

## **EXECUTIVE SUMMARY**

**To:** Rapid City Regional Airport

**From:** Kadrmas, Lee & Jackson, Inc.  
Advanced Engineering and Environmental Services, Inc.

**Date:** September 17, 2011

**Re:** **Findings of Hydraulic Analysis of Pumping and Storage Alternatives for Improved Water Supply to the Rapid City Regional Airport**

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The study was commissioned and sponsored by the Rapid City Regional Airport Board (Board) to evaluate waterline and reservoir options to address current fire flow deficiencies and plan for future needs. The study included a hydraulic analysis of the distribution system supply for the Rapid City Regional Airport (Airport); development, evaluation, and recommendation of infrastructure improvements necessary to provide acceptable water service (both quality and quantity); and provides preliminary engineering for the recommended improvements.

### **DEFINED SERVICE AREA**

The Airport receives water from the City of Rapid City distribution system via the Low Level Pressure Zone. Note that at the time of the analysis, the Elk Vale Low Level Reservoir was under construction with a scheduled completion date of October 2009.

### **WATER DEMAND PROJECTIONS**

Water system demands were based on previous study efforts for the City of Rapid City. These study efforts indicate an existing maximum day demand of 31.2 million gallons per day (MGD) for the overall system. Water levels for the reservoirs that supply the Airport (Signal Hill Reservoirs and Elk Vale Low Level Reservoir) were set at 50% for fire flow analysis. Extended period simulation and water age analysis under average day demand conditions were used to determine the interaction with a proposed reservoir and/or distribution system improvements. Available fire flow results were projected for hydrants (elevation of 3160 ft) located near the Airport terminal.

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From discussions with the City's Engineering Services and Fire Department staff, the Airport fire flow was determined to be 3,000 gpm for duration of 3 hours while maintaining a minimum of 20 psi. Current domestic demand within the vicinity of the Airport ranged from 40 to 60 gpm. For the purpose of this study, a detailed review of land use allocation and population projections was not considered. Through discussions with the Board and City staff, a future demand near the Airport was determined to range from 500 to 1,000 gpm for future growth within the vicinity of the Airport. Therefore, current capacity needed would be about 3,100 gpm with a future overall capacity of 4,000 gpm. Note that City staff indicated any potential water service to the south of East Highway 44 would be supplied by the future Morningstar Reservoir (Low-Low Level Service Zone) or limited to excess capacity in City infrastructure.

**HYDRAULIC ANALYSIS OF EXISTING SYSTEM**

A hydraulic analysis of the existing distribution system with the Elk Vale Low Level Reservoir in service and with no additional improvements indicates that the current available flow capacity to the Airport is approximately 1,500 gpm. Recall that current capacity needed is 3,100 gpm for domestic and fire flow demands. Note that the limiting factor is the single existing 12-inch water main supply line which currently does not provide any redundancy or associated looping.

**REVIEW OF ANALYSIS FOR VARIOUS ALTERNATIVES**

A total of eight water main and four water storage alternatives were initially considered for improving the water supply infrastructure at the Airport and are discussed in detail in Exhibit 4. Note that many of the alternatives were analyzed with several water main size options ranging from 12 inch to 16 inch. A meeting was held with representatives of the Airport, City Engineering Services, and City Fire Department on November 25, 2008 and Alternatives A, C, H, and J were identified as preferred alternatives. Note that two new alternatives (Alternatives M and N) were developed after the November 2008 meeting and presented in the report. These new alternatives were based on comments received from City Engineering Services in June 2009 and additional modeling efforts.

## CONCLUSIONS AND RECOMMENDATIONS

The long term solution for the Board will consist of a phased approach utilizing a combination of the alternatives previously discussed. Recommended alternatives are presented in Exhibit 2.

### Phase 1 – Alternatives M and Airport Looping

- Alternatives M and Airport Looping (Segments A, N, F1, D, E, M) with the construction of a 16-inch water main along Homestead Street/Daylight Drive to Radar Hill Road, south to Longview Road, then east to the Airport and including 12-inch Airport looping appears to be the most effective alternative to improve fire flow capacity at the Airport without creating a water quality problem. This alternative would provide 3,000 gpm of required fire demand at the Airport along with 500 gpm of domestic demand for further growth in the area. This alternative also provides a complete water main loop with the Airport which provides redundancy if there would be a water main break on either of the water mains feeding the Airport.
- A preliminary plan and profile for this route is included as Exhibit 5.
- Schedule
  - o Design – 3 to 6 months
  - o Construction – 12 months

### Phase 2 – Alternatives J and N

- In the future, as demands increase with continued growth, the preferred option to provide additional capacity is a combination of Alternatives J and N. This includes adding a PRV/control valve station and associated piping between the High Level and Low Level Pressure Zones (Alternative N) to provide additional water during high flow conditions (future fire demands, etc.). As the area surrounding the Airport is developed, a ground storage reservoir would be constructed near Site B (Alternative J). The future demand will help with water age concerns and turnover in the reservoir.
- Schedule
  - o PRV Station and Pipe Line
    - o Design – 2 to 4 months
    - o Construction – 6 months.
  - o Ground Storage Reservoir and Pipe Line
    - o Design – 4 to 8 months
    - o Construction – 12 months

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**Planning Level Total Project Cost**

- Phase 1 – Alternatives M and Airport Looping (refer to Exhibit 6 for an itemized opinion of costs)
  - Construction \$ 3,611,000
  - 40% Contingencies, Engineering, Legal, and Administrative \$ 1,445,000
  - **Phase 1 Subtotal (2009 dollars)** **\$ 5,056,000**
  
- Phase 2A – Alternative N (refer to Exhibit 7 for an itemized opinion of costs)
  - Construction \$ 647,000
  - 40% Contingencies, Engineering, Legal, and Administrative \$ 259,000
  - **Phase 2A Subtotal (2009 dollars)** **\$ 906,000**
  
- Phase 2B – Alternative J (refer to Exhibit 8 for an itemized opinion of costs)
  - Construction \$ 4,146,000
  - 40% Contingencies, Engineering, Legal, and Administrative \$ 1,659,000
  - **Phase 2B Subtotal (2009 dollars)** **\$ 5,805,000**

Items not included with this planning level opinion of probable project costs and assumptions include the following:

- Land acquisition and utility easements.
- Majority of pipeline follows gravel or low maintenance roads. Assume restoration will be limited to replacing existing pavement or seeding. Project cost will significantly increase with asphalt or concrete pavement improvements.



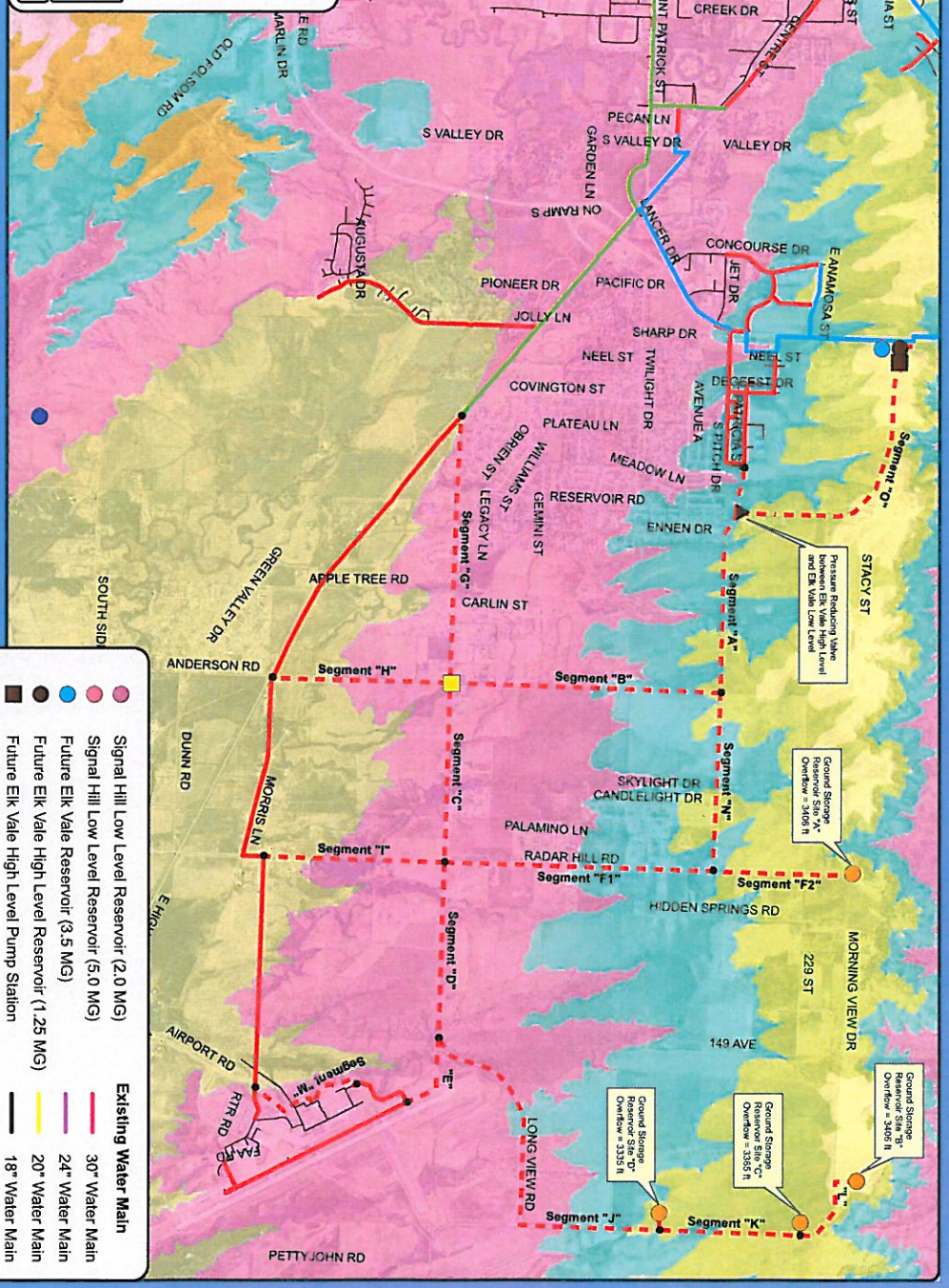
# Rapid City Water Distribution System Rapid City Regional Airport Water Supply Study

Preliminary Layout of System Options



### Pressure Zone Boundaries

- Served By Higher Pressure Zone
- North Rapid (NR) (40 to 80 psi)
- North Rapid (NR) (80 to 105 psi)
- Either LL (40 to 80 psi) or NR/Palo (105 to 135 psi)
- Low Level (LL) (80 to 135 psi)
- Served by Low Low Level Zone
- Palo Verde (40 to 80 psi)
- Canyon (40 to 105 psi)
- Canyon (80 to 105 psi)



<ul style="list-style-type: none"> <li>Signal Hill Low Level Reservoir (2.0 MG)</li> <li>Signal Hill Low Level Reservoir (5.0 MG)</li> <li>Future Elk Vale Reservoir (3.5 MG)</li> <li>Future Elk Vale High Level Reservoir (1.25 MG)</li> <li>Future Elk Vale High Level Pump Station</li> <li>Future PRV</li> <li>Potential Airport Reservoir Siles</li> <li>Future Fire Booster Pump Station</li> <li>Future Morningstar Tank</li> <li>Future Water Main</li> </ul>	<ul style="list-style-type: none"> <li>Existing Water Main</li> <li>30" Water Main</li> <li>24" Water Main</li> <li>20" Water Main</li> <li>18" Water Main</li> <li>16" Water Main</li> <li>14" Water Main</li> <li>12" Water Main</li> <li>10" and smaller</li> </ul>
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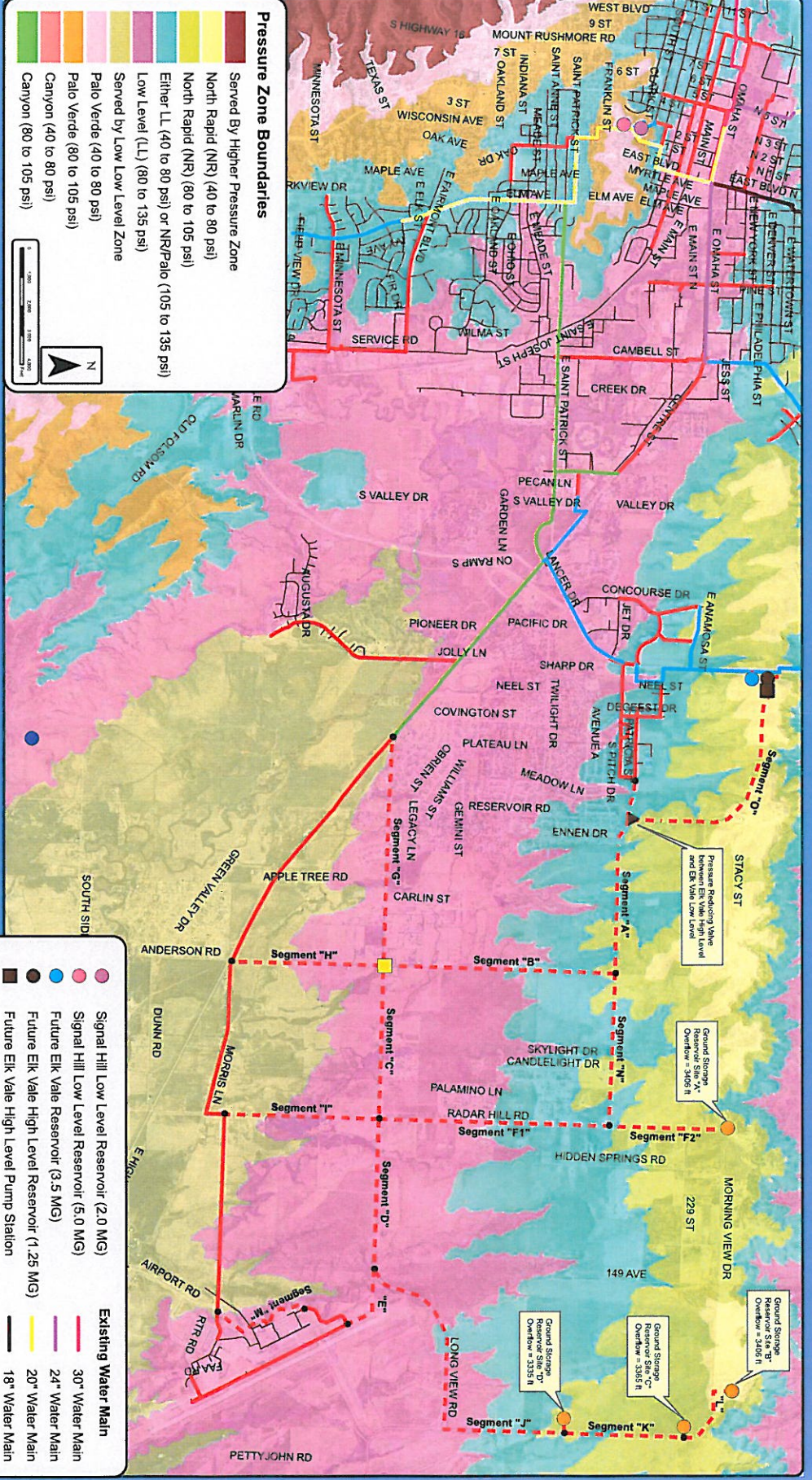
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**Legend**

- Signal Hill Low Level Reservoir (2.0 MG)
- Signal Hill Low Level Reservoir (5.0 MG)
- Future Elk Vale Reservoir (3.5 MG)
- Future Elk Vale High Level Reservoir (1.25 MG)
- Future Elk Vale High Level Pump Station
- Future PRV
- Potential Airport Reservoir Sites
- Future Fire Booster Pump Station
- Future Morningstar Tank
- Future Water Main

**Existing Water Main**

- 30" Water Main
- 24" Water Main
- 20" Water Main
- 18" Water Main
- 16" Water Main
- 14" Water Main
- 12" Water Main
- 10" and smaller

Pressure Reducing Valve between Elk Vale High Level and Elk Vale Low Level

Ground Storage Reservoir Site "A" Overflow = 3405 ft

Ground Storage Reservoir Site "C" Overflow = 3385 ft

Ground Storage Reservoir Site "D" Overflow = 3335 ft

Ground Storage Reservoir Site "B" Overflow = 3455 ft

Ground Storage Reservoir Site "E" Overflow = 3455 ft

Hydraulic Analysis of Pumping and Storage Alternatives for Improved Water Supply to the Rapid City Regional Airport						
Rapid City Airport Authority						
OPINION OF PROBABLE TOTAL PROJECT COST						
Proposed Alternatives M and Airport Looping (Pipeline)						
July 7, 2009						
AE2S Project Number: P00839-2008-00						
ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	MATERIAL COST	INSTALLED COST	
<b>1.0 General Conditions</b>						
a. Insurance, Bonds, Mobilization, Travel, Subsistence, Etc.	1	l.s.				\$204,400
<b>Subtotal General Conditions</b>						\$204,400
<b>2.0 Site Work</b>						
<b>Pavement/Road</b>						
<i>Driveway Restoration / Road Restoration</i>						
a. Aggregate Surface (8-inch depth)	32	ton	\$22.50	\$720.00		\$720
<i>Meadow Ridge Dr.</i>						
a. Demo / Remove Asphalt Concrete Pavement	5,000	s.y.	\$3.75	\$18,750.00		\$18,750
b. Aggregate Base Course (6-inch depth)	1,700	ton	\$22.50	\$38,250.00		\$38,250
c. Asphalt Paving (5-inch depth)	1,600	ton	\$95.00	\$152,000.00		\$152,000
d. Bituminous Tack Coat	800	gal	\$12.00	\$9,600.00		\$9,600
<b>Site Piping</b>						
<i>Alternative M-3 ( Segments A, N, F1, D, and E)</i>						
a. 12" PVC Watermain	2,500	l.f.	\$40.00	\$100,000.00		\$100,000
b. 16" PVC Watermain	25,050	l.f.	\$80.00	\$2,004,000.00		\$2,004,000
c. 16" Bore (assume at Longview Road and at Radar Hill Road)	250	l.f.	\$110.00	\$27,500.00		\$27,500
d. Misc. Fittings	4,000	lbs.	\$5.00	\$20,000.00		\$20,000
e. 16" MJ Gate Valve and Valve Box (assume every 900 ft)	31	ea.	\$7,500.00	\$231,750.00		\$231,750
f. Flush Hydrant w/ Aux Valve and Lead (assume every 900 ft)	31	ea.	\$3,750.00	\$115,875.00		\$115,875
g. Connect to Existing Water Main	2	ea.	\$3,000.00	\$6,000.00		\$6,000
h. Manhole w/ Air Release Valve or Blow-Off Assembly	26	ea.	\$12,000.00	\$312,000.00		\$312,000
<i>Airport Looping</i>						
a. 12" PVC Watermain	4,000	l.f.	\$40.00	\$160,000.00		\$160,000
b. Misc. Fittings	1,645	lbs.	\$5.00	\$8,225.00		\$8,225
c. 12" MJ Gate Valve and Valve Box (assume every 900 ft)	5	ea.	\$3,000.00	\$13,500.00		\$13,500
d. Flush Hydrant w/ Aux Valve and Lead (assume every 900 ft)	5	ea.	\$3,750.00	\$16,875.00		\$16,875
e. Connect to Existing Water Main	2	ea.	\$3,000.00	\$6,000.00		\$6,000
<b>Seeding</b>						
<i>Alternative M-3 ( Segments A, N, F1, D, and E)</i>						
a. Seeding (26,500 ft x 50 ft)	31.6	acre	\$2,500.00	\$79,000.00		\$79,000
b. Erosion Control	1	l.s.	\$50,000.00	\$50,000.00		\$50,000
<i>Airport Looping</i>						
a. Seeding (4,000 ft x 50 ft)	4.6	acre	\$2,500.00	\$11,500.00		\$11,500
b. Erosion Control	1	l.s.	\$25,000.00	\$25,000.00		\$25,000
<b>Subtotal Site work</b>						\$3,406,545
<b>Summary</b>						
1.0 General Conditions						\$204,400
2.0 Site Work						\$3,406,545
<b>SUBTOTAL - Construction Costs</b>						\$3,611,000
40% Contingencies, Engineering, Legal, and Administrative						\$1,445,000
<b>OPINION OF PROBABLE TOTAL PROJECT COST</b>						\$5,056,000
<b>Other Costs</b>						
a. Service connections to subdivisions (Raveen Dr, Radar Hill Rd, others?)		ea.		\$0.00		\$0
b. Land acquisition/easements (assume 25ft corridor needed for length of transmission main)	695,000	s.f.	\$0.75	\$521,250.00		\$521,250
c. Additional airport service connections on Segment M		ea.		\$0.00		\$0
<b>Assumptions</b>						
a. Assume segments A, N, F1, D, E, and M restoration consists of seeding only (no pavement improvements).						
b. Width listed is for permanent easements. Anticipate construction easement necessary for installation.						