

**Evaluation of  
Water Rights and Water Demands  
For  
The City of North Logan**

**January 2004**

**Prepared for:**  
North Logan City

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## EXECUTIVE SUMMARY

Cache-Landmark Engineering was requested to review North Logan's current water rights and sources, and to recommend improvements and/or ordinances in order to meet future water demands in the year 2020.

Currently four wells plus a group of springs in Green and Water Canyon supply culinary water to North Logan. The average daily flow (2002) is approximately 860 gpm. The projected average daily flow is 1,569 gpm in the year 2020 (see Table 4). Therefore North Logan needs to be able to provide an additional 708 gpm by 2020.

The water rights for the four city wells are 6.35 cfs (2,850 gpm) (see Figure 1). The capacity of the wells is 5.59 cfs (2,507 gpm) (see Table 9). Thus the capacity of the wells is 0.76 cfs (342.9 gpm) below their current water rights.

North Logan's spring water rights shows the springs are combined into three water rights 25-3199 (Water Canyon), 25-3063 (Water Canyon), and 25-5421 (Green Canyon). The total amount of water the City can legally withdraw from the springs is 5.428 cfs (2,436.09 gpm). The springs have produced as much as 2.23 cfs (1,000 gpm) and as little as 0.04 cfs (20 gpm). This is far below the full water right. However, the spring water rights have not been issued a certificate. An election on the water rights was filed, however the Division of Water Rights has not completed the process of this election. If this election were to be completed, the Division of Water Rights would probably issue certificate for a lower flow rate and acre-feet limitation. This flow would represent the historical flows of the springs. Therefore, North Logan cannot count on using or developing more water than has been historically used in the springs. The City will want to complete the election (or proof) during a wet year (high runoff), because this would give the city the highest possible certified water rate for its springs.

As Figure 3 (page 9) shows North Logan has water rights for the next ten years based on the project peak use. North Logan will need additional water rights to meet future water demands.

There are several improvements and ordinances or policies that North Logan can complete or adapt that will allow the City to provide the additional water. The following recommendations will allow for the additional water.

1. During the next year, determine a new well (source) location. Develop the well (source) in the next two years. Submit a change application on the existing water rights for the new well.
2. Complete the election (proof) on the springs during a wet year (high-runoff) in order to gain the maximum right in the spring.
3. Adopt a water ordinance requiring water rights/shares to be transferred to North Logan City upon development or construction (Sample Ordinances are in Appendix E). This will allow the city to not only keep up with water demands for

new areas but will also allow for better utilization of the existing rights so that all areas of the City can be served.

4. Utilize the acquired shares or rights as mitigation for new wells as needed. Or utilize the water rights/shares for a secondary water system.
5. Complete a feasibility study for a secondary water system/supply to reduce culinary peak water usage.
6. Review the feasibility of an aquifer storage and recovery system.

In conclusion North Logan can meet the future demands for water throughout the City, by transferring shares from agricultural use to culinary use as development occurs and by maximizing the current rights the City owns.

## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>I</b>
<b>TABLE OF CONTENTS .....</b>	<b>III</b>
<b>LIST OF TABLES.....</b>	<b>IV</b>
<b>LIST OF FIGURES .....</b>	<b>IV</b>
<b>1.0 INTRODUCTION .....</b>	<b>1</b>
<b>2.0 CURRENT WATER USE (2002).....</b>	<b>2</b>
<b>3.0 EXISTING WATER RIGHTS / WATER SHARES.....</b>	<b>4</b>
3.1 Evaluating Existing Water Rights.....	5
<b>4.0 FUTURE WATER USE .....</b>	<b>7</b>
4.1 Growth Projections (Population & ERUs).....	7
4.2 Future Water Use (2020).....	8
4.3 Projected Requirements for Water Sources .....	8
4.4 Projected Requirements for Water Rights.....	10
4.5 Future Storage Requirements.....	10
<b>5.0 CURRENT ZONING .....</b>	<b>12</b>
5.1 Zoning Breakdown in Irrigation Areas .....	13
<b>6.0 CURRENT LAND USE .....</b>	<b>14</b>
<b>7.0 FUTURE LAND AND WATER USE .....</b>	<b>14</b>
<b>8.0 ALTERNATIVES .....</b>	<b>17</b>
<b>9.0 CONCLUSIONS &amp; RECOMMENDATIONS.....</b>	<b>18</b>

**LIST OF TABLES**

Table 1: Reservoir Storage 2002 ..... 1  
Table 2: Water Diversion 1998-2002 ..... 2  
Table 3: Well Average Daily Flows 1998-2002..... 2  
Table 4: Total Average Daily Flows 1998-2002 ..... 2  
Table 5: Water Connections & ERU (2002)..... 3  
Table 6: Water Rights..... 4  
Table 7: Other Water Rights..... 4  
Table 8: Water Shares ..... 4  
Table 9: Well Capacity..... 5  
Table 10: Population Projection 2020 ..... 7  
Table 11: Projected ERUs ..... 7  
Table 12: Projected ERUs ..... 8  
Table 13: Projected Storage Requirements (2020) ..... 11  
Table 14: Current Zoning 2002 ..... 12  
Table 15: Irrigation Areas 2002..... 13  
Table 16: Current Land Use 2002 ..... 14

**LIST OF FIGURES**

Figure 1: Well Diversion & Water Right Limitation (2002) ..... 5  
Figure 2: Spring Diversion and Water Right Limitation (2002)..... 6  
Figure 3: Projected Peak Use (2020) ..... 9  
Figure 4: North Logan Water Projections (2020)..... 10  
Figure 5: North Logan Water Projections ..... 11

**APPENDICES**

APPENDIX A: REFERENCES

APPENDIX B: WATER RIGHTS

APPENDIX C: WATER USE  
Source Information C-1 – C-4  
Water Use Information C-5

APPENDIX D: MAPS  
Irrigation Areas  
Zoning  
Land Use  
Land Use Summary  
East Bench

APPENDIX E: SAMPLE ORDINANCES AND AGREEMENTS  
Delta City Ordinance for Water Right Requirement  
Nibley City Ordinance for Water Right Requirement  
Irrigation Company Agreement

## 1.0 INTRODUCTION

North Logan City requested the professional services of Cache-Landmark Engineering to review North Logan's water rights and water sources and to make recommendations for future water needs. This study will review existing water rights, existing water sources, current water use, current zoning, and current land use. With this information this study will predict North Logan's future needs for water rights and water sources.

### *Existing Water System*

Currently four wells (Two in the mouth of Green Canyon, one near Jack's Tire & Oil, and one on the Northeast end of the city) and springs in Green and Water Canyon supply culinary water to North Logan. The capacity of the springs and wells is discussed in Section 3.0 (see Table 9). The spring water from the canyons is treated at the North Logan Treatment Plant located at the mouth of Green Canyon. Current water demand is met by these existing sources. Current water use will be discussed in the Section 2.0.

The City's water storage currently consists of three reservoirs with a combined capacity of 2.5 million gallons (see Table 1). Future storage requirements will be discussed in Section 5.3.

Table 1: Reservoir Storage 2002

<b>Name</b>	<b>Location</b>	<b>Capacity (mg)</b>	<b>Year Built</b>
Reservoir #1	Mouth of Green Canyon	0.5	1971
Reservoir #2	Mouth of Green Canyon	1.0	1995
Beef Hollow Reservoir	Northeast Bench	1.0	1995
<b>Total</b>		<b>2.5</b>	

Source: Bowen, Collins & Associates (2002)

Distribution throughout North Logan City is through pipelines ranging in size from 4" to 12" in diameter. Three booster pumps are also in use to pump water from Reservoir #2 to the Beef Hollow Reservoir, and from the 1<sup>st</sup> West Well (Jack's Well) to higher-pressure zones. A distribution analysis was not in the scope of work for this report. The water distribution analysis was completed in the Water System Master Plan Update completed by Bowen, Collins, & Associates (2002).

## 2.0 CURRENT WATER USE (2002)

North Logan currently uses (diverts) 1,386.9 acre-feet (a-f) a year. Table 2 illustrates the amount of water diverted (acre-feet (a-f)) from each source for the last five years. Table 3 and 4 shows the average flows from the four wells and the springs.

Table 2: Water Diversion 1998-2002

<b>Year</b>	<b>Wells (a-f/yr)</b>	<b>Springs (a-f/yr)</b>	<b>Total Diversion (a-f/yr)</b>
1998	136.6	1,034.6	1,171.2
1999	358.9	1,043.0	1,401.9
2000	849.5	529.6	1,379.1
2001	1,024.8	330.4	1,355.2
2002	1,014.7	372.2	1,386.9

Table 3: Well Average Daily Flows 1998-2002

<b>Year</b>	<b>Green Canyon #1</b>	<b>Green Canyon #2</b>	<b>Beef Hollow</b>	<b>1<sup>st</sup> West Well</b>	<b>Total Wells (gpm)</b>
1998	34.46	45.07	5.15	7.0	91.68
1999	117.48	98.20	6.82	0.0	222.50
2000	272.47	225.91	6.13	21.51	526.02
2001	315.56	271.17	2.91	45.50	635.14
2002	324.48	204.52	1.67	98.63	629.30

Table 4: Total Average Daily Flows 1998-2002

<b>Year</b>	<b>Wells (gpm)</b>	<b>Springs (gpm)</b>	<b>Total Avg. Flow (gpm)</b>	<b>Total Avg. Flow (cfs)</b>
1998	91.68	641.41	733.09	1.63
1999	222.50	646.61	869.11	1.93
2000	526.02	328.33	854.35	1.90
2001	635.14	204.84	839.98	1.87
2002	629.30	230.75	860.05	1.92

*Water Connections*

In addition to the 1,574 residential connections in 2002, North Logan City has commercial, industrial, institutional, and stock water connections. Residential connections account for 92 % of the connections, but only 70 % of the water usage. A breakdown of the connections and usage is found in Appendix C-5. The last five-year average (1998-2002) annual usage of residential connection is 0.56 acre-feet/year. Table 5 shows the five-year annual water usage per connection. Also, the equivalent residential unit (ERU) is shown in the table to equate the number of residential connections to other water use types. The ERU is calculated by dividing the annual usage of a connection by the average residential annual usage (0.56 a-f/yr).

Table 5: Water Connections & ERU (2002)

<b>Description</b>	<b>Connections</b>	<b>Five-Year Avg. Annual Usage Per Connection</b>	<b>ERU Ratio</b>	<b>ERUs</b>
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
Residential	1,574	0.56	1	1,574.0
Commercial	79	2.68	4.79	378.4
Industrial	9	1.02	1.82	16.4
Institutional	38	2.69	4.80	182.4
Stock	4	0.01	0.02	0.1
Other	1	1.49	2.66	2.66
<b>Total (2002)</b>	<b>1,705</b>	<b>-</b>	<b>-</b>	<b>2,153.9</b>

1—Connections 2002

2—See Appendix C-5 (a-f/yr)

3—ERU Ratio = Column 2 divided by 0.56 a-f/yr

4—ERUs = Column 1 multiplied by column 3

Reviewing the residential usage for the last thirteen years (see Appendix C-5) shows the average annual use from residential connections in North Logan has not changed a significant amount (ranging from a low of 0.45 a-f/yr in 1995 to a high of 0.61 a-f/yr in 1998). The thirteen-year average for residential connection is 0.52 a-f/yr.

### 3.0 EXISTING WATER RIGHTS / WATER SHARES

North Logan currently has water rights for four wells and springs in Green Canyon and Water Canyon. Table 6 lists current water rights. Information on each individual water right is found in Appendix B.

Table 6: Water Rights

W.R. Number	Status	Priority	Source	Flow (cfs)	a-f/yr (Limitation)
25-3199	Cert	1955	4 Springs (Water Canyon)	0.56	
25-3063	Cert	1933	Water Canyon	0.87	
25-9568	Cert	1978	Underground Water Wells (4)	1.45	241.85
25-3425	Cert	1962	Underground Water Wells (4)	4.90	
25-6074			4 Springs (Water Canyon)	-	
25-5421	Dil	1898	Green Canyon Creek (sinks)	4.00	
<b>TOTAL</b>				<b>11.78</b>	

North Logan City has other water rights submitted under their name, however these water rights have been unapproved, lapsed, or withdrawn. These rights are listed in Table 7.

Table 7: Other Water Rights

W.R. Number	Status	Priority	Source	Flow (cfs)
25-9046	Unapproved	1990	Underground Well (Green Canyon)	2.00
25-9127	Unapproved	1991	Green Canyon Springs	1.00
25-9126	Unapproved	1991	Red Rock Hollow Springs	1.00
25-9045	Unapproved	1990	Underground Well (Beef Canyon)	4.00
25-5181	Withdrawn	1971	Red Rock Hollow Springs	
25-8514	App (Power)	1983	Green & Water Canyons	4.00
25-3399	Lapsed		Unnamed Spring	
25-5301	Withdrawn		Unnamed Springs	

In addition to the above water rights, North Logan City has shares in local canal companies. Table 8 lists the current shares in canal companies.

Table 8: Water Shares

Canal Company	Shares
Logan, Hyde Park, Smithfield	25.74
Logan & Northern Irrigation	13.75
Hyde Park Irrigation	57
<b>Total</b>	<b>96.49</b>

### 3.1 Evaluating Existing Water Rights

#### Wells

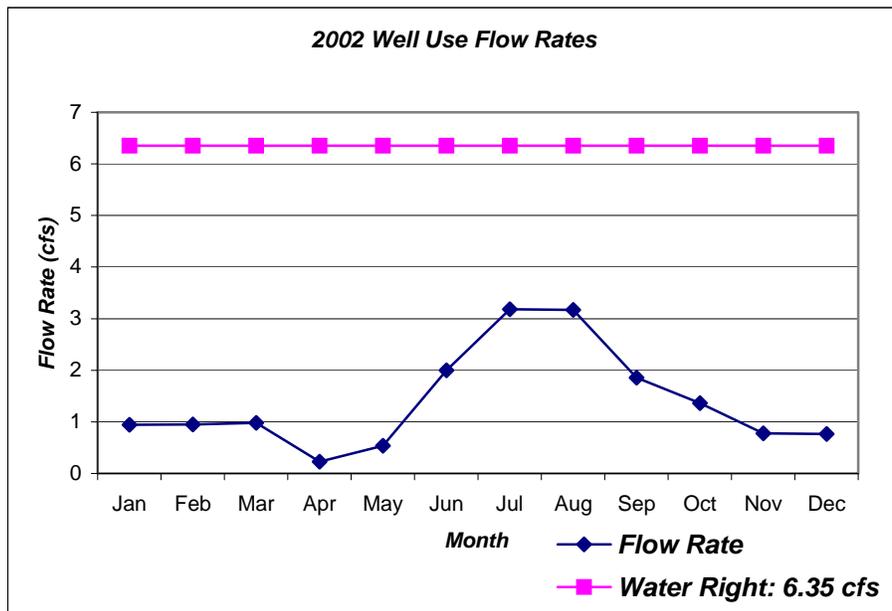
Reviewing North Logan’s well water rights shows the four wells are combined into two water rights 25-3425 and 25-9568. The amount of water the City can legally withdraw from their wells is 6.35 cfs (2,849.88 gpm). The City cannot exceed this flow rate at any given time. Water right 25-9568 is limited to 1.45 cfs (650.8 gpm) and a withdrawal of 241.85 acre-feet/year. Water right 25-3425 is limited to 4.90 cfs (2,199.1 gpm). The wells and their source capacity (amount of water the well can physically produce) are listed in Table 9.

Table 9: Well Capacity

Well	Capacity (cfs)	Capacity (gpm)
1 <sup>st</sup> West Well	3.34	1,500
Green Canyon Well #1	1.56	700
Green Canyon Well #2	0.67	300
Beef Hollow Well	0.01	7
<b>Total</b>	<b>5.59</b>	<b>2,507</b>

Comparing the total water right 6.35 cfs (2,849.88 gpm) with the total source capacity 5.59 cfs (2,507 gpm) shows the four wells’ capacity is 0.76 cfs (342.88 gpm) below the water right peak flow rate of 6.35 cfs (2,849.88 gpm). This means the City would have the right to drill another well and add this well to the current water rights, however all wells combined would not be able to divert more than the 6.35 cfs. The City will need to complete a change application on the two existing water rights (25-3425, 25-9568) to add the new well to the system. This information is represented in Figure 1 below.

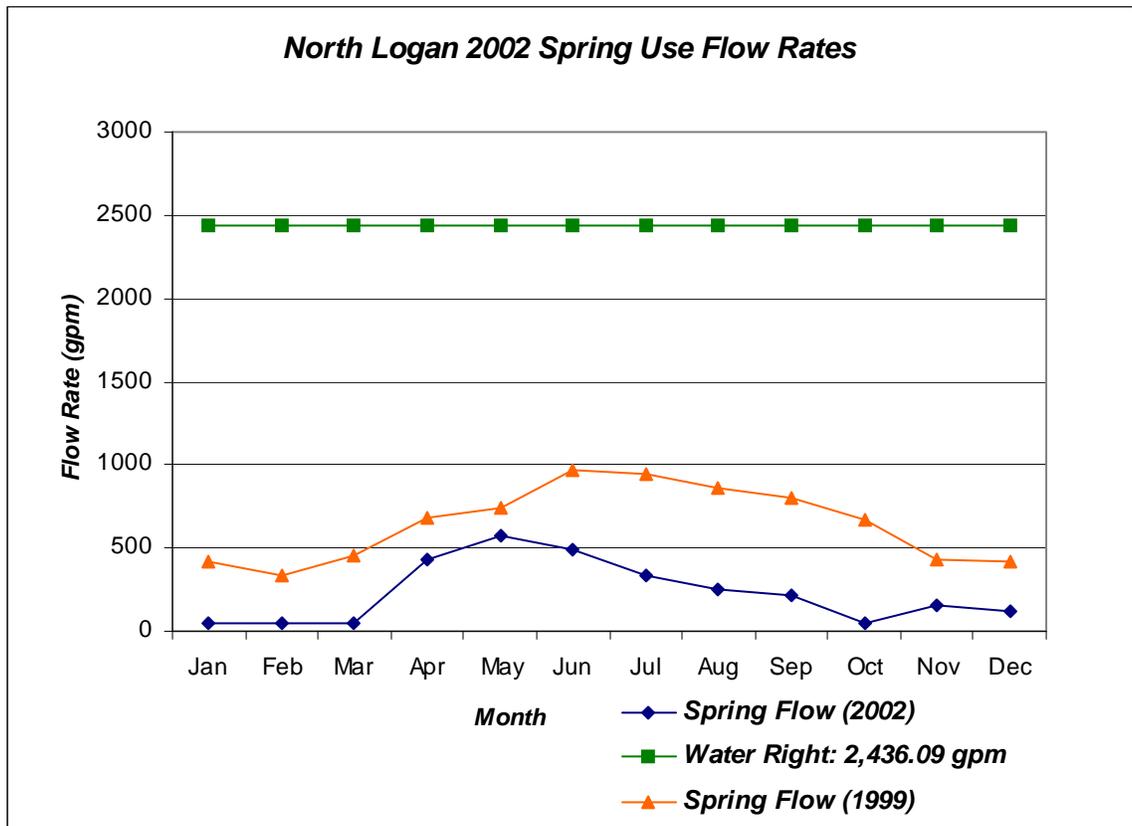
Figure 1: Well Diversion & Water Right Limitation (2002)



## Springs

Reviewing North Logan's spring water rights shows the springs are combined into three water rights 25-3199 (Water Canyon), 25-3063 (Water Canyon), and 25-5421 (Green Canyon). The total amount of water the City can legally withdraw from the springs is 5.428 cfs (2,436.09 gpm). The City cannot exceed this flow rate at any given time. Furthermore, there is a limitation of 1,993.82 acre-feet/year on the amount of water that can be diverted from the springs. The springs have produced as much as 2.23 cfs (1,000 gpm) and as little as 0.04 cfs (20 gpm). This is far below the full water right.

Figure 2: Spring Diversion and Water Right Limitation (2002)



The spring water rights have not been issued a certificate. An election on the water rights was filed, however the Division of Water Rights has not completed this election. If this election were to be completed the certificate would probably issue a lower flow rate and acre-feet limitation. This flow would represent the historical flows of the springs. Therefore, North Logan cannot count on using or developing more water than has been historically used in the springs. The City will want to complete the election (or proof) during a wet year (high runoff).

However, there is a minimal chance of utilizing the excess spring water right. The City could segregate the excess water right and submit a change application from the springs to the wells. The probability of this being approved by the Division of Water Rights is low due to the current groundwater policy, state statutes, and protestants downstream. Therefore, this report did not consider this an alternative to acquire additional water rights.

#### 4.0 FUTURE WATER USE

##### 4.1 Growth Projections (Population & ERUs)

To determine future water needs (water rights and source) a reasonable growth prediction must be determined. The North Logan City population in the year 2000 was 6,163 according to the 2000 Census. In the ten-year period from 1990 to 2000 the City experienced an increase of 63.6% in population (5.02% per year).

The 2002 Water System Master Plan Update (Bowen, 2002) showed in the year 2020 a city population of 17,500 (Growth rate 5.36% per year). The City Staff felt the projected growth rate of the study was overstated. Currently, the last eight-year average for residential building permits is approximately 50 permits per year. Comparing the average permits per year to the current residential connections shows a growth rate of 3.19%. This study will use an assumed growth rate of 3.25% per year. Table 10 shows the population projections.

Table 10: Population Projection 2020

<b>Year</b>	<b>Population</b>
1990	3,775
2000	6,163
2010	8,500 <sup>1</sup>
2020	11,700 <sup>2</sup>

1—Growth rate 3.28% a year

2—Growth rate 3.25 % a year

The future water demands of the City are calculated by assuming the equivalent residential units (ERUs) will grow at the same rate as the population growth rate. The total number of ERUs in the year 2020 is 3,834. Table 11 shows the projected number of ERUs.

Table 11: Projected ERUs

<b>Year</b>	<b>ERUs</b>
2002	2,154 <sup>1</sup>
2010	2,785
2020	3,834

1—see Table 5

#### 4.2 Future Water Use (2020)

With the assumption that the residential connections in the year 2020 will use the same amount of water as 2002 residential connections (0.56 a-f/yr (see Table 5)), the total amount of water usage for the year 2020 is 2,147.0 a-f/yr. The 2,147.0 a-f/yr is the ERU water usage not the water diverted from the water sources (springs and wells).

North Logan City loses approximately 15% through distribution lines or other areas not monitored or metered (see Appendix C-5). Adding this loss to the water usage equates to 2,525.9 a-f/yr of water diversion. This is the amount of water the City's sources (springs and wells) need to produce in order to meet future water demands. Table 12 shows the future water usage and water diversions.

Table 12: Projected ERUs

<b>Year</b>	<b>Total Water Usage (a-f/yr)</b>	<b>Total Water Diversion (a-f/yr)</b>	<b>Average Daily Flow (gpm)</b>
2002	1,178.0	1,386.9	860.0 <sup>1</sup>
2010	1,559.6	1,834.8	1,138.9 <sup>2</sup>
2020	2,147.0	2,525.9	1,568.5 <sup>2</sup>

1—See Table 4

2—Yearly Average Daily Flow not Peak Flow Rate

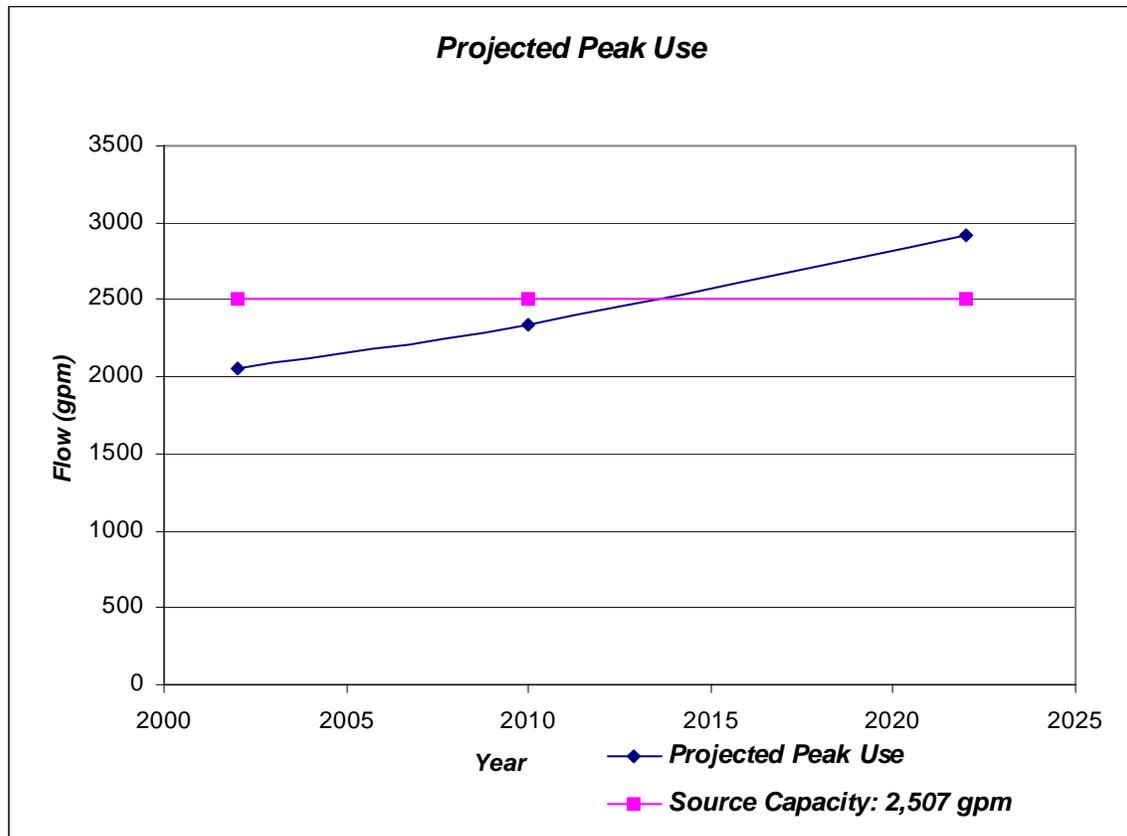
#### 4.3 Projected Requirements for Water Sources

Table 12 showed the amount of water to be diverted in the year 2020. Figure 4 (page 10) shows the projected water use, source capacity, and water rights. The graph shows North Logan will not have the source capacity or water rights to meet future demands in the year 2020. To meet future water demands North Logan will need to add additional water sources to the water system. There are alternatives to reducing the peak water demand, such as secondary water systems, however the City needs additional culinary sources. There are a couple of alternatives to meet future culinary water needs.

1. Add additional wells to the water system
2. Additional water for the City's water treatment plant in Green Canyon. Additional water coming from canals running through North Logan.

The water sources will need to divert 2,525.9 a-f/yr (see Table 12) and be able to meet a peak flow rate of 6.51 cfs (2,923.3 gpm). The projected peak flow use is shown in Figure 3 (next page) with the current well source capacity (see Table 9 for source capacity).

Figure 3: Projected Peak Use (2020)



Currently North Logan City wells in Green Canyon run 20 hrs a day. The 1<sup>st</sup> West Well runs to supplement the peak demands of the system (5-8 hrs a day during peak). As the City grows the dependency on this well will grow until it reaches its capacity. The City will reach its source capacity in ten years (see Figure 3).

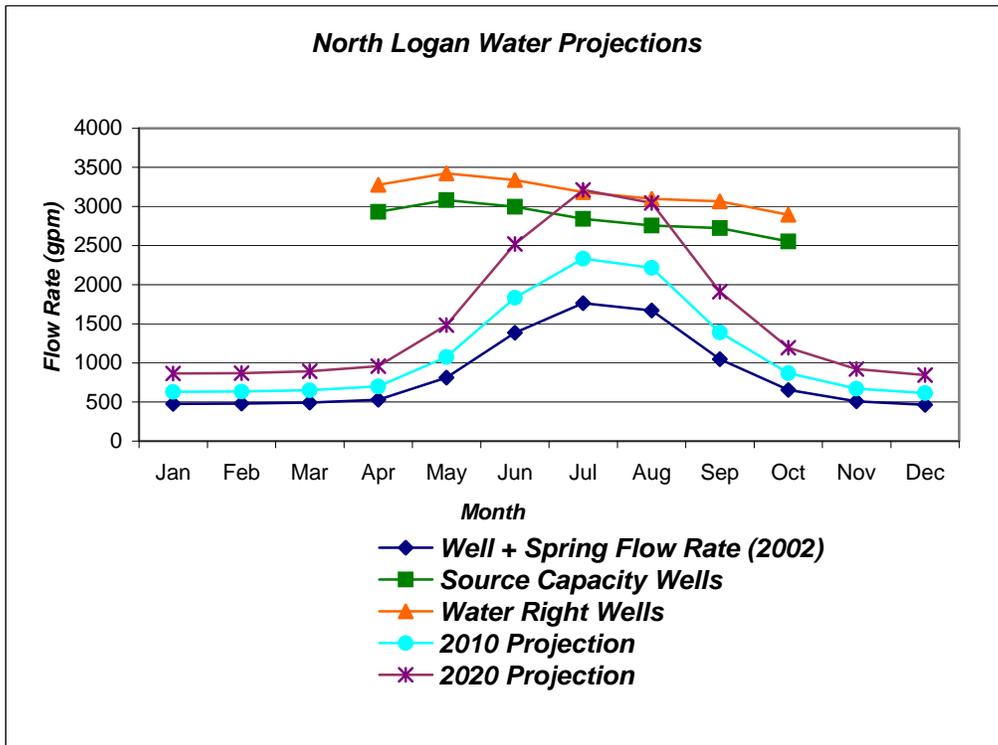
Typically wells are designed to run 50% of the time to meet water demands. To meet future water demands, we recommend North Logan determine a new well site and begin the approval process for a new culinary well. This will require a change application on existing water rights.

#### 4.4 Projected Requirements for Water Rights

The State of Utah (DDW, 2001) requires all sources to legally and physically meet water demands under two separate conditions. (1) Shall meet the anticipated water demand on the day of highest water consumption (Peak Day Demand). (2) Provide one year's supply of water (Average Yearly Demand)

Figure 3 shows North Logan will need additional water rights in ten to eleven years to meet future peak demands. Figure 4 (page 10) shows North Logan has water rights for the next fifteen to meet average daily demands. North Logan will need additional water rights to meet future water demands. There are different alternatives involved in acquiring water rights. These alternatives will be discussed in Section 8.0.

Figure 4: North Logan Water Projections (2020)



#### 4.5 Future Storage Requirements

Table 13 and Figure 5 shows the future storage requirements. North Logan currently has 2.5 million gallons of storage (see Table 1). Storage requirements are based on the three criteria listed below.

- Equalization (satisfy peak day demands)
- Fire suppression
- Emergency Storage

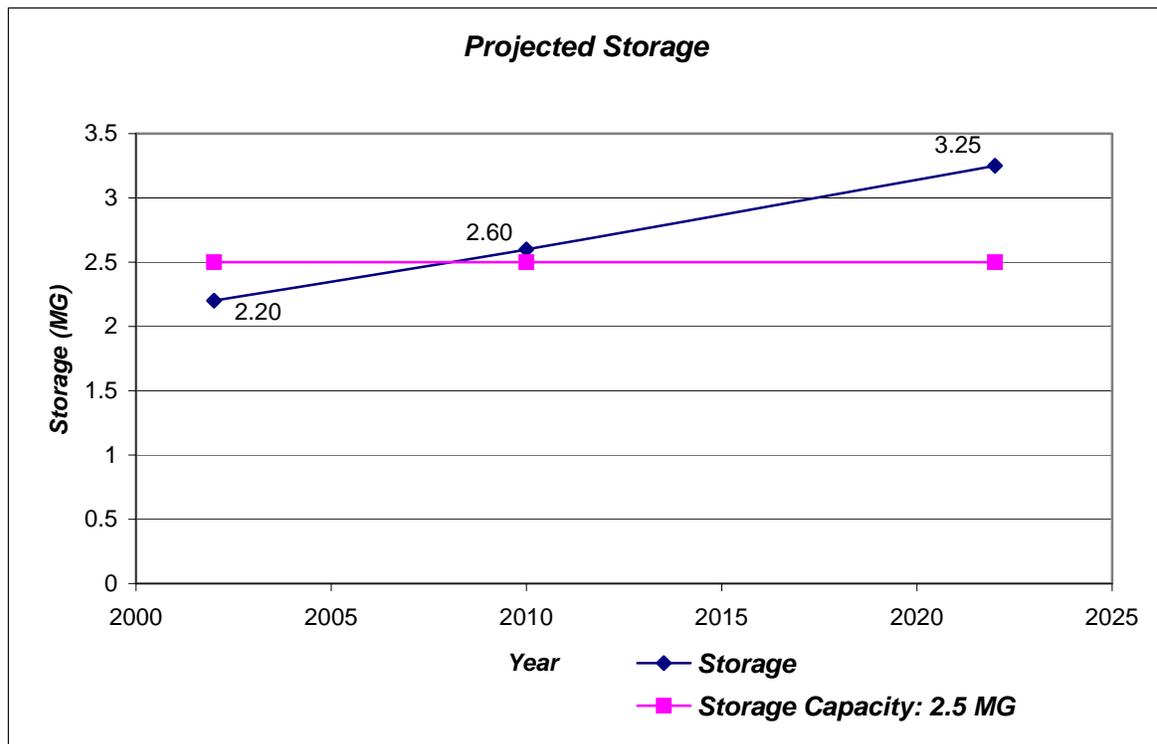
Equalization is based on the City’s water system. The equalization in Table 13 is based on the City’s total water diversion (see Table 12). The fire flow is based upon the size and type of structure to be protected by the city’s water system. Currently, the largest building requires a fire flow of 4,250 gpm for a four-hour duration (1.0 MG). Requiring all large structures to have fire sprinkler system could reduce this requirement. This requirement can reduce the amount up to 75%.

The City has emergency storage in the excess storage capacity of the existing reservoir system. As the City grows the emergency storage will decrease in the system. Based upon the current growth rate the City will need to develop new reservoir storage in the next three years. Furthermore, the City can increase it’s emergency storage by installing backup power on wells and on future wells.

Table 13: Projected Storage Requirements (2020)

Year	Equalization Demand (MG)	Fire Suppression (MG)	Storage Requirement (Million gallons)
2002	1.23	1.0	2.2
2010	1.6	1.0	2.6
2020	2.25	1.0	3.25

Figure 5: North Logan Water Projections



## 5.0 CURRENT ZONING

As mentioned in the previous section North Logan needs additional water rights to meet future water demands. One alternative to obtain water rights/shares to meet future demands is to require water rights/shares as land is developed. This section will review the City's current zoning, the next section will review current land use, and Section 7.0 will evaluate future land and water use. With this information it can be determined what water rights are available to use for future water sources and demands.

North Logan City is zoned into 16 different types of zones. Table 14 lists the Zones and their corresponding minimum residential lot sizes, and the current acreage of each zone in North Logan City.

Table 14: Current Zoning 2002

<b>Zone</b>	<b>Description</b>	<b>Min. Res. Lot Size</b>	<b>Current Acreage</b>
<b>MC</b>	Manuf./Heavy Comm.	No Minimum	221.53
<b>CG</b>	General Comm.	No Minimum	463.83
<b>PR</b>	Professional	No Minimum	28.01
<b>CC</b>	Community Comm.	No Minimum	64.63
<b>M2</b>	High Tech. Manuf. & Res.	per Innovation Campus Master Plan	124.96
<b>HOSP</b>	Hospital	No Minimum	17.83
<b>A-10</b>	Agriculture	435,600	67.94
<b>RE-1</b>	Residential Estate	43,560	1,880.04
<b>RE-2</b>	Residential Estate	87,120	19.44
<b>R-1-30</b>	Single Fam. Res.	30,000	6.62
<b>R-1-20</b>	Single Fam. Res.	20,000	40.12
<b>R-1-15</b>	Single Fam. Res.	15,000	9.04
<b>R-1-12</b>	Single Fam. Res.	12,000	1,160.61
<b>R-1-10</b>	Single Fam. Res.	10,000	186.32
<b>RM</b>	Multi-Fam. Res.	6,000-16,000	32.63
<b>RB</b>	Residential Business	Conform w/adj. Zone	10.48
<b>TOTAL</b>			<b>4,334.03</b>

A current zoning map can be seen in Appendix D.

### 5.1 Zoning Breakdown in Irrigation Areas

Four canals run through North Logan dividing the city into five irrigation areas. These areas are shown on the map Irrigation Areas (B2) in Appendix D. Table 15 lists the acreages of the different zones in these areas. The canals were not accounted for in the breakdown, hence the difference in the sum of irrigation areas and current zoning (see Table 15).

Table 15: Irrigation Areas 2002

<b>Zone</b>	<b>Hyde Park Irr. (Twin Ditches)</b>	<b>Logan North Field Irr. (Twin Ditches)</b>	<b>Logan Northern (Middle Canal)</b>	<b>Logan Smithfield Hyde Park Irr. (Upper Canal)</b>	<b>Above Canal</b>
MC	221.47	-	-	-	-
CG	255.11	208.66	-	-	-
CC	-	36.61	16.79	10.96	-
M2	-	-	109.75	14.08	-
PR	-	27.95	0.00	-	-
HOSP	17.77	-	-	-	-
A-10	-	-	67.88	-	-
RE-1	-	-	170.95	611.62	1088.95
RE-2	-	-	19.38	-	-
R-1-30	-	-	6.56	-	-
R-1-20	-	-	11.95	28.11	-
R-1-15	-	-	8.98	-	-
R-1-12	219.23	109.24	200.50	338.44	289.21
R-1-10	-	-	67.23	119.03	-
RM	-	27.36	2.35	2.52	-
RB	-	-	10.42	-	-
<b>Total</b>	<b>713.58</b>	<b>409.82</b>	<b>692.75</b>	<b>1124.78</b>	<b>1378.16</b>

## 6.0 CURRENT LAND USE

Although the zoning has been set forth for North Logan City by ordinances, the actual land use occurring in a particular area of a zone in many cases is different than the specified land use for the zone type. A summary of current land use is listed in Table 16. In addition, the land uses in the specific irrigation areas (see Section 5.1) are shown in Appendix D along with a current land use map.

Table 16: Current Land Use 2002

<b>Land Use</b>	<b>Acres</b>
Residential	876.18
Vacant	1,229.53
Church	39.14
Commercial	370.27
Agricultural	1,621.65
Hospital	13.03
NLC Parks	141.62
Schools	14.06
Transportation (Rights-of-way)	13.61
Canals	14.94
<b>Total</b>	<b>4,334.03</b>

Most of the current land use is agricultural, residential, and vacant. The vacant land is mostly east of the Logan, Hyde Park, and Smithfield Canal (Upper Canal).

## 7.0 FUTURE LAND AND WATER USE

Section 6.0 lists (Table 16) the largest land use is agricultural land. Most of the agricultural land use is in residential or commercial zoned areas. Only approximately 63.99 acres of agricultural land is actually zoned agricultural land. The second largest land use is vacant land. Vacant land is also in residential and commercial zoned areas.

Typically, land use changes from agricultural to vacant land to residential or commercial. The available land for development is 2,788.19 acres (see Appendix D for summary). Not all of this land can be developed. There are sensitive lands such as steep slopes, drainage basins, and wetlands that are included in the available land. Vacant land in a current residential subdivision is also considered developable.

To determine the future water use and the availability of water rights to meet future demands, two examples of developments are shown in this section.

### *East Bench*

Most land in North Logan is below canals except for the east bench. Most land west of the canals is irrigated. The east bench is not irrigated. Water demand and depletion estimation is calculated in this section for the east bench.

A map of the east bench is provided in Appendix D. The residential zoning for the east bench consists of RE-1 and R-1-12 (see Table 14 for zone descriptions). To determine the maximum number of lots in each zone the power easement, steep slopes (> 30%), open space requirement, sensitive lands, rights-of-way (ROW) and the City Park (Cemetery) were removed from the raw acreage. Dividing the net acreage by the zoning minimum requirements yielded the maximum number of lots on the east bench (east of the Upper Canal).

- RE-1 740 lots
- R-1-12 460 lots
- Total lots = 1,200 lots

The water use for the east bench is shown below.

- East Bench Water Use
  - Assumptions
    - Average indoor use = 0.45 a-f/yr/resident (DDW, 2001)
    - Average outdoor use = 1.87 a-f/yr/irr. acre (DDW, 2001)
  - Diversion (Indoor)
    - 740 lots x 0.45 acre-feet/yr/ lot = 333.0 a-f/yr
    - 460 lots x 0.45 a-f/yr/lot = 207.0 a-f/yr
  - Diversion (Outdoor)
    - 10,000 SF irr. Area/ lot RE-1
    - 740 lots x 0.23 acre/lot x 1.87 a-f/yr/irr. acre = 318.3 a-f/yr
    - 9,000 SF irr. Area/ lot R-1-12
    - 460 lots x 0.21acre/lot x 1.87 a-f/yr/irr. acre = 177.2 a-f/yr
    - North Logan Cemetery (44 irr. ac )
    - 44 irr. ac x 1.87 a-f /yr/irr. acre = 82.3 a-f/yr
  - Total Diversion
    - $333.0+207.0+318.3+177.2 + 82.3 = 1,117.8$  a-f / yr
  - Depletion (Indoor)
    - Indoor 15 %
    - Logan Sewer Lagoons 22%
    - Equates to 0.14 a-f/yr
    - Indoor Depletion =  $(740 + 460) \times 0.14$  a-f/yr
    - Equates to 168.0 a-f/yr
  - Depletion (Outdoor)
    - Lawn (Turf) 1.22 a-f/acre/yr (Hill, 1994)
    - Outdoor Depletion =  $((740 \times 0.23)+(460 \times 0.21)) \times 1.22$  a-f/yr = 325.5 a-f/yr
  - Total Depletion
    - $325.5 + 168.0 = 493.5$  a-f/yr

*Development below the Logan, Hyde Park, and Smithfield Canal*

This example development is on irrigated agricultural land below the Logan, Hyde Park, and Smithfield Canal. The raw acreage of the parcel is 218.55 acres and is currently zoned RE-1. The maximum number of available lots that could be developed is calculated below according to North Logan City Ordinances.

- Available lots
  - Sensitive lands (None)
  - Open Space (54.6 acres)
  - Open Space remains agricultural
  - ROW (16% = 26.3 acres)
  - Developable Land = 137.7 acres
  - 218 lots at an average of 0.63 acre/ lot

The water use of this development is based upon the maximum number of lots and the average lot size.

- Water Use
  - Diversion (Indoor)
    - $218 \text{ lots} \times 0.45 \text{ acre-feet/yr/ lot} = 98.1 \text{ a-f/yr}$
  - Diversion (Outdoor)
    - 15,000 SF irr. Area/ lot
    - $218 \text{ lots} \times 0.34 \text{ acre/lot} \times 1.87 \text{ a-f/yr/acre} = 140.7 \text{ a-f/yr}$
  - Total Diversion
    - $98.1 + 140.7 = 238.8 \text{ a-f / yr}$
  - Depletion (Indoor)
    - Indoor 15 %
    - Logan Sewer Lagoons 22%
    - Equates to 0.14 a-f/yr/lot
    - Indoor Depletion =  $218 \times 0.14 \text{ a-f/yr}$
    - Equates to 30.52 a-f/yr
  - Depletion (Outdoor)
    - Outdoor Depletion =  $218 \text{ lots} \times 0.34 \text{ acre/lot} \times 1.22 \text{ a-f/yr/acre} = 90.43 \text{ a-f/yr}$
  - Total Depletion
    - $90.43 + 30.52 = 120.9 \text{ a-f/yr}$

Assuming the developed agriculture parcel has a full supply of water from the Logan, Hyde Park, and Smithfield Canal Company, the required water shares to supply the development and open space is calculated below.

- Agricultural Land
  - 218 Shares in Canal Company
  - 1 Share = 1 Acre
  - 54 Shares remain with open space to irrigate
  - Remaining shares (164) used for new appropriation or secondary water system. This would offset the development on the east bench with no current water rights.

The remaining shares (164) could be used for a new appropriation under the Cache Valley Ground Water Management Plan or used for a secondary water system. These two development examples show, as development occurs, the City needs to require water rights/shares to meet future water demands. The City can meet these water demands by using the acquired water rights/shares in a new appropriation, secondary water system, or an aquifer storage and recovery project.

## **8.0 ALTERNATIVES**

Upon reviewing the North Logan water information, the City has different alternatives that must be furthered studied to determine the best way to utilize the City's water resources.

As mentioned in previous sections the City needs additional water rights and water sources to meet future water demands. Listed below are the different alternatives the City has to meet these future water demands.

1. *Additional culinary water wells.*
2. *Secondary water system.* This alternative will reduce the summer water demands, thence reducing the dependency on the culinary wells during the summer peak demands. This alternative could involve a citywide system, a partial city system, or the City could require secondary systems for new developments. This alternative will still need water rights/shares. The water rights/shares would come through developing land on previously irrigated land.
3. *Aquifer storage and recovery.* This alternative involves using the shares obtained by the City to be treated (at water treatment facility) to the same water quality as the water withdrawn from the groundwater (culinary wells) and then injected into the aquifer during non-peak use. The water is then withdrawn (from culinary wells) during peak use.

All of the alternatives listed above are to meet the future water source demands. In other words, these are alternatives to increase the water sources. All of these alternatives will need water rights. Listed below are the alternatives to meet future water right needs.

1. *Change Application to Existing Water Rights.* This alternative will allow the city to add an additional well to their existing water rights. This is a short-term fix for water rights.
2. *Require water right/shares as development occurs.* Most land in North Logan is below irrigation canals. Requiring shares will enable the City to use these shares in a culinary well under the Cache Valley Ground Water Management Plan or in citywide secondary water system. The City needs to require, at least the shares needed for residential culinary water use (0.45 a-f/yr/lot).
3. *Participate in water bank.* Recently a water bank was created for cities in Cache Valley to obtain water (set monetary value per a-f/yr) to divert from the cities culinary wells. The city can buy the water or require the developer to buy the water from the water bank.

There are other alternatives to water rights such as: buying water rights/shares on the open market or buying an agricultural farm with water rights and transferring the rights to the City's wells.

## **9.0 CONCLUSIONS & RECOMMENDATIONS**

There are several improvements and ordinances or policies that North Logan can complete or adapt that will allow the City to provide the additional water. The following recommendations will allow for the additional water.

1. During the next year, determine a new well (source) location. Develop the well (source) in the next two years. Submit a change application on the existing water rights for the new well.
2. Complete the election (proof) on the springs during a wet year (high-runoff) in order to gain the maximum right in the spring.
3. Adopt a water ordinance requiring water rights/shares to be transferred to North Logan City upon development or construction (Sample Ordinances are in Appendix E). This will allow the city to not only keep up with water demands for new areas but will also allow for better utilization of the existing rights so that all areas of the City can be served.
4. Utilize the acquired shares or rights as mitigation for new wells as needed. Or utilize the water rights/shares for a secondary water system.
5. Complete a feasibility study for a secondary water system/supply to reduce culinary peak water usage.
6. Review the feasibility of an aquifer storage and recovery system.

In conclusion North Logan can meet the future demands for water throughout the City, by transferring shares from agricultural use to culinary use as development occurs and by maximizing the current rights the City owns.

# **APPENDIX A**

References Cited

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# **APPENDIX B**

WATER RIGHTS

# **APPENDIX C**

WATER USE

Source Information

Water Use Information

# **APPENDIX D**

MAPS

Irrigation Areas

Zoning

Land Use

Land Use Summary

East Bench

# **APPENDIX E**

SAMPLE ORDINANCES

& AGREEMENTS

Delta City Ordinance for Water Rights

Nibley City Ordinance for Water Rights

Irrigation Company Agreement

*The above appendixes are too large to include here. The information in these appendixes is available for viewing at the North Logan City Offices.*