Alignment Evaluation Report

16" Oakland Church Road Water Main

PREPARED FOR:

City of Columbia, Missouri
Water and Light Department

PREPARED BY:
HDR ENGINEERING, INC.

REPORT: MARCH 2014

HDR NO. 224950

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Abbreviations and Acronyms

The following is a list of abbreviations and acronyms referenced in this report:

CW&L	Columbia Water and Light
FEMA	Federal Emergency Management Agency
ft	Feet
in	Inches
MDNR	Missouri Department of Natural Resources
MoDOT	Missouri Department of Transportation
MSDIS	Missouri Spatial Data Information Service
NWI	National Wetland Inventory
PVC	Polyvinyl Chloride
PWSD	Public Water Supply District
ROW	Right-of-Way
USGS	United States Geological Survey

1 INTRODUCTION

1.1 BACKGROUND

The Columbia Water and Light Department (Department) has identified the need to construct several new 16-inch water mains in the Northeast Pressure Zone. The construction of these new 16-inch water mains will provide a looped path for finished water to and from the Stephens Station Water Tower and, thus, improve the operation and reliability of the water system infrastructure in the Northeast Pressure Zone.

One of these new water distribution mains, the 16-inch Oakland Church Road Water Main, will connect the existing Stephens Station Water Tower to an existing 16-inch water main located near the intersection of Oakland Gravel Road and North Teresa Drive. This water main is identified in the "2008 Long Range Water System Study for the City of Columbia Water and Light Department". In addition to meeting the Department's overall goals described in the paragraph above, the 16-inch Oakland Church Road Water Main will also provide water service to existing and future customers and fire protection within that portion of the Department's Service Area described in the following paragraph.

The geographic limits for this evaluation are bound by Oakland Church Road on the north; the COLT Railroad on the east; Oakland Gravel Road (its center line extended east to the COLT Railroad) on the south, and North Teresa Drive on the west. A project location map of this area is found in Appendix A.

1.2 PURPOSE

The purpose of this alignment study is to identify the preferred alignment for the new 16-inch Oakland Church Road Water Main as it provides a looped connection between the Stephens Station Water Tower and an existing 16-inch water main located near the intersection of Oakland Gravel Road and North Teresa Drive.

2 EXISTING CONDITIONS

As-built records, gathered by the Department, provide information for the connection at Heller Road, the connection at Peabody Road and the connection at Oakland Gravel Road and North Teresa Drive.

The distribution main at Oakland Gravel Road and North Teresa Drive was constructed in 1999 as part of the *Gregory Heights Header & Interior Upgrade 6" & 16" PVC Project*. The project extended a distribution main along Oakland Gravel Road to provide service to the Gregory Heights Subdivision. The distribution main has a 16-inch diameter and is comprised of polyvinyl chloride (PVC) material. The alignment is in an easement on the north side of Oakland Gravel Road. A temporary flush fire hydrant is installed at the end of the line.

The distribution main at Heller Road was constructed in 1998 as part of the *Water Main Extension – Ewing Industrial Park, Plat 2 Project*. The distribution main has a 16-inch diameter and is made of PVC material. The alignment ends in the south easement of Heller Road at a gate valve and a tee.

Any connection of the proposed 16-inch Oakland Church Road Water Main near Peabody Road will be to the existing 16-inch PVC water main installed as the *Water Main Extension – Ewing Industrial Park, Plat 2 Project.*

3 ALIGNMENT EVALUATION

A screening process was used to identify the preferred alignment. The process for evaluating the preferred alignment is described in this section.

3.1 BASE MAPPING

To begin the selection process, a base map was created to illustrate existing and proposed conditions in the project area. Data from the following resources was collected and plotted onto the map:

- Aerial photography from Missouri Spatial Data Information Service (MSDIS)
- Roads and Highways from MoDOT
- Parcel lines from the Boone County Assessor
- Existing utilities from the City, utility companies and field reconnaissance
- Floodplain mapping from FEMA
- Wetlands from the National Wetland Inventory (NWI)
- Future right-of-way (ROW) from Boone County

After the base map was created, three (3) preliminary alignment options were developed using engineering judgment and then plotted on the map. The alignment options were named Alignment Option 1, 2 and 3. Figures depicting each alignment are included in Appendix B of this Report. Note: At this stage of the study, Alignment Option 2 (PURPLE) connected to a tee in Heller Road via a water main along the east side of Brown Station Road.

3.2 INTERESTED PARTIES MEETING

An Interested Parties Meeting was held on February 13, 2014 at Alpha Hart Lewis Elementary School to gather input from the public regarding the three (3) preliminary alignment options. Property owners affected by the project, a representative from the Public Water Supply District (PWSD) 4, Department staff, and HDR staff attended the meeting. Comments from the attending stakeholders were considered during the alignment selection process.

3.3 CONNECTION AT PEABODY ROAD AND BROWN STATION ROAD

During discussions with the Department prior to the Interested Parties meeting, it was determined that a connection to the existing 16” distribution main that runs north to south along Brown Station Road may be more favorable than the connection at Heller Road. The connection, a proposed tee into the main on the east side of Brown Station Road and north of Peabody Road, would reduce pipe quantities by approximately 3,000 feet. Following the meeting, Department staff performed a hydraulic model of this portion of the Department’s water system and concluded that this connection is feasible and will allow for the proper long term operation of the Stephens Water Tower in keeping with the Department’s long term goals for the Northeast Pressure Zone.

The east connection of Alignment Option 2 was revised to connect at this point, as shown in Appendix B, and a fourth alignment option, Alignment Option 4, was created from segments of Alignment Options 2 and 3.

3.4 SELECTION CRITERIA

The following selection criteria were developed for use in the screening process:

- **Capital Cost**: The estimated cost of construction, including estimated easement costs and a 25% contingency. Alignment options with a lower capital cost are more favorable than other alternatives.
- **Accessibility for Maintenance**: The ability to access the alignment for emergency or routine maintenance. Alignment options located along existing easements or roadways are more favorable than other alternatives.
- **Environmental Impact/Streams/Wetlands**: The disturbance of existing streams, wetlands, and habitats important to local wildlife and vegetation. Alignment options that cross fewer streams and wetlands are more favorable than other alternatives. The wetland shown on the west side of Oakland Gravel Road on the Booker Property was identified by NWI as a *Freshwater Forested/Shrub Wetland*. At this time, the estimated area disturbed during construction is less than a half acre, and is therefore, a minor environmental concern. The designation or delineation may also be revised upon investigation by an environmental scientist.
- **Easement Acquisition**: The number of properties from which easements must be acquired for construction. Alignment options that require fewer easements to acquire are more favorable than other alternatives.
- **Ability to Service Development**: The ability to serve existing and future development within the Department's service area. Alignment options that are centrally located to existing and future development are more favorable than other alternatives.
- **Minimization of Tree Clearing:** The amount of tree clearing required. Alignment options that minimize the removal of trees are more favorable than other alternatives.
- **Conflicts with Existing Utilities**: The potential conflict with existing utilities (i.e. gas, electrical, water, and sewer). Alignment options that minimize potential conflicts with existing utilities are more favorable than other alternatives. This item is difficult to accurately determine at this time, since the full extent of existing utilities is unknown.

3.5 ALIGNMENT SCORING

Each alignment option was assigned a numerical value according to its evaluation against the selection criteria. Those numerical values are generally 4, 3, 2 and 1, with 4 considered to be the most favorable alignment option in regards to a specific selection criteria and 1 being the least favorable.

It is noted that alignment scoring was further refined for some selection criteria if a particular alignment option was not obviously more favorable than another. One example of this further refinement is shown in Section 4 in Table 1 regarding the alignment scoring for capital cost. The capital cost for Alignment Option 1 and Alignment Option 3 were within 0.5% of each other, and thus, a score of 1.5 was assigned

to each. Additionally, the capital cost for Alignment Option 2 and Alignment Option 4 were similar, within 2.3%, and scores of 3.4 and 3.6 were assigned to each, respectively.

3.6 WEIGHTED CRITERIA

To further evaluate the four alignment options each of the criteria listed in Section 3.4 was assigned a numerical value according to the criteria's importance in evaluating the alignment options. Those numerical values are 10, 8, 6, 4 and 2, with 10 deemed to be the criteria of greatest importance and 2 the criteria of lowest importance. In consultation with Department staff, the weighted values were assigned to the selection criteria as follows:

- Capital Cost: 10
- Accessibility for Maintenance: 8
- Environmental Impact/Streams/Wetlands: 8
- Easement Acquisition: 8
- Ability to Service Development: 6
- Minimization of Tree Clearing: 4
- Conflicts with Existing Utilities: 2

4 ALIGNMENT DESCRIPTIONS AND EVALUATION

Descriptions of each of the four (4) alignment options and the evaluations of those options are presented in this Section. Exhibits of each of the alignment options are included in Appendix B.

4.1 ALIGNMENT DESCRIPTIONS

4.1.1 ALIGNMENT OPTION 1 (RED)

Alignment Option 1, the red alignment, begins at the connection with an existing 16-inch tee on Heller Road north of the Stephens Station Water Tower. The proposed alignment runs north under Heller Road, then immediately turns west, crossing under the COLT Railroad and Brown Station Road on the north side of Oakland Church Road until it reaches the east side of Route B. The alignment then crosses under Route B and continues west on the north side of Oakland Church Road until it reaches the east side of Oakland Gravel Road. The alignment then turns south under Oakland Church Road on the east side of Oakland Gravel Road and continues approximately 2,700 feet until it deflects westerly under Oakland Gravel Road to west side of the Road. The alignment then turns south along the west side of Oakland Gravel Road and continues until the curve in Oakland Gravel Road where the alignment turns west along the north side of Oakland Gravel Road until it connects with an existing 16-inch water main north of the intersection of North Teresa Drive and Oakland Gravel Road.

Alignment Option 1 measures approximately 13,000 feet.

4.1.2 ALIGNMENT OPTION 2 (PURPLE)

Alignment Option 2, the purple alignment, begins at the connection with an existing 16-inch water main in the vicinity of the intersection of Brown Station Road and Peabody Road. The proposed alignment runs northwesterly, crossing under the COLT Railroad and Brown Station Road until it reaches the south side of the Central Electric Power Cooperative Easement (Electric Easement) on the north side of the COLT Railroad's Terminal. The alignment then turns west along the south line of the Electric Easement and continues west until it reaches the east side of Route B. The alignment then goes under Route B along the south line of the Electric Easement and continues west within the Electric Easement until it reaches a point approximately 2,700 feet east of Oakland Gravel Road. The alignment then turns south along the west line of the JWPD Investments, LLC Property and then turns west along the north lines of the ACORN 6B Arbor Point and Bretthorst Properties until it reaches the east side of Oakland Gravel Road. The alignment then follows along the curve in Oakland Gravel Road, where the alignment turns west along the south side of Oakland Gravel Road until it reaches a point approximately 250 feet east of North Teresa Drive. The alignment then turns north under Oakland Gravel Road and then west along the north side of Oakland Gravel Road until it connects with an existing 16-inch water main north of the intersection of North Teresa Drive and Oakland Gravel Road.

Alignment Option 2 measures approximately 9,750 feet.

4.1.3 ALIGNMENT OPTION 3 (BLUE)

Alignment Option 3, the blue alignment, begins at the connection with an existing 16-inch tee on Heller Road north of the Stephens Water Tower. The proposed alignment runs north under Heller Road, then immediately turns west, crossing under the COLT Railroad and Brown Station Road on the north side of Oakland Church Road until it reaches the east side of Route B. The alignment then turns south and crosses under Oakland Church Road and continues south along the east side of Route B until it reaches the south side of the Central Electric Power Cooperative Easement (Electric Easement). The alignment then turns west under Route B along the south line of the Electric Easement and continues west within the Electric Easement until it reaches the east side of Oakland Gravel Road. The alignment then goes under Oakland Gravel Road to the west side of the Road. The alignment then turns south along the west side of Oakland Gravel Road and continues until the curve in Oakland Gravel Road where the alignment turns west along the north side of Oakland Gravel Road until it connects with an existing 16-inch water main north of the intersection of North Teresa Drive and Oakland Gravel Road.

Alignment Option 3 measures approximately 12,950 feet.

4.1.4 ALIGNMENT OPTION 4 (GREEN)

Alignment Option 4, the green alignment, begins at the connection with an existing 16-inch water main in the vicinity of the intersection of Brown Station Road and Peabody Road. The proposed alignment runs northwesterly, crossing under the COLT Railroad and Brown Station Road until it reaches the south side of the Central Electric Power Cooperative Easement (Electric Easement) on the north side of the COLT Railroad's Terminal. The alignment then turns west along the south line of the Electric Easement and continues west until it reaches the east side of Route B. The alignment then goes under Route B along the south line of the Electric Easement and continues west within the Electric Easement until it reaches the east side of Oakland Gravel Road. The alignment then goes under Oakland Gravel Road to west side of the Road. The alignment then turns south along the west side of Oakland Gravel Road and continues until the curve in Oakland Gravel Road where the alignment turns west along the north side of Oakland Gravel Road until it connects with an existing 16-inch water main north of the intersection of North Teresa Drive and Oakland Gravel Road.

Alignment Option 4 measures approximately 9,500 feet.

4.2 EVALUATION OF ALIGNMENT OPTIONS

4.2.1 ALIGNMENT SCORING MATRIX

The alignment evaluation criteria described in Section 3 was applied to the four alignment options described in Section 4. These results are presented in Table 1 as follows:

Table 1 – Alignment Scoring Matrix

Selection Criteria	Criteria Weight	Alignment 1 (RED)		Alignment 2 (PURPLE)		Alignment 3 (BLUE)		Alignment 4 (GREEN)	
		Score	Total	Score	Total	Score	Total	Score	Total
Capital Cost	10	1.5	15	3.4	34	1.5	15	3.6	36
Accessibility for Maintenance	8	4	32	1	8	2	16	3	24
Environmental Impact/ Streams/ Wetlands	8	2	16	2.5	20	2.5	20	3	24
Easement Acquisition	8	1	8	2.5	20	2.5	20	4	32
Service to Existing & Future Development	6	1	6	2	12	3	18	4	24
Minimization of Tree Clearing	4	3	12	2	6	1	6	4	16
Conflicts with Existing Utilities	2	1	2	2.5	5	3	6	3.5	7
TOTAL SCORE			**91**		**107**		**99**		**163**

4.2.2 ANALYSIS OF THE ALIGNMENT SCORING MATRIX

The results of the Alignment Scoring Matrix lead to the following conclusions:

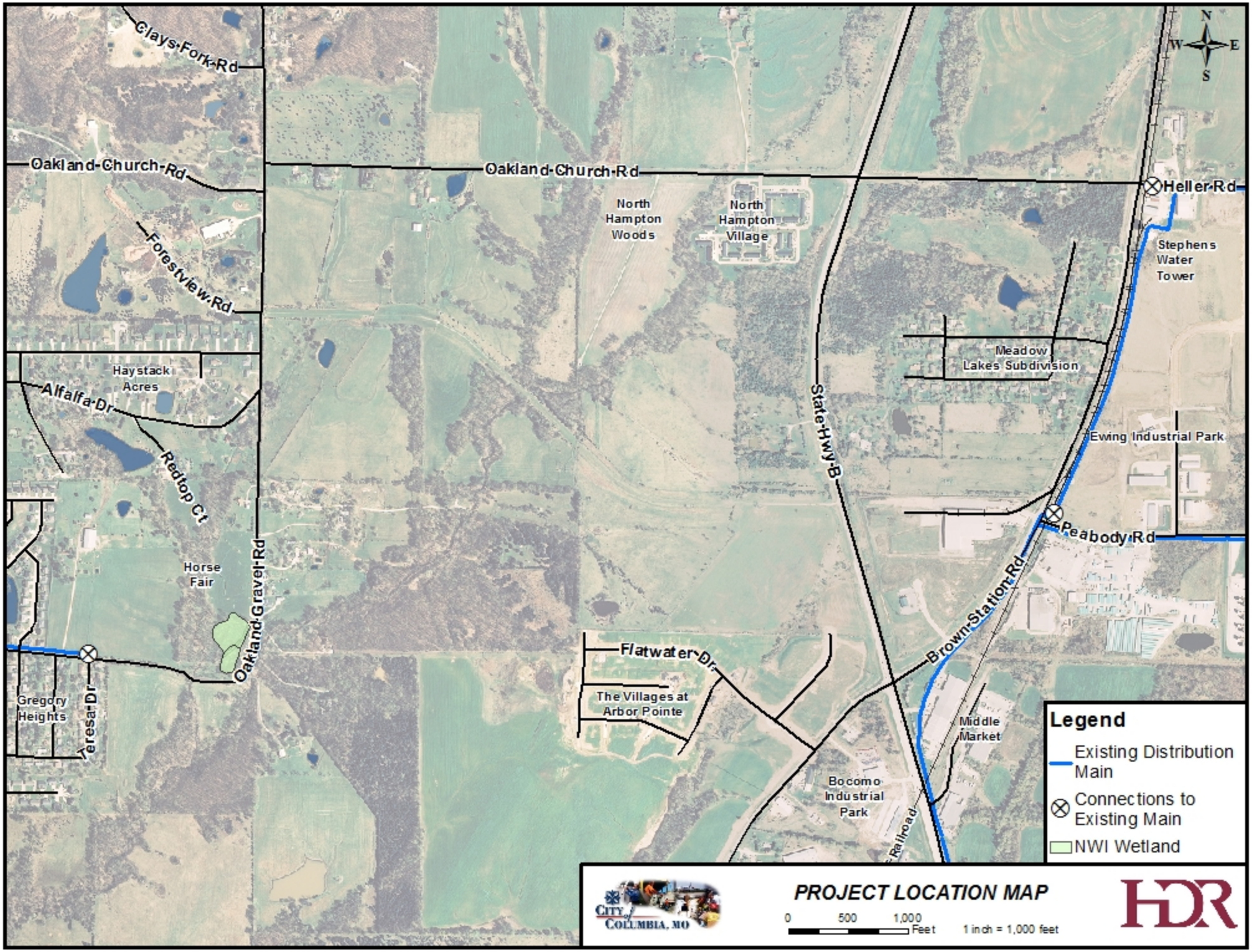
- The two more favorable alignments, Alignment Option 2 and Alignment Option 4, are 3,200-3,500 feet shorter in length than Alignment Options 1 and 3, and the reduction in materials and easement acquisition costs, corresponds to over $500,000 in savings. Appendix C includes estimates of capital costs for all of the alignment options.
- The most favorable alignment, Alignment Option 4, uses considerably more of the Central Electric Power Cooperative Easement (Electric Easement) than the lesser favorable alignments. The use of this Electric Easement provides a higher degree of accessibility for future maintenance; a central location from which to serve future development within the Department's Service Area and minimizes the amount of trees that have to be removed during construction.
- The most favorable alignment, Alignment Option 4, received the highest total weighted score for a majority of the selection criteria and also received the highest total score by a wide margin.

5 RECOMMENDATIONS

As determined by the alignment evaluation process detailed in this Report, Alignment Option 4, the green alignment, received the highest ranking of the four alignment options by a significant margin. It also meets the Department's objective of providing a looped path for finished water to and from the Stephens Station Water Tower, thereby, improving the operation and reliability of the water system infrastructure in the Northeast Pressure Zone.

For the reasons stated above, this Report recommends the Department select Alignment Option 4 as the alignment for the 16-inch Oakland Church Road Water Main.

APPENDIX A
Project Location Map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Oakland Church Rd
Heller Rd
North Hampton Woods
North Hampton Village
Stephens Water Tower
Forestview Rd
Meadow Lakes Subdivision
Haystack Acres
Alfalfa Dr
State Hwy B
Ewing Industrial Park
Redtop Ct
Peabody Rd
Horse Fair
Oakland Gravel Rd
Brown Station Rd
Flatwater Dr
The Villages at Arbor Pointe
Gregory Heights
Teresa Dr
Middle Market
Bocomo Industrial Park
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Existing Distribution Main
Connections to Existing Main
NWI Wetland
CITY of COLUMBIA, MO
PROJECT LOCATION MAP
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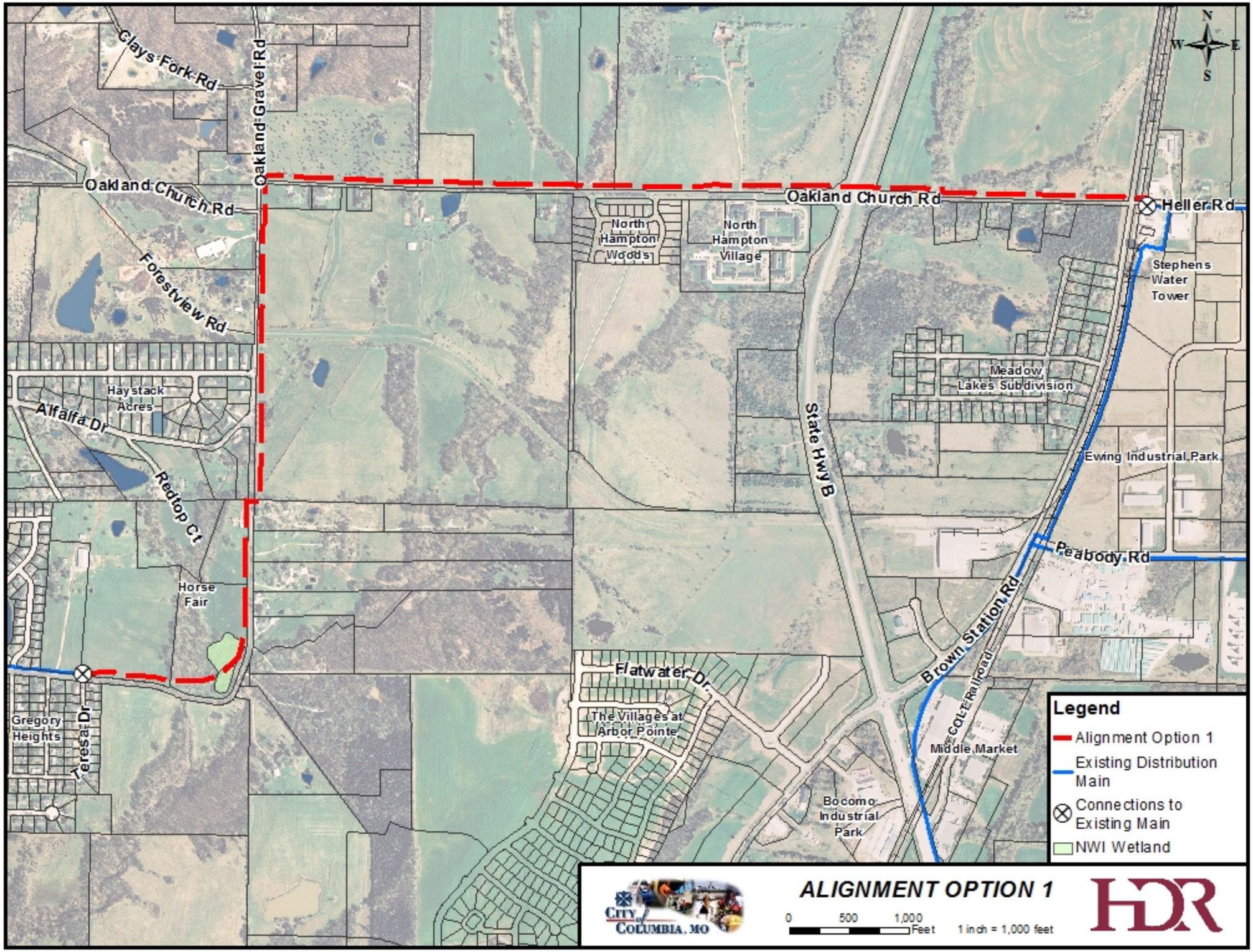
Feet
1 inch = 1,000 feet
HDR

APPENDIX B
Alignment Option Exhibits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Brown Station Rd
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The Villages at Arbor Pointe
Gregory Heights
Teresa Dr
COLT Railroad
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Alignment Option 1
Existing Distribution Main
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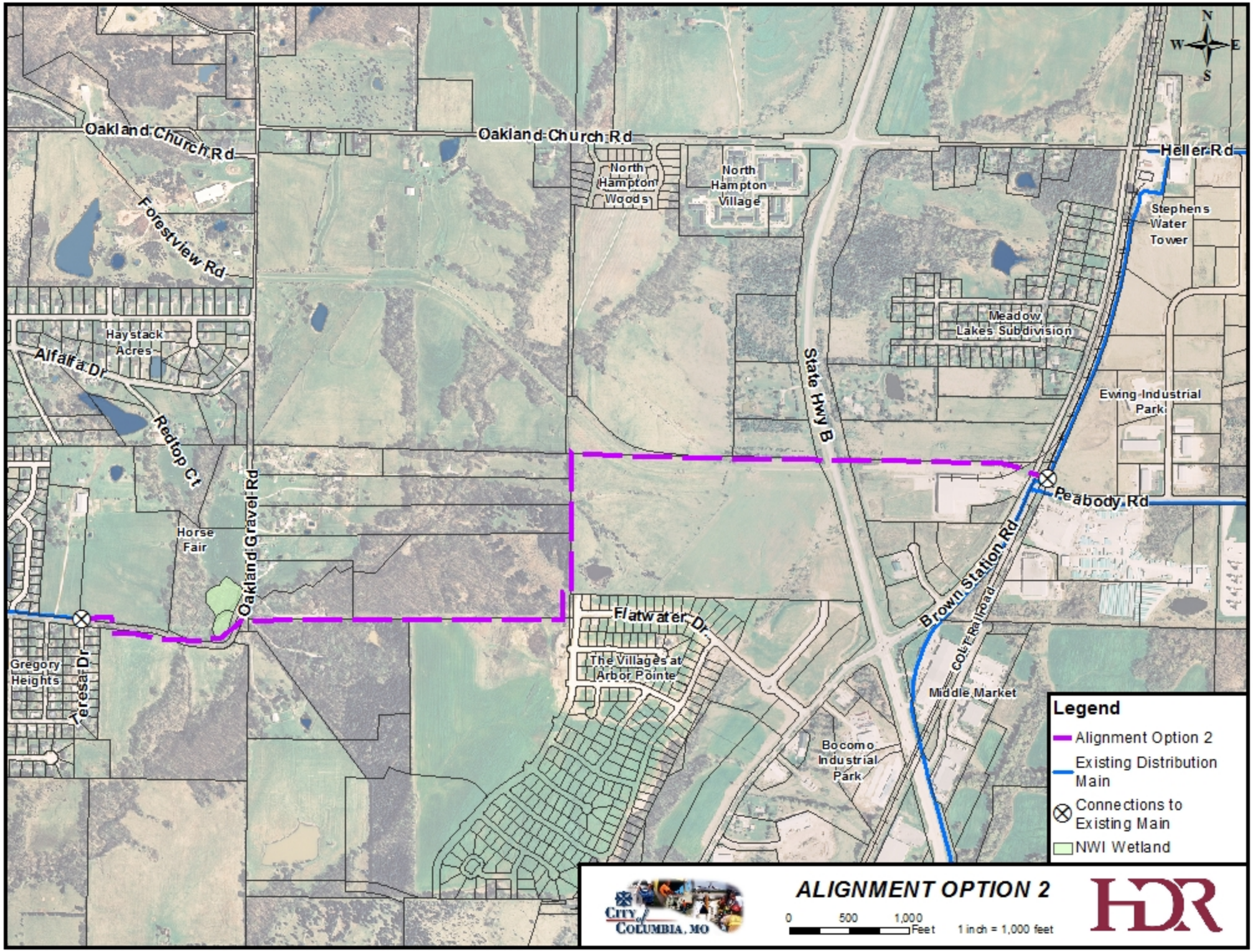
1 inch = 1,000 feet
City of Columbia, MO
HDR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COLT Railroad
Gregory Heights
Teresa Dr
The Villages at Arbor Pointe
Middle Market
Bocomo Industrial Park
Legend
Alignment Option 2
Existing Distribution Main
Connections to Existing Main
NWI Wetland
CITY of COLUMBIA, MO
ALIGNMENT OPTION 2
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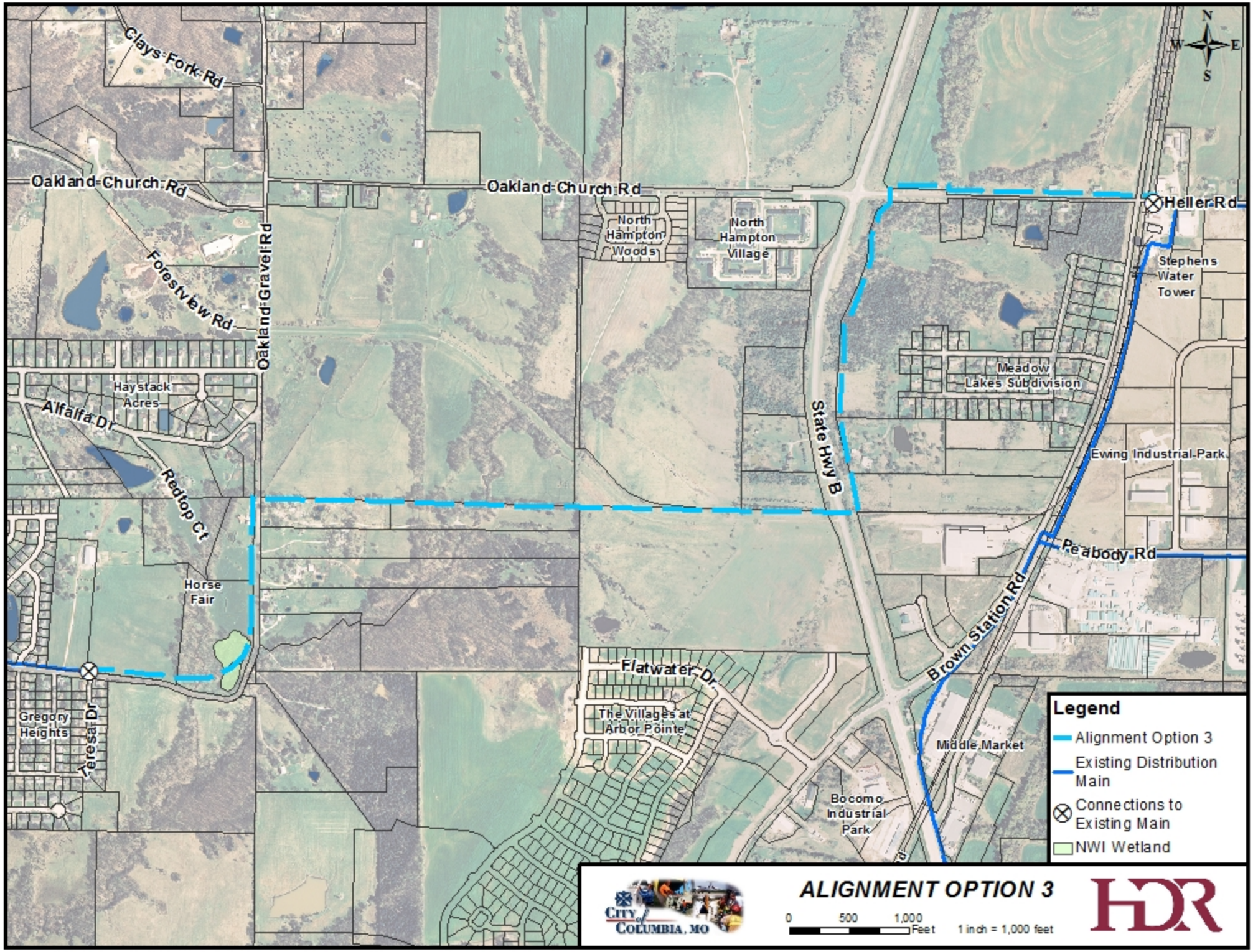
Feet
1 inch = 1,000 feet
HDR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City of Columbia, MO
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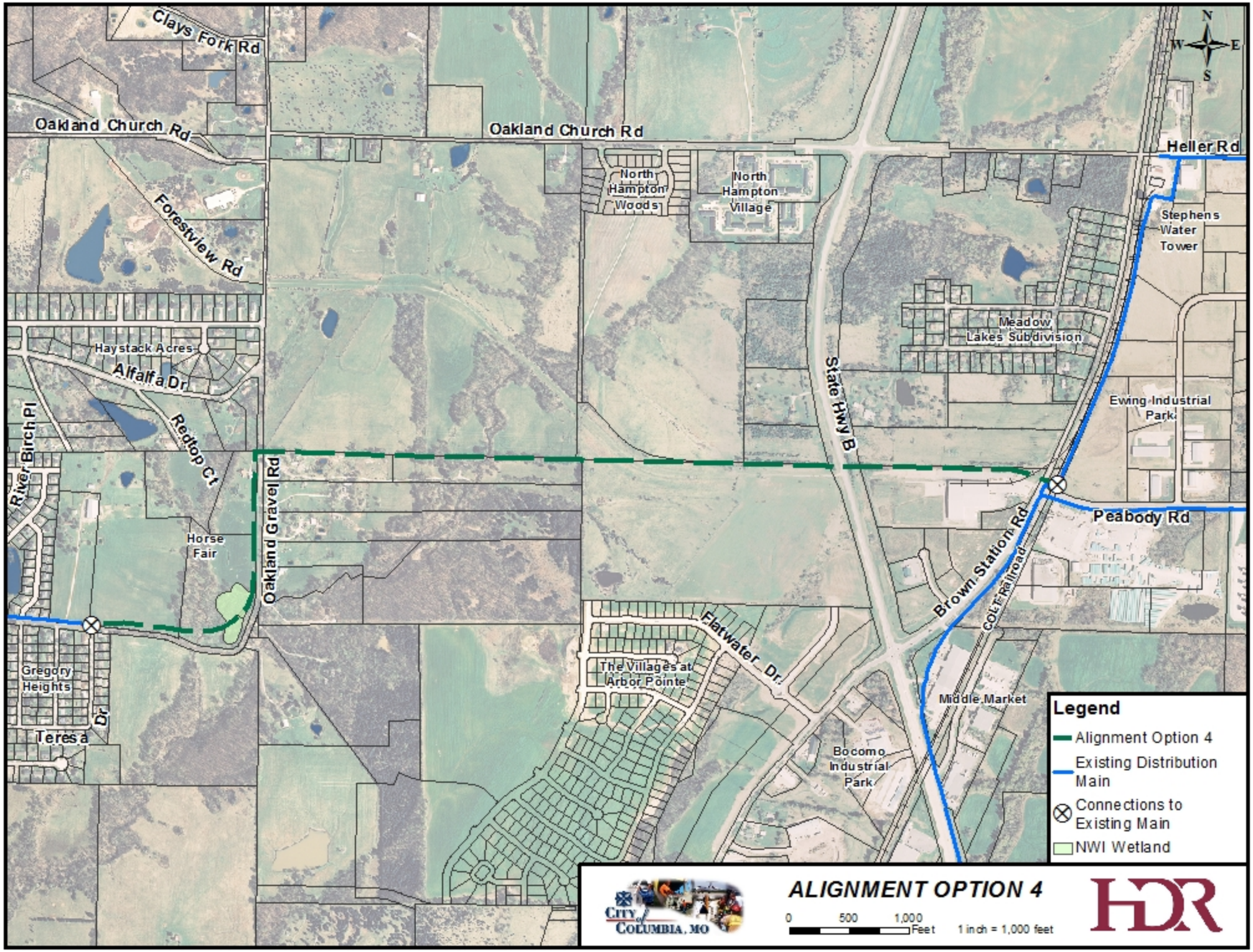
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Connections to Existing Main
NWI Wetland
ALIGNMENT OPTION 4
0
500
1,000
Feet
1 inch = 1,000 feet
CITY of COLUMBIA, MO
HDR

APPENDIX C
Capital Costs for Alignment Options

Capital Costs for Alignment Options

ALIGNMENT 1 (RED)						
Item No.	**Description**	**Quantity**	**Unit**	**Unit Price**		**Price**
1.	Mobilization (Not to exceed 2% of base bid amount)	2%	% base bid	-	$	37,300.00
2.	16 IN Water Main	12,400	LF	$ 100.00	$	1,240,000.00
3.	16 IN Valve	14	EA	$ 5,000.00	$	70,000.00
4.	Connection to Existing Water Main	2	EA	$ 5,000.00	$	10,000.00
5.	Fire Hydrant Assembly	25	EA	$ 3,500.00	$	87,500.00
6.	30 IN Dia. Bore & Casting with 16 IN Dia. Carrier Pipe	620	LF	$ 400.00	$	248,000.00
7.	Erosion Control Fence	12,400	LF	$ 3.00	$	37,200.00
8.	Surface Restoration	14.2	acres	$ 2,500.00	$	35,500.00
9.	Easement Acquisition	-	LS	$ 99,232.00	$	99,232.00
				Subtotal:	*$*	*1,865,000.00*
				Contingency (25%):	*$*	*466,000.00*
				Total:	**$**	**2,331,000.00**

ALIGNMENT 2 (PURPLE)						
Item No.	**Description**	**Quantity**	**Unit**	**Unit Price**		**Price**
1.	Mobilization (Not to exceed 2% of base bid amount)	2%	% base bid	-	$	28,800.00
2.	16 IN Water Main	9,150	LF	$ 100.00	$	915,000.00
3.	16 IN Valve	11	EA	$ 5,000.00	$	55,000.00
4.	Connection to Existing Water Main	2	EA	$ 5,000.00	$	10,000.00
5.	Fire Hydrant Assembly	19	EA	$ 3,500.00	$	66,500.00
6.	30 IN Dia. Bore & Casting with 16 IN Dia. Carrier Pipe	600	LF	$ 400.00	$	240,000.00
7.	Erosion Control Fence	9,150	LF	$ 3.00	$	27,450.00
8.	Surface Restoration	10.5	acres	$ 2,500.00	$	26,250.00
9.	Easement Acquisition	-	LS	$ 73,160.00	$	73,160.00
				Subtotal:	*$*	*1,442,000.00*
				Contingency (25%):	*$*	*361,000.00*
				Total:	**$**	**1,803,000.00**

Capital Costs for Alignment Options

ALIGNMENT 3 (BLUE)					
Item No.	**Description**	**Quantity**	**Unit**	**Unit Price**	**Price**
1.	Mobilization (Not to exceed 2% of base bid amount)	2%	% base bid	-	$ 37,100.00
2.	16 IN Water Main	12,320	LF	$ 100.00	$ 1,232,000.00
3.	16 IN Valve	14	EA	$ 5,000.00	$ 70,000.00
4.	Connection to Existing Water Main	2	EA	$ 5,000.00	$ 10,000.00
5.	Fire Hydrant Assembly	25	EA	$ 3,500.00	$ 87,500.00
6.	30 IN Dia. Bore & Casting with 16 IN Dia. Carrier Pipe	620	LF	$ 400.00	$ 248,000.00
7.	Erosion Control Fence	12,320	LF	$ 3.00	$ 36,960.00
8.	Surface Restoration	14.1	acres	$ 2,500.00	$ 35,250.00
9.	Easement Acquisition	-	LS	$ 98,560.00	$ 98,560.00
				Subtotal:	*$ 1,855,000.00*
				Contingency (25%):	*$ 464,000.00*
				Total:	**$ 2,319,000.00**

ALIGNMENT 4 (GREEN)					
Item No.	**Description**	**Quantity**	**Unit**	**Unit Price**	**Price**
1.	Mobilization (Not to exceed 2% of base bid amount)	2%	% base bid	-	$ 28,100.00
2.	16 IN Water Main	8,890	LF	$ 100.00	$ 889,000.00
3.	16 IN Valve	10	EA	$ 5,000.00	$ 50,000.00
4.	Connection to Existing Water Main	2	EA	$ 5,000.00	$ 10,000.00
5.	Fire Hydrant Assembly	18	EA	$ 3,500.00	$ 63,000.00
6.	30 IN Dia. Bore & Casting with 16 IN Dia. Carrier Pipe	600	LF	$ 400.00	$ 240,000.00
7.	Erosion Control Fence	8,890	LF	$ 3.00	$ 26,670.00
8.	Surface Restoration	10.2	acres	$ 2,500.00	$ 25,500.00
9.	Easement Acquisition	-	LS	$ 71,128.00	$ 71,128.00
				Subtotal:	*$ 1,403,000.00*
				Contingency (25%):	*$ 351,000.00*
				Total:	**$ 1,754,000.00**