

**SECTION 4**

# **Transmission Pipeline Evaluation**

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# Transmission Pipeline Evaluation

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## Introduction

This section presents the analysis of and recommendations for finished water transmission pipeline improvements for the three site options being considered for the new WTP and discussed in Section 2, Water Treatment Plant Site Selection.

The three sites were illustrated in Exhibit 2-1. Each one has different finished water transmission pipeline needs. A property located along River Drive will require a longer length of transmission piping because it is further away from the existing water distribution system. The Tree Farm and Weyerhaeuser sites are located closer to the city's existing system and require shorter lengths and smaller diameter pipelines to connect to the system.

## Analysis Approach, Assumptions, and Design Criteria

The hydraulic model of the city's water distribution system, developed as part of the 2007 Lebanon *Water System Master Plan*, was used to evaluate the finished water transmission pipeline needs for the city's new WTP. The hydraulic model was first updated with new pipelines constructed after the *Water System Master Plan* was published.

Three demand conditions were modeled for each WTP site option: a phase one maximum day demand (MDD) of 6 mgd and peak hour demand (PHD) of 9 mgd, and a phase two MDD of 14 mgd. As discussed in Section 5, Storage Alternatives, additional distribution storage may be provided at the new WTP site. If this occurs, a portion of the PHD will be supplied from this storage, so the rate of pumping of finished water from the WTP will be greater than the WTP capacity. A pumping rate of 9 mgd (1.5 x 6 mgd) was modeled to represent a worst case demand under phase one. The phase two MDD was used to evaluate the system under buildout conditions, and to determine future needs and staging opportunities for transmission piping.

The design criteria for evaluating new transmission pipelines were as follows:

- Minimum system pressure = 40 pounds per square inch (psi)
- Maximum system pressure = 80 psi
- Maximum flow velocity = 7 feet per second (fps)

## Analysis Results

The modeling results provide guidance for determining the transmission pipeline needs and the required pumping head for each potential WTP site. After an initial modeling effort, CH2M HILL and city staff collaborated to review the approach and assumptions, and to refine pipeline alignments.

**Exhibits 4-1 through 4-3** show proposed transmission pipelines required for a WTP located at one of the River Drive properties, the Tree Farm site, and the Weyerhaeuser site, respectively. To minimize costs, pipe alignments and diameters were optimized to provide the lowest amount of pipe required for phase one, while meeting the design criteria for pressure and flow. The optimum diameters and lengths of pipe for each of the transmission pipeline options are shown in **Exhibit 4-4**.

**EXHIBIT 4-4**

Summary of Transmission Pipeline Length by WTP Site (feet of pipe)

*City of Lebanon Water Improvement*

*Lebanon, OR*

Site	Pipe Length by Diameter			Total Length
	16-inch	20-inch	24-inch	
River Drive	3,520	-	4,930	8,450
Tree Farm	4,790	-	-	4,790
Weyerhaeuser	4,660	1,230	-	5,890

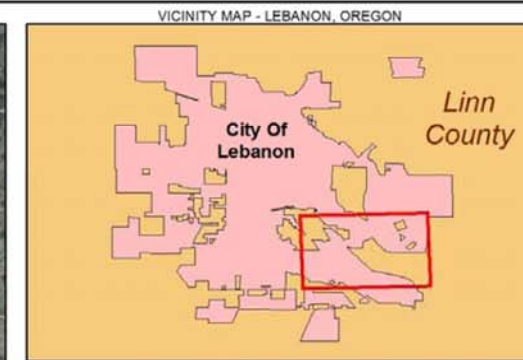
For the Tree Farm site, all design criteria can be satisfied with 16-inch diameter pipe. The Weyerhaeuser property requires some pipe to be 20-inches in diameter, and the River Drive properties require 24-inch diameter piping. The larger diameters are required because of the long length of the pipelines and correspondingly higher head loss.<sup>1</sup>

**Exhibits 4-5 through 4-7** show system-wide pressures for the phase one plant capacity of 6 mgd. **Exhibits 4-8 through 4-10** show system-wide pressures for a PHD equal to 9 mgd. As development continues in the city and demand increases, new pipes will be required to provide additional transmission as outlined in the *Water System Master Plan*.

In addition to evaluating the pipeline requirements for each WTP option, the pumping head for each of the WTP options was also determined. **Exhibit 4-11** shows the system curve for each of the three WTP site options. The system curve was developed with the hydraulic model under MDD conditions and the water storage tanks one-half full. The required hydraulic grade line (HGL) at each of the WTP sites is approximately 520 feet when pumping 6 mgd and increases to approximately 550 feet when pumping 9 mgd.

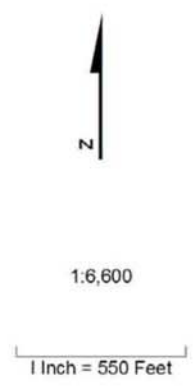
The pumping head required at each site was estimated as equal to the HGL minus the suction head from an assumed water elevation in the storage tank at the WTP. For comparison between sites, the water elevation was set at 360 feet, representing a nearly full, buried tank. The resulting pumping heads are shown in **Exhibit 4-12** for each WTP site. At 6 and 9 mgd all three sites have similar energy requirements. As demand increases beyond 9 mgd, additional distribution system modifications will change the system curves. High service pumping represents a large portion of the energy use for the plant.

<sup>1</sup> A 20-inch diameter pipeline from the River Drive sites can satisfy the 7 fps criterion, but because of high head loss, the 80 psi maximum pressure is exceeded at 9 mgd.



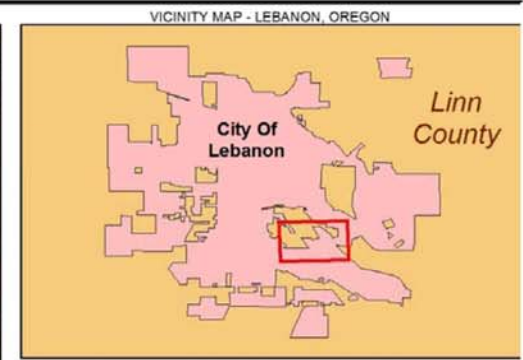
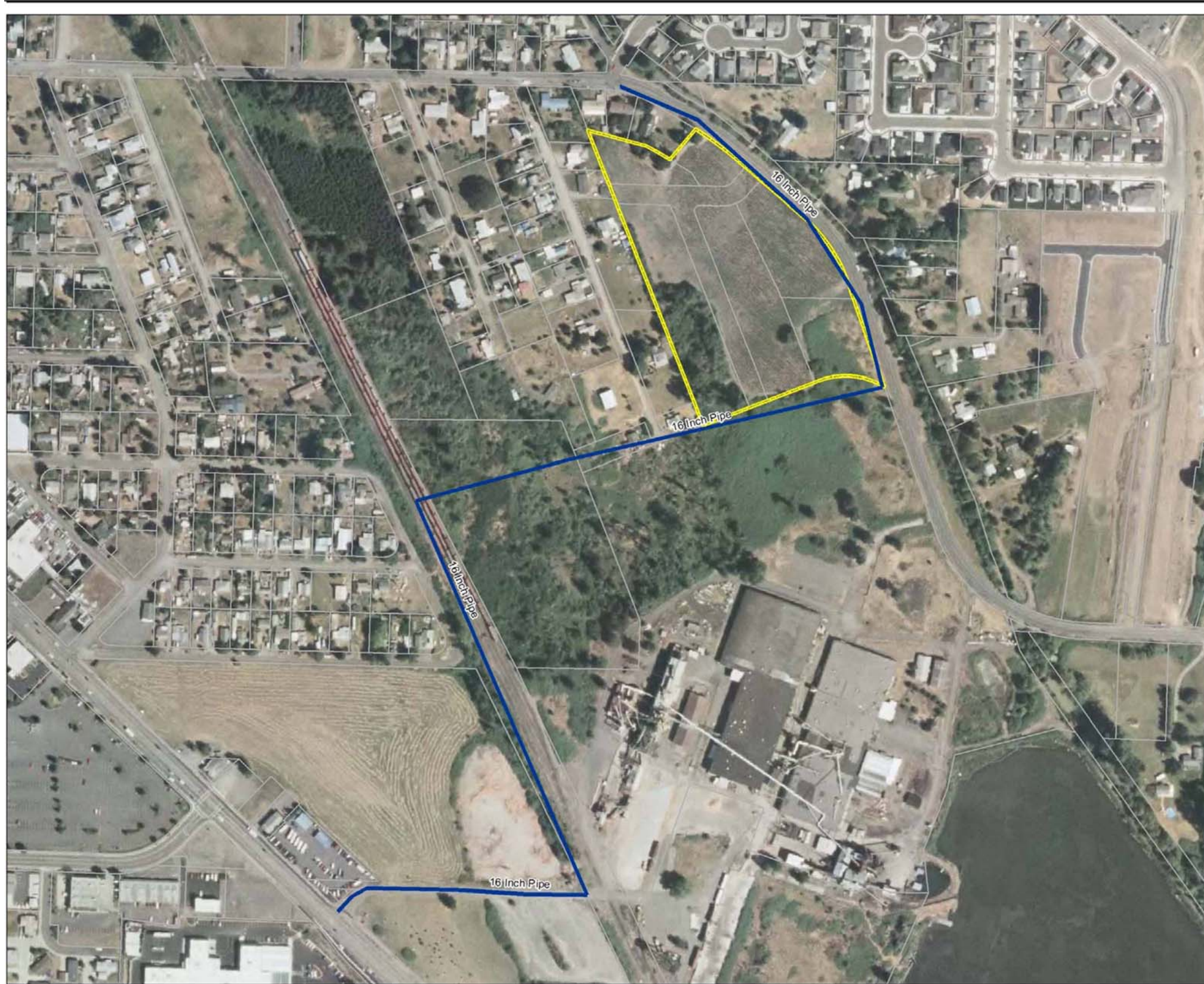
- LEGEND**
- River Drive Site
  - Taxlot
- Pipe**
- 16 Inch Pipe
  - 24 Inch Pipe

- Notes:**
1. Aerial Photo, 2005, Oregon Explorer Streaming Imagery
  2. Taxlots, City of Lebanon, OR



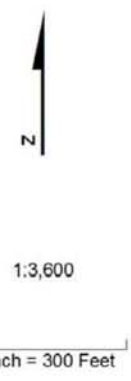
**EXHIBIT 4-1**  
 River Drive Site Pipeline Requirements  
 City of Lebanon Water Improvement  
 Lebanon, OR

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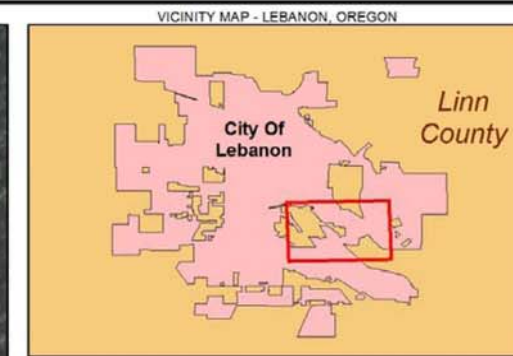
- LEGEND**
- Tree Farm Site
  - Taxlot
- Pipe**
- 16 Inch Pipe

- Notes:**
1. Aerial Photo, 2005, Oregon Explorer Streaming Imagery
  2. Taxlots, City of Lebanon, OR



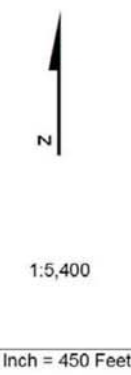
**EXHIBIT 4-2**  
 Tree Farm Site Pipeline Requirements  
 City of Lebanon Water Improvement  
 Lebanon, OR

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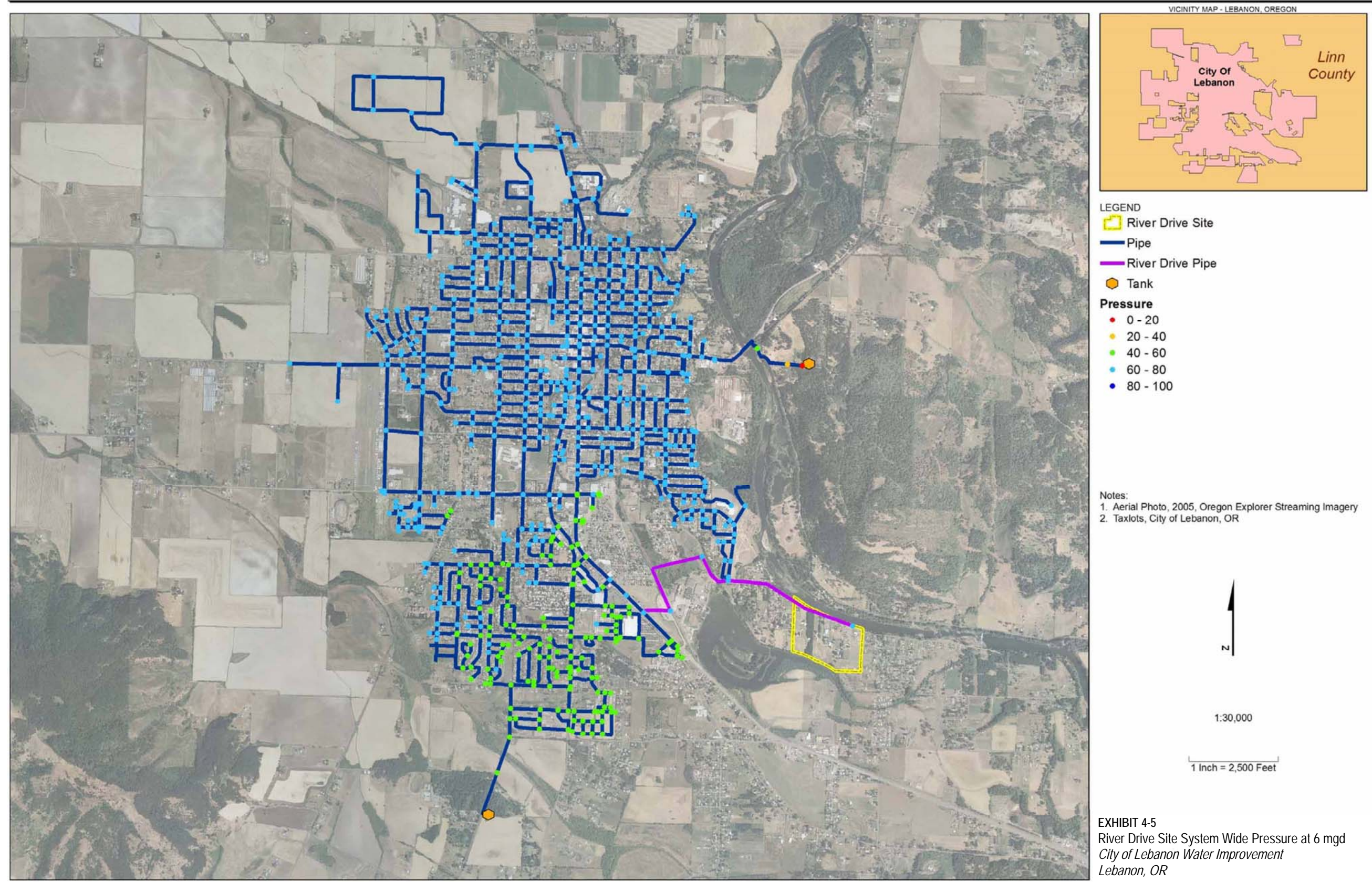
- LEGEND**
- Weyco Site
  - Taxlot
- Pipe**
- 16 Inch Pipe
  - 20 Inch Pipe

- Notes:**
1. Aerial Photo, 2005, Oregon Explorer Streaming Imagery
  2. Taxlots, City of Lebanon, OR



**EXHIBIT 4-3**  
 Weyerhaeuser Site Pipeline Requirements  
 City of Lebanon Water Improvement  
 Lebanon, OR

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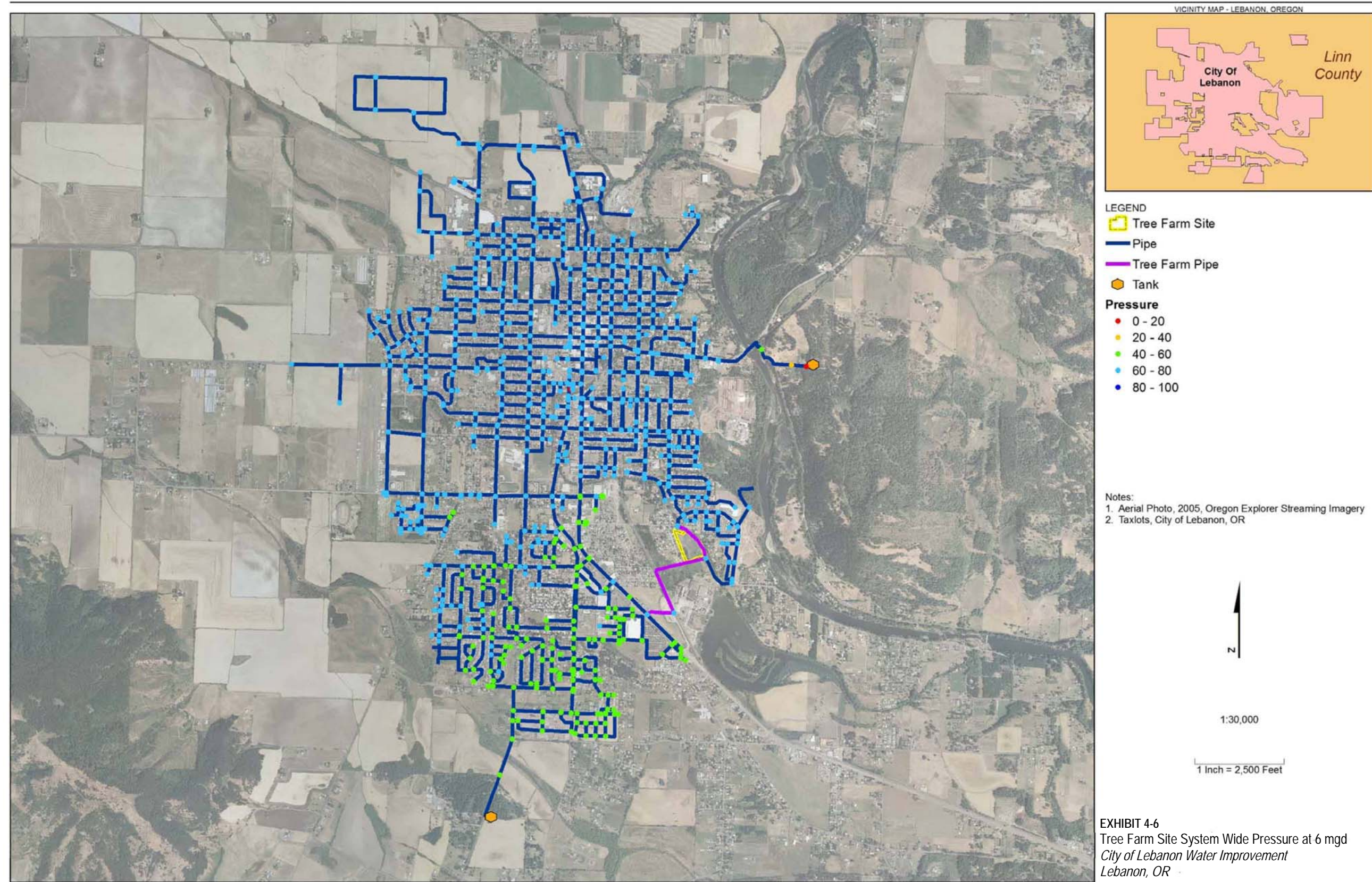
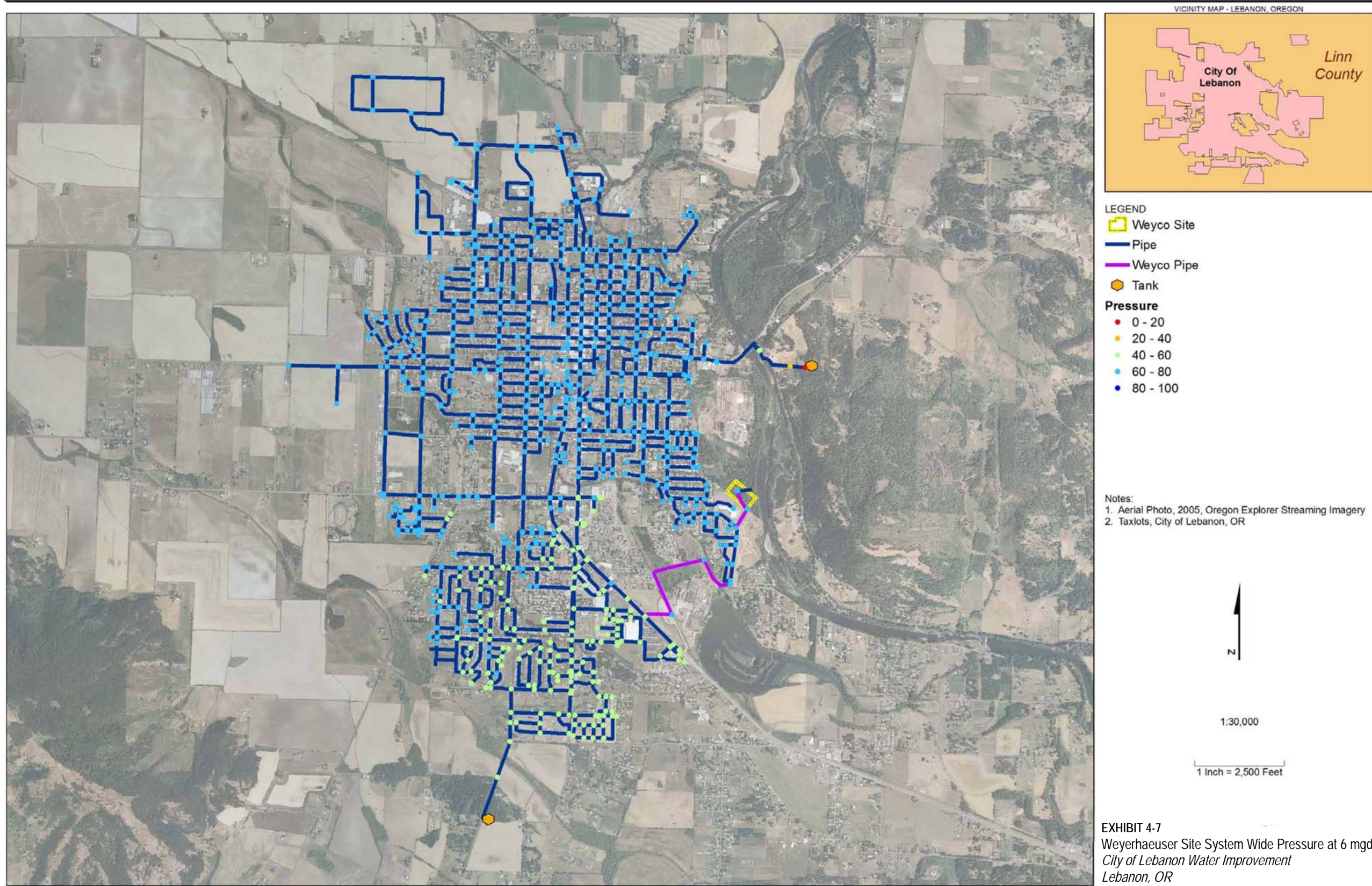


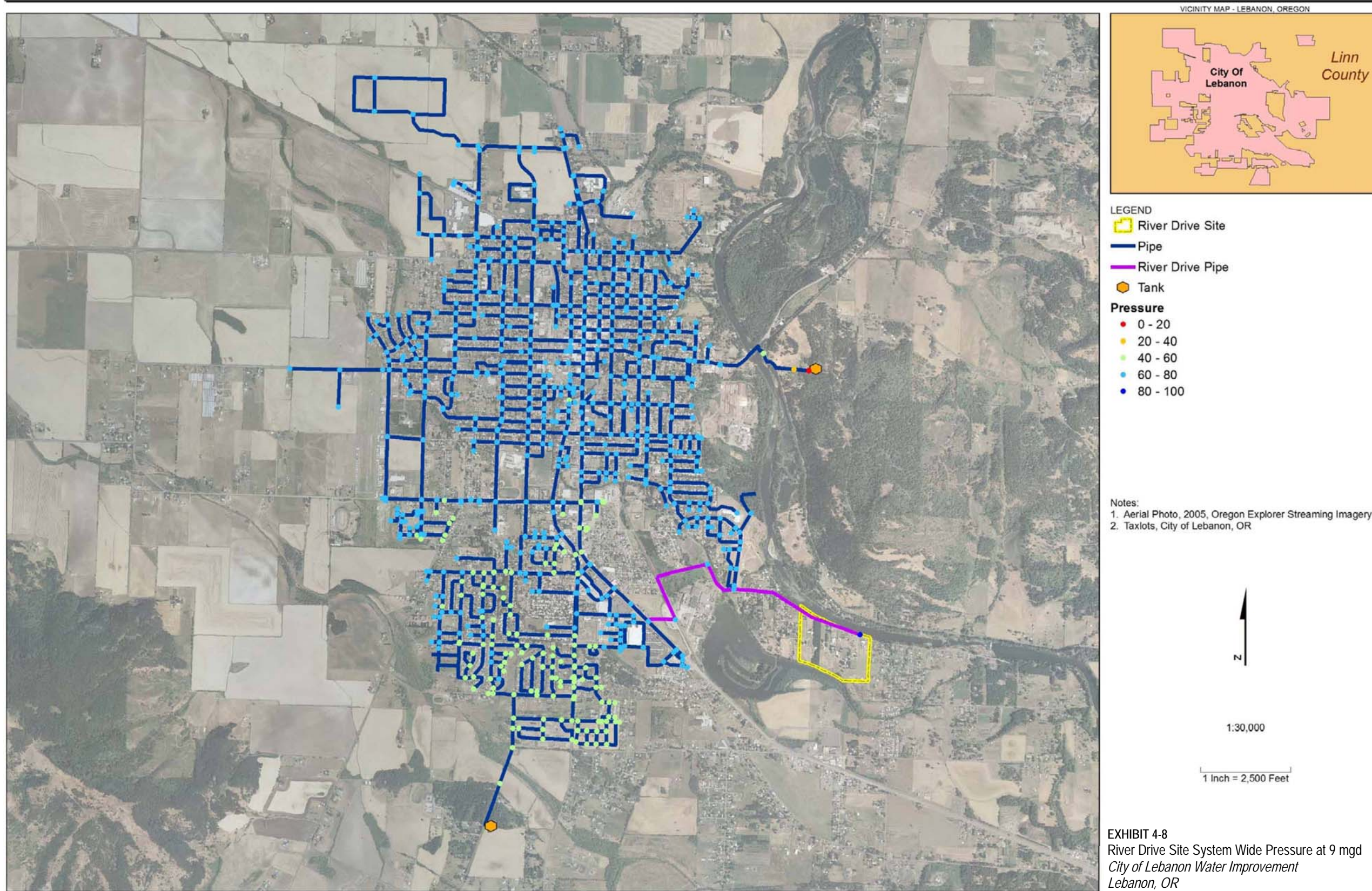
EXHIBIT 4-6  
Tree Farm Site System Wide Pressure at 6 mgd  
City of Lebanon Water Improvement  
Lebanon, OR

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- LEGEND
- River Drive Site
  - Pipe
  - River Drive Pipe
  - Tank
- Pressure**
- 0 - 20
  - 20 - 40
  - 40 - 60
  - 60 - 80
  - 80 - 100

Notes:

1. Aerial Photo, 2005, Oregon Explorer Streaming Imagery
2. Taxlots, City of Lebanon, OR

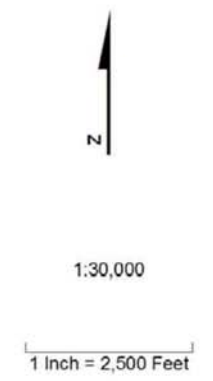
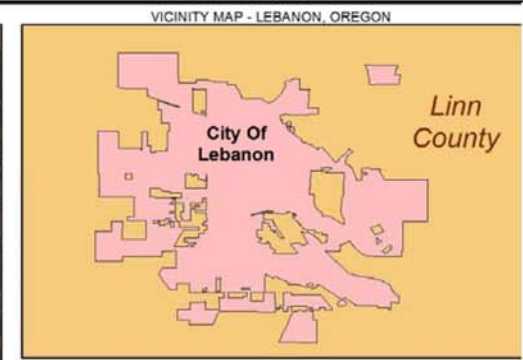
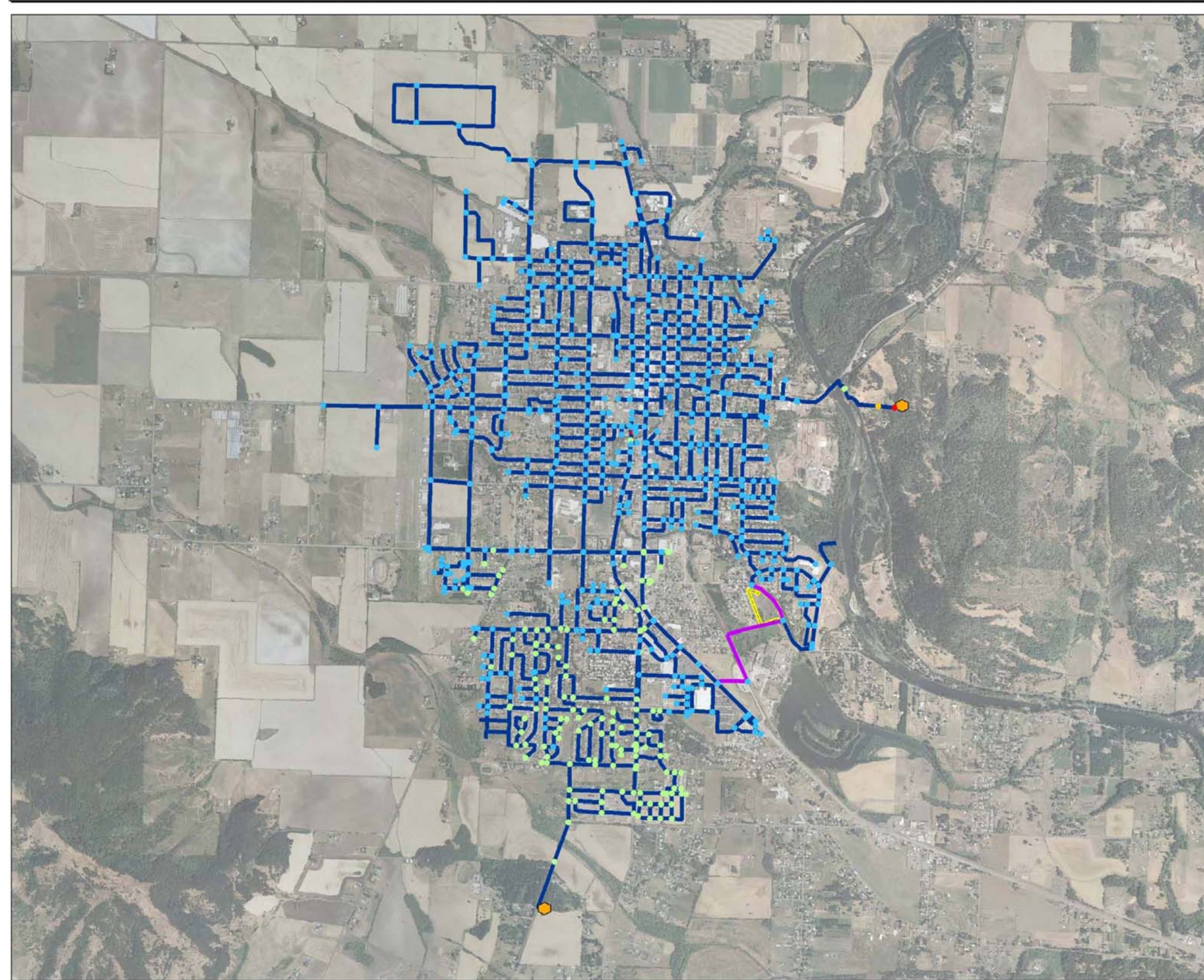


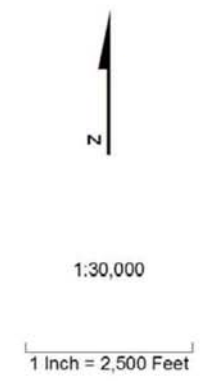
EXHIBIT 4-8  
 River Drive Site System Wide Pressure at 9 mgd  
*City of Lebanon Water Improvement  
 Lebanon, OR*

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- LEGEND**
- Tree Farm Site
  - Pipe
  - Tree Farm Pipe
  - Tank
- Pressure**
- 0 - 20
  - 20 - 40
  - 40 - 60
  - 60 - 80
  - 80 - 100

**Notes:**  
 1. Aerial Photo, 2005, Oregon Explorer Streaming Imagery  
 2. Taxlots, City of Lebanon, OR



**EXHIBIT 4-9**  
 Tree Farm Site System Wide Pressure at 9 mgd  
 City of Lebanon Water Improvement  
 Lebanon, OR

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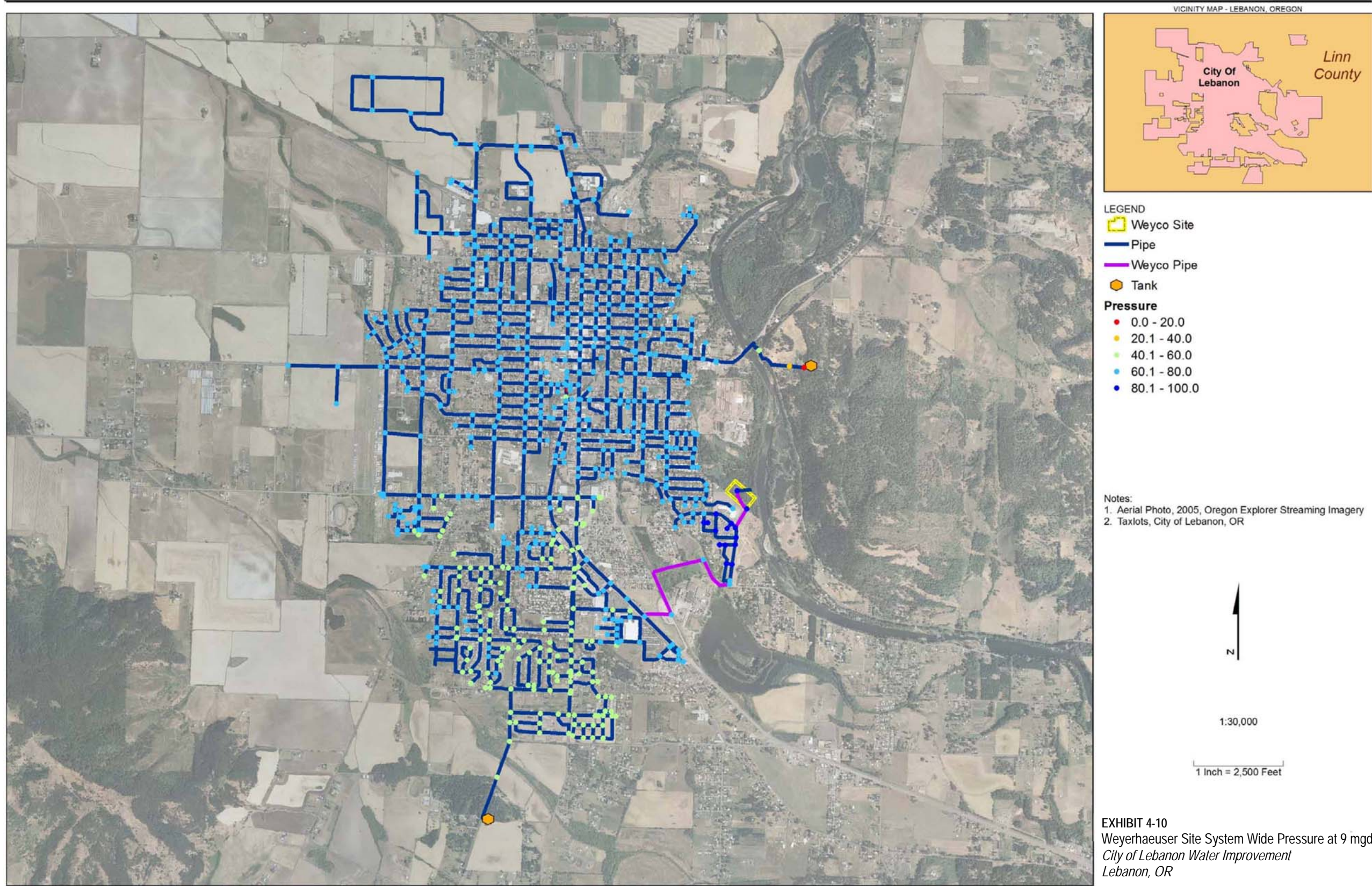
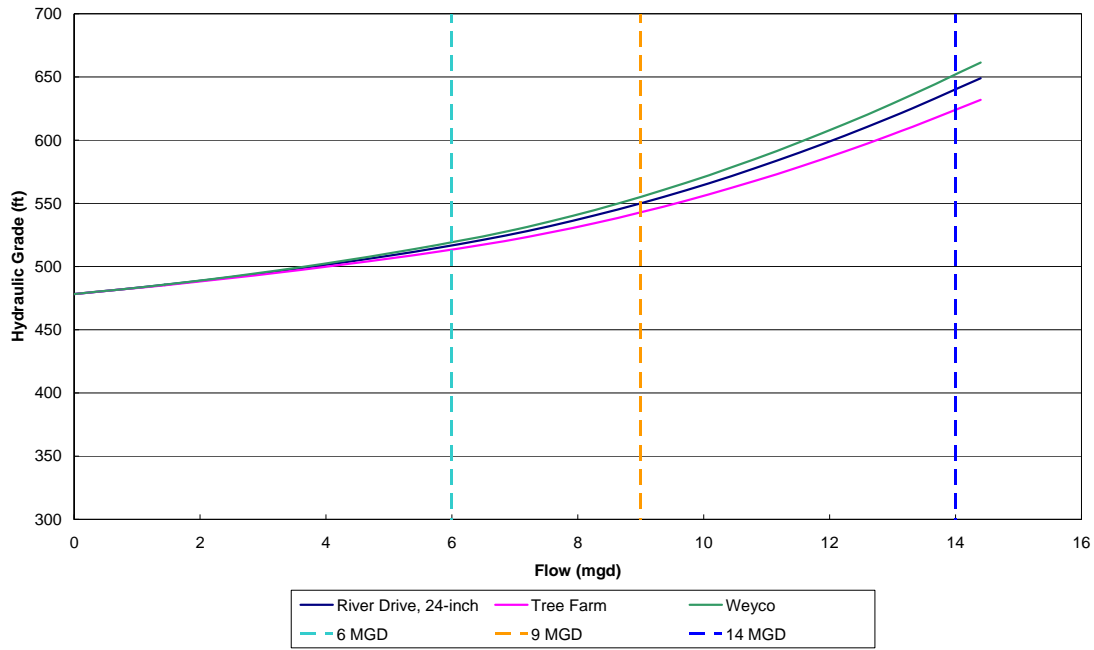


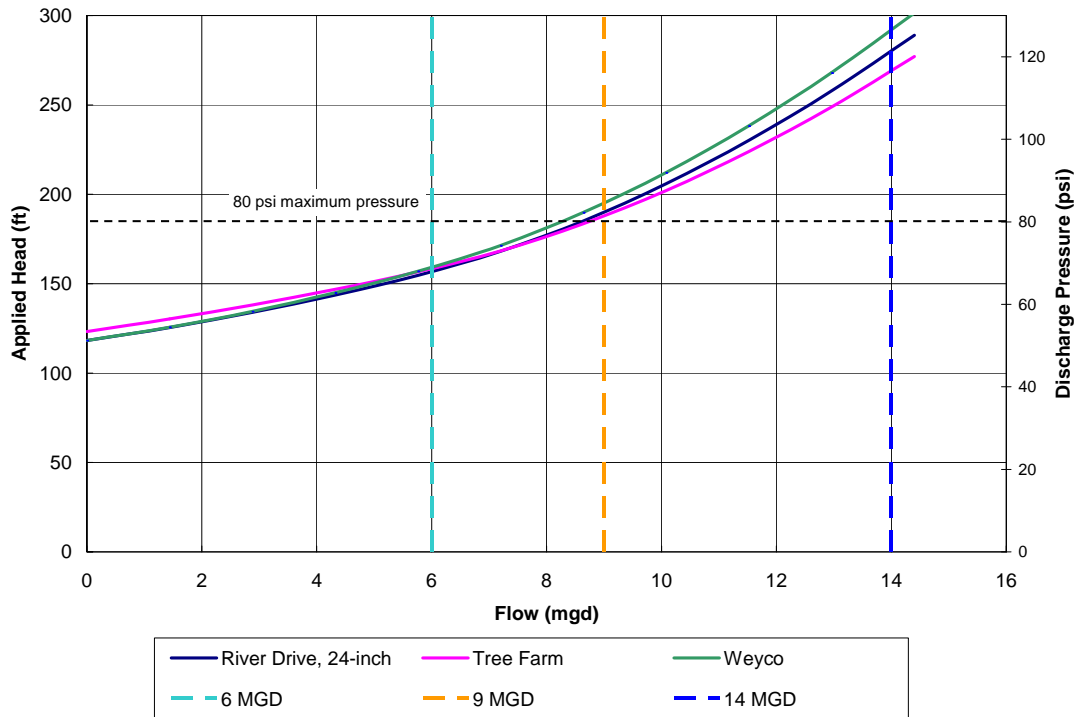
EXHIBIT 4-10  
Weyerhaeuser Site System Wide Pressure at 9 mgd  
City of Lebanon Water Improvement  
Lebanon, OR

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**EXHIBIT 4-11**  
 System Curves for WTP Sites  
*City of Lebanon Water Improvement*  
 Lebanon, OR

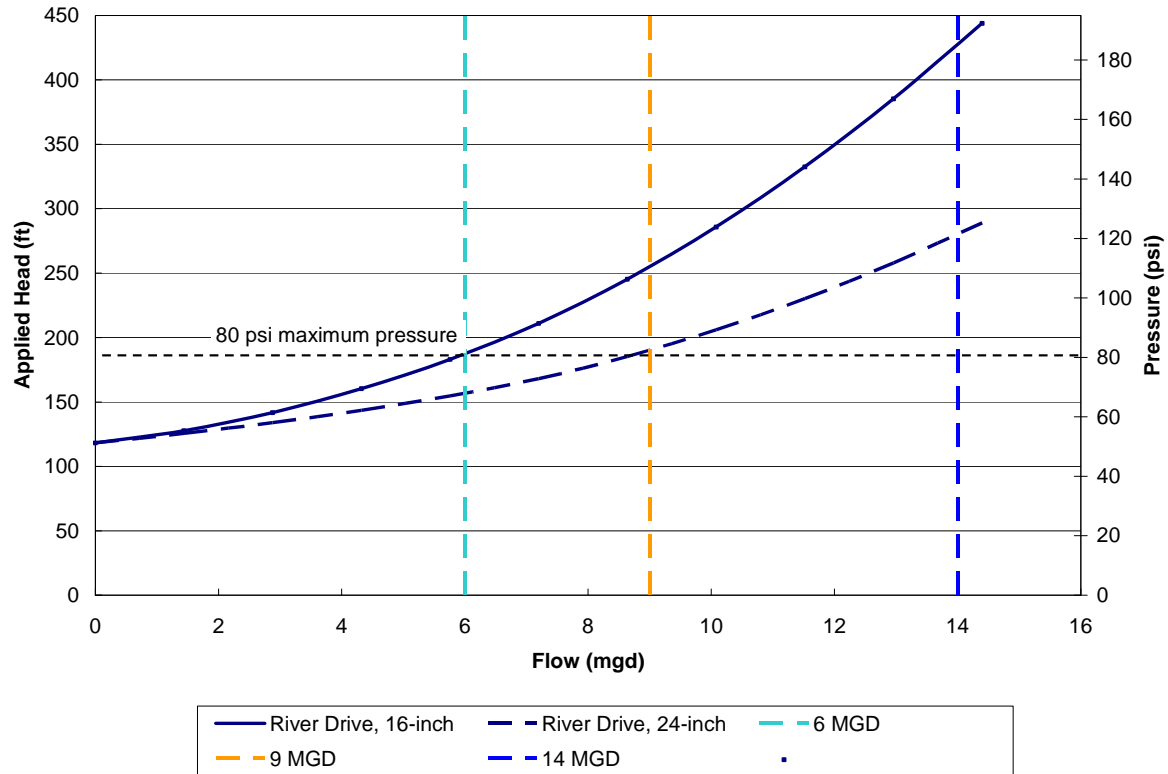


**EXHIBIT 4-12**  
 Comparison of Required Pumping Head for WTP Site Options  
*City of Lebanon Water Improvement*  
 Lebanon, OR



**Exhibit 4-13** shows the effect of pipe diameter on pumping head for the River Drive properties. If the pipe diameter is reduced from 24 inches to 16 inches, the required pumping head is increased, and the discharge pressure exceeds 80 psi at a flow of 9 mgd.

**EXHIBIT 4-13**  
 Comparison of River Drive System Curve for 16-inch Transmission Pipeline and 24-inch Transmission Pipeline  
*City of Lebanon Water Improvement*  
*Lebanon, OR*



## Costs

**Exhibit 4-14** summarizes conceptual-level phase one transmission pipeline capital costs for each site. Costs were developed using a unit cost of \$10 per diameter-inch per foot of pipeline length, and the dimension presented in Exhibit 4-4.

**EXHIBIT 4-14**  
 Transmission Pipeline Costs by WTP Site  
*City of Lebanon Water Improvement*  
*Lebanon, OR*

Site	Estimated Pipeline Cost
River Drive	\$1,750,000
Tree Farm	\$770,000
Weyerhaeuser	\$990,000

## Recommendations

All three sites are acceptable. The Tree Farm site is most favored because it requires the least amount of piping compared to the other two options, and requires a lower pumping head. Because the Tree Farm site is more centrally located, it has the advantage of a number of options for discharge to the distribution system. This provides more flexibility for future system development. The transmission pipeline costs presented in Exhibit 4-14 are included in the overall cost comparison between the three sites presented in Exhibit 2-7.