the City of Deadwood (DWD) contracted with Towey Design Group, Inc (TDG) to review and make recommendations concerning the City's existing water system. This Water System Facility Plan is really the culmination of two individual tasks performed over the past year.

- The scope of the first task was to develop a working water model of the existing system. The modeling software chosen for this project was EPANET version 2.2. Once an effective water system model was prepared, the model was then used to evaluate the system for reliability and functionality.
- The scope of the second task was to develop various improvements that could be made to the system that would improve system redundancy and reliability.

The results of the first task showed the City has two major areas of concern with the system. First, the City needs to address a serious lack of redundancy issues with the system due to the number of different pressure zones and the growing number of long dead-end lines to major portions of the City. Second, the City of Deadwood has limitations within its existing system for future expansion.

One such major limitation in the system is the Denver Street booster pump station. This booster pump station is the sole source of supply to the Roosevelt Reservoir which is the supply source for several of the higher elevation pressure zones within the city. If the booster pump failed, it could then cause major disruptions to service not only for residential users but also a good portion of their commercial customers.

The second task was to then develop various improvements that could be made to the system that would improve system redundancy and reliability. TDG staff developed 12 options and provided a rating scale to define which improvements would be most beneficial to the system.

This report focuses on the City of Deadwood's water distribution system and establishes a planning area and design population through the year 2043. It will review and expand upon the information generated in the first and second tasks of the water system study and provide a plan for the City's water system necessary upgrades and expansion moving forward through the design period of 2043. Alternatives to correct existing deficiencies will be developed, evaluated, and options for system expansion will be presented. Final recommendations are presented with suggested courses of action in response to the analysis findings.

PROJECT BACKGROUND

The City of Deadwood, the County seat for Lawrence County, is located in the northern Black Hills, 10 miles south of Interstate 90 in a canyon of the Black Hills created by Whitewood Creek. Deadwood's closest neighbor, Lead, SD, located 10 miles to the southwest along Highway 85. Its closest neighbor along Interstate 90 is Spearfish, SD located 15 miles to the northwest. The largest city of the Black Hills region, Rapid City, SD is located 45 miles to the southeast along Interstate 90.



Deadwood was established in the later part of the 1800's as gold mining settlement. Through the later part of the 1900's, although still primarily supporting the gold mining industry of the Black Hills, it has developed a significant tourism industry due to the beauty and outdoor activities available within the Black Hills. With the introduction of legalized gaming in the late 1900's and the closing of the Homestake Gold Mine in Lead, Deadwood's tourist industry jumped in to high gear and has become the driving industry of present-day Deadwood. The large number of tourism-based commercial businesses within Deadwood consume more than 50% of the daily water use.

Topography

Deadwood is located in EPA ECO Region Level III Middle Rockies¹. Soil in the area is primarily assorted rock outcroppings, high mica loam, gravelly loam, and silty loam. Whitewood Creek runs through Deadwood along with numerous hillside ravens draining into Whitewood Creek². FEMA floodplain mapping has established the 100-year floodplain through Deadwood which is a factor when considering new development and utility expansions. Floodplain maps and related information are included within

Appendix A.

Climate

Deadwood has a mild summer and a typical mountain winter climate. The average precipitation is 28.3 inches with an average snow fall of 106 inches. The average year-round wind speed is 11.5 mph with average maximum gusts during storm events of 61.8 mph³.

Table 2.1

Temperature			Winds	
Month	Average High (°F)	Average Low (°F)	Average Wind Speed (mph)	Maximum Gust, mph
January	38	14.4	10.6	71
Feb	38.8	14.2	11.7	53
Mar	48	21.9	13.6	71
April	54.8	29.8	18.9	75
May	64.6	38.9	11.2	72
June	75.3	49.1	9.8	53
July	82.9	55.8	9.5	75
Aug	81.8	53.6	8.4	47
Sept	72.9	44.1	9.2	48
Oct	58.3	31.4	10.3	59
Nov	47.1	21.9	11.7	55
Dec	37.9	14.5	13.1	63
Average			11.5	61.8

¹U.S. Environmental Protection Agency, 2013¹, Level III ecoregions of the continental United States:

²U.S. Department of Agriculture, 1990, Soils Survey of Lawrence County, Black Hills Parts, South Dakota:

³Western Region Climate Data, U.S. Department of Commerce, NOAA, Monthly Climatological, Summary

Population Trends

Deadwood's population has shown steady decline since the 1990's. However, the last ten years have seen a stabilization in the city's population⁴.

Table 2.2

Ten Year Census Results	
Year	Population
2020	1149
2010	1270
2000	1380
1990	1830

Table 2.3

Annual Population	
Year	Population
2011	1291
2012	1284
2013	1306
2014	1288
2015	1273
2016	1281
2017	1315
2018	1304
2019	1243
2020	1149
2021	1317

Conversely, the total number of people working in Deadwood has shown a steady increase since 2010⁴ less the pandemic year of 2021.

Table 2.4

Employment Status	
Year	Working Population
2010	843
2011	968
2012	1035
2013	1034
2014	1040
2015	1104
2016	1157
2017	1255
2018	1349
2019	1444
2020	1439
2021	1185

This trend indicates the additional worker are commuting from surrounding communities or developments. This trend may relate to the lack of housing growth in Deadwood over the past years.

⁴U.S. Census Bureau



Socio-Economic Status

The 2020 Census Data showed Deadwood's median household income to be \$47,273, an employment rate of 61.9%, a poverty level of 12%, a median age of 50.4 and a total number of housing units of 849⁴.

Environmental Resources Status

Whitewood Creek runs through Deadwood flowing to the north. The land inside Deadwood adjacent to Whitewood Creek is primarily zoned for commercial use on the northern end of the city with some mixed commercial and residential on the southern end. The residential areas of Deadwood are on each side of Whitewood Creek at the base of and up the hillsides, generally out of the 100-year floodplain. Threatened and Endangered species that reside in Lawrence County include: the American Dipper, the Osprey, the Peregrine Falcon, the Finescale Dace, and the Longnose Sucker⁵.

Cultural Resources

As specific projects are defined and scheduled, the State Historic Preservation Office should be contacted to determine if any cultural resources may be present within the project area. This information may be necessary for future funding applications.

Projected Growth

The City currently has three active development projects within the city limits. This includes Stage Run Subdivision, the Ridge, and Boot Hill Subdivision. All three developments fall at the end of a very long single line connections and lack any form of back up water supply or redundancy in the system. All three subdivisions currently rely on water that is supplied through the Denver Avenue booster station and funneled through various conduits and reservoirs.

Stage Run is proposing expansion for 160 dwelling units in a combination of apartment units and single-family units. The Ridge Subdivision is proposing a development for 264 dwelling units in a combination of apartment and single-family units. The Boot Hill Subdivision is proposing a development for 298 dwelling units in a combination of apartment and single-family units. At full build out, these three developments represent 722 additional water service connections to Deadwood's existing 845 connection, 85% growth.

City staff has also received requests to extend water beyond City limits to outlying subdivisions in an effort to regionalize their service area. City staff has been discussing this for years and believes there is benefit to all involved if this became a reality. Other major changes within Deadwood include the construction of the new Lawrence County Office Facility which includes a 50-unit jail wing.

With the addition of 722 dwelling units over some time period and the assumption of 2.65 people per dwelling unit, this equates to a conservative population growth of 1,913 people, a 130% growth, in the very near future. With a very conservative growth projection of 1% per year, this will put Deadwood's population near 2,540 at the end of this report period.

⁴U.S. Census Bureau

⁵Biennial Commission Review South Dakota Threatened and Endangered Species List July 2022 Commission minutes

Deadwood's population and traditional business growth has been steady but very slow, however there is a new segment of the tourism industry that has shown tremendous movement in the northern Black Hills region. The growth is in the "Vacation Rental" business. This new addition to the tourism industry has blossomed in the northern Black Hills due to the numerous multi-day events that are undertaken each year (Days of "76", "Cool Deadwoods" nights, Corvette Rally in Spearfish, Sturgis's Motorcycle Rally, Mustang and Camaro Rallies etc.) along with the winter snow sports and summer 4-wheeling. The rise in demand for "Vacation Rental" property is one of the factors leading to new developments detailed above under the **Projected Growth** segment of this report.

Although there is no way at the present time to know the exact number, activity in the areas surrounding Deadwood indicate a large number of residential lots will be developed into vacation rental type properties that historically have higher than normal residential water usages. The significance of the "Vacation Rental" phenomenon is that these units typically see higher water usage than normal residential property. A study completed by the Eastsound Water Users Association, Eastsound, Washington (part of the San Juan Islands), clearly determined the "Season Vacation Rental" properties used a minimum of 75% more and up to 100% more water than a standard single family residence⁶. This condition has become so prevalent that the California Department of Water Resources commissioned the UC Davis Center for Water-Energy Efficiency to study and report on Method for Estimating Seasonal Populations Water and Energy use⁷.

This higher water use can be attributed to several factors. Comments from AirBNB owners⁸ state guests take multiple showers per day, often 20 minutes or longer compared to a normal homeowner taking one 10-minute shower per day, hot tub use, and poor water conservation attitude because they "have paid for the water" through rental fees all lead to higher water consumption in vacation rental properties.

The factors stated above relating to water use are equally applicable to sanitary and solid waste needs of a "Vacation Rental" also.

Due to Deadwood's tourist-based economy, it is safe to assume that existing and new developments, will make up a portion of the growth in Deadwood and will include a significant number of "Vacation Rental" properties. This being the case, the normal assumptions for water use and demand for new development must be altered and Deadwood's staff members should consider ordinance modifications to attribute necessary development cost to the appropriate entities.

Deadwood City Council recently began the process of addressing the "Vacation Rental" properties with additions to City Ordinance 17.08 to define the different types of rental properties in Deadwood.

Population Centers and Regional Growth

Deadwood, due to its location within the Whitewood Creek basin, has historically been very limited in finding economically available developable land, thus it has not seen the historic growth seen by its neighbors of Spearfish (population 12,360), Sturgis (population 7,110), or Rapid City (population 76,200).

⁶Island Sounder October 5, 2021

⁷California Department of Water Resources, June 22, 2022

⁸USA-Airbnb Community website



EXISTING WATER SYSTEM

Existing Water Demand

The City of Deadwood's water records dating back to 2011 show Deadwood has a water demand of between 280 and 317 gallons per person per day with a 10-year average of 298 gallons per person per day. See Table 3.1

Table 3.1

Water Demand

Year	Annual Water Use, gallons	Gallons per Day	Population, Table 2.3	Per Capita Daily Consumption	
2004	155,433,000	424,680			
2005	147,888,600	425,844			
2006	144,957,500	405,174			
2007	140,825,100	397,144			
2008	142,900,620	390,439			
2009	154,706,100	391,509			
2010	131,881,300	423,852			
2011	142,345,700	361,319	1291	302.1	gallons / person/day
2012	141,570,020	386,803	1284	302.1	gallons / person/day
2013	139,499,700	387,863	1306	292.6	gallons / person/day
2014	135,458,700	382,191	1288	288.1	gallons / person/day
2015	133,220,400	371,120	1273	286.7	gallons / person/day
2016	145,326,500	397,067	1281	310.8	gallons / person/day
2017	143,913,400	398,155	1315	299.8	gallons / person/day
2018	137,210,900	394,283	1304	288.3	gallons / person/day
2019	127,126,800	375,920	1243	280.2	gallons / person/day
2020	132,977,100	363,325	1149	317.1	gallons / person/day
2021	150,543,800	364,321	1317	313.2	gallons / person/day
2022	137,918,400	412,449			
Average daily per capita demand				298.3	gallons / person / day

The numbers shown are extremely skewed based on the transient traffic in Deadwood. Our model assumes 98 gpcpd for a single-family residence, which at a population of 1,317 people would consume an average of 129,066 gallons per day. Therefore, it is estimated that water usage within the commercial districts (primarily food and hotel uses) consumes an average of 235,520 gallons per day in 2021.

Existing Water Supply

The City of Deadwood receives its domestic water supply from the Lead-Deadwood Sanitary District (LDSD). The LDSD has Vested Water Rights Nos. 1587-1, 1588-1, 1590-1, 1591-1 and 1594-1, which are authorized diversions from surface water collection systems previously operated and maintained by the Homestake

Mining Company from Spearfish Creek, Whitewood Creek, and Rapid Creek drainage basins. The total volume of water diverted shall not exceed 5,800 acre-feet per year when averaged of a 10-year period (5,800 acre-feet equals 1.89 billion gallons). This total supply was originally appropriated to be used for Homestake Mining Company mining and milling operations in Lead, power generation, municipal uses for Lead, Deadwood, and Central City and miscellaneous domestic taps. Although, Deadwood is not LDSO's only water customer, LDSO has an abundant water supply for meeting regional future growth needs.

Water Quality testing is performed and monitored by the LDSO. Deadwood has a history of excellent quality water as shown by the 2023 Annual Water Quality Report found in the **Appendix B**.

Existing Distribution System

Deadwood's distribution system, see **Figure 1**, consists of eight (8) pressure zones, three (3) tank locations, a major booster pump station (Denver Avenue booster pump station) and numerous pressure reducing valves (PRV's) and control valves. See also **Figure 2**. The distribution system consists of a piping network with water mains ranging in size from 4" to 12", predominantly 6" and 8" mains, and service lines ranging in size from ½" to 6" lines which operate within normal pressure ranges which are controlled and maintained by PRV's within the system. A high pressure main of 10" ductile iron pipe operating up to 270 psi, serves the higher elevation areas of Deadwood. The overall system presently serves between 800 and 900 users based on seasonal fluctuations.

Existing Storage

The existing Deadwood water system is supported by a series of 6 water storage reservoirs. The reservoirs are a mix of welded and bolted steel tanks of varying sizes, see **Table 3.2** below. Deadwood maintains a very active and detailed maintenance and inspection program for the reservoirs. Inspections consist of visual (with tank empty) and remotely operated underwater camera system inspections (with water in tank). Repairs and maintenance consist of tank repairs as needed, based upon visual inspections, interior and exterior painting, as needed, tank washout to remove silt buildup and regularly scheduled mixer equipment maintenance. All tanks are rated in in "Good" or better conditions per the last inspections.

TABLE 3.2 - Tank Names, Capacity, Overflow Elevations, Type, Condition and Zones Served.

Deadwood Water Storage Reservoirs

<i>Tank name</i>	<i>Capacity (MG)</i>	<i>Overflow Elevation</i>	<i>Tank Type</i>	<i>Condition at last inspection</i>	<i>Pressure Zone Served</i>	<i>Date Erected</i>
McGovern	0.400	4791.25	Welded Steel	Good	2	1966
McGovern	0.500	4791.25	Welded Steel	Good	2	1979
Pluma #1	0.208	4881.67	Bolted Steel	Good	1	1986
Pluma #2	0.388	4881.67	Bolted Steel	Good	1	2005
Deadwood Hill	0.572	5114.00	Bolted Steel	Good	4 and 5	1996
Roosevelt	0.341	5137.67	Bolted Steel	Good	4	1992



TABLE 3.3 – Actual current storage capacity based on SCADA settings today

<i>Tank name</i>	<i>Finished Floor Elev.</i>	<i>Overflow Elevation</i>	<i>Average Fill Elevation</i>	<i>Diameter of Tank</i>	<i>Estimated Volume</i>
McGovern #1	4749.25	4791.25	4783.25	40	357,200
McGovern #2	4749.25	4791.25	4783.25	44	432,200
Pluma #1	4841.67	4881.67	4874.67	30	174,400
Pluma #2	4841.67	4881.67	4874.67	40	310,200
Deadwood Hill	5095.00	5114.00	5108.00	60	274,900
Roosevelt	5121.67	5137.67	5134.67	70	374,200

South Dakota Department of Agriculture and Natural Resources (DANR) design criteria states the total storage available in distribution system should be sized to meet the domestic usage plus fire flow demand⁹. Assuming a fire flow of 1,500 gpm for two hours, yields a fire flow requirement of 180,000 gallons. Adding the fire flow to the 2022 Peak Day demand of 691,800 gallons (0.692 MG) results in a required storage capacity of 871,800 gallons (0.872 MG). Using the projected 2043 peak day demand of 1,571,700 gallons, the future total storage requirement is estimated to be 1,751,700 gallons (1.75 MG). Present day maximum storage is 2.41 MG (See **Table 3.2**) or 1.92 MG (based on today's settings), see **Table 3.3**, and the 2043 theoretical need would be 1.75 MG so the system does not need additional storage for water demand but the additional storage being proposed would be for operational improvements, cutting down pump run times, the ability to schedule reservoir refilling and off-peak demand times for power, etc.

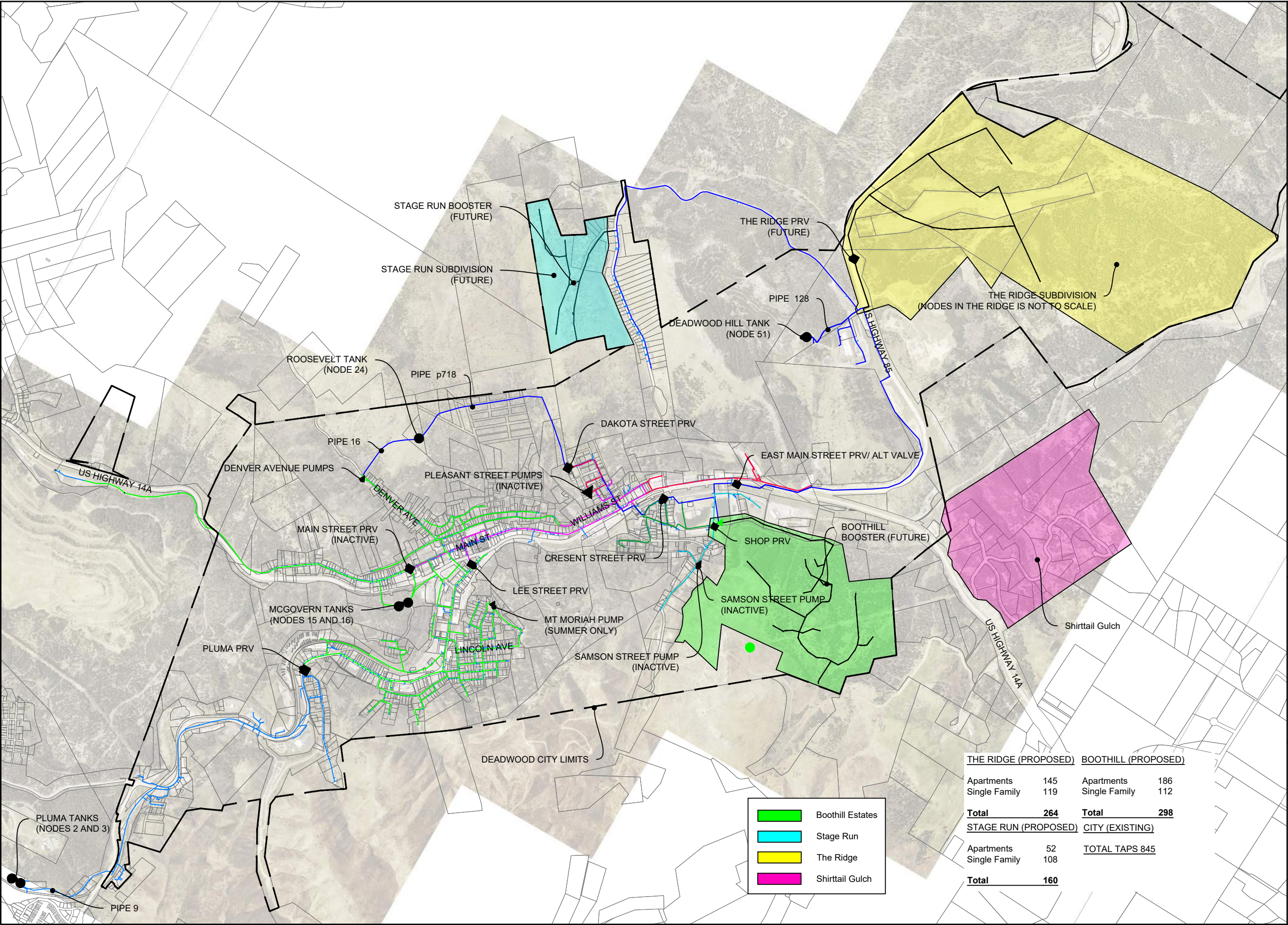
The Pluma Reservoirs (floor elevation = 4841.67) are located north of Kirk Road 0.35 miles west of US Highway 385. They are the first reservoirs on the Deadwood water system being filled by gravity feed from the LDS's water supply, see **Figure 3**, for the reservoirs operational elevation data.

The McGovern Reservoirs (floor elevation 4749.35) are located on the hill south of the Highway 14A (Pioneer Way) and the Highway 85 intersection serves the core area of Deadwood, the original town, and Main Street area, along Whitewood Creek. These tanks are filled via gravity feed through the primary Deadwood supply line from LSD. See **Figure 3** for the reservoir's operational elevation data.

The Roosevelt Reservoir (floor elevation = 5121.67) is located northwest of the McGovern tanks, across Highway 14A. This is the highest elevation tank on the system. This serves higher elevation properties in Deadwood that are primarily residential use. This tank is fed from the primary LDS supply line with assistance from the Denver Avenue booster pump station to get water into the higher elevation tank. The Denver Avenue booster pump station is one of the most critical elements of the Deadwood water distribution system. A failure for any length of time (more than 1 day) in the booster station would result in a large portion of the residential population being without water service, domestic and fire. See **Figure 3** for the reservoir operational elevation data.

The last tank site, the Deadwood Hill Reservoir (floor elevation = 5095) is located on the north end of Deadwood above Highway 14A. The Deadwood Hill tank is fed by the high-pressure main that runs through

⁹ Criteria for Design of Public Water Supply Facilities in South Dakota, 1979, Section Ten State Standards for Water Works 2012, Section 7.2.2



- ZONE 1
- ZONE 2
- ZONE 3
- ZONE 4
- ZONE 5
- ZONE 6
- ZONE 7
- ZONE 8

- RESERVOIR
- PRV/ ALT VALVE
- PUMP

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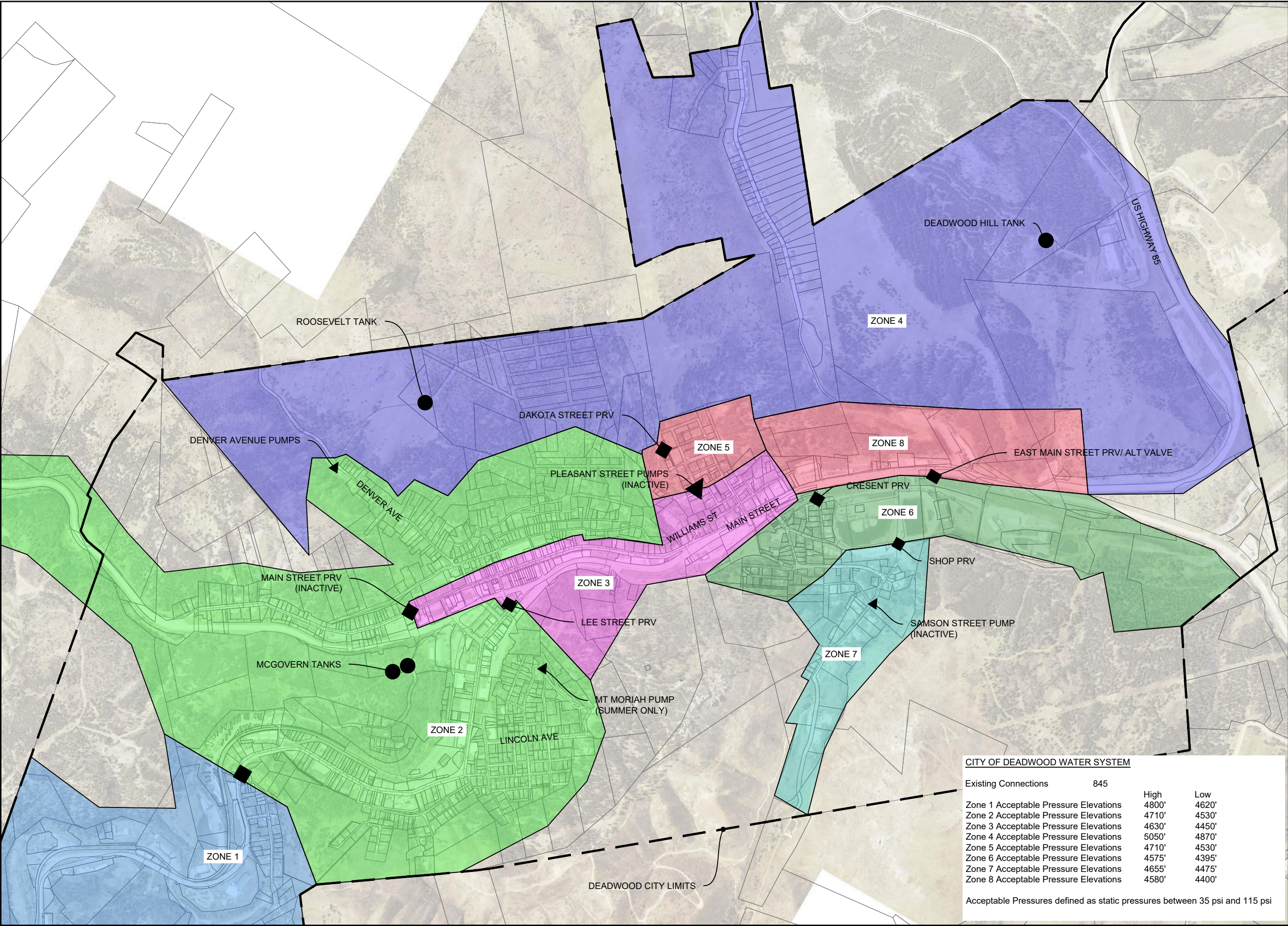


800' 400' 0 800' 1600'
SCALE: 1"= 1600'

THE RIDGE (PROPOSED)		BOOTHILL (PROPOSED)	
Apartments	145	Apartments	186
Single Family	119	Single Family	112
Total	264	Total	298
STAGE RUN (PROPOSED)		CITY (EXISTING)	
Apartments	52	TOTAL TAPS 845	
Single Family	108		
Total	160		

- Boothill Estates
- Stage Run
- The Ridge
- Shirttail Gulch

FIGURE 1
DISTRIBUTION
SYSTEM



- ZONE 1
- ZONE 2
- ZONE 3
- ZONE 4
- ZONE 5
- ZONE 6
- ZONE 7
- ZONE 8
- RESERVOIR
- PRV/ ALT VALVE
- PUMP

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500' 250' 0 500' 1000'
SCALE: 1"= 1000'

CITY OF DEADWOOD WATER SYSTEM

Existing Connections	845	
Zone 1 Acceptable Pressure Elevations	High 4800'	Low 4620'
Zone 2 Acceptable Pressure Elevations	4710'	4530'
Zone 3 Acceptable Pressure Elevations	4630'	4450'
Zone 4 Acceptable Pressure Elevations	5050'	4870'
Zone 5 Acceptable Pressure Elevations	4710'	4530'
Zone 6 Acceptable Pressure Elevations	4575'	4395'
Zone 7 Acceptable Pressure Elevations	4655'	4475'
Zone 8 Acceptable Pressure Elevations	4580'	4400'

Acceptable Pressures defined as static pressures between 35 psi and 115 psi

**FIGURE 2
EXISTING PRESSURE
ZONES**

5200

5100

5000

4900

4800

4700

4600

4500

4400

4300

--- 5129 --- Roosevelt Tank
--- 5122 ---
--- 5108 ---
--- 5095 --- Deadwood Hill Tank

--- 4875 --- Pluma Tanks
--- 4842 ---
Pluma PRV (4852)
(105 psi to 70 psi)

--- 4787 --- McGovern Hill Tanks
--- 4750 ---
Dakota St PRV (4740)
(175 psi to 20 psi)

Denver Ave Booster Pump
(4660) (50 psi to 200 psi)

Lee St PRV (4534)
(115 psi to 80 psi)

Shop PRV (4464)
(284 psi to 116 psi)

E Main PRV (4471)
(274 psi to 81 psi)

Crescent PRV (4477)
(284 psi to 78 psi)

ZONE 4 (4870-5050)

ZONE 1 (4620-4800)

ZONE 2 (4530-4710)

ZONE 3 (4450-4630)

ZONE 5 (4530-4710)

ZONE 6 (4395-4575)

ZONE 7 (4475-4655)

ZONE 8 (4400-4580)

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**FIGURE 3
PRESSURE ZONES
& FACILITIES
ELEVATIONS**



Deadwood along the Main Street corridor and is controlled by an altitude valve in the East Main Street PRV /Altitude Valve Vault. The Roosevelt Tank and the Deadwood Hill Tank are at different elevations which hinders the ability to simply connect the two to provide redundancy for the higher elevation tanks. See **Figure 3** for the reservoir operational elevation data.

Existing Pressure Zones

The Deadwood distribution system operates with eight pressure zones. The zones are divided by elevation which creates the resulting hydrostatic pressure available for the residents within each zone. Pressures within each zone are controlled and maintained by pressure reducing valves (PRV's) and booster pump stations (BPS). **Figures 2 and 3** shows a graphic representation of each pressure zone depicting the elevations and hydrostatic pressures of each zone. The figure details the highest and lowest static pressures within each zone. The highest pressure being when the respective storage reservoir is at maximum capacity and lowest pressure when the storage reservoir is at its lowest level. A description of each pressure zones is given below:

Zone 1

Zone 1 serves the area along Highway 85 south of the Peck Street/Highway 85 intersection. This area is provided service from the Pluma storage reservoirs. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone consist of 6" and 12" C-900 PVC pipe. The recent leak/break history shows a break on Cliff Street and one on Calamity Lane in the 12" main.

Zone 2

Zone 2 is pressure controlled by a PRV at Highway 85 and Peck Street and is served by the two McGovern Tanks, serves the Highway 85 area down to approximately Lee Street, the upper (western) end of the Main Street, the upper (western) and west central portion of Williams Street, and the area above Williams Street including Denver Avenue.

Zone 2 has a booster pump station to serve the Mt. Moriah Historic Cemetery. This is only used during the summer months. No residents are served thru the Mt. Moriah booster station. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone consist of 4", 6", 8", 10", and 12" C-900 PVC, 6" cast iron, and 12" ductile iron pipes. No recent breaks have been recorded in this zone.

Zone 3

Zone 3 is controlled thru the Lee Street PRV and also served by the McGovern Tanks. Zone 3 serves the core business area along Main Street and east central portion of Williams Street to a point just east of the Main Street/Dunlop Avenue intersection. The far west end of Zone 3 on Main Street is also served by the Main Street PRV which has been deactivated by city staff to improve fire flows in the higher elevations of Zone 3. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone consist of 4", 6" and 12" C-900 PVC and 10" ductile iron pipes. No recent breaks have been recorded in this zone.



Zone 4

Zone 4 serves the higher elevation portion of the west side of Deadwood. Zone 4 is served through the Roosevelt and Deadwood Hill storage reservoirs. The Roosevelt and Deadwood Hill reservoirs are not directly connected with piping as an altitude valve separates them. Water is provided to the Roosevelt Reservoir through the Denver Avenue booster pump station. The Deadwood Hill Reservoir is provided water through a high-pressure water main that runs through Deadwood within Main Street and up the hill along Highway 85 as it runs north towards I-90. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone consist of 8" and 12" C-900 PVC and 10" ductile iron pipes. No recent breaks have been recorded in this zone.

Zone 5

Zone 5 consists of a small residential area above the north end of Zone 3. Zone 5's water comes from Zone 4 thru the Dakota Street PRV. The lower (east) side of Zone 5 also had an inactive booster pump station, the Pleasant Street booster pump station. The Pleasant Street booster pump station is inactive but kept operational because it is used as a backup to serve Zone 5 in the event of a failure in the Dakota Street PRV. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone consist of 4" and 6" C-900 PVC and 10" ductile iron pipes. Two breaks have been recorded recently on the high end of Burnham Avenue in the high pressure main, 10" ductile iron pipe.

Zone 6

Zone 6 is the lower (northern) portion of Deadwood east of Highway 85. This would be the Rodeo Grounds area, the residential area southwest of Rodeo Grounds and the undeveloped area north east of the LDSD Wastewater Treatment Plant. The pressure to this area is controlled by the Crescent Street PRV. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone consist of 6" and 8" C-900 PVC and 10" ductile iron pipes. No recent breaks have been recorded for this zone.

Zone 7

Zone 7 is the residential area west of the City Shop consisting of Sampson Street and portions of Railroad Avenue and Dudley Street. The area is served by the high pressure main through the Shop PRV. The Sampson Street booster pump station is located in this zone. It is listed as "inactive" but is maintained as a backup in the event there is a failure in the Shop PRV. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.

Water mains within this zone are 8"C-900 PVC. No recent breaks have been recorded for this zone.

Zone 8

Zone 8 is the lower (northern) portion of Deadwood west of Highway 85. The pressure within Zone 8 is controlled by the East Main Street PRV. See **Figure 2** for a city map view of the pressure zones. See **Figure 3** for the hydraulic data for the zone.



Water mains within this zone consist of 6" C-900 PVC and 10" ductile iron pipes. No recent breaks have been recorded for this zone.

Existing Booster Pump Stations

The Deadwood water system has four booster pump stations, Denver Street, Mt. Moriah, Pleasant Street and Sampson Street. The Denver Street booster pump station is active year-round. The Mt. Moriah booster pump station is seasonal use, which is only used to serve the historic Mt. Moriah Cemetery. Both the Pleasant Street and Sampson Street booster pump stations are currently inactive but are kept operational for backup uses. These two booster pump stations could be activated if there was a shut down of the Denver Street booster pump station or a line break in one of the critical connects between pressure zones.

Deadwood Avenue Booster Pump Station

The Denver Avenue booster pump station is located on the south side of Denver Avenue approximately 1,000 feet west of Williams Street. This booster pump station is the most critical element of the Deadwood distribution system. It provides water to the Roosevelt Reservoir. The pump station is a concrete block building housing 2 – 50 HP head driven pumps and controls for operation of the pumps. The pump station's operation is controlled by the Roosevelt Reservoir water levels. The pump station is rated at 350 gpm but the impellers in the existing pumps are in very poor condition.

Mt. Moriah Booster Pump Station

The Mt. Moriah booster pump station is located in a concrete block building located just east of the Mt. Moriah Drive/Jackson Street intersection on the north side of Mt. Moriah Drive. The booster pump station consists of a single 5 HP pump and the necessary pressure driven controls to operate the pump station. This booster pump station is a season use only; the booster pump station only serves the Mt. Moriah Cemetery. It does not provide adequate pressure to the Cemetery.

Pleasant Street Booster Pump Station

The Pleasant Street booster pump station is in a wood frame building on the southwest corner of the Pleasant Street and Highland Avenue intersection. This booster station consists of a 2 HP and a 7.5 HP pumps and the pressure driven controls necessary to operate the pumps. This booster station is currently inactive but is maintained as it is kept as a backup to serve Zone 5 if there is a failure with the Dakota Street PRV.

Sampson Street Booster Pump Station

The Sampson Street booster pump station is in a surface enclosure at the corner of Sampson and Spring Streets. It is a single 2 HP pump and the pressure driven controls necessary to operate the station. This booster pump is currently inactive but is maintained as it is kept as a backup to serve Zone 7 if there is a failure in the Shop PRV.

Existing Pressure Reduction Valves

Pressure reducing valves (PRV's), detailed previously in this report (see Existing Pressure Zones, **Figure 2**, reduce the inlet pressure to maintain a continuous downstream discharge pressure to the point set. PRV's on the Deadwood system serve as boundaries between different pressure zones. PRV's can also be configured to allow flow between zones to supplement a pressure zones water supply in the event of low pressures due to fire flows or other emergencies.



Pluma PRV

This PRV is located in a concrete building, with a decorative river rock façade constructed in 1987. The PRV is a 4" valve set at a discharge pressure of 70 psi. See **Table 3.4**.

Lee Street PRV

The Lee Street PRV is located in a buried concrete vault in Lee Street between Sherman Street and Highway 85 constructed in 1991. The PRV is a 6" valve set at discharge pressure of 70 psi. See **Table 3.4**.

Dakota Street PRV

The Dakota Street PRV is in a concrete block building located at the west end of Pearl Street constructed in 1992. The PRV is a 2 ½" valve set at a discharge pressure of 20 psi. See **Table 3.4**.

Crescent Street PRV

The Crescent Street PRV is located in a concrete block building at the Crescent Drive/Rodeo Street Intersection constructed in 1994. The PRV is a 2 ½" valve set at a discharge pressure of 80 psi. See **Table 3.4**.

Shop PRV

The Shop PRV is located in a concrete block building northeast of the City Shop constructed in 1994. The PRV is a 2 ½" valve set at a discharge pressure of 127 psi. See **Table 3.4**.

East Main Street PRV / Altitude Valve

The East Main PRV and Altitude Valves are housed in a concrete block building located on the east side of Highway 85 just north on the Days of 76 Rodeo ground entrance constructed in 2002. The PRV portion of the facility controls pressures to ensure the Deadwood Hill Reservoir can be filled. The altitude valve portion of the facility controls the filling of the Deadwood Hill Reservoir. The PRV is a 2 ½" valve set at a discharge pressure of 89 psi. See **Table 3.4**.

Denver Street PRV (Inactive)

The Denver Street PRV is located next to the Denver Street booster pump station. It is a concrete block building constructed in 1992 and is currently inactive. It is used when there is a loss of water feed to the Denver Street booster pump station. The PRV is a 2 ½" set at a discharge pressure of 20 psi. See **Table 3.4**.

Main Street PRV (Inactive)

The Main Street PRV is located within a buried concrete vault in Main Street just north of the Main Street / Armory Street intersection constructed in 1991. This PRV is a 6" valve set at a discharge pressure of 60 psi. This PRV is listed as inactive because it is only used as a backup to the Lee Street PRV. Both PRV's cannot be in operation at the same time. See **Table 3.4**.

Table 3.4

Pressure Reducing Valves

	Valve Size	Discharge Pressure	Valve Condition	Vault Condition	Vault Construction	Year Constructed
Pluma PRV	4"	70 psi	good	good	Concrete	1987
Lee Street	6"	70 psi	good	good	Concrete	1991
Dakota Street	2.5"	20 psi	good	good	Block	1992
Crescent Street	2.5"	80 psi	good	good	Block	1994
East Main Street PRV/ Altitude Valve	2.5"	89 psi	good	good	Block	2002
Shop PRV	2.5"	127 psi	good	good	Block	1994
Main Street (inactive)	6"	60 psi	good	good	Concrete	1991
Denver Street PRV (inactive)	2.5"	20 psi	good	good	Block	1992

WATER STUDY

Hydraulic Model Development and Modeling (Phase 1)

Initially, TDG was contracted to develop an effective water model for the City of Deadwood. The model provides a graphic representation of the Deadwood water distribution system. It incorporated all features of the system, piping sizes, materials and conditions, valves, pump stations, reservoirs, elevation data, etc. When completed, existing water usage data, PRV pressure readings, and reservoir water level elevations were entered into the model creating a series of scenarios which were run to calibrate the model, thus creating an effective working model of the system.

The working model was then used to evaluate the systems reliability and expandability. The results of the first task showed the existing system have several weak points when reviewing the reliability and within the system. The system, in its present state, has reliability and redundancy issues due to the Denver Street booster pump station and the single connection points to several pressure zones. One thing to note adding additional new taps beyond the Denver Street Boosters Station and Roosevelt Reservoir could cause the Denver Street Booster Station to run none stop during high demand periods.

Therefore, the task for Phase 2 of the project used the effective water model to evaluate improvements necessary to address the redundancy concerns and to accommodate future growth. The process looked for weak points within the system and evaluated the system for demands which could be placed on the system depending on future growth of the City.

Development and Evaluation of Alternatives (Phase 2)

With the completion of the water model, Phase 2 of the project was undertaken to evaluate proposed system improvements that could provide solutions to the redundancy concerns and address balancing the system functionality.

Work options considered for system improvements include booster station upgrades, looping of mains to create redundancy and allow for additional connections to existing pressure zones, combining existing pressure zones, upsizing the existing high pressure main from 10" to 12" or 16", extensions of large diameter



mains, the additions of new PRV's to create additional pressure zones, adding storage reservoirs at the Deadwood Hill reservoir and Roosevelt reservoir sites or add a new tank above the Boot Hill Subdivision, and the addition of another water source on the north side of Deadwood.

Design Criteria

Existing system analysis completed during the first part of the Deadwood Water Study included a fire flow analysis on the existing system. The fire flow criteria included a 1,200 gpm at one hydrant location. Tank levels were set at half full conditions except the McGovern Tanks which are set at equilibrium pressure levels. Demands were set at an average peak day flow demand and the scenario was ran for 2 hours. It was determined that adequate storage and pressure is available for a majority of existing fire hydrants. Improvements can be made to create more pressure/available flow at certain fire hydrant locations.

Proposed scenarios were evaluated on a system wide impact analysis. Each option listed as part of the Task 2 report was simulated with 3 use cases;

1. Steady Average Day Usage
2. Steady Peak Day Usage
3. Peak Day Usage

"Steady" indicates that all water usages do not change with time, meaning every house/building that uses water does not change that usage throughout the day. "Average Day" is the average amount of water a house/building will use in a day. "Peak Day" is the largest amount of water a house/building will use in a day. The "Steady Average Day Usage" and "Steady Peak Day Usage" both are sub-categorized into 6 sub-categories shown in **Table 4.1**. The peak day usage scenario was used to look at peak hour flow rates within the system, to verify acceptable pressures and velocities in pipes.

Table 4.1: Assumed Average and Peak Day Demands

Land Use	Steady Average Day Demand	Steady Peak Day Demand
Residential (gpm/du)	0.18	0.25
Commercial (gpm/acre)	0.21	0.24
Industrial/ Park (gpm/acre)	0.21	0.25
Multi-Family/ Hotel (gpm/du)	0.13	0.16
Proposed Residential (gpm/ du)	0.40	1.8
Proposed Multi-Family (gpm/du)	0.30	1.3

All existing water usages were calibrated and estimated based on existing water usages and pump run times within the existing Deadwood water system. Proposed water usages were taken from Table 3.9.2 within the Rapid City Infrastructure Design Criteria Manual (IDCM).

The Steady Average Day Scenario was run for 4 days and day 4 of the system was used for analysis. The Steady Peak Day scenario was run for 2 days and both days were used for analysis. The Peak Day scenario was run for 2 days and the first and second day were used for analysis. A shorter time period for peak days was chosen as multiple peak days ran consecutively create unrealistic design conditions.

The option was considered viable if these conditions were met.

1. No future or existing node dropped below 20 psi during the simulation.

- Excluding tank and certain PRV nodes that are always below 20 psi.
- Excluding Existing nodes that are usually at or below 20 psi from the existing system
- 2. No tank during the scenarios emptied during the duration of the analysis.
- 3. Pipe velocities in the existing/ proposed infrastructure did not exceed the following velocities

Maximum Water Pipe Velocity	
Conditions	Maximum Allowable Pipe Velocity
Average Day Demand	Six (6) feet per second (fps)
Peak Hour Demand	Ten (10) feet per second (fps)

Study Alternative Categorization

The studied alternatives were placed into three categories:

- *Urgent Upgrades* are options that address existing system limitations and address future system needs. These are options would correct redundancy limitations and improve the current distribution system.
- *Medium Priority Upgrades* represent improvements that will be needed after the Urgent Upgrades have been completed. These improvements include additional storage and additional system looping.
- *Low Priority Upgrades* represent options that will increase redundancy or increase pressure and fire flows within the existing and future system.

Potential upgrades can be seen graphically in **Figure 4**.

Environmental Impacts

With the review of each alternative evaluated potential environmental impacts were considered. For all options considered there will be necessary/typical stormwater controls placed on all construction activity to minimize run-off contamination. Standard SDDANR Stormwater Pollution Prevention Plan (SWPPP) policies and procedures should be adhered to for all scopes of work.

For *Urgent Options 1, 2, and 3*, it was determined there would be no significant impacts as all work associated with these options would be performed within existing previously disturbed public rights-of-way. *Urgent Option No. 4* includes a crossing of Whitewood Creek. Special controls and considerations will be required if this option is selected.

Medium Priority Option No. 1 would require work on an existing previously disturbed site. Standard DANR SWPPP requirements will apply. *Medium Priority Option No. 2 and 3* will require environmental reviews as each will be on a new, previously undisturbed sites. *Medium Priority Option No. 4* would follow a previously disturbed route.

Low Priority Upgrades were not reviewed for environmental concerns as they are 8 to 10 years out and conditions will change enough in that time period that the options may not even be practical to consider.

Land Requirements

The need for additional land/right-of-way follows right in line with environmental concerns. No additional right-of-way should be needed for any of the *Urgent Options*. *Medium Priority Option No. 2, 3, and 4* will



require easements or utility rights-of-way. Again, no land requirements were reviewed for the Low Priority Upgrades.

Potential Construction Concerns

No significant construction concerns are anticipated for any option considered within this report. Pipe installation projects will most likely encounter rock excavation, especially options that rise above the core area of Deadwood out of the Whitewood Creek influence. Significant geotechnical work should be anticipated for any potential reservoir site and reservoir siting should be heavily influenced by geotechnical factors.

Selection of Alternatives

As can be seen in previous reports, numerous options were considered. After the initial group of viable options were prepared, TDG had a meeting with City staff to review the options, get feedback and seek other potential options to address the city's need for expansion capability. With input from the City Staff, the viable options were placed into one of three categories, Urgent Upgrades, Medium Priority Upgrades, and Low Priority Upgrades.

Urgent Option

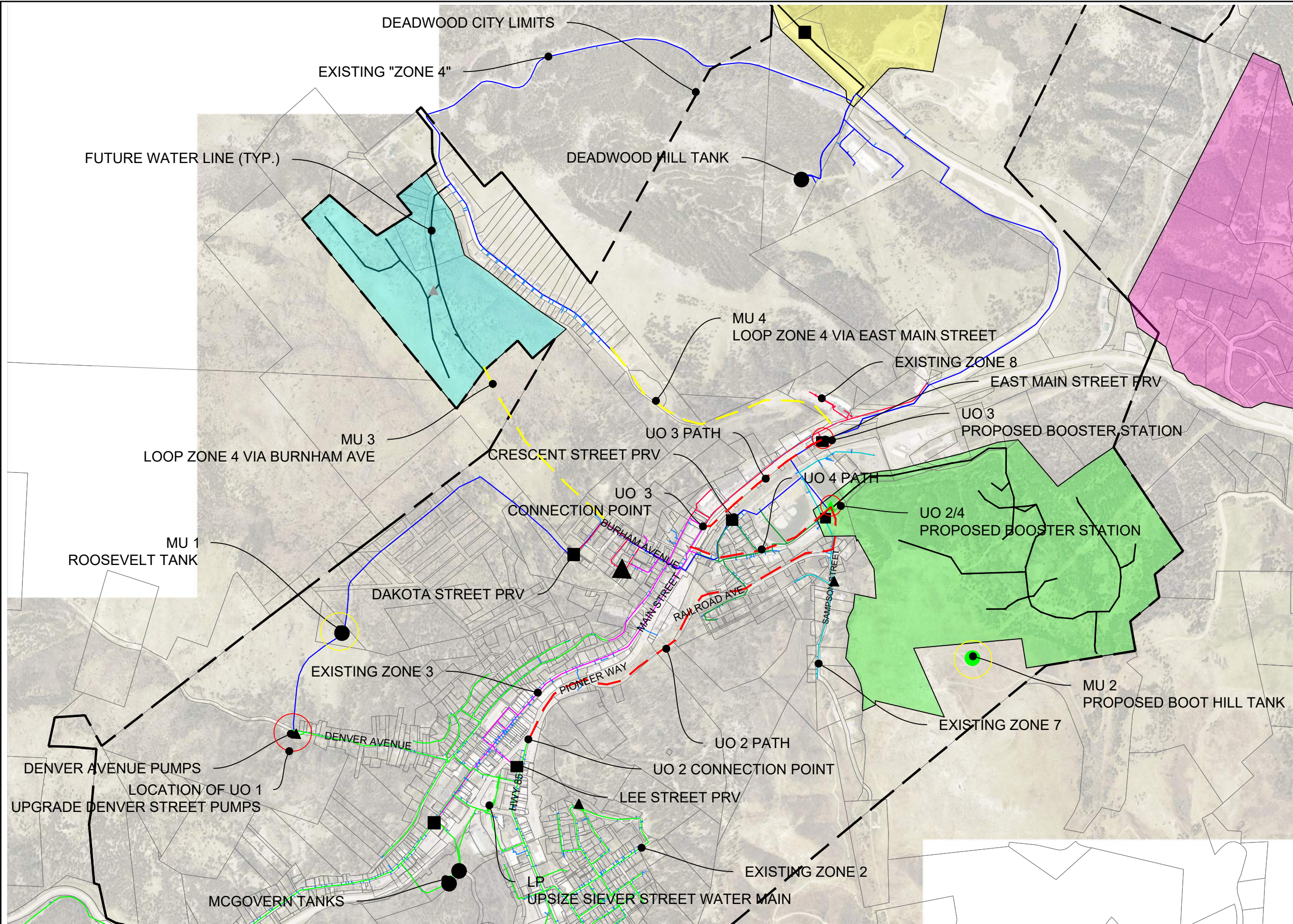
The "Urgent Upgrade" options were evaluated based on a system wide impact analysis. Fire flows were not part of the analysis. Each option was run with 3 flow demand scenarios, "Steady Average Day Usage", "Steady Peak Day Usage", and "Peak Day Usage". "Steady Average Day" means the average amount of water the house / building will use in a day. "Steady Peak Day" means the water usage in the house/building is constant throughout the day. "Peak Day" means the largest amount of water the house/building will use in a day.

Urgent Upgrade No. 1 – Upgrade Denver Street Booster Pumps

Upgrades to the Denver Street booster pump station were determined to be the top priority. The Denver Avenue booster pump station is the sole feed for the Roosevelt Reservoir which serves Zones 4, 5, 6, 7, and 8. If this pump station goes out of service for any extended period of time, Zones 4, 5, 6, 7, and 8 could be without water. The current static pressure of the station, when the pumps are not operating is 49-psi. When the pumps are in operation the static pressure drops to 35-psi in the feed line. The cost estimate for the pump station upgrade is shown in **Table 4.2**. This can be seen graphically in **Figure 4**.

When this upgrade is completed, there will be needed improvements to the Deadwood Hill reservoir supply to address the demand that will be placed on the reservoir by potentially developable area. The City should consider that costs of these improvements should be borne by the developments which have created the demand.

Upgrades to the Denver Street booster pump station improves overall system reliability as finding parts for the existing pumps was nearly impossible, newer pumps would be beneficial. But either way if the pumps go down, so does the system. The upgrades will serve Zones 4, 5, 6, 7, 8 and future development areas and improves overall system operations.



ZONE 1

ZONE 2

ZONE 3

ZONE 4

ZONE 5

ZONE 6

ZONE 7

ZONE 8

RESERVOIR

PRV/ ALT VALVE

PUMP

KEY

UO - URGENT OPTION
MU - MEDIUM UPGRADE
LP - LOW PRIORITY

KEY

-PROPOSED BOOT HILL

-PROPOSED STAGE RUN

-PROPOSED THE RIDGE

-EXISTING SHIRT TALE

Towey Design Group

475 Villa Drive, Suite #3

Box Elder, SD 57719

605.600.3758

500'

250'

0

500'

1000'

SCALE: 1"= 1000'

**FIGURE 4
PROPOSED OPTION
OVERVIEW MAP**



Table 4.2

Urgent Upgrade No. 1, Denver Avenue Pump Station Upgrade

Cost Estimate

		Quantity	Units	Unit Price		Price
1	Mobilization	1	LS	\$ 40,000.00	/LS	\$ 40,000.00
2	Traffic Control	1	LS	\$ 2,000.00	/LS	\$ 2,000.00
3	Construction Staking	1	LS	\$ 4,000.00	/LS	\$ 4,000.00
3	Stormwater Controls	1	LS	\$ 2,500.00	/LS	\$ 2,500.00
4	Pavement Removal	1,815	SF	\$ 13.00	/SF	\$ 23,595.00
5	Site Preparation	1	LS	\$ 75,000.00	/SY	\$ 75,000.00
6	Connection to Ex. Main	2	LS	\$ 5,000.00	/LS	\$ 10,000.00
7	10" Water Main	180	LF	\$ 150.00	/LF	\$ 27,000.00
8	10" Bends	4	EA	\$ 4,000.00	/EA	\$ 16,000.00
9	10" Tee	1	EA	\$ 2,000.00	/EA	\$ 2,000.00
10	Prefabricated Booster Pump Station	1	LS	\$ 350,000.00	/EA	\$ 350,000.00
Construction Subtotal						\$ 552,095.00
Contingencies (+/- 25%)						\$ 139,905.00
Engineering						\$ 115,000.00
Estimated Total Project Cost						\$ 807,000.00

After reviewing this option with the city, a pump consultant was brought in to review the site, the building, and the existing pumps and controls. After this evaluation, it was determined the existing building could support minor upgrades to the pumps and controls. Thus, the need for a new building were eliminated. The upgrade to the booster pump station will include replacement of the existing 50 HP pump with new 50 HP pumps with an increased low capacity of 50 gpm. As stated earlier in this report the Denver Avenue Booster Station is rated at 350 gpm with worn pumps. These improvements will upgrade the station to a 400-gpm facility.

Urgent Upgrade No. 2 – Build a dedicated line from Zone 2 to Shop Booster Pump Station

The second option to increase the redundancy and improve system reliability is to extend a dedicated 12" line from Hwy 85 just northeast of the Lee Street PRV to the maintenance shop area to a new booster pump station. This proposed line would serve the Deadwood Hill Reservoir, creating a backup supply to the reservoir, and create a potentially new pressure zone for future development to the northeast.

The proposed new line would run along Hwy 85 near the Whitewood Creek box culvert and then follow Railroad Avenue and Sampson Street to the new booster pump station location. The construction of the new line could take place the same time that South Dakota Department of Transportation (SDDOT) is replacing the Whitewood Creek box culvert as a cost savings measure.

The new booster pump station would be sized to pump 1,300 gpm and provide approximately 355 ft. of head. The cost estimate for Urgent Upgrade No. 2 is shown in **Table 4.3**. This can be seen graphically in **Figure 4**.



Table 4.3

Urgent Upgrade No. 2, New 12" Water Main from existing Main just north of Sherman / Pioneer intersection to proposed pump station east of City Shop at Rodeo Grounds

Cost Estimate

		Quantity	units	Unit Price		Price
1	Mobilization	1	LS	\$ 145,000.00	/LS	\$ 145,000.00
2	Traffic Control	1	LS	\$ 13,000.00	/LS	\$ 13,000.00
3	Construction Staking	1	LS	\$ 19,000.00	/LS	\$ 19,000.00
4	Stormwater Controls	1	LS	\$ 7,500.00	/LS	\$ 7,500.00
5	Pavement Removal	1,815	SF	\$ 13.00	SF	\$ 23,595.00
6	Concrete Pavement Removal	1,200	SY	\$ 70.00	SY	\$ 84,000.00
7	Connection to Ex. Main	1	LS	\$ 5,000.00	/LS	\$ 5,000.00
8	12" Water Main	4,450	LF	\$ 175.00	/LF	\$ 778,750.00
9	12" Gate Valves	16	EA	\$ 6,500.00	EA	\$ 104,000.00
10	12x6x12 Tees	8	EA	\$ 3,000.00	EA	\$ 24,000.00
11	12" Bends	31	EA	\$ 2,750.00	EA	\$ 85,250.00
12	6" Water Main (FH Runs)	160	LF	\$ 100.00	/LF	\$ 16,000.00
13	FH Assembly w/ 6" gate valve	8	EA	\$ 11,000.00	EA	\$ 88,000.00
14	Surfacing Repair Base Course, 8" thickness	2,670	TN	\$ 50.00	/TN	\$ 133,500.00
15	Asphalt Pavement Repair, 5"	510	TN	\$ 170.00	TN	\$ 86,700.00
16	Prefab. Booster Pump Station	1	LS	\$ 350,000.00	/LS	\$ 350,000.00
17	Concrete. Pavement Repair, 8"	270	CY	\$ 125.00	CY	\$ 33,750.00
Construction Subtotal						\$ 1,997,045.00
Contingencies (+/- 25%)						\$ 499,955.00
Engineering						\$ 400,000.00
Estimated Total Project Cost						\$ 2,897,000.00

The most efficient way to expand the system and increase redundancy would be to add an additional 500,000-gallon storage reservoir to the system. The new reservoir can either be located next to the Deadwood Hill Reservoir or above Boot Hill Subdivision. The additional supply source to the Deadwood Reservoir or a new tank adds redundancy to the overall system. The key point being that the new reservoir should be built at the same elevation as the existing Deadwood Hill Reservoir. See Medium Priority No. 2. Staging of the new reservoir above Boot Hill Estates would provide the City an opportunity for future regionalization projects.

Medium Priority Upgrades

This section provides plans and details for the second steps after the Urgent Options. Each Medium Priority Upgrade was looked at for each Urgent Option. In some cases, a Medium Priority Upgrade options did not make sense for some Urgent Upgrade paths and in those cases the Medium Priority Upgrade were disregarded and not implemented into the model evaluation. The Medium Priority Upgrades selected for future consideration are detailed below.

Medium Priority Upgrade No. 2 – Construct Boot Hill Reservoir

The Boot Hill Reservoir is not required at this time. The addition of the proposed new reservoir also requires the new booster pump station as discussed in Urgent Upgrade No. 2. This is a preferred option and has three potential future benefits.

First, it will provide a water source to the northeast part of town. It will provide service to the higher elevation above Boot Hill Subdivision. The installation of the Boot Hill Reservoir will decrease the number of pump cycles per day and relieve some of the head loss concerns within the system.

The second benefit will be Deadwood's ability to potentially provide water service east of Deadwood along Highway 14A. This is a very long-term concept but one that needs to be considered within the 20-year time frame of this report. The desire to create regional systems is a concept being promoted by DANR staff as a way to maximize resources and streamline administration throughout South Dakota.

This new reservoir should be placed at the same elevation as the Deadwood Hill Reservoir to maximize system benefits and efficiency while minimizing needed control equipment. This would substantially increase redundancy in the system.

Also noted in Item #2, it is recommended to loop Zone 4 or to upsize the Highway 85 water main. It is also recommended to loop Zone 4 along Main Street near the First Gold Casino. Looping off of Burnham Avenue with a PRV is possible with the correct settings of the valve. A cost estimate for Medium Priority Upgrade No. 2 is shown in **Table 4.4**.



Table 4.4

Medium Priority Upgrade #2, Construct Boot Hill Reservoir

Cost Estimate

		Qty		Unit Price		Total Price
1	Mobilization	1	LS	\$ 280,000.00	/LS	\$ 280,000.00
2	Traffic Control	1	LS	\$ 26,000.00	/LS	\$ 26,000.00
3	Construction Staking	1	LS	\$ 35,000.00	/LS	\$ 35,000.00
4	Stormwater Controls	1	LS	\$ 10,000.00	/LS	\$ 10,000.00
5	PCC Pavement Removal	43	SY	\$ 75.00	/SF	\$ 3,225.00
6	Connection to Ex. Main	1	LS	\$ 5,000.00	/LS	\$ 5,000.00
7	12" Water Main*	8,305	LF	\$ 200.00	/LF	\$ 1,661,000.00
8	12" Bends	55	EA	\$ 2,750.00	EA	\$ 151,250.00
9	12" Tee	1	EA	\$ 3,000.00	EA	\$ 3,000.00
10	12" Gate Valve	14	EA	\$ 6,000.00	EA	\$ 84,000.00
11	6" Water Main (FH Runs)	60	LF	\$ 100.00	/LF	\$ 6,000.00
12	FH Assembly w/ 6" gate valve	6	EA	\$ 11,000.00	EA	\$ 66,000.00
13	Gravel Surfacing, 20-ft Wide	8,872	TN	\$ 40.00	/TN	\$ 354,868.00
14	PCC Tank Foundation	45	SY	\$ 125.00	/SF	\$ 5,625.00
15	500,000 Gallon Tank	1	LS	\$ 1,000,000.00	/EA	\$ 1,000,000.00
16	Retaining Wall	150	LF	\$ 200.00	/LF	\$ 30,000.00
17	Topsoil Placement	1,640	CY	\$ 60.00	/TN	\$ 98,418.00
18	Reseeding	9,850	SY	\$ 2.50	/SF	\$ 24,625.00
Construction Subtotal						\$ 3,844,011.00
Contingencies (+/- 25%)						\$ 949,989.00
Engineering						\$ 765,000.00
Estimated Total Project Cost						\$ 5,559,000.00

*Watermain length may vary based on route up the mountain (min length 5,800)

Medium Priority Upgrade No. 3 and No. 4 have been kept as potential project at this time. With the completion of the previous projects proposed Deadwood will be in a position to be able to wait several years (potentially 8-10 years) to decide whether to proceed with Option No. 3 or No. 4.

Medium Priority Upgrade No. 3 – Loop Zone 4 via Burnham Avenue

This was another option considered to meet the system needs. This option would benefit the upgraded Denver Street booster pump station and the Roosevelt Reservoir upgrade option, the most. The easiest way to provide additional flow to the Deadwood Hill Reservoir is to loop Zone 4 off of the end of Burnham Avenue with a PRV. This will help the existing pressure problems since there will be less head loss during peak morning times and peak water use days. The cost estimate for Medium Priority Upgrade No. 3 is shown in **Table 4.5**.

Table 4.5

Medium Priority Upgrade #3, Loop Zone 4 Via Burnham Avenue

Cost Estimate

		Qty		Unit Price		Total Price
1	Mobilization	1	LS	\$ 79,000.00	/LS	\$ 79,000.00
2	Traffic Control	1	LS	\$ 4,500.00	/LS	\$ 4,500.00
3	Construction Staking	1	LS	\$ 9,800.00	/LS	\$ 9,800.00
4	Stormwater Controls	1	LS	\$ 1,500.00	/LS	\$ 1,500.00
5	Connection to Ex. Main	2	LS	\$ 5,000.00	/LS	\$ 10,000.00
6	12" Water Main	2190	LF	\$ 210.00	/LF	\$ 459,900.00
7	12" Bends	9	EA	\$ 2,750.00	/EA	\$ 24,750.00
8	12" Tee	2	EA	\$ 3,000.00	/EA	\$ 6,000.00
9	12" Gate Valve	5	EA	\$ 6,000.00	/EA	\$ 30,000.00
10	Gravel Surfacing, 20-ft Wide	2300	TN	\$ 50.00	/TN	\$ 115,000.00
11	Prefabricated PRV Station	1	LS	\$ 300,000.00	/LS	\$ 300,000.00
12	Topsoil Placement	415	CY	\$ 60.00	/CY	\$ 24,900.00
13	Reseeding	2470	SY	\$ 2.50	/SY	\$ 6,175.00
Construction Subtotal						\$ 1,071,525.00
Contingencies (+/- 25%)						\$ 267,475.00
Engineering						\$ 215,000.00
Estimated Total Project Cost						\$ 1,554,000.00

Medium Priority Upgrade No. 4 – Loop Zone 4 via East Main Street

This option will be beneficial if the Boot Hill Tank was constructed. This option will not require a new altitude valve since new pumps will serve the zone. If this is not the case, then the connection needs to be downstream of the existing East Main Street altitude valve. This loop has the same benefit as the Burnham Avenue loop (Medium Priority Upgrade No. 3) however it is less beneficial to the upgraded Denver Street booster pump stations because of the extra pipe length and the high velocity the water has to travel in Zone 4 to split into each side loop. The new booster pumps would not need to pump water through as much pipe length before the flow split and therefore there would be less head loss in the system. The cost estimate for the Medium Priority Upgrade #4 is shown **Table 4.6**.



Table 4.6

Medium Priority Upgrade #4, Loop Zone 4 Via East Main Street

Cost Estimate

		Qty		Unit Price		Total Price
1	Mobilization	1.0	LS	\$	75,000.00 /LS	\$ 75,000.00
2	Traffic Control	1.0	LS	\$	4,500.00 /LS	\$ 4,500.00
3	Construction Staking	1.0	LS	\$	7,100.00 /LS	\$ 7,100.00
4	Stormwater Controls	1.0	LS	\$	1,500.00 /LS	\$ 1,500.00
5	AC Pavement Removal	680.0	SY	\$	75.00 /SY	\$ 51,000.00
6	PCC Sidewalk Removal	200.0	SF	\$	7.00 /SF	\$ 1,400.00
7	Concrete C&G Removal	75.0	LF	\$	20.00 /LF	\$ 1,500.00
8	Connection to Ex. Main	2.0	LS	\$	5,000.00 /LS	\$ 10,000.00
9	12" Water Main	3209.0	LF	\$	210.00 /LF	\$ 673,890.00
10	12" Bends	20.0	EA	\$	2,750.00 /EA	\$ 55,000.00
11	12" Tee	1.0	EA	\$	3,000.00 /EA	\$ 3,000.00
12	12" Gate Valve	2.0	EA	\$	6,000.00 /EA	\$ 12,000.00
13	1" Agg. Base Course	500.0	TN	\$	50.00 /TN	\$ 25,000.00
14	Concrete C&G Replacement	75.0	LF	\$	50.00 /LF	\$ 3,750.00
15	PCC Sidewalk Replacement	200.0	SF	\$	25.00 /SF	\$ 5,000.00
16	Topsoil Placement	20.0	CY	\$	60.00 /CY	\$ 1,200.00
17	Reseeding	230.0	SY	\$	2.50 /SY	\$ 575.00
Construction Subtotal						\$ 931,415.00
Contingencies (+/- 25%)						\$ 233,585.00
Engineering						\$ 175,000.00
Estimated Total Project Cost						\$ 1,340,000.00

Low Priority Upgrades

This section covers low priority upgrades that were considered for the Deadwood water system to meet future growth needs. These upgrades would increase redundancy, create better zone pressures, or improve fire flows in the existing and future grown Deadwood water system.

Upsize Siever Street Water Main

If the new booster pump station, near the City Shop (Urgent Upgrade No. 2), is selected, whenever the pump is running a high demand will be place on the 12" main through upper downtown Deadwood. Construction a new line in Siever Street will allow the McGovern Reservoirs to contribute to the pumps demands and reduce pressure drop at the lower areas of Zone 2. This is an optional project. If the consumers don't notice the effect of the pumps because the pressures are already high in the area, the improvement would not be needed.

Denver Street Booster Pumps Service Line

If the Denver Street booster pump option is selected, this is an optional upgrade unless the city would upsize the booster pumps to a size not covered within this analysis. The existing 10-inch main in Denver Street can handle booster pumps with a demand of 1,400 gpm (1,400 gpm is based upon an average day pipe velocity of 6 ft/sec.). If larger pumps are required to meet flow requirements, larger than 1,400 gpm, then upsizing the main to reduce water velocity would be recommended.

Combining Zones 6 and 8

As part of the existing system evaluation Fire Flow test were run using 1,200 gpm flow at one hydrant location. The reservoir levels were set at half full except the McGovern Reservoirs which were set at equilibrium pressure levels. All other nodes were set at average peak day flow demands. This scenario was run at multiple critical hydrant locations in each pressure zone.

This process determined the most efficient way to combine and loop Zone 6 to Zone 8. One way includes a new line crossing Whitewood Creek to connect the northeast portion of Zone 6 to Zone 8. This loop will allow more emergency flow to be accessible to each zone. By increasing the East Main Street PRV setting to 90-psi it increases the tap pressure for each connection by 9-psi in Zone 8 and by 10-psi in Zone 6. Fire flow test results indicate better fire flows to the northeast portion of Zone 8 and unchanged fire flows in Dudley Street located to the southwest of Zone 6, when compared to the existing model.

Combining these two zones will help with dead end service areas in both zones and help with water quality concerns. Combining the zones also reduces the total maintenance of PRV's as the Crescent Street PRV can be used as a backup for the East Main Street PRV.

Constructing Additional Infrastructure to allow Roosevelt Reservoir to Expand Service Area

If the city chooses not to upgrade the Denver Street booster pump station and construct a new booster pump station near the maintenance shop, the area the Roosevelt Reservoir serves will be limited to Zones 5 and 6. It is recommended that additional water infrastructure be built to allow the Roosevelt Reservoir to serve zones 7 and 8 as it does now. The infrastructure would be a 22-psi main being constructed near the rodeo grounds to connect Zone 7 to Zone 8 with another water main crossing of Whitewood Creek.

Move Deadwood Hill Reservoir to a Higher Elevation

This concept would solve some problems and allow the Roosevelt and Deadwood Hill Reservoirs to be synchronized without the use of an altitude valve or PRV. This scenario would raise the Deadwood Hill Reservoir so its overflow elevation would match the Roosevelt Reservoirs overflow elevation.

This would allow for easier looping of Zone 4 and create more pressure for the Stage Run Subdivision. The water pressure at The Lodge would increase by approximately 12-psi, as well as any taps in the Stage Run Subdivision. No specific analysis of this idea through the model was performed, however this is a good idea for system operations and the overall redundancy of the system.

Improvement Ideas that do not Work

The purpose of this section is to show ideas that were tested through the system model that did not meet the minimum criteria.



Combine Zones 2 and 5

Combining Zones 2 and 5 is an idea to help reduce the demand on the Denver Street booster pumps. After the model analysis there is no solution that allows the upper regions of Burnham Avenue to have adequate fire flow. It was also determined the cost was too high compared to the relative gain to the system.

Merging a portion of Zone 6 with Zone 3

This scenario consists of combining the upper half of Zone 6 with Zone 3. All of Zone 6 cannot be economically combined with Zone 3 due to elevation differences. The only benefit of this idea would be a shortened water main connection to the new booster pump station near the City Shop. This idea would require the Dunlop Avenue Creek crossing to be upgraded to 12", as well as the main in Dunlop Avenue, and an additional PRV would be required. All of these costs make this option no better than simply constructing a new Zone 3 dedicated main along Dunlop Avenue and keeping Zone 6 as is.

NON-INFRASTRUCTURE CONSIDERATIONS

System Management and Operational Policy Considerations

Along with physical upgrades to the system, the City needs to review its management and operational policies to consider changing socio-economic factors. Growth is coming to the Black Hills region and all communities will be affected by this growth. Considerations need to be specified today before any future development or regionalization projects can be established.

In all cases the city needs to ensure future growth pays its fair share of off-site costs. The present residents of Deadwood should not be burdened with covering development costs for improvement that do not benefit them. This should be true for expansion both inside and outside of Deadwood. This is not implying that the concept addressed in this report does not also benefit the existing residents in some scenarios.

The City also needs to review service policies and water rates. Service policies may need to be revised to reflect water use changes for short-term rentals as discussed in **PROJECTED GROWTH** section of the report.

PROPOSED PROJECT IMPLEMENTATIONS

This section of the Plan summarizes the selected water system alternatives and steps the city should take to implement to selected alternatives. The "no action" alternatives will not be considered as it does not address any of the system deficiencies and will be the selected alternative until the embarks upon an improvement project. During this, the City will use this document as a planning tool to develop their project priorities, build reserves and seek funding for chosen improvement projects.

Recommended Distribution System Improvements

The first recommendation is to proceed with improvements to the Denver Street Booster Pump Station, *Urgent Upgrade No. 1*. This will stabilize the overall system, provide a higher level of safety, since the booster station is so critical to the entire system.

Currently the City is working to correct this problem. An alternative was discovered while this study was being completed includes replacing the existing pumps with newer pumps without having to reconstruct the entire facility.

The second recommendation would be the *Urgent Upgrade No 2*, a dedicated line from Zone 2 to the Shop Booster Pump Station. The City should be prepared to undertake Urgent Upgrade No. 2 to address redundant water supply needs. This will ensure adequate water supply for the Boot Hill Subdivision as well as supply for the Boot Hill and Deadwood Hill Reservoirs.

The third recommendation would be to construct the *Medium Priority Upgrade No. 2, Construct Boot Hill Reservoir* project. The addition of this reservoir will provide service to the Boot Hill area. The new reservoir should be placed at the same elevation as the Deadwood Hill Reservoir. Long range planning also shows that this reservoir, when placed at the same elevations as the Deadwood Hill Reservoir has potential to serve areas north and east of Deadwood. This is the most likely future growth area for the 20-year period of this report.

The fourth recommendation will be for the city to proceed with *Medium Priority Upgrade No. 3 – Loop Zone 4 via Burnham Avenue* or *Medium Priority Upgrade No 4, - Loop Zone 4 via East Main Street*. Either option will provide the necessary benefits but as the need is several years out selection of the best option can wait. Changes to the present scenario will likely make the choice between the two options very clear when the time comes to make the selection. Long range planning (8-10 years) should have either of these upgrades as the top priority.

Additional System Improvements Non-Infrastructure Recommendations

Changes already happening in the Black Hills region make it necessary for the City of Deadwood to review existing ordinances, rate schedules, and policies to ensure entities benefiting from the growth pay their fair share of development costs and that the existing residents of Deadwood are not unduly burdened. This is not to say that existing residents should not be part of normal rate increases that reflect increased costs for water production and maintenance of the existing system.

Existing policies regarding cost sharing and over-size cost sharing should be reviewed. Rate structures for unique facility uses should be reviewed. The standard \$/gallon water use rate structure may not be appropriate due to demands being placed on the system. As an example, sporadic/seasonal high-water users in an area designed for normal residential water use may adversely affect full time residents and may make unusually high demands on the system.

Permitting Requirements

The permitting requirements for the proposed scopes of work should not be burdensome. DNR approvals will be required for all proposed scopes of work. USACE approvals will be required for any work that may be needed for the crossing of Whitewood Creek.

Funding Strategy

The city should start funding searches as soon as feasible possible. DNR funding through loans and grants can be applied for through the State Water Plan. Submission of this Water Facility Plan to be placed on the State Water Plan should happen as soon as possible. Once a project is on the State Water Plan, funding applications can be submitted.

The city should also track road and highway improvement projects planned for the future. If roadway work is proposed that could impact any of the proposed water projects an effort should be made to at least install any facility that would be impacted by the roadway project to save on future road restoration costs.



Public input and participation

Upon final review and adoption by the City of Deadwood, this Water Facility Plan will be made available to the public for review and comment. If the City receives any comments or finds any area requiring further evaluations or corrections, these items will be addressed prior to final approval.

Appendix A

FEMA Mapping

46081C0213F

46081C0214F

46081C0326F

46081C0350F

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

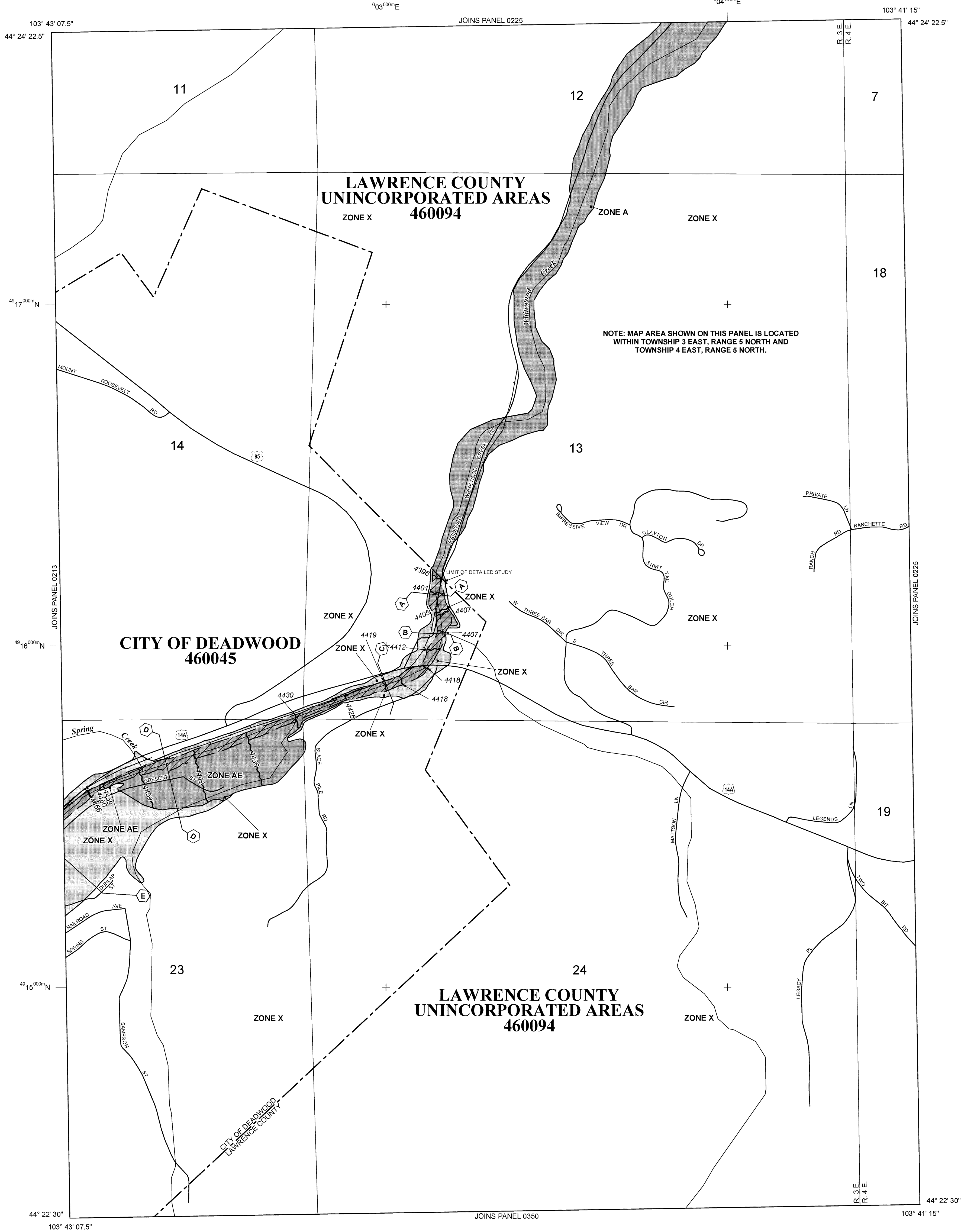
To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713- 3242, or visit its website at <http://www.ngs.noaa.gov>.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unreviewed streams may differ from what is shown on previous maps.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfip>.



SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

 FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

 COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundaries

_____ Roadway boundary

_____ Zone D boundary

_____ CRPS and CDA boundaries

Boundary dividing Special Flood Hazard Area Zones and boundary

dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

Base Flood Elevation line and value: elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

Cross section line

Transert line

Geographic coordinates referenced to the North American Datum of 1983

1983 (NAD 83) Western Hemisphere

1000-meter Universal Transverse Mercator grid values, zone 13

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP

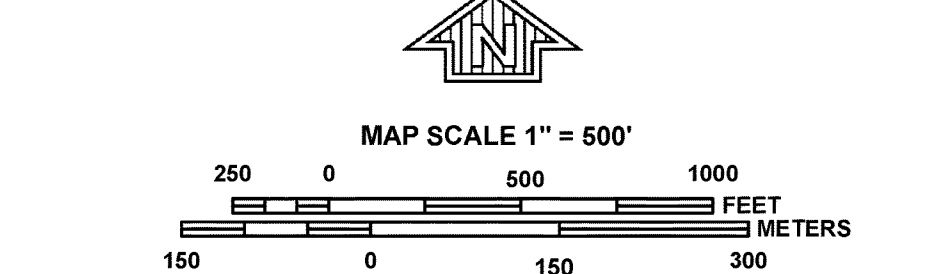
FLOOD INSURANCE RATE MAP
April 17, 2012

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent

or call the National Flood Insurance Program at 1-800-638-6620.



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0214F

FIRM

FLOOD INSURANCE RATE MAP

LAWRENCE COUNTY, SOUTH DAKOTA AND INCORPORATED AREAS

PANEL 214 OF 550
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

<u>COMMUNITY</u>	<u>MAP NUMBER</u>	<u>PANEL</u>	<u>SUFFIX</u>
DEADWOOD, CITY OF	460045	0214	F
LAWRENCE COUNTY	460094	0214	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



MAP NUMBER
46081C0214F

EFFECTIVE DATE
APRIL 17, 2012

Federal Emergency Management Agency

NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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Base map information shown on this FIRM was provided in 2007 by the State of South Dakota GIS Department.

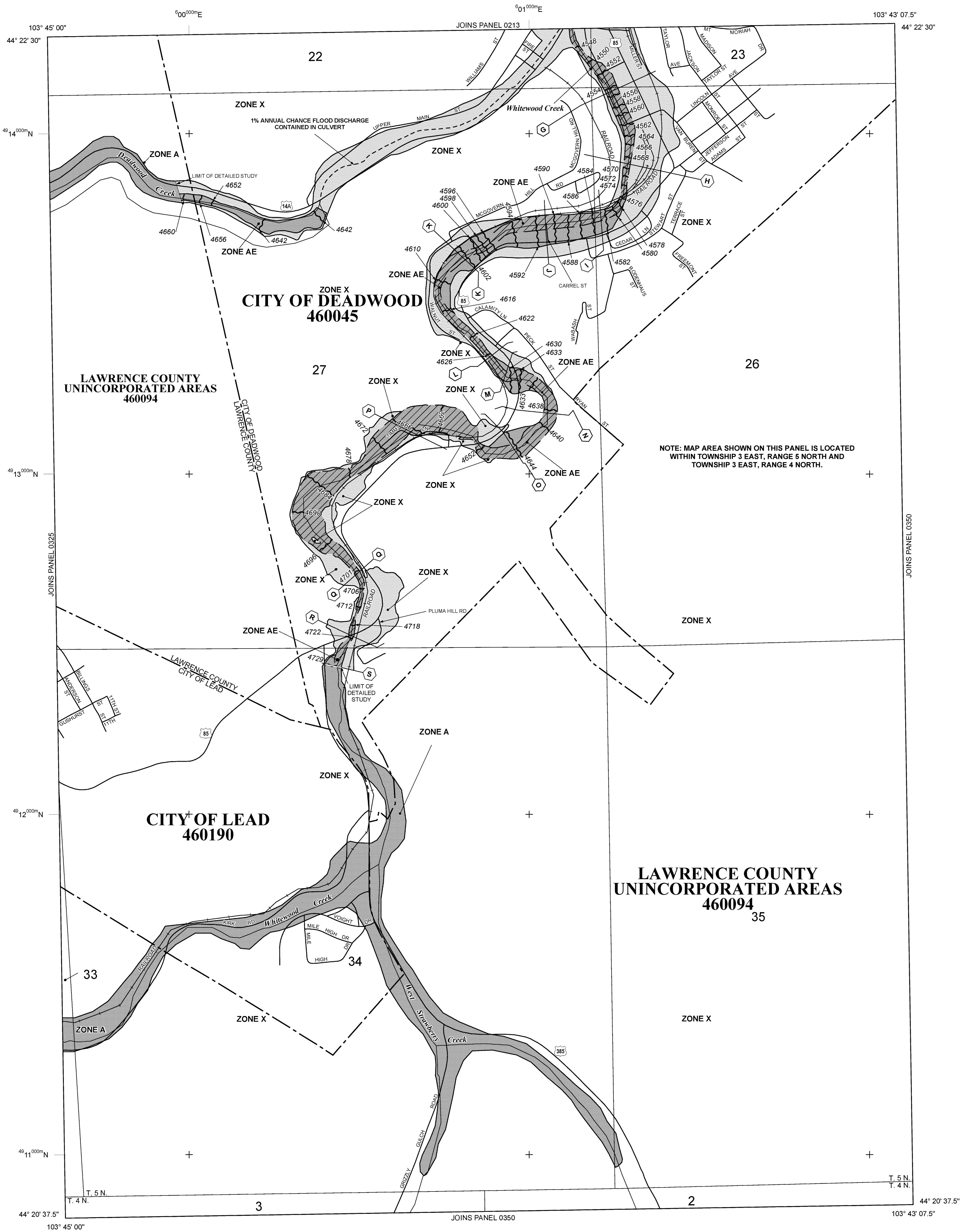
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Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

Base Flood Elevation line and value; elevation in feet*

Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A Cross section line

23 Transsect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

1000-meter Universal Transverse Mercator grid values, zone 13

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

April 17, 2012

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0326F

FIRM
FLOOD INSURANCE RATE MAP
LAWRENCE COUNTY,
SOUTH DAKOTA
AND INCORPORATED AREAS

PANEL 326 OF 550
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DEADWOOD, CITY OF	460045	0326	F
LAWRENCE COUNTY	460094	0326	F
LEAD, CITY OF	460190	0326	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
46081C0326F
EFFECTIVE DATE
APRIL 17, 2012
Federal Emergency Management Agency

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NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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Base map information shown on this FIRM was provided in 2007 by the State of South Dakota GIS Department.

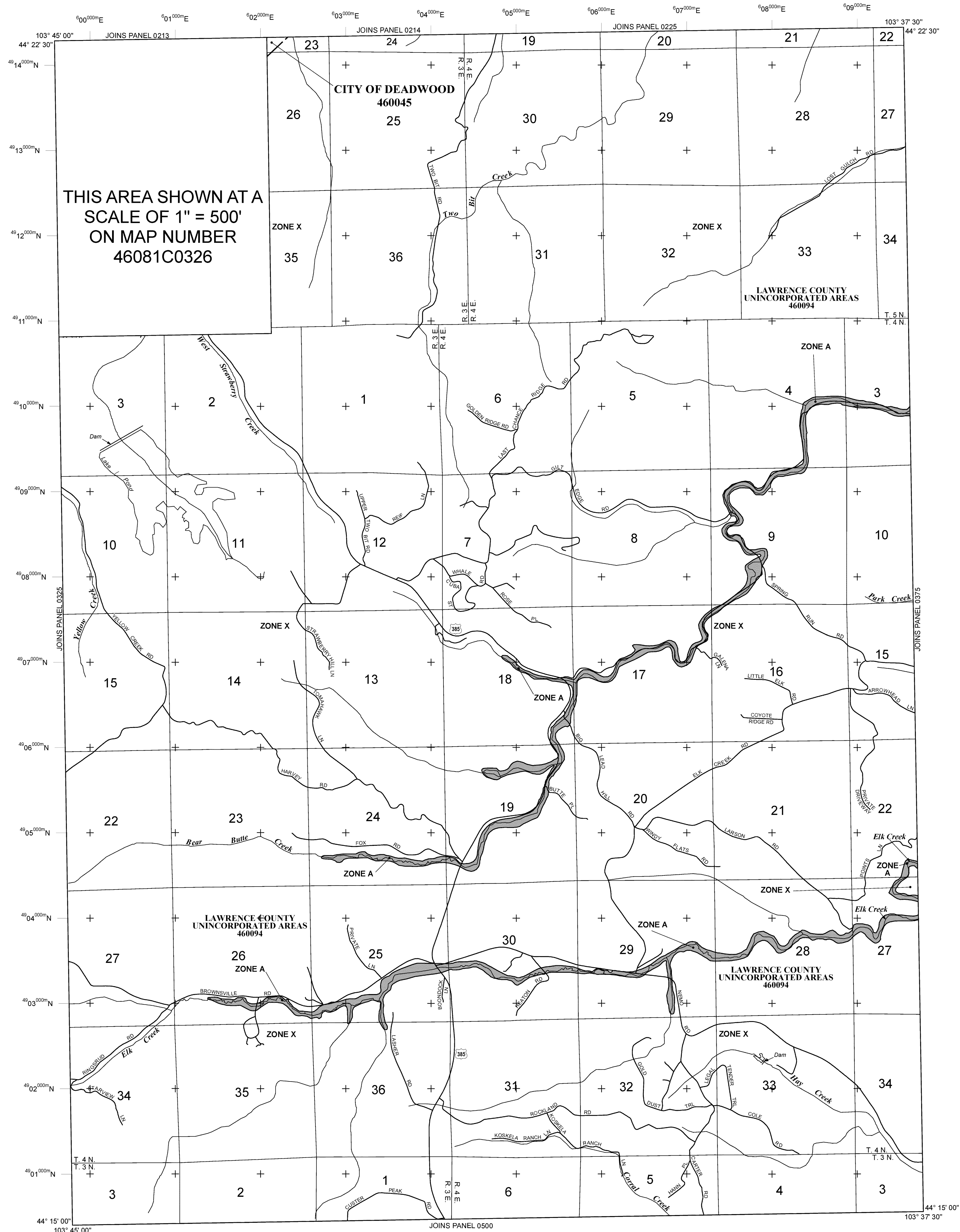
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
0.2% Annual Chance Floodplain Boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
Base Flood Elevation line and value; elevation in feet*
Base Flood Elevation value where uniform within zone; elevation in feet*

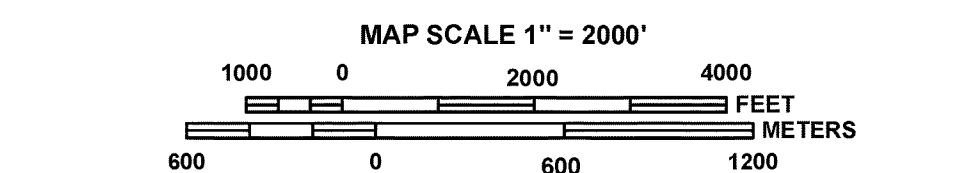
*Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 13
Bench mark (see explanation in Notes to Users section of this FIRM panel)
River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 17, 2012
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0350F

FIRM
FLOOD INSURANCE RATE MAP
LAWRENCE COUNTY,
SOUTH DAKOTA
AND INCORPORATED AREAS

PANEL 350 OF 550
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DEADWOOD, CITY OF	460045	0350	F
LAWRENCE COUNTY	460094	0350	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
46081C0350F
EFFECTIVE DATE
APRIL 17, 2012
Federal Emergency Management Agency

Appendix B

Report

2022 Drinking Water Report

CITY OF DEADWOOD



2022

Drinking Water Report

Contact us by calling (605)578-2600 or write us at 102 Sherman Street
Deadwood SD 57732

City of Deadwood

DRINKING WATER REPORT WATER QUALITY



Secretary's Award

The City of Deadwood has supplied twenty-two consecutive years of safe drinking water to the public it serves and has been awarded the Secretary's Award for Drinking Water Excellence by the South Dakota Department of Agriculture and Natural Resources. This report is a snapshot of the quality of the water that we provided last year. Included are details about where your water comes from, what it contains, and how it compares to Environmental Protection Agency (EPA) and state standards. We are committed to providing you with information because informed customers are our best allies.

Water Source

We serve more than 1,270 customers an average of 348,000 gallons of water per day. Our water is surface water that we purchase from another water system. The state has performed an assessment of our source water and they have determined that the relative susceptibility rating for the Deadwood public water supply system is medium.

For more information about your water and information on opportunities to participate in public meetings, call (605)578-2600 and ask for Jessica McKeown.

Additional Information

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

- *Microbial contaminants*, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- *Inorganic contaminants*, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- *Pesticides and herbicides*, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- *Organic chemical contaminants*, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.

- *Radioactive contaminants*, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. FDA regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants can be obtained by calling the Environment Protection Agency's Safe Drinking Water Hotline (800-426-4791).

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The City of Deadwood public water supply system is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at <http://www.epa.gov/safewater/lead>.

Detected Contaminants

The attached table lists all the drinking water contaminants that we detected during the 2022 calendar year. The presence of these contaminants in the water does not necessarily indicate that the water poses a health risk. Unless otherwise noted, the data presented in this table is from testing done January 1 – December 31, 2022. The state requires us to monitor for certain contaminants less than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year. Some of the data, though representative of the water quality, is more than one year old.

The City of Deadwood public water system purchases 100% of their water from Lead-Deadwood Sanitary District (0190).

2022 Table of Detected Regulated Contaminants For Deadwood (EPA ID 0104)

Terms and abbreviations used in this table:

- * Maximum Contaminant Level Goal(MCLG): the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
- * Maximum Contaminant Level(MCL): the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
- * Action Level(AL): the concentration of a contaminant which, when exceeded, triggers treatment or other requirements which a water system must follow. For Lead and Copper, 90% of the samples must be below the AL.
- * Treatment Technique(TT): A required process intended to reduce the level of a contaminant in drinking water. For turbidity, 95% of samples must be less than 0.3 NTU
- * Running Annual Average(RAA): Compliance is calculated using the running annual average of samples from designated monitoring locations.

Units:

- *MFL: million fibers per liter

*mrem/year: millirems per year(a measure of radiation absorbed by the body)

*NTU: Nephelometric Turbidity Units
- *pCi/l: picocuries per liter(a measure of radioactivity)

*ppm: parts per million, or milligrams per liter(mg/l)

*ppb: parts per billion, or micrograms per liter(ug/l)
- *ppt: parts per trillion, or nanograms per liter

*ppq: parts per quadrillion, or picograms per liter

*pspm: positive samples per month

Substance	90% Level	Test Sites > Action Level	Date Tested	Highest Level Allowed (AL)	Ideal Goal	Units	Major Source of Contaminant
Copper	0.1	0	08/18/20	AL=1.3	0	ppm	Corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives.
Lead	1	0	08/19/20	AL=15	0	ppb	Corrosion of household plumbing systems; erosion of natural deposits.

Substance	Highest Level Detected	Range	Date Tested	Highest Level Allowed (MCL)	Ideal Goal (MCLG)	Units	Major Source of Contaminant
Barium *	0.068		02/26/20	2	2	ppm	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits.
Fluoride *	0.85	0.61 - 0.85	09/20/22	4	<4	ppm	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories.
Haloacetic Acids (RAA)	10.4		08/17/22	60	0	ppb	By-product of drinking water chlorination. Results are reported as a running annual average of test results.
Total trihalomethanes (RAA)	10.9		08/17/22	80	0	ppb	By-product of drinking water chlorination. Results are reported as a running annual average of test results.

Please direct questions regarding this information to Mr Cory Percy with the Deadwood public water system at (605)578-2600.

* Lead-Deadwood Sanitary District (0190) test result.