

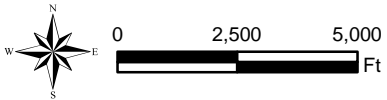


**FEMA Flood Zones**

-  Floodway
-  100 yr
-  500 yr

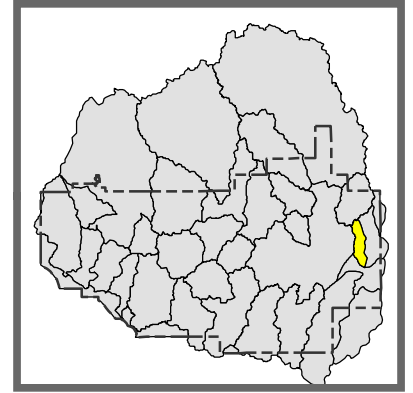
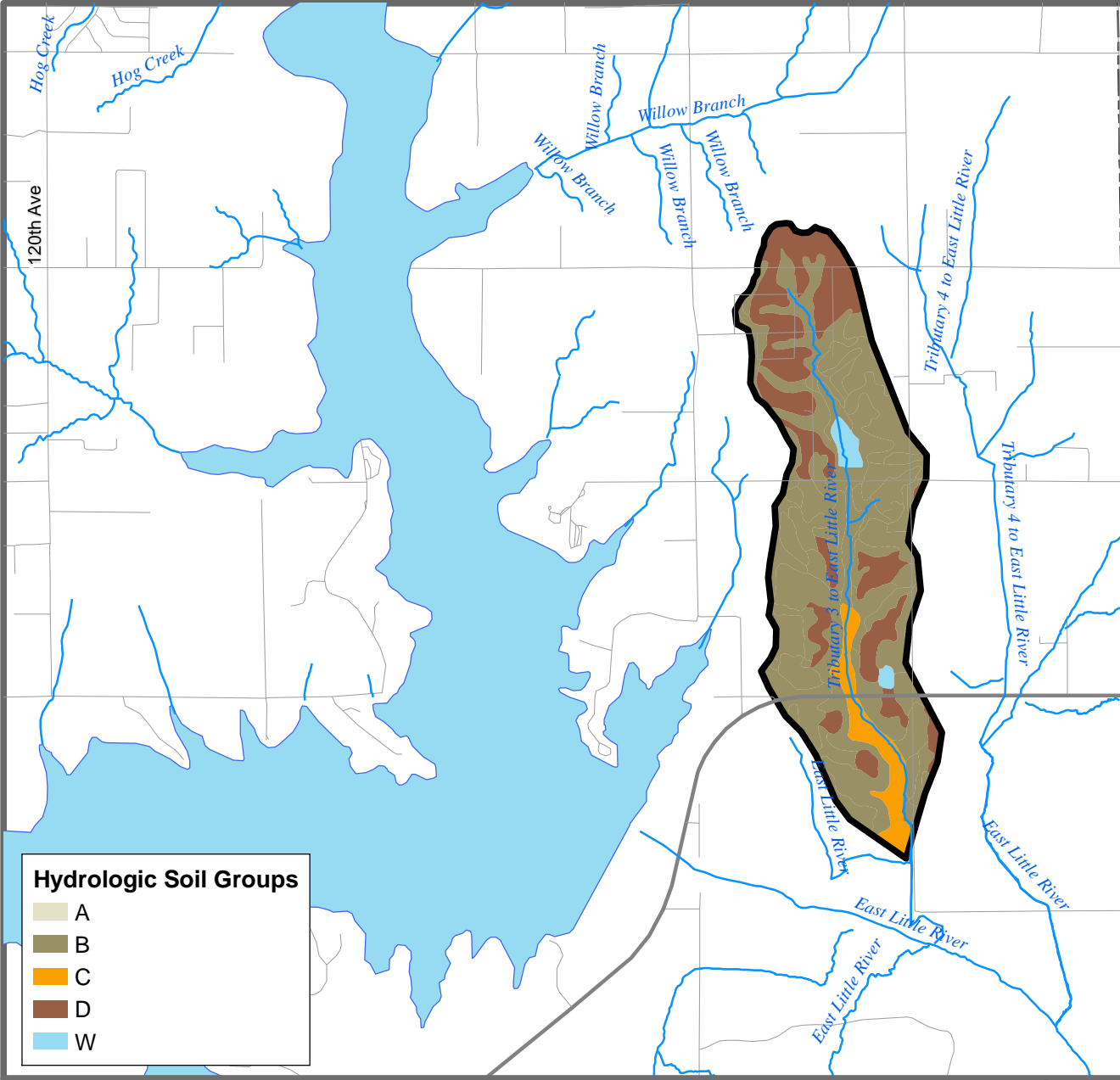


**City of Norman Stormwater Master Plan  
Tributary 3 to East Little River**

**FEMA Flood Zones**

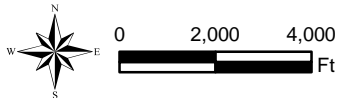
Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

- A
- B
- C
- D
- W



**City of Norman Stormwater Master Plan**  
**Tributary 3 to East Little River**

**Hydrologic Soil Groups**

Scale: 1:48,000      Prepared By: Vieux & Associates, Inc.

Drainage Area (sq. mi.): 1.65

**Current Zoning**

Zoning	Percentage
A-2: Rural Agricultural	80.3%
RE: Residential Estates	14.4%
T: Transportation	4%
TC: Tourist Commercial	1.3%

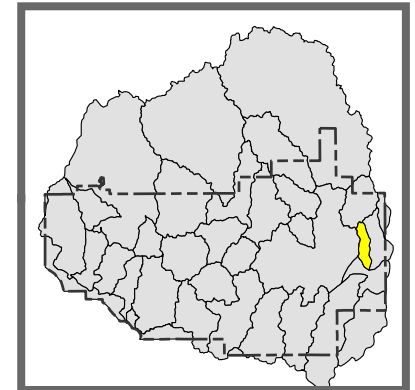
**Projected Landuse**

Landuse	Percentage
Commercial	1.3%
Country Residential	77.7%
Floodplain	4.6%
Institutional	11.5%
Park	0.9%
Transportation	4%

Hydrologic Soil Group	Percentage
B	68.8%
C	6.2%
D	23.3%
W	1.7%

FEMA Flood Zone	Percentage
100	6.0%

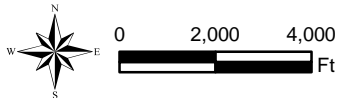
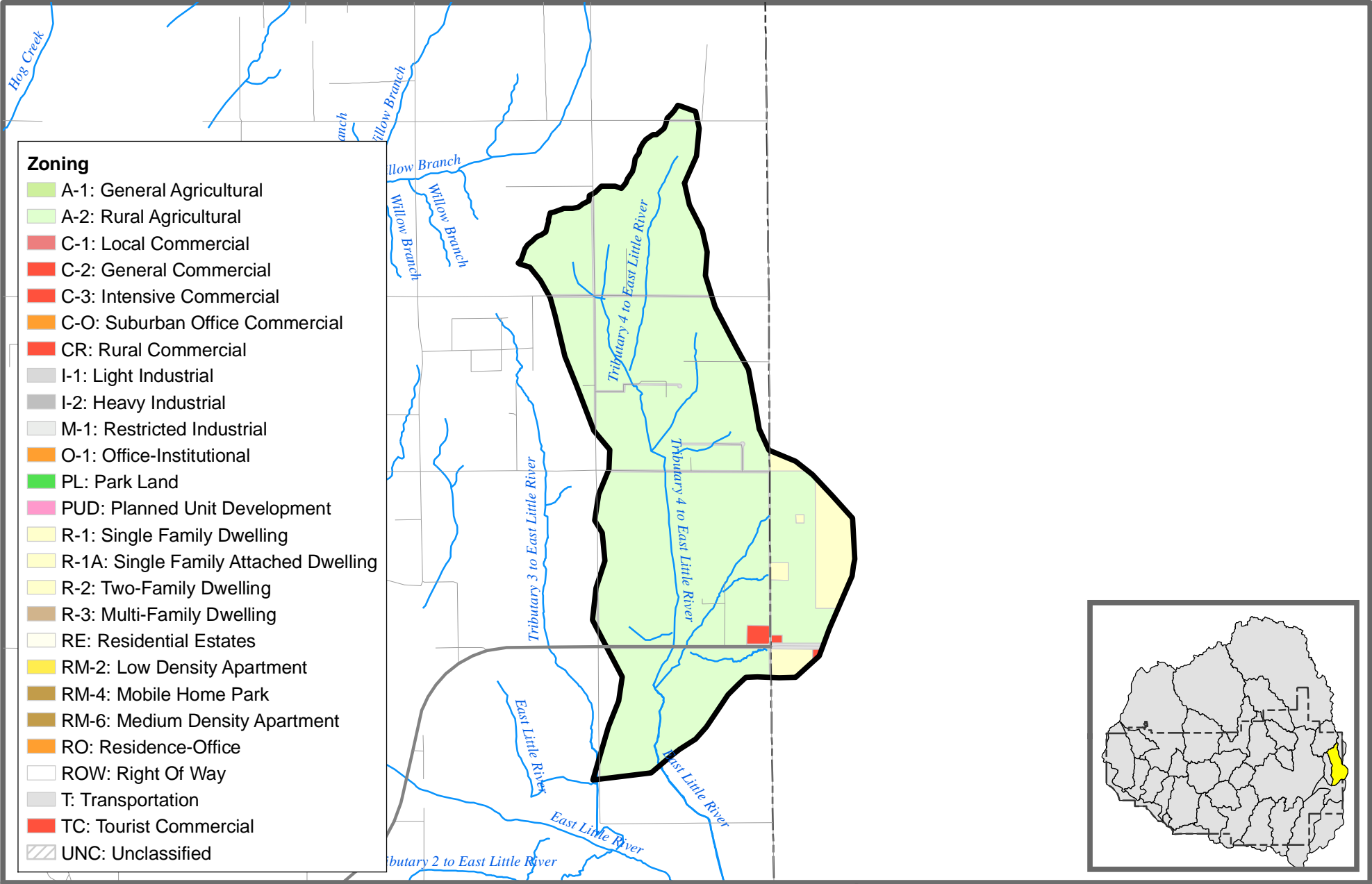
Impervious (%): 4.4



**City of Norman Stormwater Master Plan  
Tributary 3 to East Little River**

**Basin Statistics**

Prepared By: Vieux & Associates, Inc.

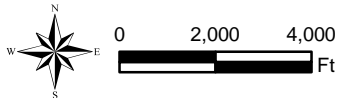
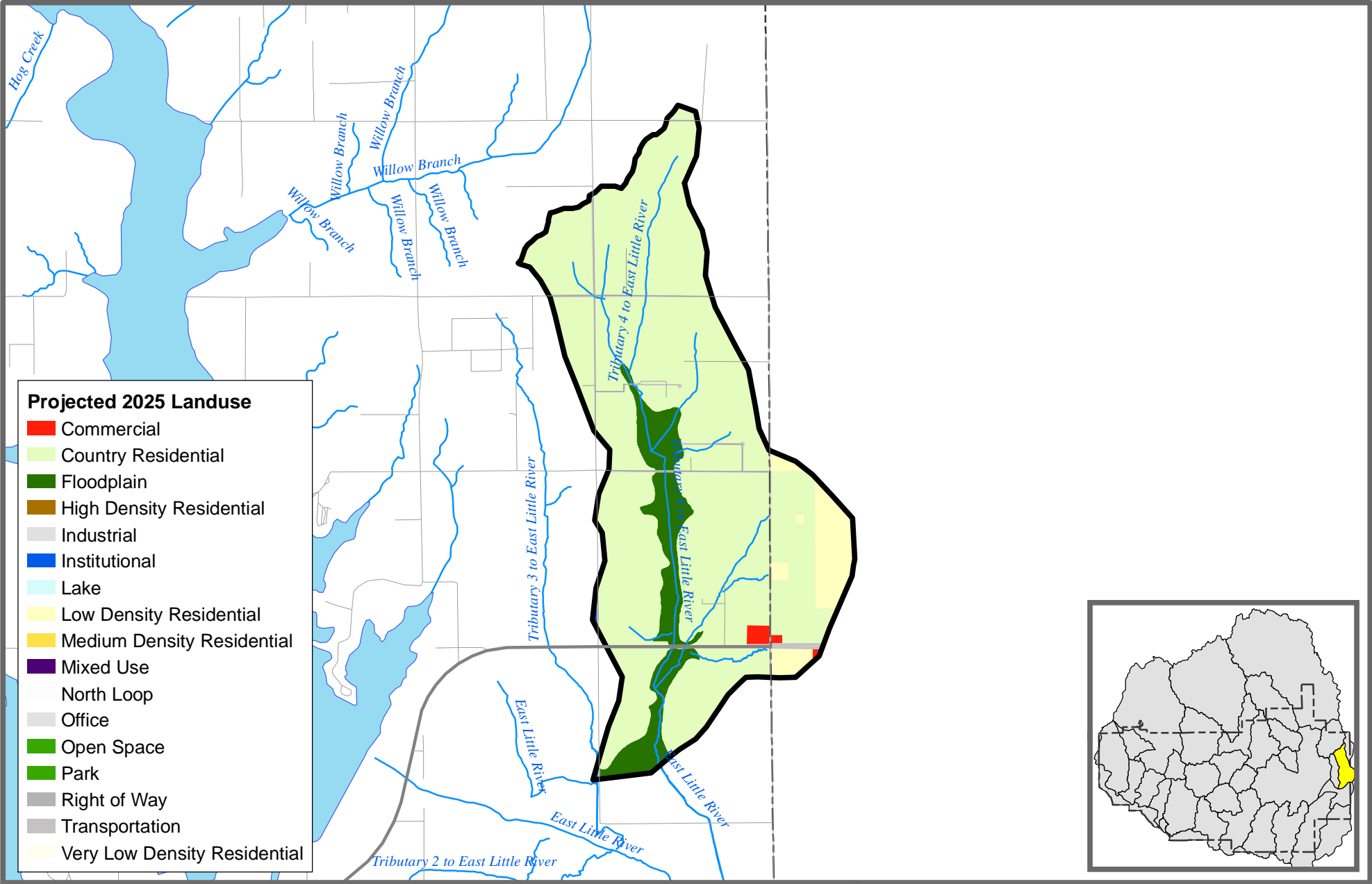


**City of Norman Stormwater Master Plan  
Tributary 4 to East Little River**

**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

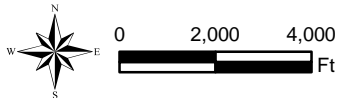
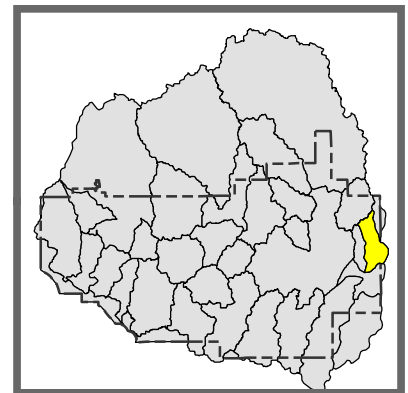
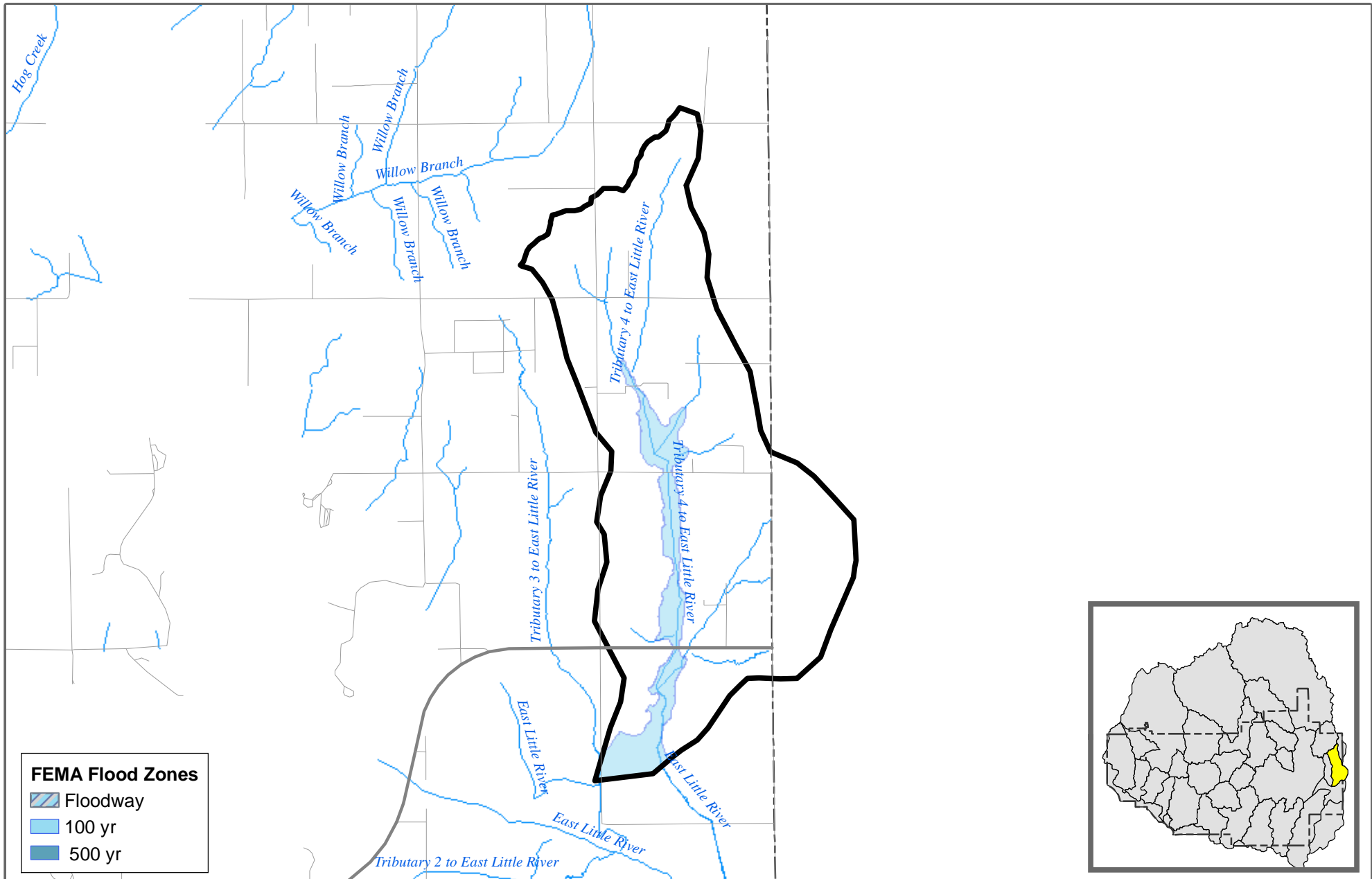


**City of Norman Stormwater Master Plan  
Tributary 4 to East Little River**

**Projected 2025 Landuse**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**City of Norman Stormwater Master Plan  
Tributary 4 to East Little River**

**FEMA Flood Zones**

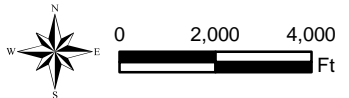
Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

A
B
C
D
W



**City of Norman Stormwater Master Plan  
Tributary 4 to East Little River**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

**Drainage Area (sq. mi.): 3.48**

**Current Zoning**

Zoning	Percentage
A-2: Rural Agricultural	91.3%
C-2: General Commercial	0.2%
R-1: Single Family Dwelling	5.4%
T: Transportation	2.8%
TC: Tourist Commercial	0.4%

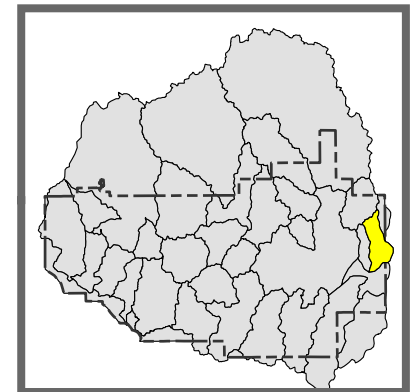
**Projected Landuse**

Landuse	Percentage
Commercial	0.5%
Country Residential	81.7%
Floodplain	9.5%
Institutional	0.1%
Low Density Residential	5.4%
Transportation	2.9%

Hydrologic Soil Group	Percentage
B	52.2%
C	6.2%
D	39.9%
W	1.8%

FEMA Flood Zone	Percentage
100	9.0%

**Impervious (%): 3.3**

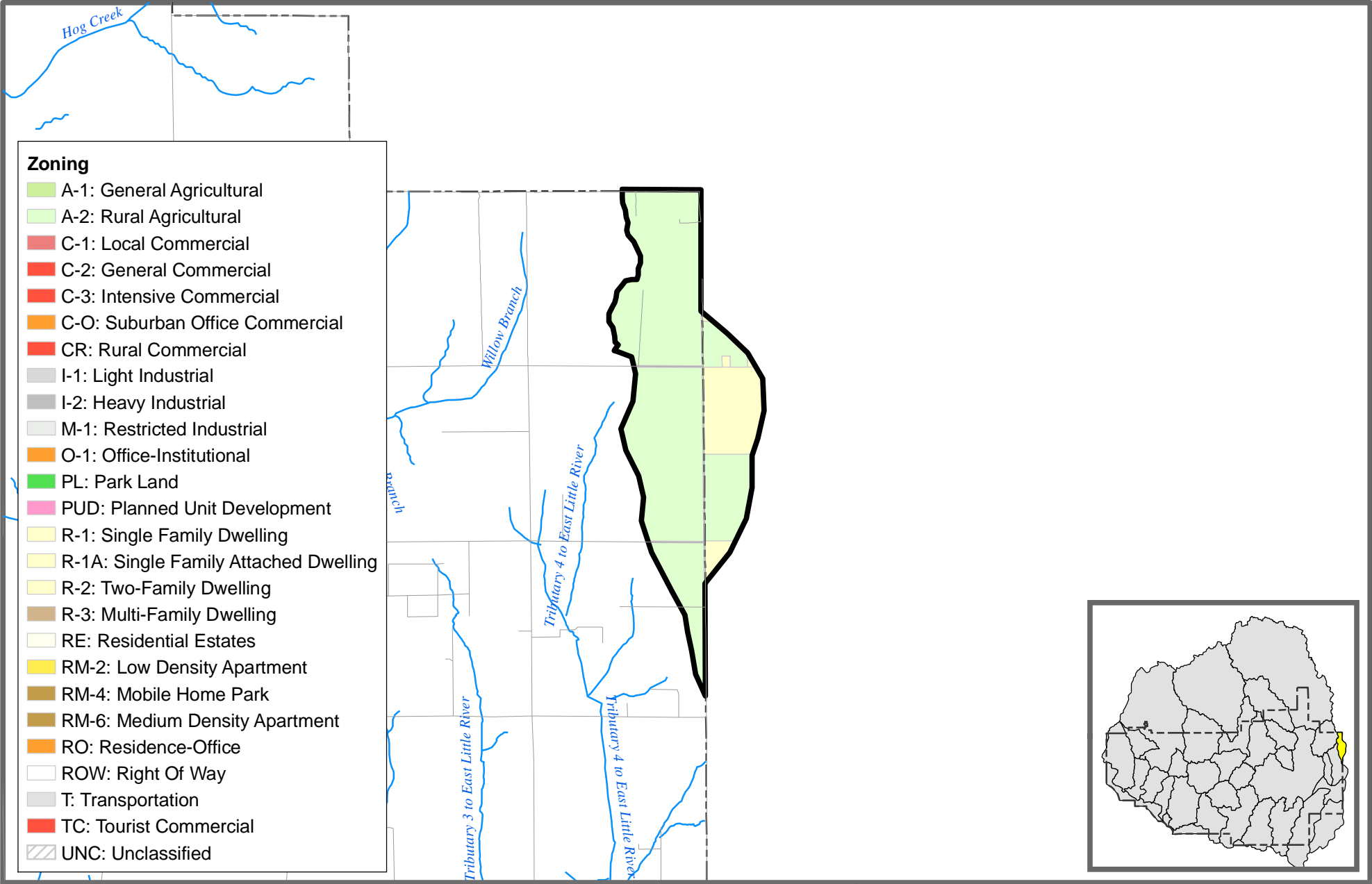


**City of Norman Stormwater Master Plan  
Tributary 4 to East Little River**

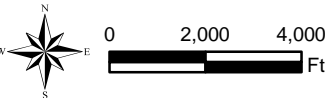
**Basin Statistics**

Prepared By: Vieux & Associates, Inc.





- Zoning**
- A-1: General Agricultural
  - A-2: Rural Agricultural
  - C-1: Local Commercial
  - C-2: General Commercial
  - C-3: Intensive Commercial
  - C-O: Suburban Office Commercial
  - CR: Rural Commercial
  - I-1: Light Industrial
  - I-2: Heavy Industrial
  - M-1: Restricted Industrial
  - O-1: Office-Institutional
  - PL: Park Land
  - PUD: Planned Unit Development
  - R-1: Single Family Dwelling
  - R-1A: Single Family Attached Dwelling
  - R-2: Two-Family Dwelling
  - R-3: Multi-Family Dwelling
  - RE: Residential Estates
  - RM-2: Low Density Apartment
  - RM-4: Mobile Home Park
  - RM-6: Medium Density Apartment
  - RO: Residence-Office
  - ROW: Right Of Way
  - T: Transportation
  - TC: Tourist Commercial
  - UNC: Unclassified

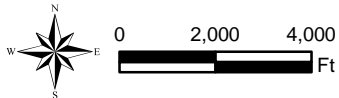
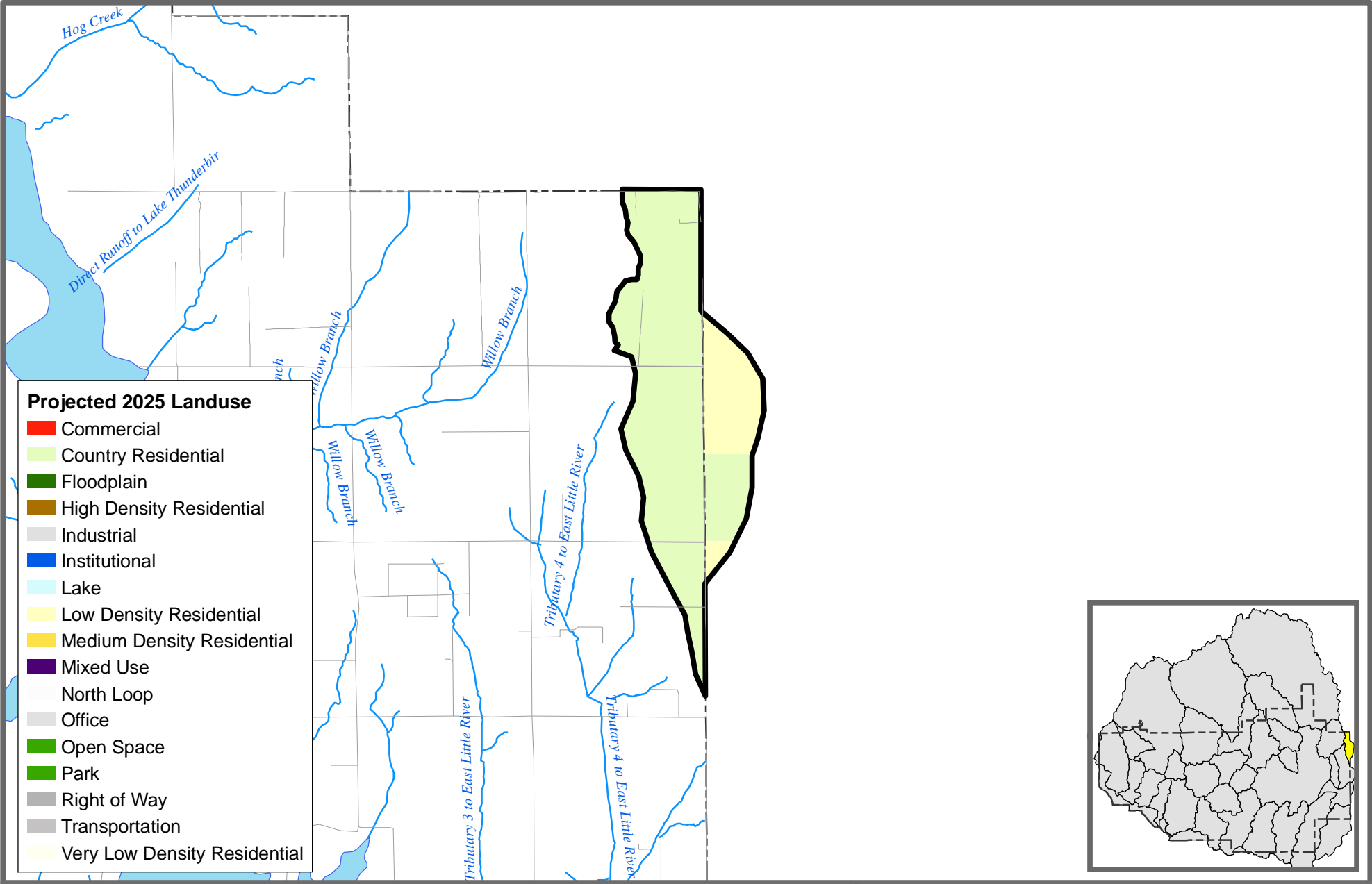


**City of Norman Stormwater Master Plan  
Tributary 5 to East Little River**

**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

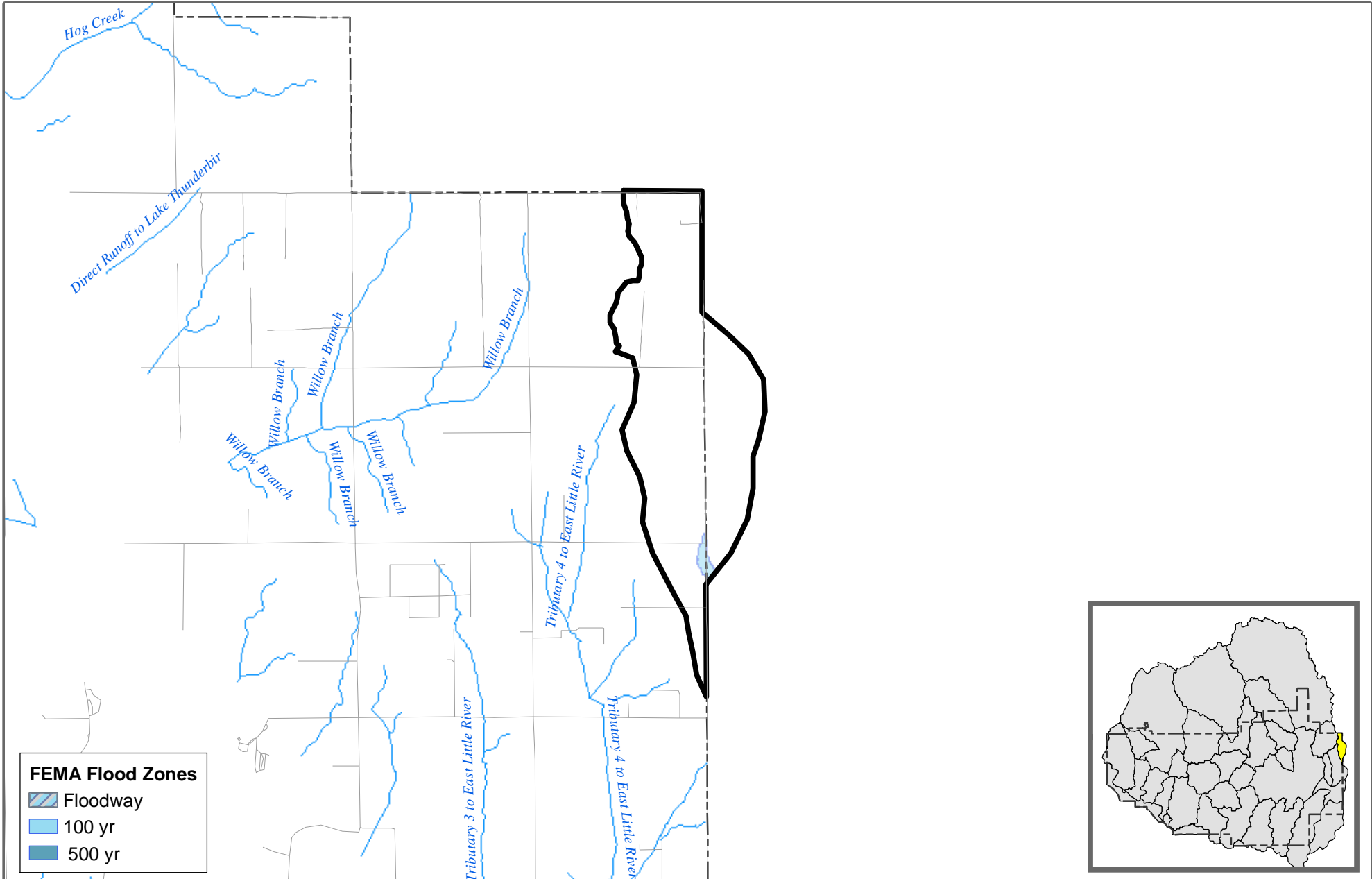


**City of Norman Stormwater Master Plan  
Tributary 5 to East Little River**




**Projected 2025 Landuse**

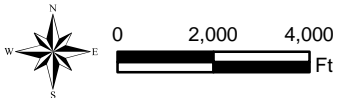
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Prepared By: Vieux & Associates, Inc.



**FEMA Flood Zones**

-  Floodway
-  100 yr
-  500 yr

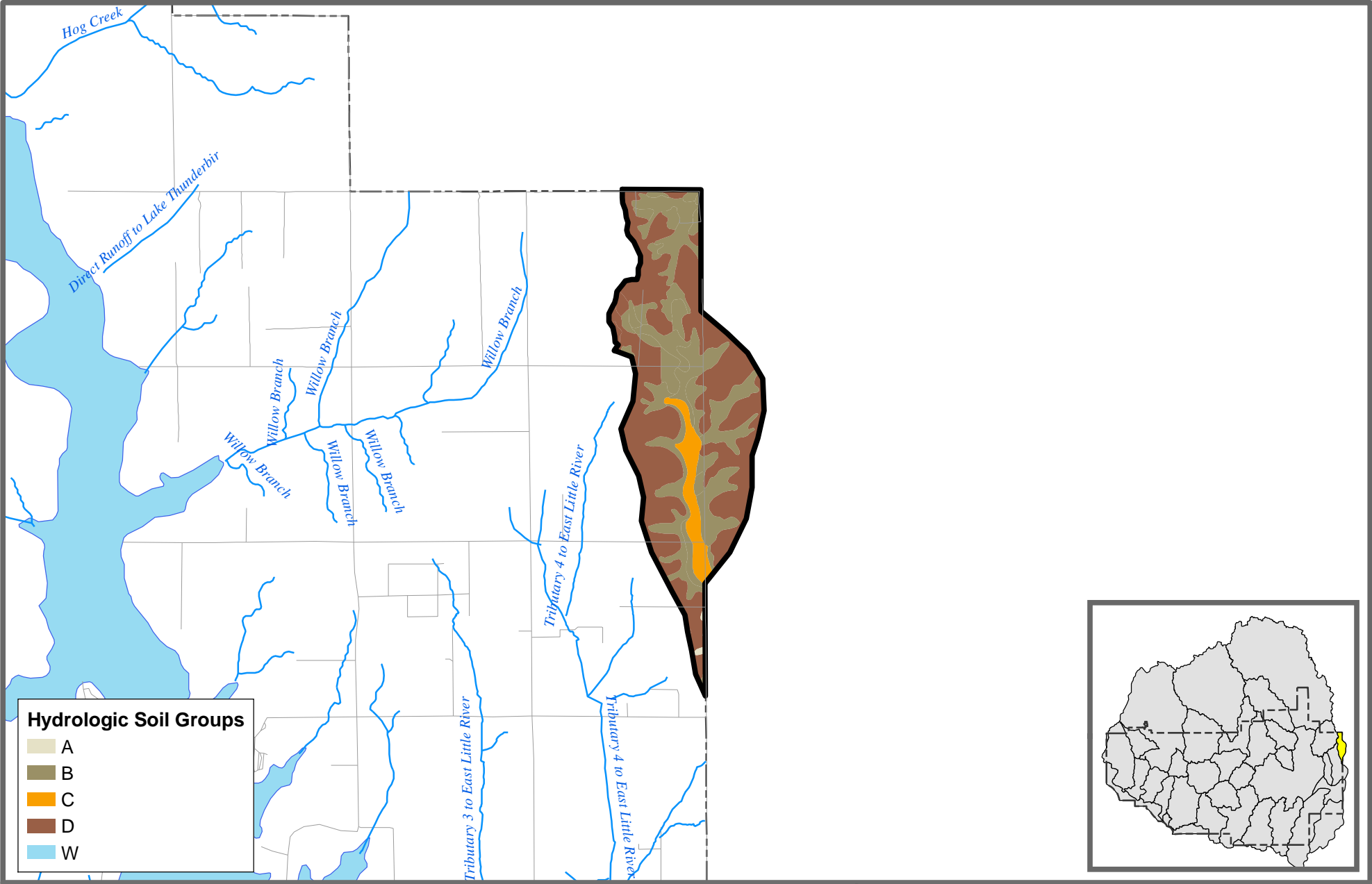


**City of Norman Stormwater Master Plan  
Tributary 5 to East Little River**

**FEMA Flood Zones**

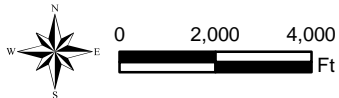
Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

	A
	B
	C
	D
	W



**City of Norman Stormwater Master Plan  
Tributary 5 to East Little River**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

**Drainage Area (sq. mi.): 1.32**

**Current Zoning**

Zoning	Percentage
A-2: Rural Agricultural	83.2%
R-1: Single Family Dwelling	14.6%
T: Transportation	2.1%

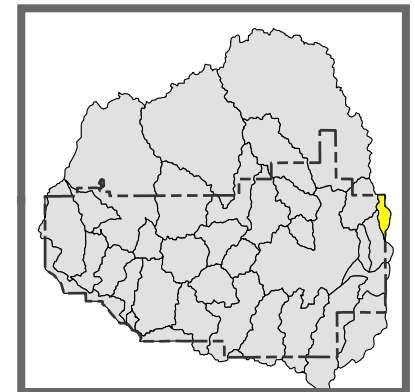
**Projected Landuse**

Landuse	Percentage
Country Residential	79.7%
Low Density Residential	18.1%
Transportation	2.1%

Hydrologic Soil Group	Percentage
A	0.3%
B	37.7%
C	5.8%
D	56.2%

FEMA Flood Zone	Percentage
100	1.0%

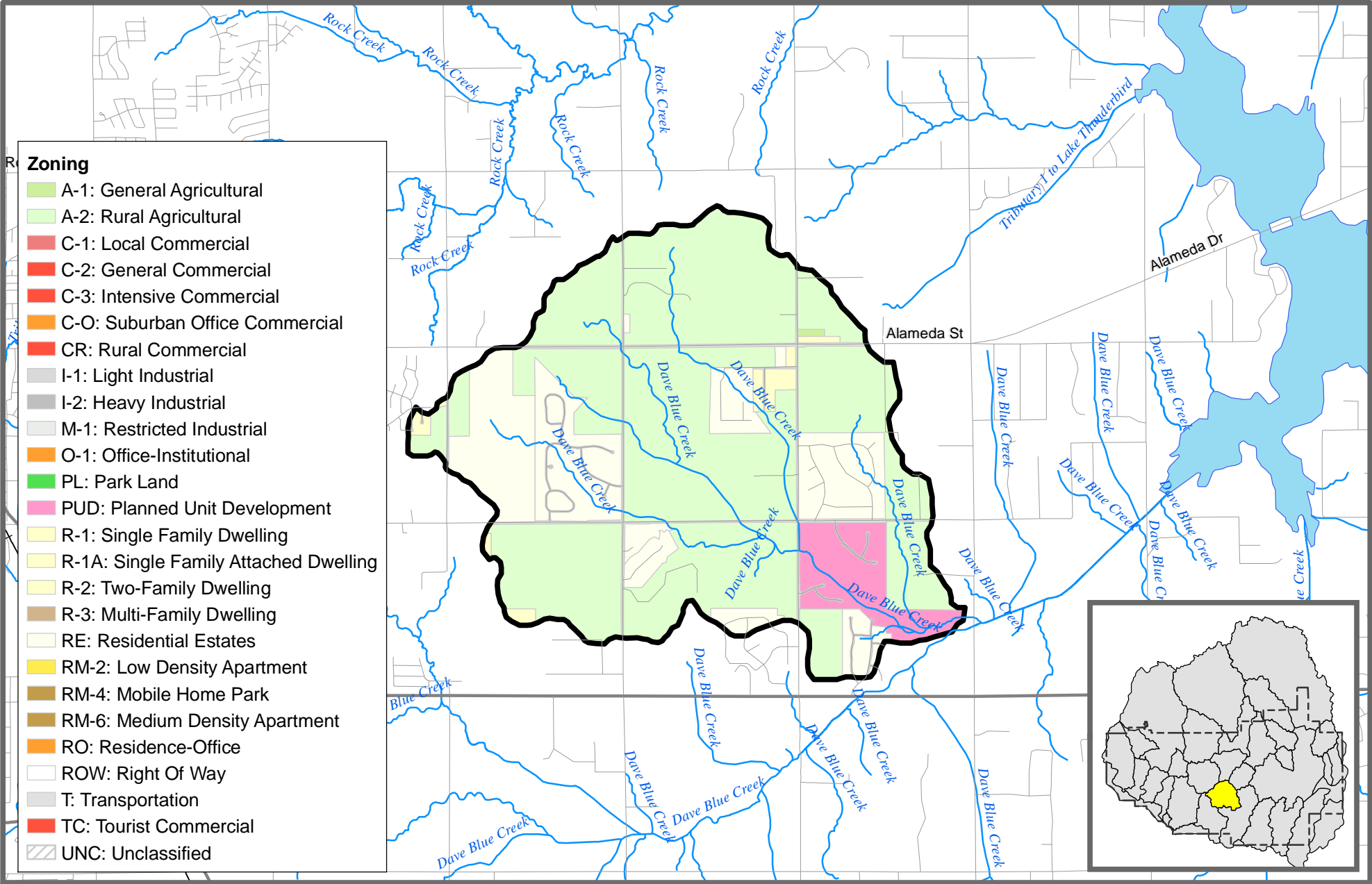
**Impervious (%): 2.7**



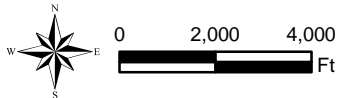
**City of Norman Stormwater Master Plan  
Tributary 5 to East Little River**

**Basin Statistics**

Prepared By: Vieux & Associates, Inc.



- Zoning**
- A-1: General Agricultural
  - A-2: Rural Agricultural
  - C-1: Local Commercial
  - C-2: General Commercial
  - C-3: Intensive Commercial
  - C-O: Suburban Office Commercial
  - CR: Rural Commercial
  - I-1: Light Industrial
  - I-2: Heavy Industrial
  - M-1: Restricted Industrial
  - O-1: Office-Institutional
  - PL: Park Land
  - PUD: Planned Unit Development
  - R-1: Single Family Dwelling
  - R-1A: Single Family Attached Dwelling
  - R-2: Two-Family Dwelling
  - R-3: Multi-Family Dwelling
  - RE: Residential Estates
  - RM-2: Low Density Apartment
  - RM-4: Mobile Home Park
  - RM-6: Medium Density Apartment
  - RO: Residence-Office
  - ROW: Right Of Way
  - T: Transportation
  - TC: Tourist Commercial
  - UNC: Unclassified

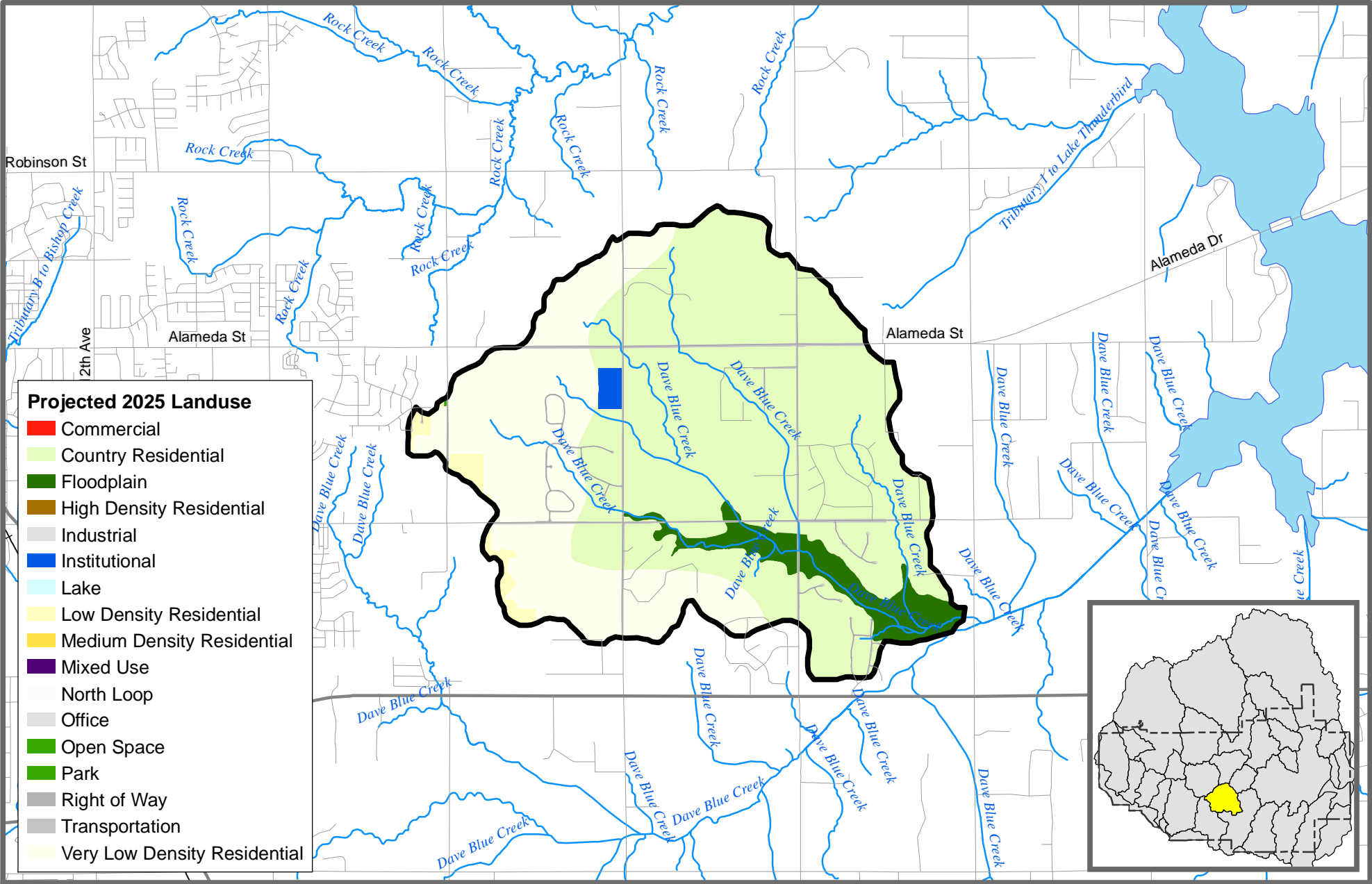


**City of Norman Stormwater Master Plan  
Tributary to Dave Blue Creek**

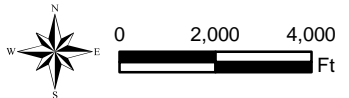
**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



- Projected 2025 Landuse**
- Commercial
  - Country Residential
  - Floodplain
  - High Density Residential
  - Industrial
  - Institutional
  - Lake
  - Low Density Residential
  - Medium Density Residential
  - Mixed Use
  - North Loop
  - Office
  - Open Space
  - Park
  - Right of Way
  - Transportation
  - Very Low Density Residential

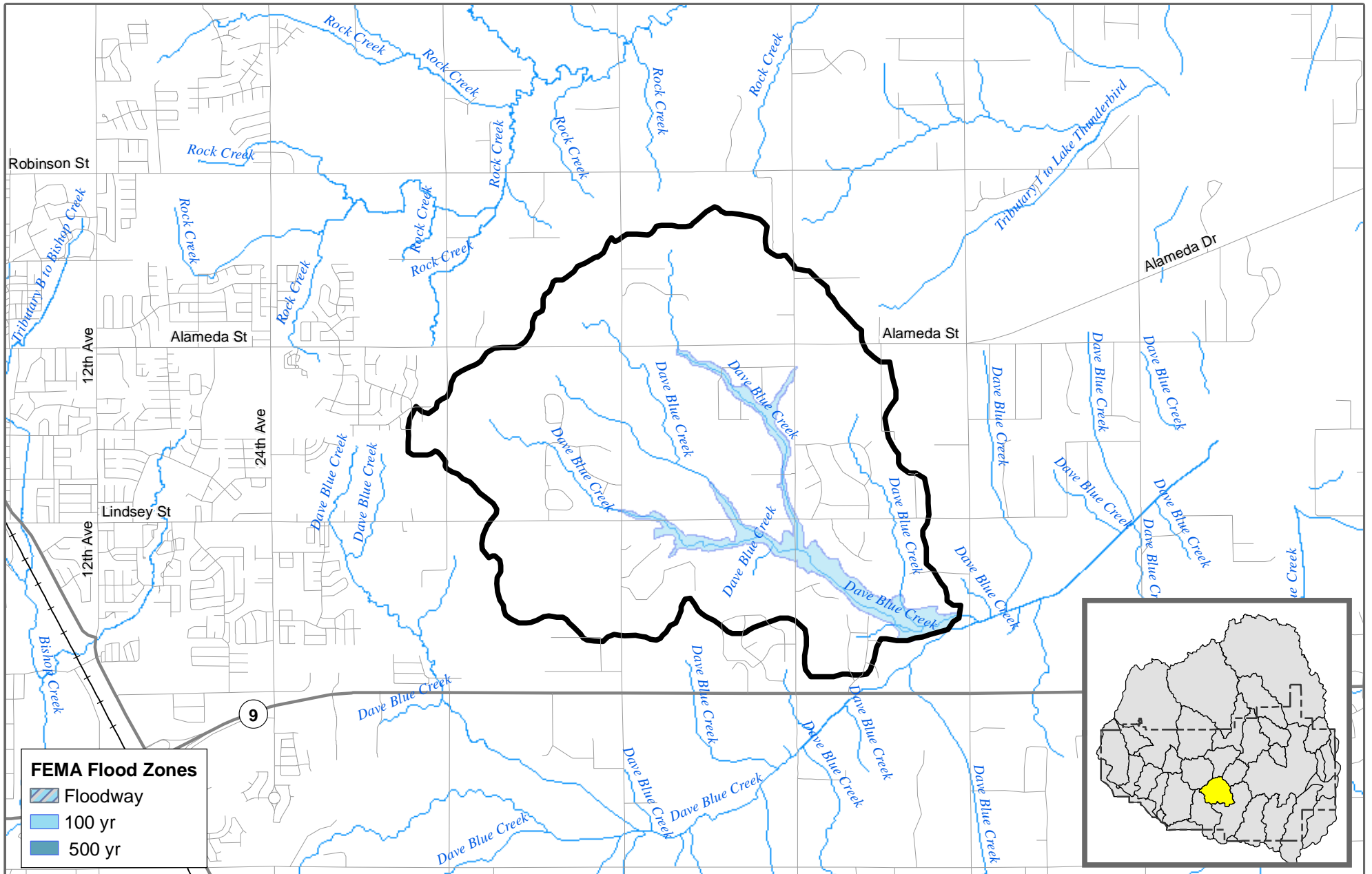


**City of Norman Stormwater Master Plan  
Tributary to Dave Blue Creek**

**Projected 2025 Landuse**

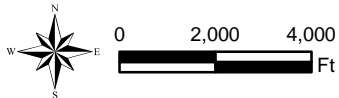
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Prepared By: Vieux & Associates, Inc.



**FEMA Flood Zones**

- Floodway
- 100 yr
- 500 yr



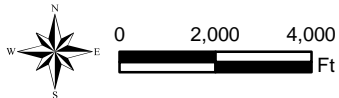
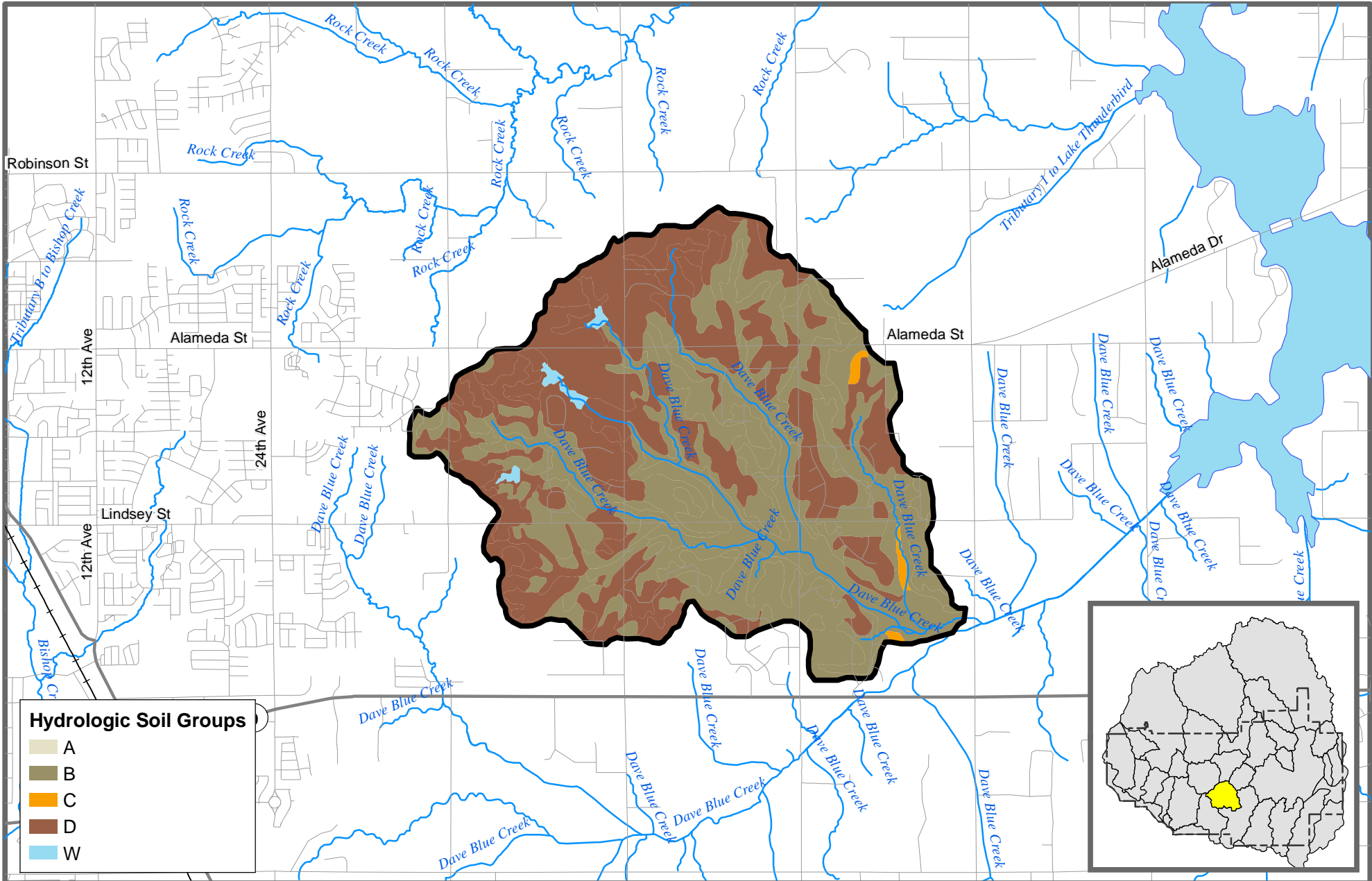
**City of Norman Stormwater Master Plan  
Tributary to Dave Blue Creek**

**FEMA Flood Zones**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.





**City of Norman Stormwater Master Plan  
Tributary to Dave Blue Creek**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

Drainage Area (sq. mi.): 5.24

**Current Zoning**

Zoning	Percentage
A-1: General Agricultural	0.11%
A-2: Rural Agricultural	66.25%
PUD: Planned Unit Developme	5.93%
R-1: Single Family Dwelling	1.81%
RE: Residential Estates	22.38%
T: Transportation	3.52%

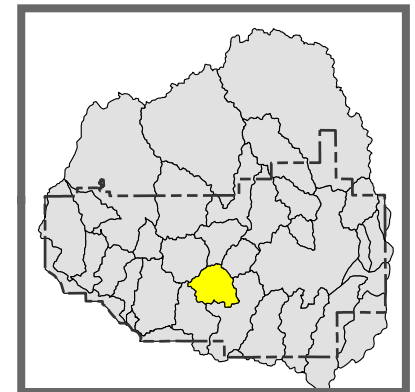
**Projected Landuse**

Landuse	Percentage
Country Residential	60.26%
Floodplain	6.04%
Institutional	0.57%
Low Density Residential	1.89%
Park	0.01%
Transportation	3.47%
Very Low Density Residential	27.76%

Hydrologic Soil Group	Percentage
B	54.3%
C	0.6%
D	44.5%
W	0.6%

FEMA Flood Zone	Percentage
100	5.7%

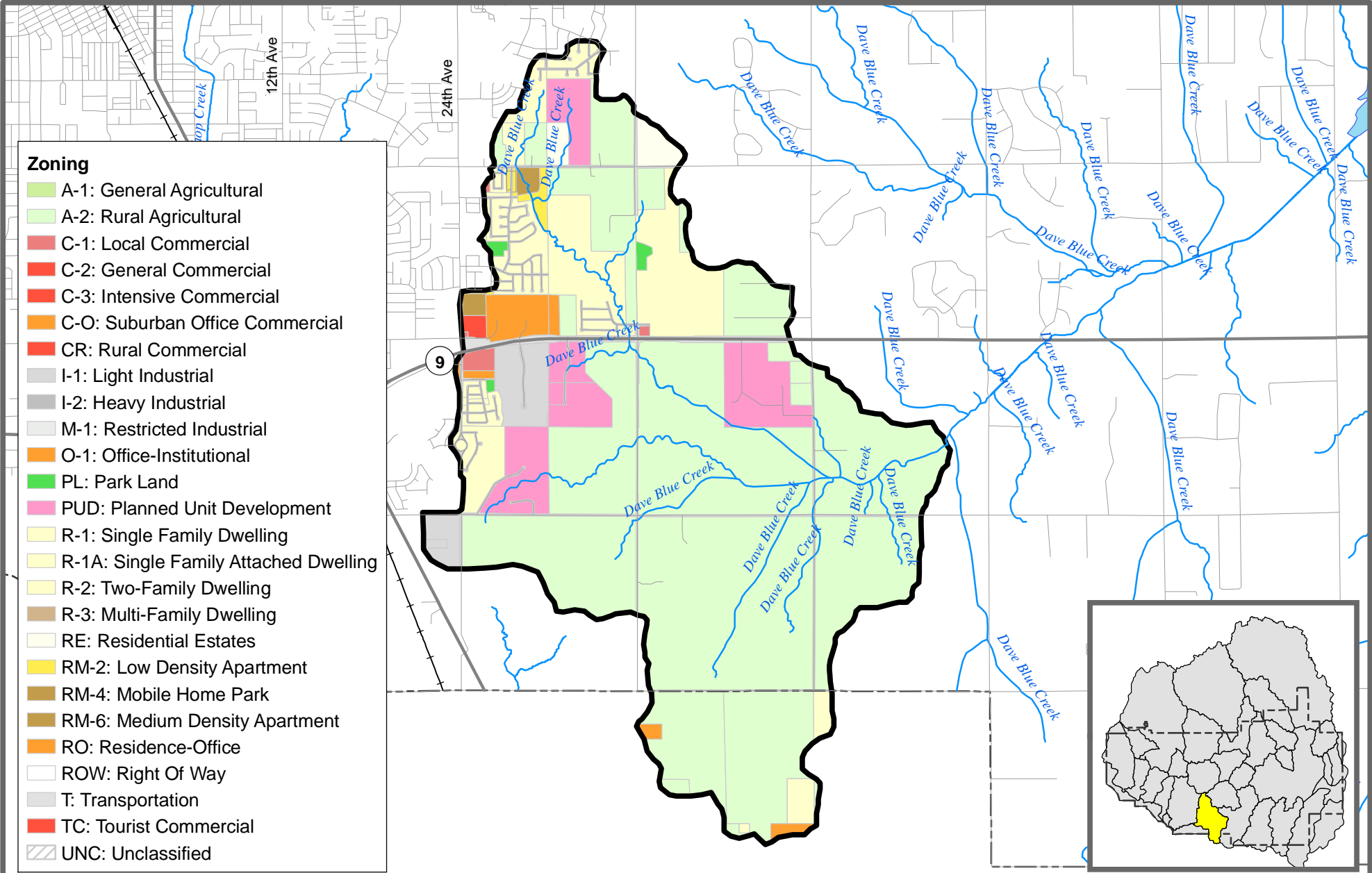
Impervious (%): 4.5



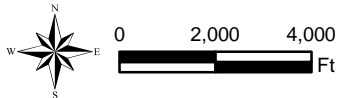
**City of Norman Stormwater Master Plan  
Tributary to Dave Blue Creek**

**Basin Statistics**

Prepared By: Vieux & Associates, Inc.



- Zoning**
- A-1: General Agricultural
  - A-2: Rural Agricultural
  - C-1: Local Commercial
  - C-2: General Commercial
  - C-3: Intensive Commercial
  - C-O: Suburban Office Commercial
  - CR: Rural Commercial
  - I-1: Light Industrial
  - I-2: Heavy Industrial
  - M-1: Restricted Industrial
  - O-1: Office-Institutional
  - PL: Park Land
  - PUD: Planned Unit Development
  - R-1: Single Family Dwelling
  - R-1A: Single Family Attached Dwelling
  - R-2: Two-Family Dwelling
  - R-3: Multi-Family Dwelling
  - RE: Residential Estates
  - RM-2: Low Density Apartment
  - RM-4: Mobile Home Park
  - RM-6: Medium Density Apartment
  - RO: Residence-Office
  - ROW: Right Of Way
  - T: Transportation
  - TC: Tourist Commercial
  - UNC: Unclassified

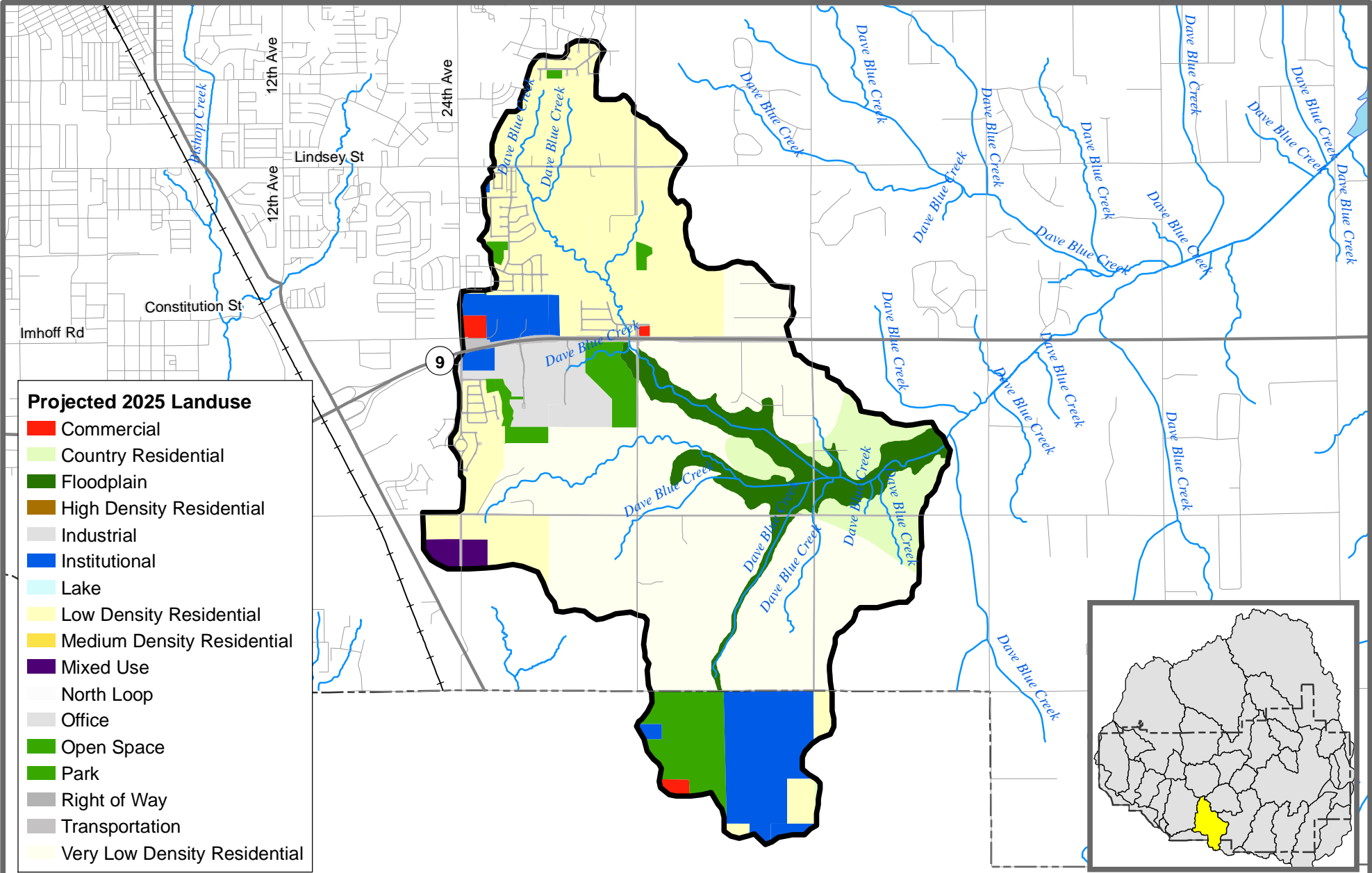


**City of Norman Stormwater Master Plan  
Upper Dave Blue Creek**

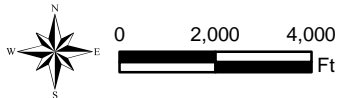
**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



- Projected 2025 Landuse**
- Commercial
  - Country Residential
  - Floodplain
  - High Density Residential
  - Industrial
  - Institutional
  - Lake
  - Low Density Residential
  - Medium Density Residential
  - Mixed Use
  - North Loop
  - Office
  - Open Space
  - Park
  - Right of Way
  - Transportation
  - Very Low Density Residential

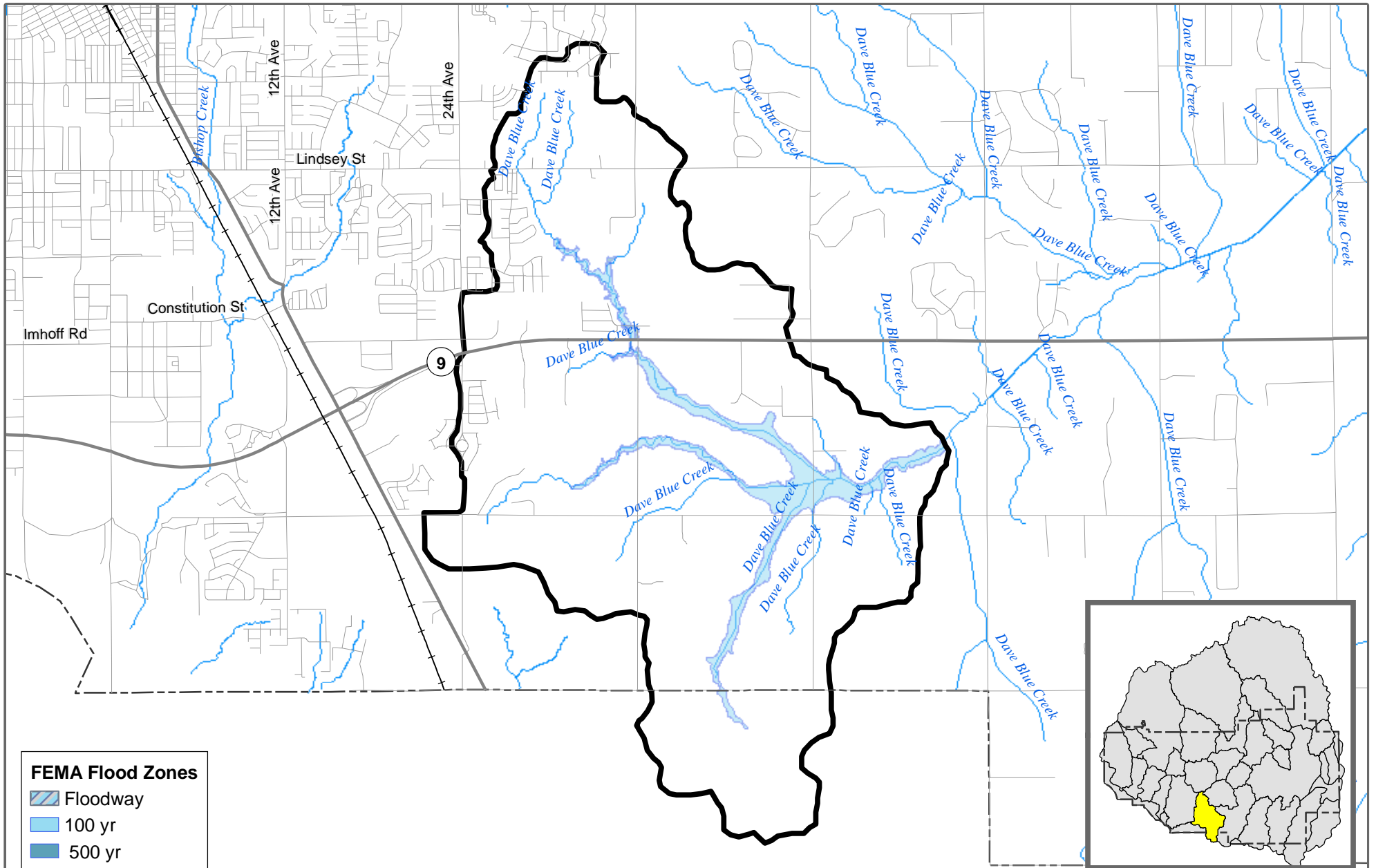


**City of Norman Stormwater Master Plan  
Upper Dave Blue Creek**




**Projected 2025 Landuse**

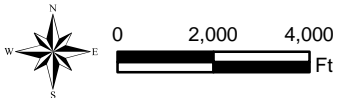
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Prepared By: Vieux & Associates, Inc.



**FEMA Flood Zones**

-  Floodway
-  100 yr
-  500 yr

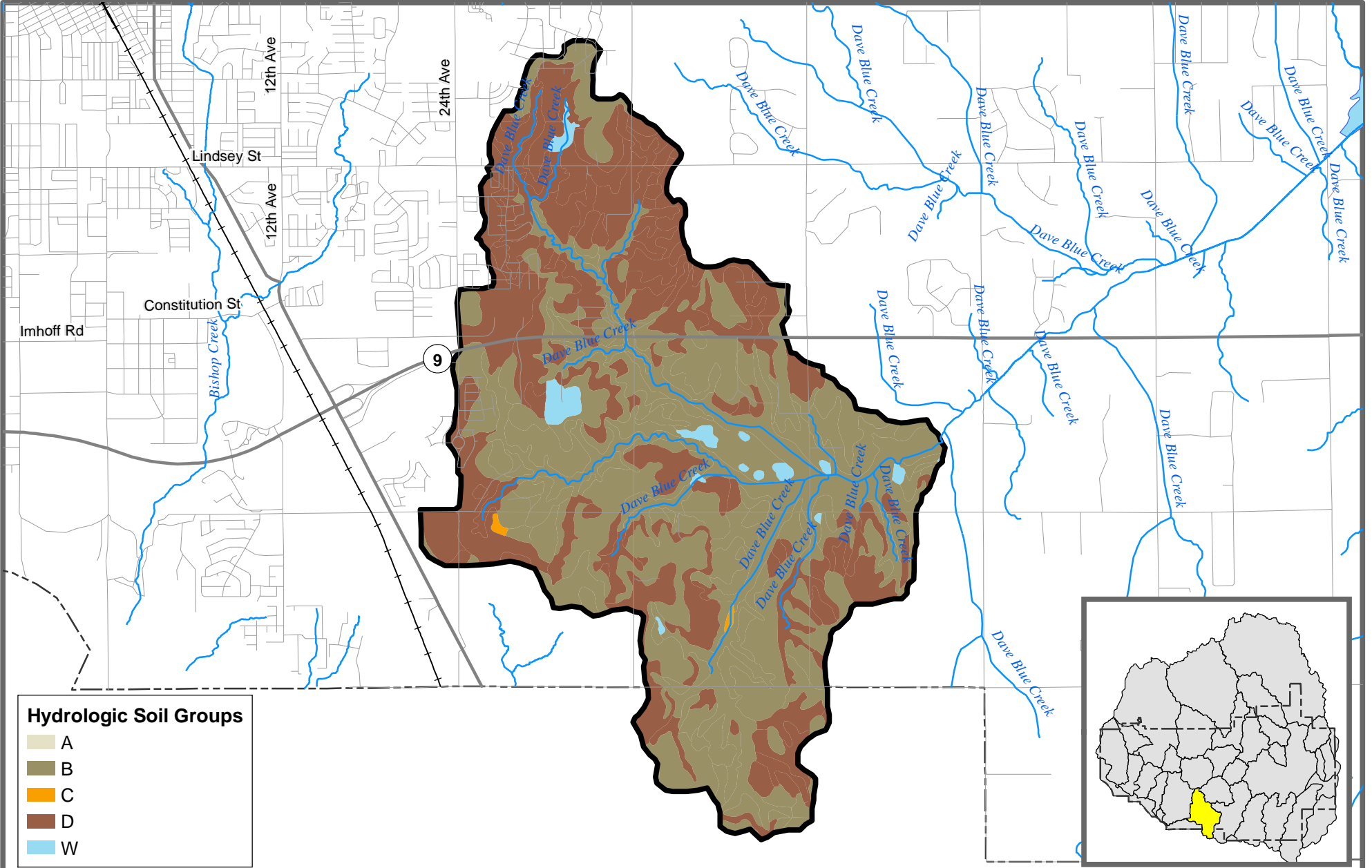


**City of Norman Stormwater Master Plan  
Upper Dave Blue Creek**

**FEMA Flood Zones**

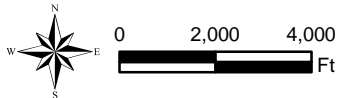
Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

- A
- B
- C
- D
- W



**City of Norman Stormwater Master Plan  
Upper Dave Blue Creek**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

**Drainage Area (sq. mi.): 6.81**

**Current Zoning**

Zoning	Percentage
A-2: Rural Agricultural	65.03%
C-1: Local Commercial	0.4%
C-2: General Commercial	0.24%
C-O: Suburban Office Commercial	1.59%
I-1: Light Industrial	2.74%
O-1: Office-Institutional	0.46%
PL: Park Land	0.34%
PUD: Planned Unit Development	7.99%
R-1: Single Family Dwelling	14.52%
R-1A: Single Family Attached Dwelling	0.14%
RE: Residential Estates	1.22%
RM-2: Low Density Apartment	0.52%
RM-6: Medium Density Apartment	0.53%
T: Transportation	4.27%

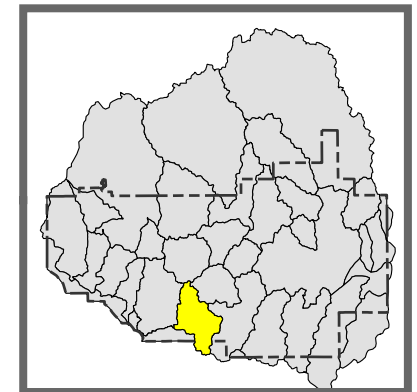
**Projected Landuse**

Landuse	Percentage
Commercial	0.51%
Country Residential	5.8%
Floodplain	7.18%
Industrial	3.6%
Institutional	7.49%
Low Density Residential	26.07%
Mixed Use	0.76%
Office	0.17%
Open	3.94%
Park	1.81%
Transportation	4.18%
Very Low Density Residential	38.48%

Hydrologic Soil Group	Percentage
B	57.3%
C	0.2%
D	41.0%
W	1.6%

FEMA Flood Zone	Percentage
100	5.3%
500	5.4%

**Impervious (%): 7.3**



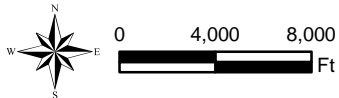
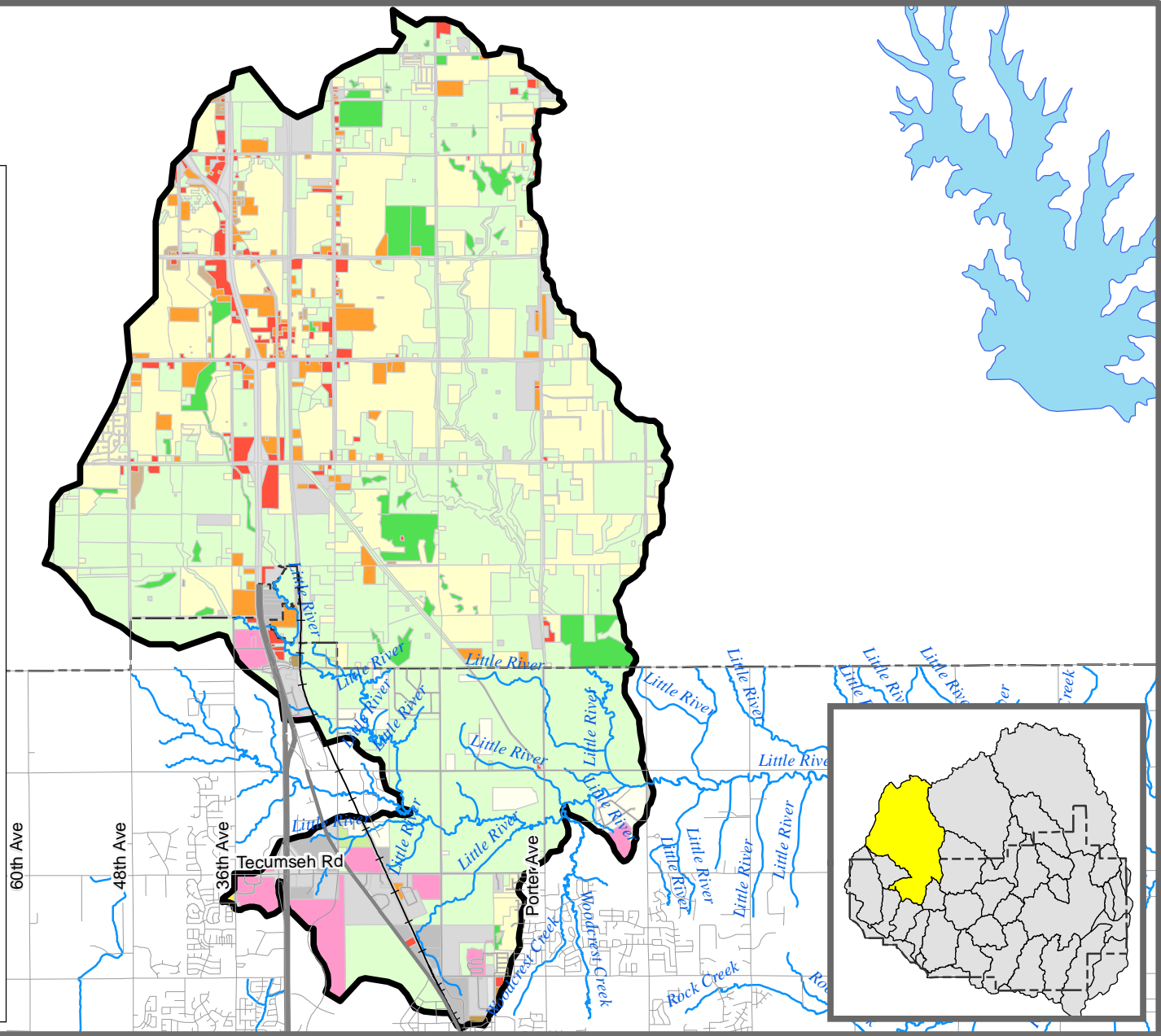
**City of Norman Stormwater Master Plan  
Upper Dave Blue Creek**

**Basin Statistics**

Prepared By: Vieux & Associates, Inc.

**Zoning**

- A-1: General Agricultural
- A-2: Rural Agricultural
- C-1: Local Commercial
- C-2: General Commercial
- C-3: Intensive Commercial
- C-O: Suburban Office Commercial
- CR: Rural Commercial
- I-1: Light Industrial
- I-2: Heavy Industrial
- M-1: Restricted Industrial
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- RM-6: Medium Density Apartment
- RO: Residence-Office
- ROW: Right Of Way
- T: Transportation
- TC: Tourist Commercial
- UNC: Unclassified



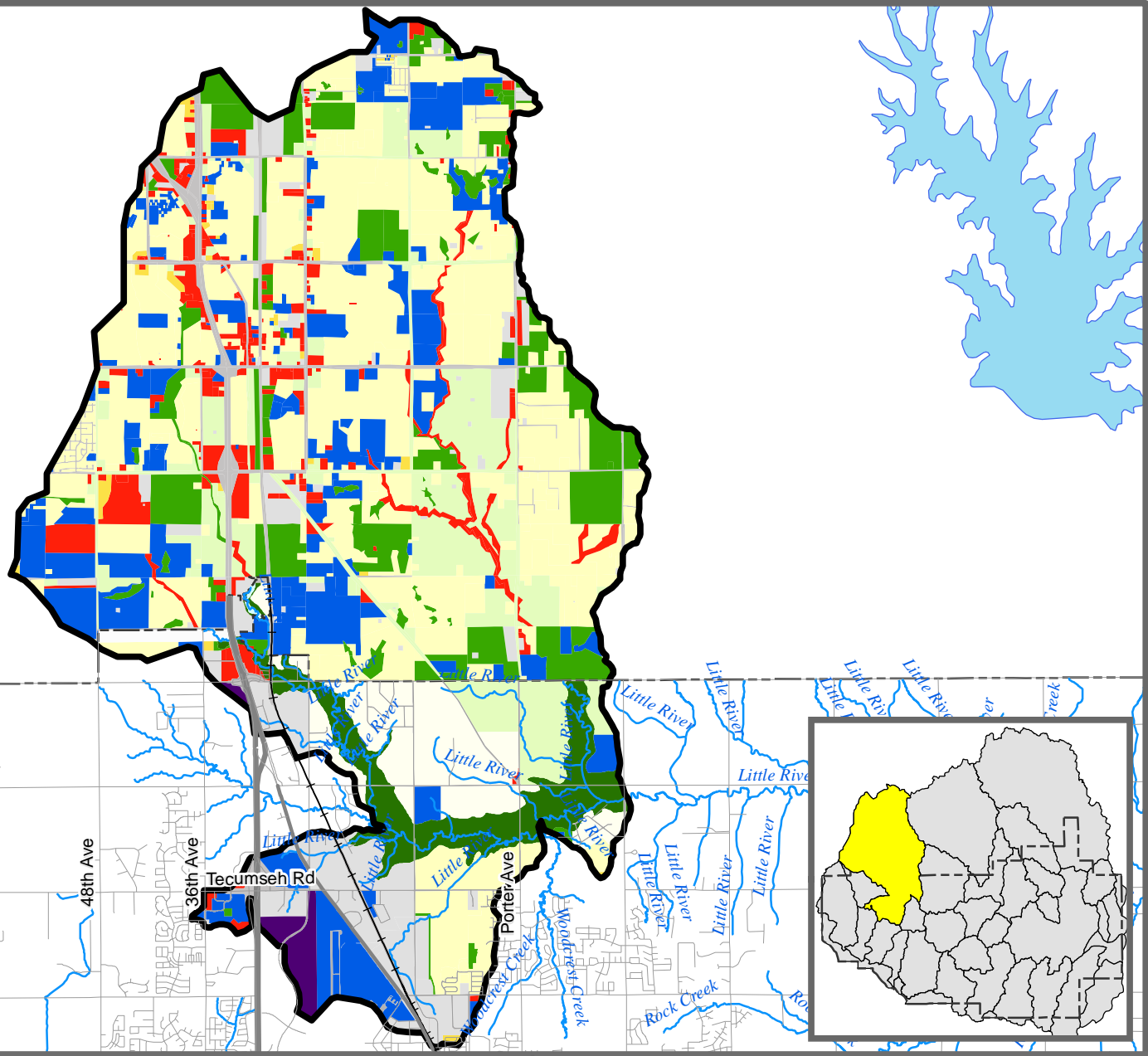
**City of Norman Stormwater Master Plan  
Upper Little River**

**Current Zoning**

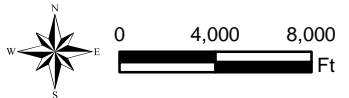
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Prepared By: Vieux & Associates, Inc.





- Projected 2025 Landuse**
- Commercial
  - Country Residential
  - Floodplain
  - High Density Residential
  - Industrial
  - Institutional
  - Lake \ Floodplain
  - Low Density Residential
  - Medium Density Residential
  - Mixed Use
  - North Loop
  - Office
  - Open Space
  - Park
  - Right of Way
  - Transportation
  - Very Low Density Residential

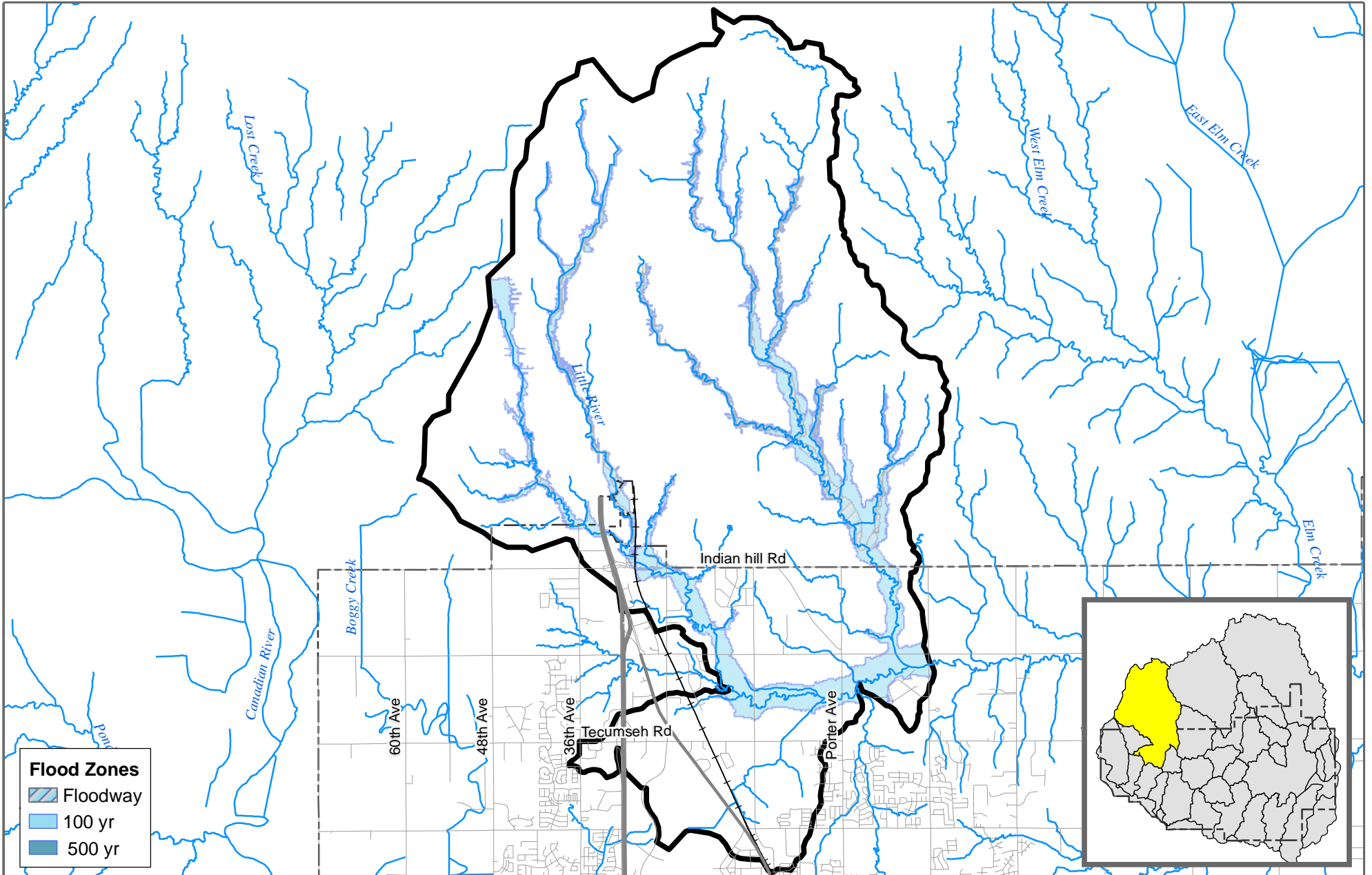


**City of Norman Stormwater Master Plan  
Upper Little River**


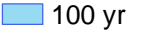

**Projected 2025 Landuse**

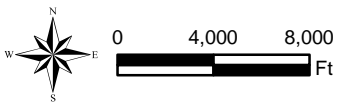
Scale: 1:96,000

Prepared By: Vieux & Associates, Inc.



**Flood Zones**

-  Floodway
-  100 yr
-  500 yr

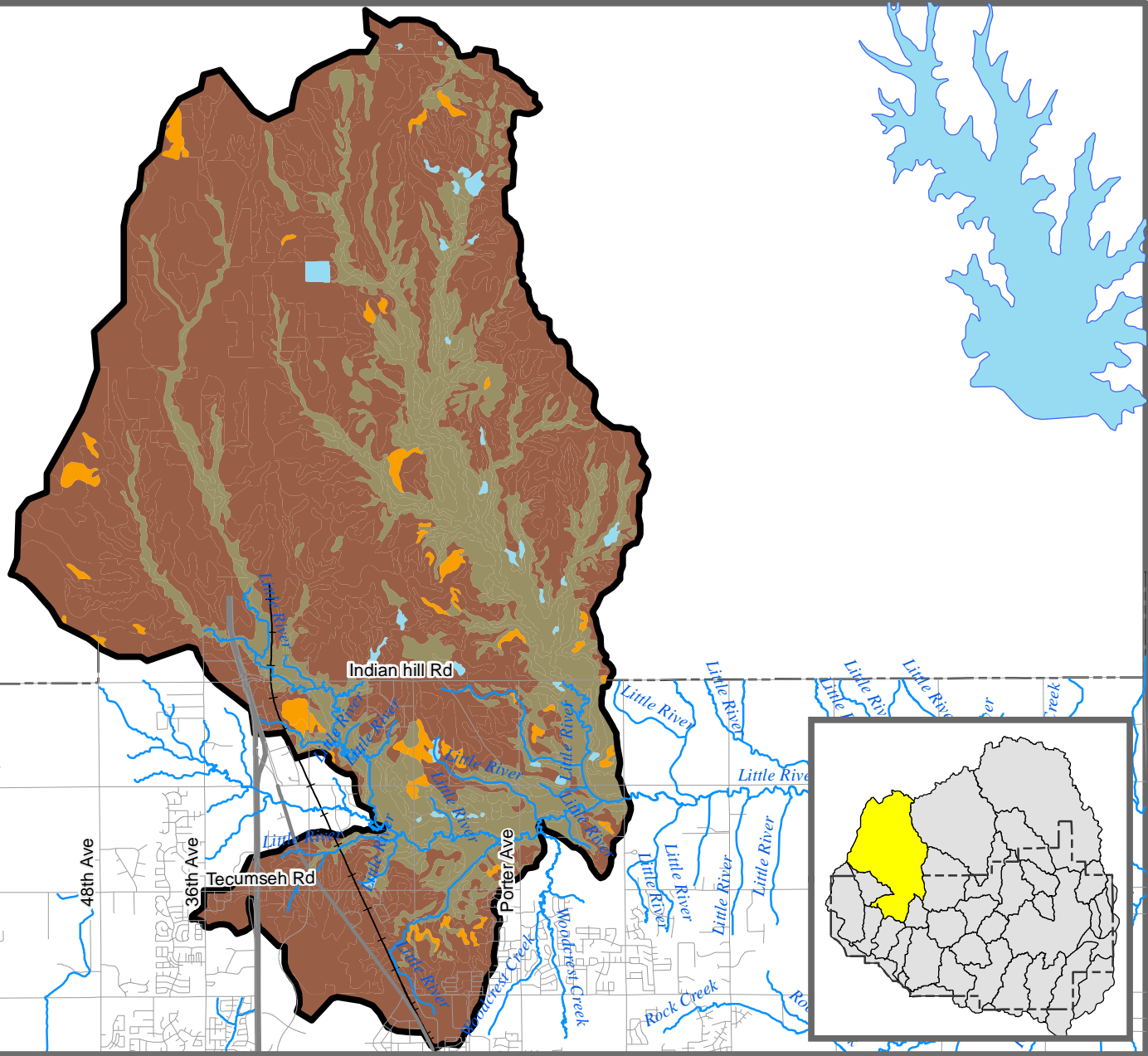


**City of Norman Stormwater Master Plan  
Upper Little River**

**Flood Insurance Zones**

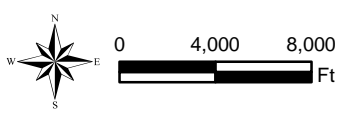
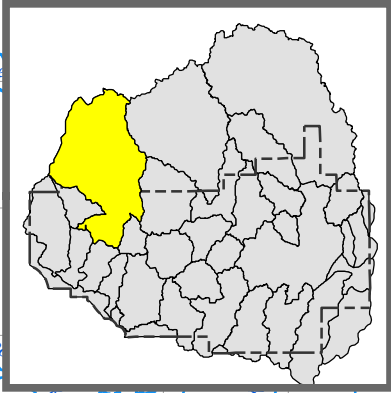
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Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

- A
- B
- C
- D
- W



**City of Norman Stormwater Master Plan  
Upper Little River**

**Hydrologic Soil Groups**

Scale: 1:96,000      Prepared By: Vieux & Associates, Inc.

Drainage Area (sq. mi.): 34.86

### Current Zoning

Zoning	Percentage
A-1: General Agricultural	0.15%
A-2: Rural Agricultural	50.66%
C-2: General Commercial	2.01%
C-O: Suburban Office Commercial	0.98%
CR: Rural Commercial	0.09%
I-1: Light Industrial	4.11%
I-2: Heavy Industrial	1.25%
M-1: Restricted Industrial	0.08%
O-1: Office-Institutional	2.15%
PL: Park Land	3.64%
PUD: Planned Unit Development	2.21%
R-1: Single Family Dwelling	24.35%
R-1A: Single Family Attached Dwelling	0.08%
R-3: Multi-Family Dwelling	0.38%
RE: Residential Estates	1.66%
RM-2: Low Density Apartment	0.02%
RM-4: Mobile Home Park	0.08%
RM-6: Medium Density Apartment	0.04%
T: Transportation	6.06%

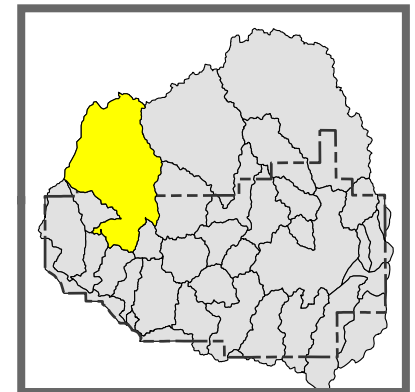
### Projected Landuse

Landuse	Percentage
Commercial	5.8%
Country Residential	11.52%
Floodplain	4.62%
High Density Residential	0.01%
Industrial	6.87%
Institutional	14.11%
Lake/ Floodplain	0.05%
Low Density Residential	33.85%
Medium Density Residential	0.56%
Mixed Use	0.95%
North Loop	0.42%
Open	3.47%
Park	6.54%
Right of Way	0.08%
Transportation	6.12%
Very Low Density Residential	5.05%

Hydrologic Soil Group	Percentage
B	26.3%
C	2.1%
D	70.8%
W	0.8%

FEMA Flood Zone	Percentage
100	10.4%
500	10.7%
Floodway	1.5%

Impervious (%): 21.7



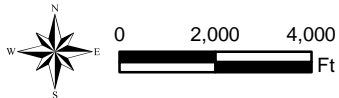
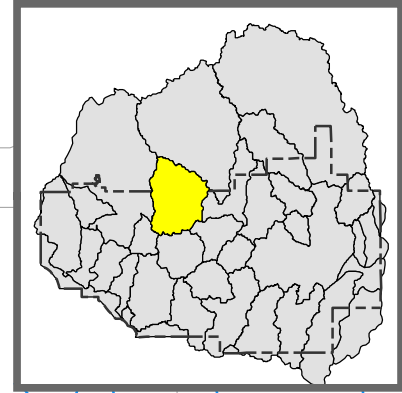
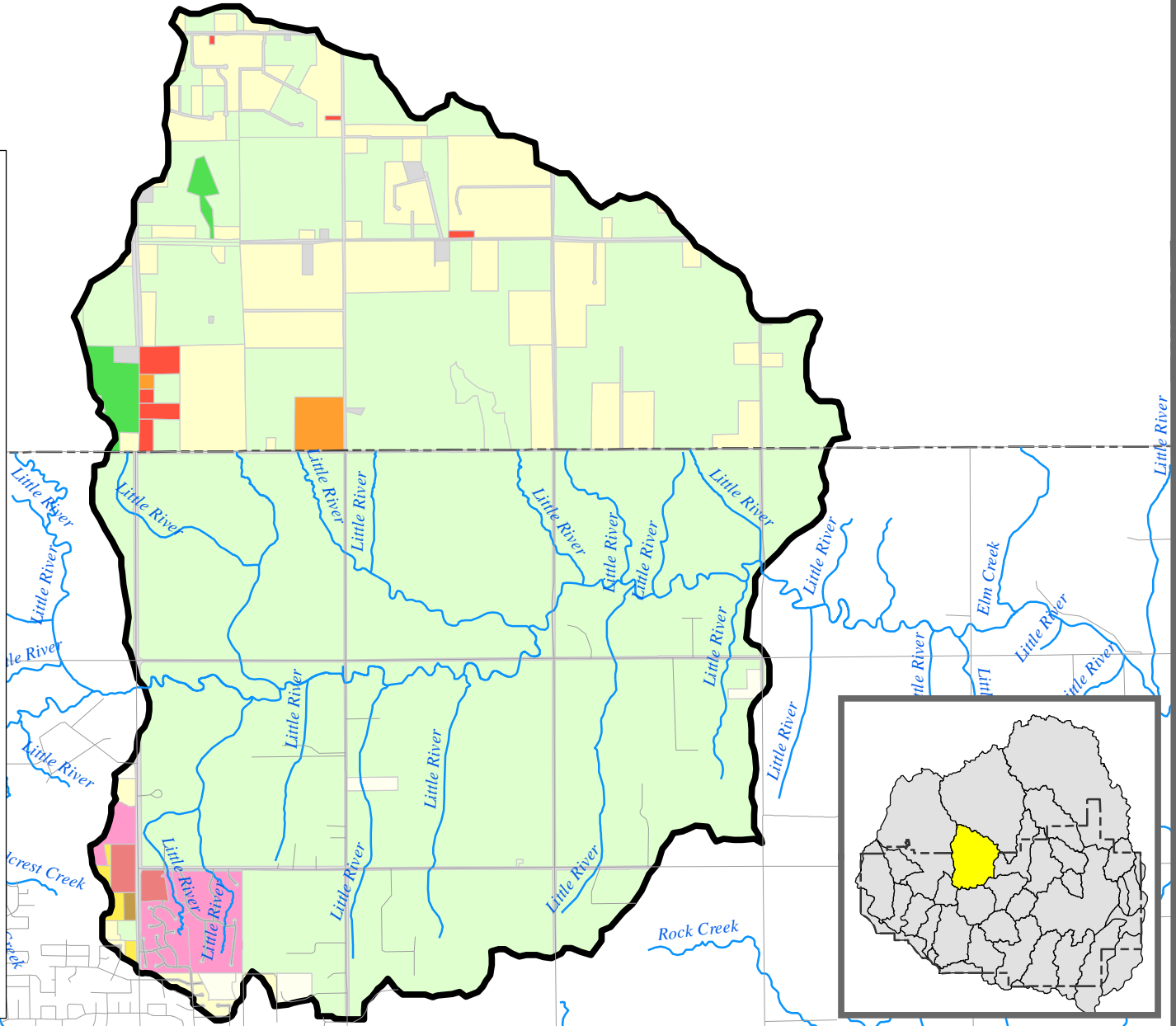
City of Norman Stormwater Master Plan  
Upper Little River

Basin Statistics

Prepared By: Vieux & Associates, Inc.

**Zoning**

- A-1: General Agricultural
- A-2: Rural Agricultural
- C-1: Local Commercial
- C-2: General Commercial
- C-3: Intensive Commercial
- C-O: Suburban Office Commercial
- CR: Rural Commercial
- I-1: Light Industrial
- I-2: Heavy Industrial
- M-1: Restricted Industrial
- O-1: Office-Institutional
- PL: Park Land
- PUD: Planned Unit Development
- R-1: Single Family Dwelling
- R-1A: Single Family Attached Dwelling
- R-2: Two-Family Dwelling
- R-3: Multi-Family Dwelling
- RE: Residential Estates
- RM-2: Low Density Apartment
- RM-4: Mobile Home Park
- RM-6: Medium Density Apartment
- RO: Residence-Office
- ROW: Right Of Way
- T: Transportation
- TC: Tourist Commercial
- UNC: Unclassified

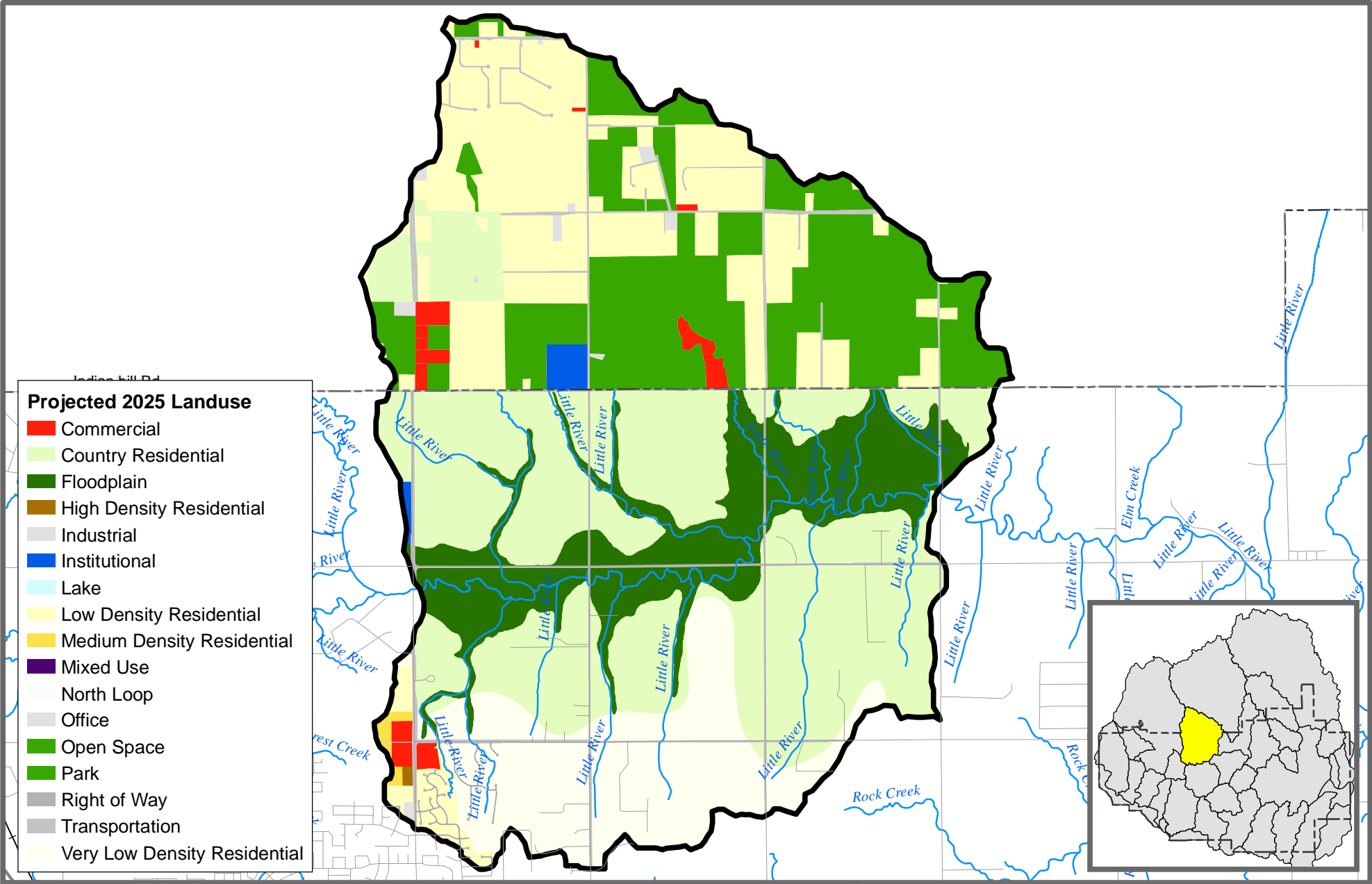


**City of Norman Stormwater Master Plan  
Upper Mid Little River**

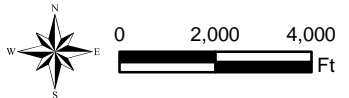
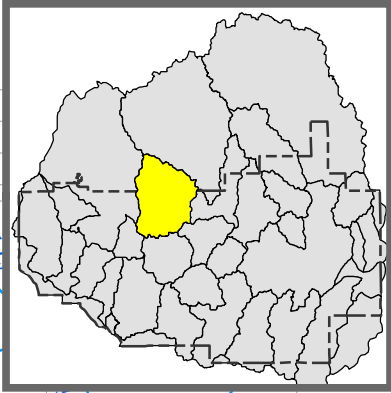
**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



- Projected 2025 Landuse**
- Commercial
  - Country Residential
  - Floodplain
  - High Density Residential
  - Industrial
  - Institutional
  - Lake
  - Low Density Residential
  - Medium Density Residential
  - Mixed Use
  - North Loop
  - Office
  - Open Space
  - Park
  - Right of Way
  - Transportation
  - Very Low Density Residential

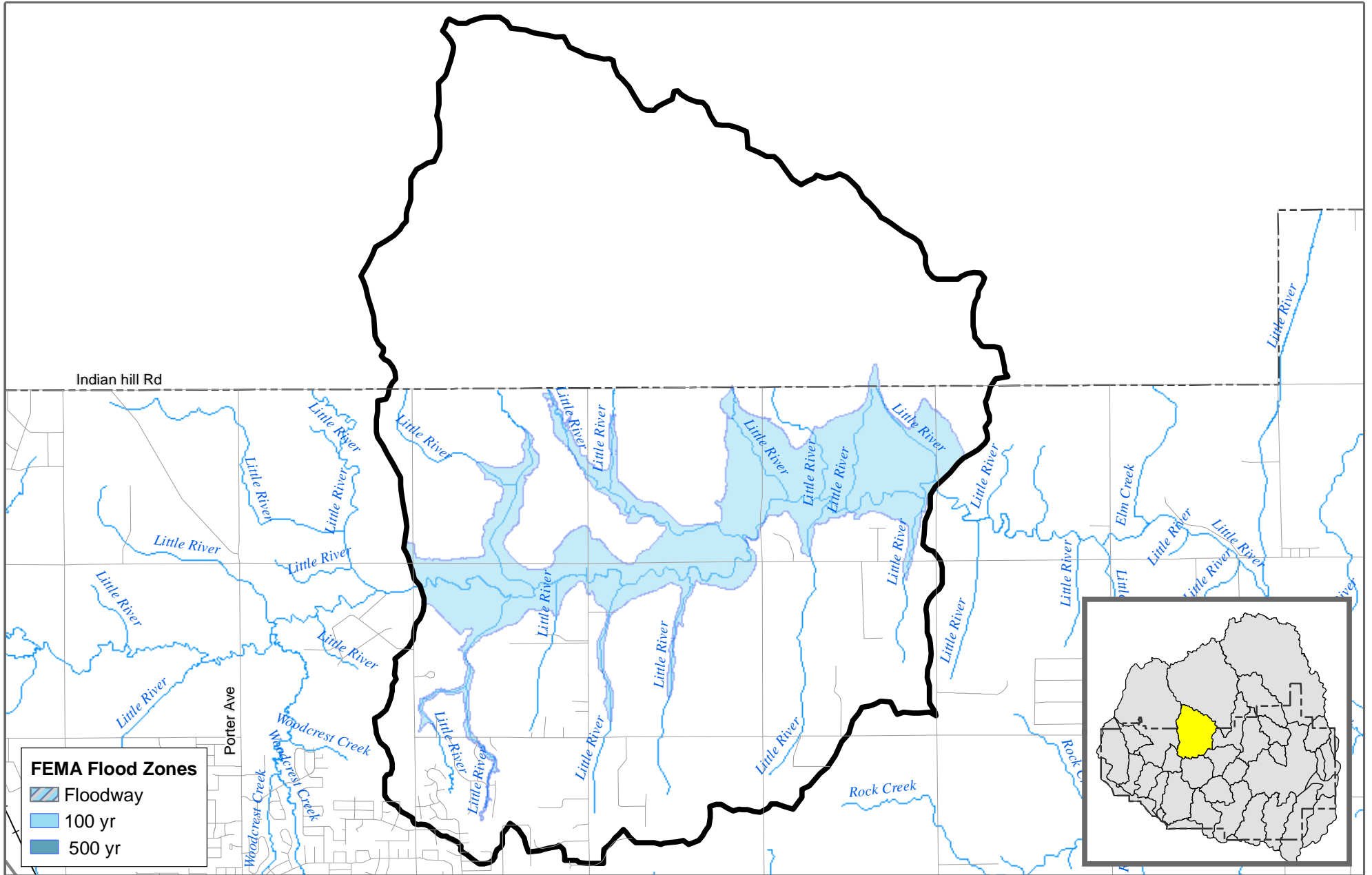


**City of Norman Stormwater Master Plan  
Upper Mid Little River**

**Projected 2025 Landuse**

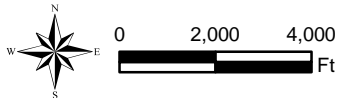
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Prepared By: Vieux & Associates, Inc.



**FEMA Flood Zones**

- Floodway
- 100 yr
- 500 yr

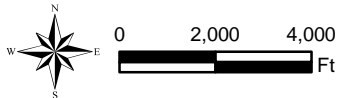
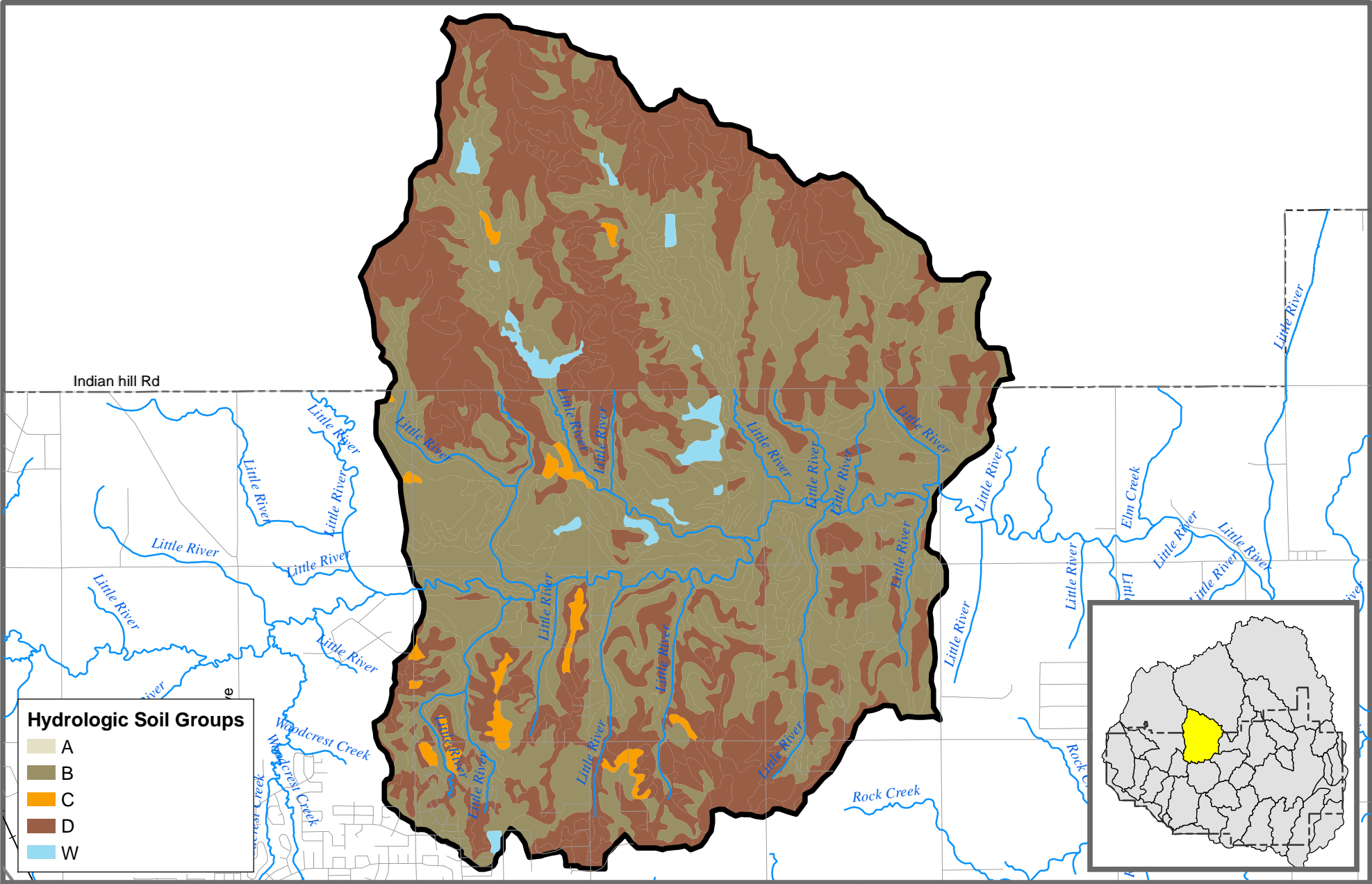


**City of Norman Stormwater Master Plan  
Upper Mid Little River**

**FEMA Flood Zones**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**City of Norman Stormwater Master Plan  
Upper Mid Little River**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



Drainage Area (sq. mi.): 12.54

### Current Zoning

Zoning	Percentage
A-2: Rural Agricultural	78.47%
C-1: Local Commercial	0.36%
C-2: General Commercial	0.51%
C-O: Suburban Office Commercial	0.04%
I-1: Light Industrial	0.33%
O-1: Office-Institutional	0.48%
PL: Park Land	0.83%
PUD: Planned Unit Development	1.81%
R-1: Single Family Dwelling	12.66%
RE: Residential Estates	0.64%
RM-2: Low Density Apartment	0.19%
RM-6: Medium Density Apartment	0.06%
T: Transportation	3.61%

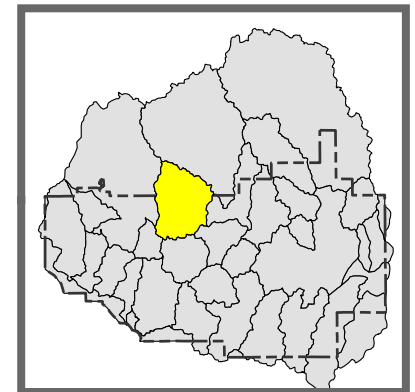
### Projected Landuse

Landuse	Percentage
Commercial	1.27%
Country Residential	32.7%
Floodplain	13.3%
High Density Residential	0.05%
Industrial	0.33%
Institutional	0.6%
Low Density Residential	17.58%
Medium Density Residential	0.25%
Office	0.05%
Open	17.05%
Park	0.83%
Transportation	3.6%
Very Low Density Residential	12.38%

Hydrologic Soil Group	Percentage
B	57.0%
C	1.3%
D	40.3%
W	1.4%

FEMA Flood Zone	Percentage
100	13.6%

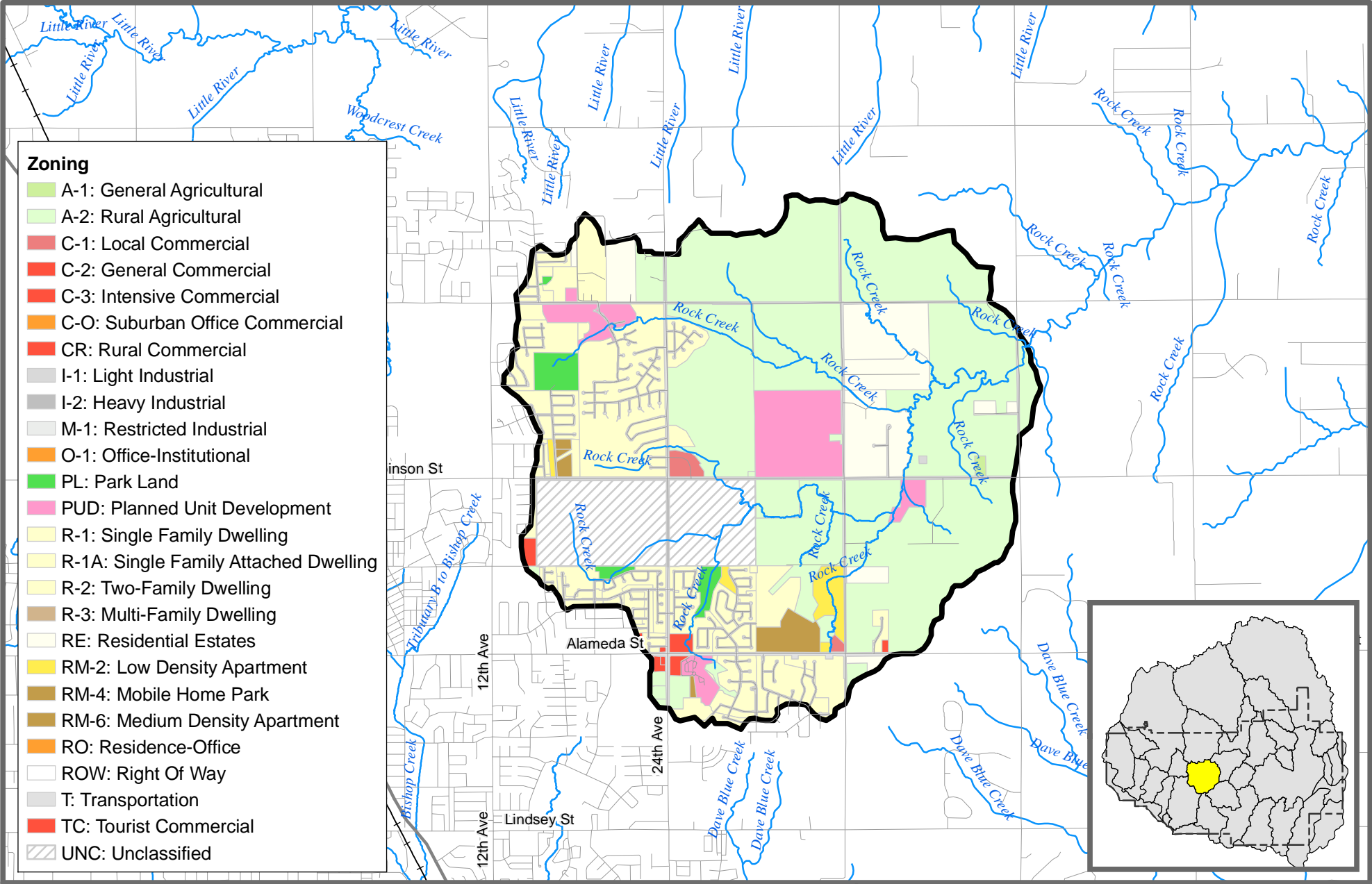
Impervious (%): 3.5



## City of Norman Stormwater Master Plan Upper Mid Little River

### Basin Statistics

Prepared By: Vieux & Associates, Inc.

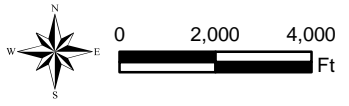


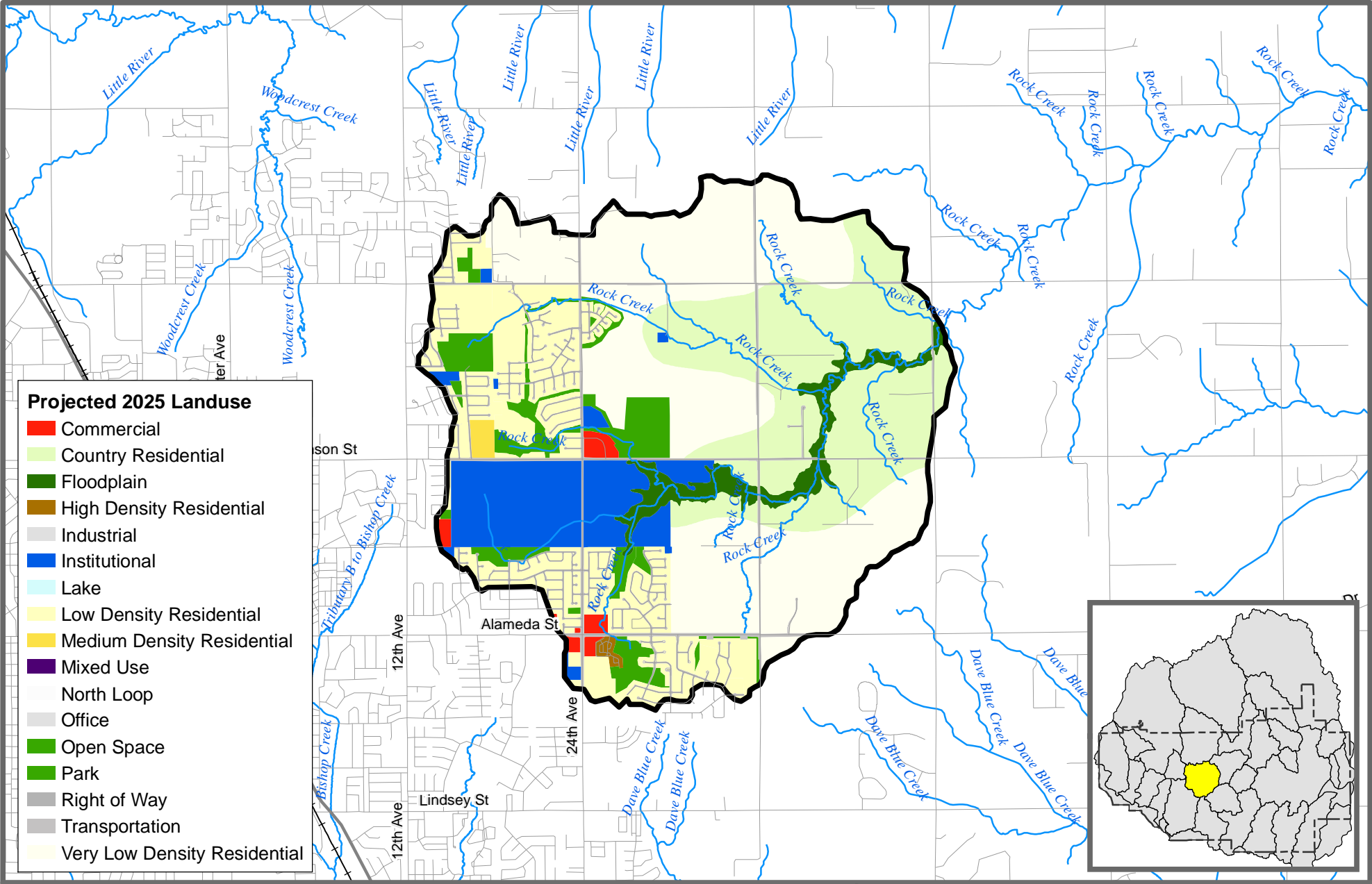
**City of Norman Stormwater Master Plan  
Upper Rock Creek**

**Current Zoning**

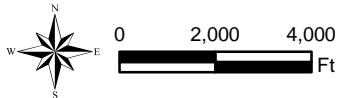
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Prepared By: Vieux & Associates, Inc.





- Projected 2025 Landuse**
- Commercial
  - Country Residential
  - Floodplain
  - High Density Residential
  - Industrial
  - Institutional
  - Lake
  - Low Density Residential
  - Medium Density Residential
  - Mixed Use
  - North Loop
  - Office
  - Open Space
  - Park
  - Right of Way
  - Transportation
  - Very Low Density Residential

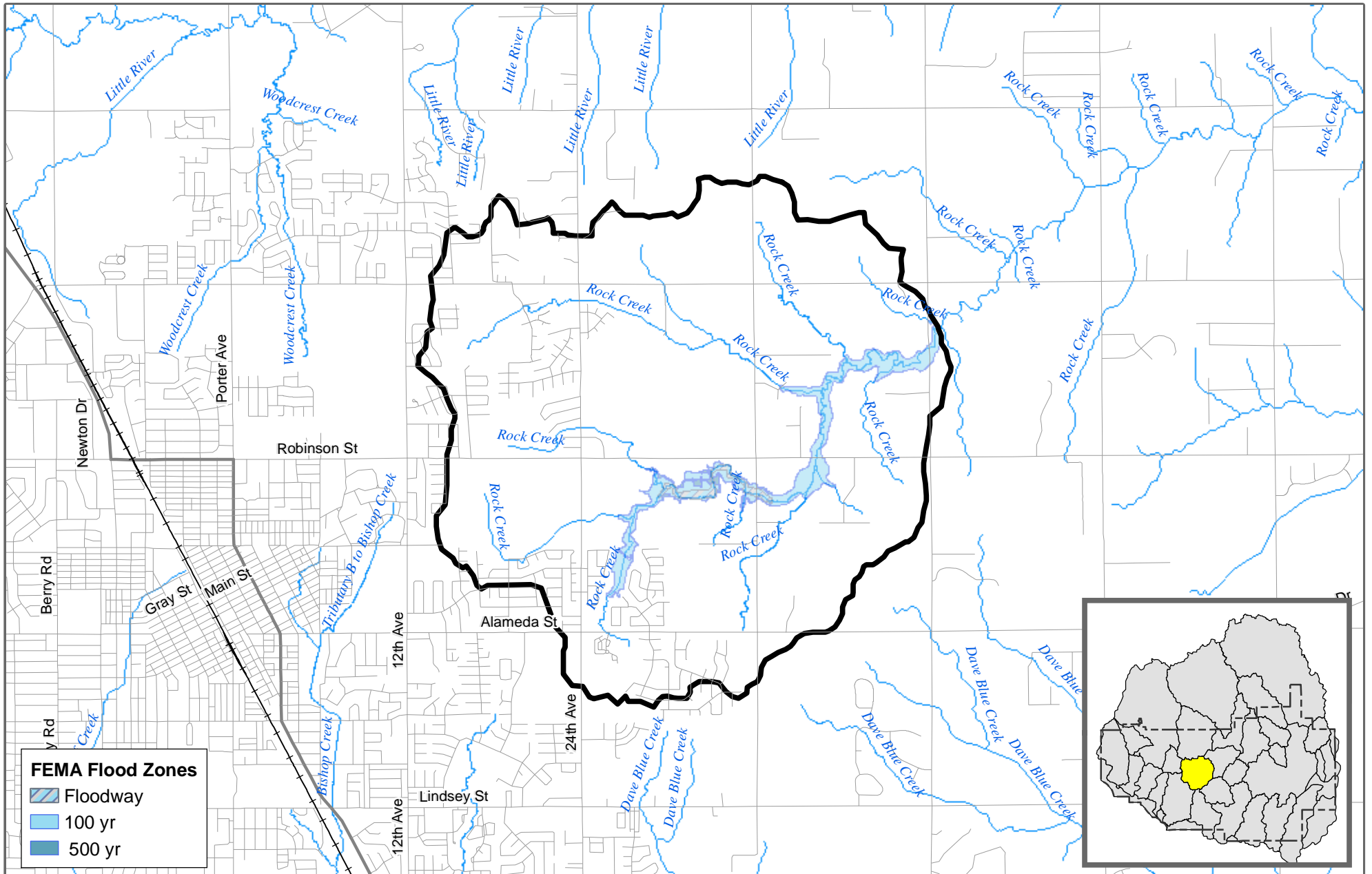


**City of Norman Stormwater Master Plan  
Upper Rock Creek**


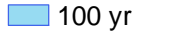

**Projected 2025 Landuse**

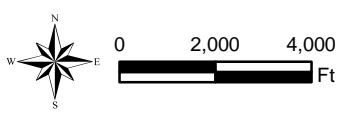
Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**FEMA Flood Zones**

-  Floodway
-  100 yr
-  500 yr

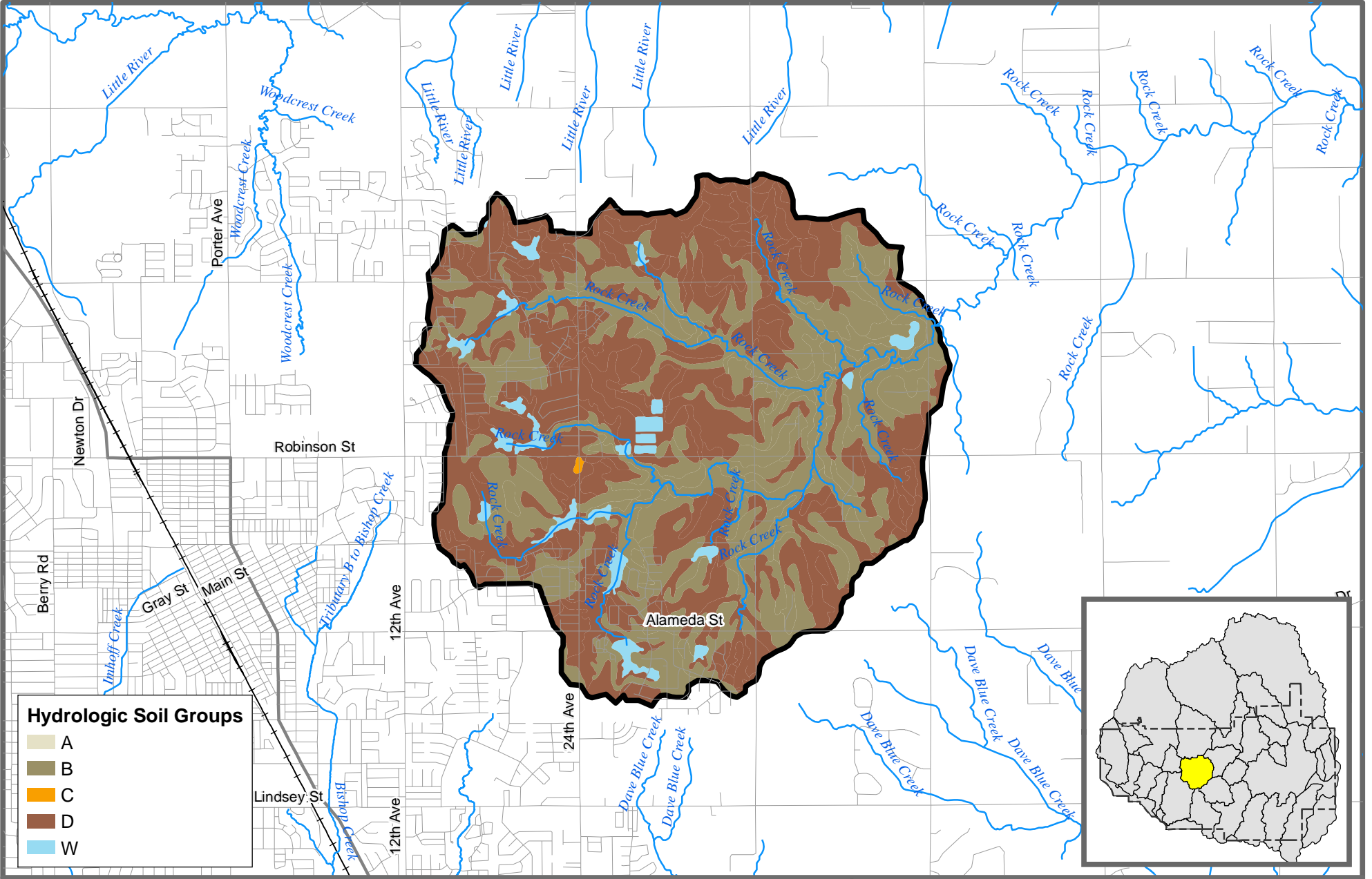


**City of Norman Stormwater Master Plan  
Upper Rock Creek**

**FEMA Flood Zones**

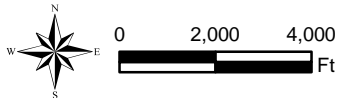
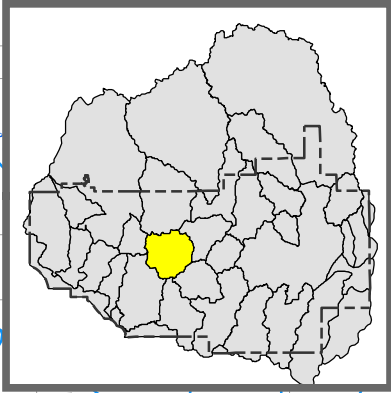
Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

- A
- B
- C
- D
- W



**City of Norman Stormwater Master Plan  
Upper Rock Creek**

**Hydrologic Soil Groups**

Scale: 1:48,000      Prepared By: Vieux & Associates, Inc.

Drainage Area (sq. mi.): 6.69

**Current Zoning**

**Projected Landuse**

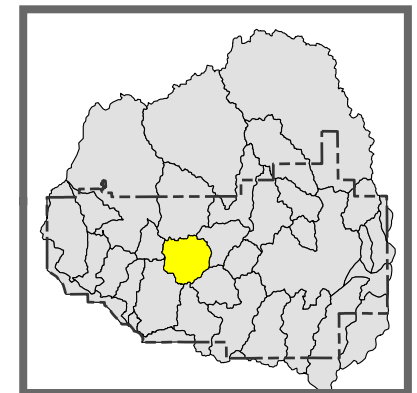
Zoning	Percentage
A-1: General Agricultural	0.11%
A-2: Rural Agricultural	45.72%
C-1: Local Commercial	0.46%
C-2: General Commercial	0.66%
C-O: Suburban Office Commercial	0.01%
CR: Rural Commercial	0.04%
I-1: Light Industrial	0.03%
PL: Park Land	1.42%
PUD: Planned Unit Development	5.65%
R-1: Single Family Dwelling	20.48%
R-1A: Single Family Attached Dwelling	0.15%
RE: Residential Estates	7.61%
RM-2: Low Density Apartment	1.08%
RM-6: Medium Density Apartment	1.28%
T: Transportation	6.27%
UNC: Unclassified	9.03%

Landuse	Percentage
Commercial	1.03%
Country Residential	23.31%
Floodplain	3.95%
High Density Residential	0.25%
Institutional	9.37%
Low Density Residential	16.83%
Medium Density Residential	0.43%
Open	3.71%
Park	2.39%
Transportation	6.16%
Very Low Density Residential	32.57%

Hydrologic Soil Group	Percentage
B	43.0%
C	0.1%
D	53.9%
W	3.0%

FEMA Flood Zone	Percentage
100	3.7%
500	3.9%
Floodway	0.4%

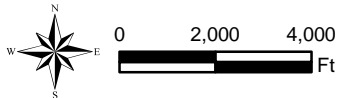
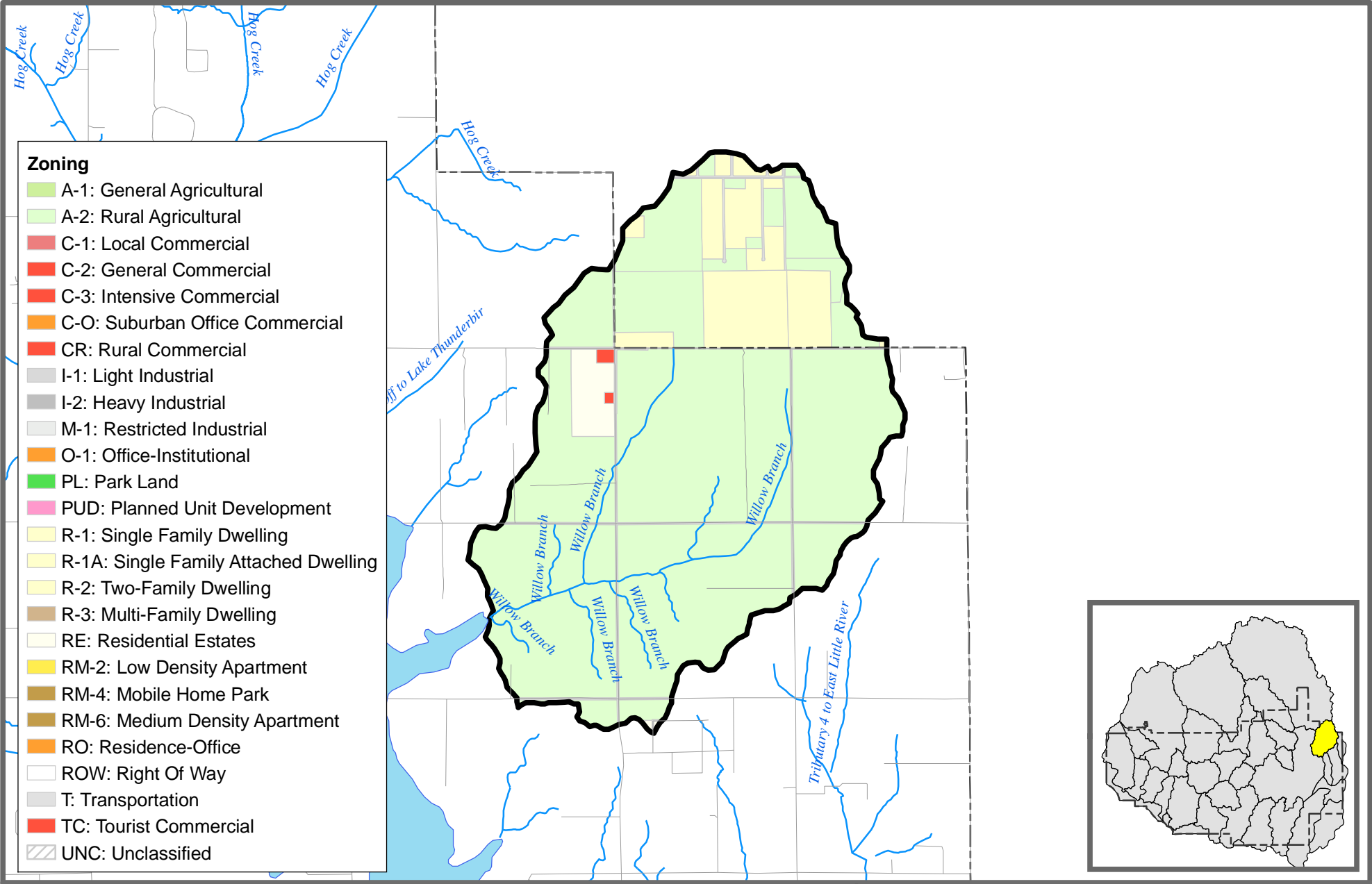
Impervious (%): 9.0



**City of Norman Stormwater Master Plan  
Upper Rock Creek**

**Basin Statistics**

Prepared By: Vieux & Associates, Inc.

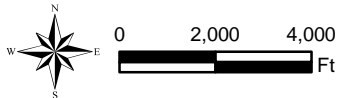
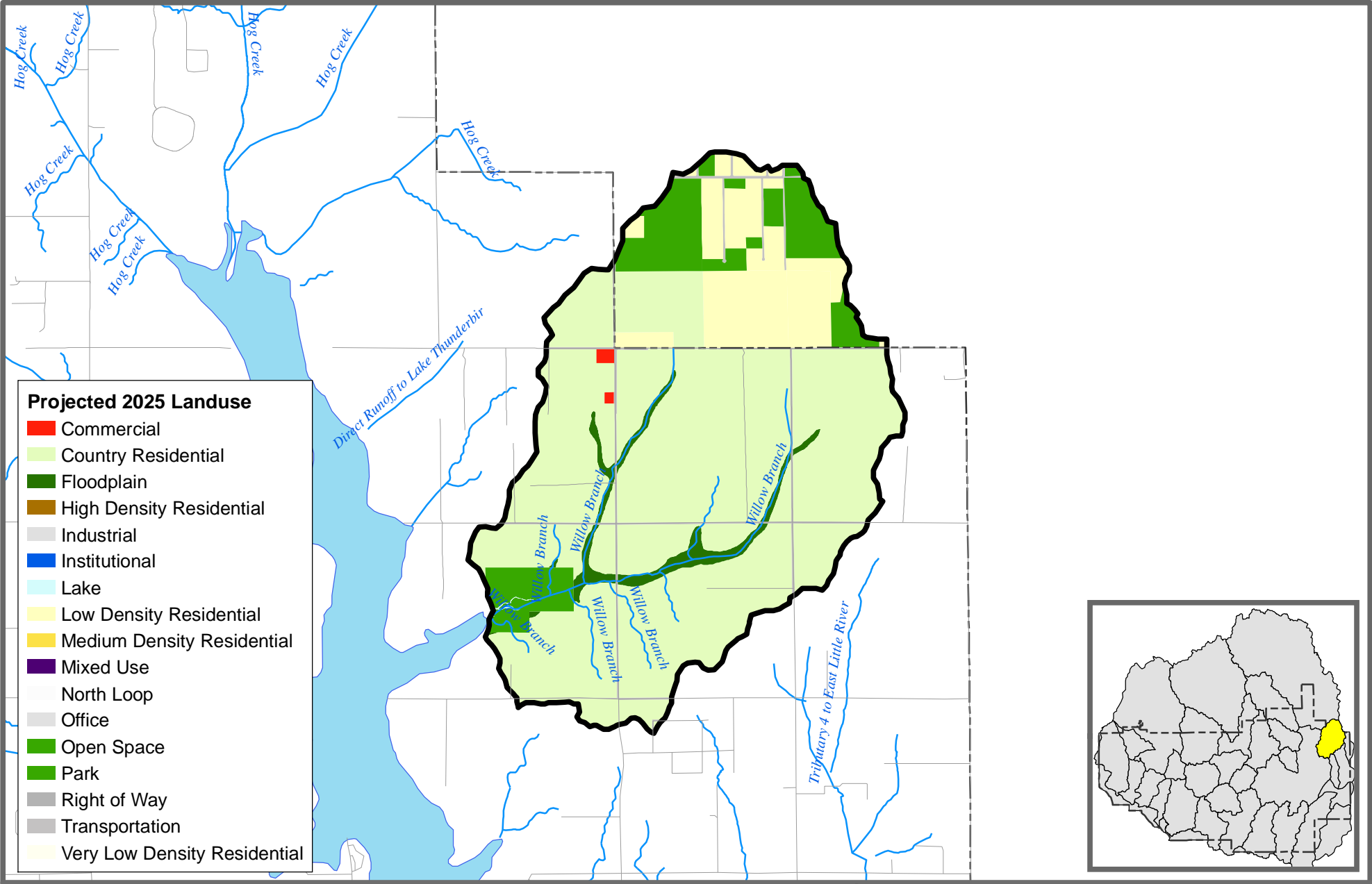


**City of Norman Stormwater Master Plan  
Willow Branch**

**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



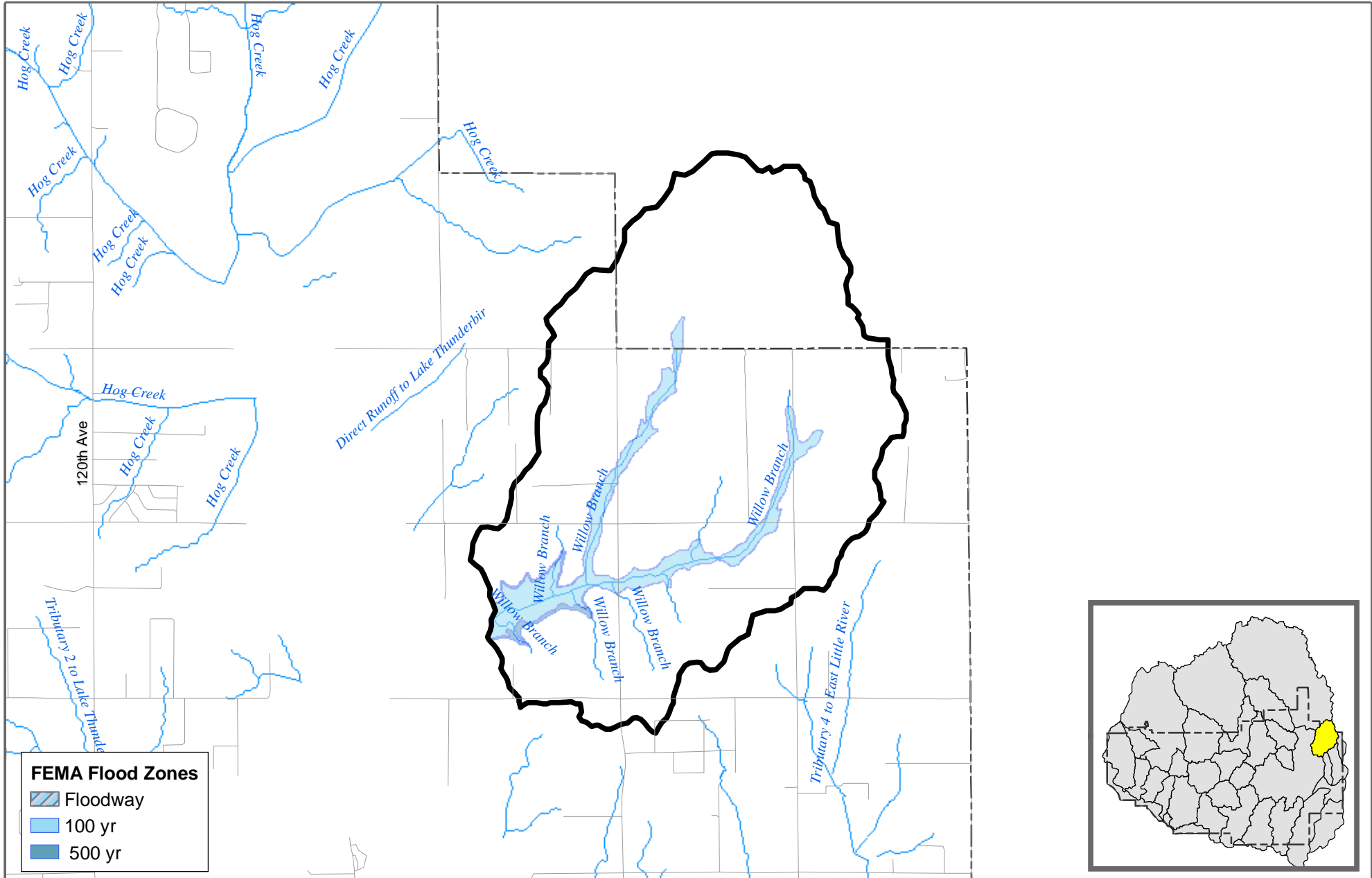
**City of Norman Stormwater Master Plan  
Willow Branch**

**Projected 2025 Landuse**




Scale: 1:48,000

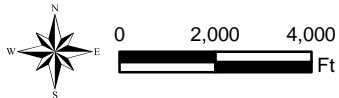
Prepared By: Vieux & Associates, Inc.





**FEMA Flood Zones**

-  Floodway
-  100 yr
-  500 yr

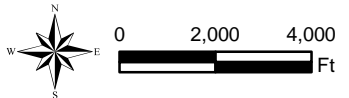
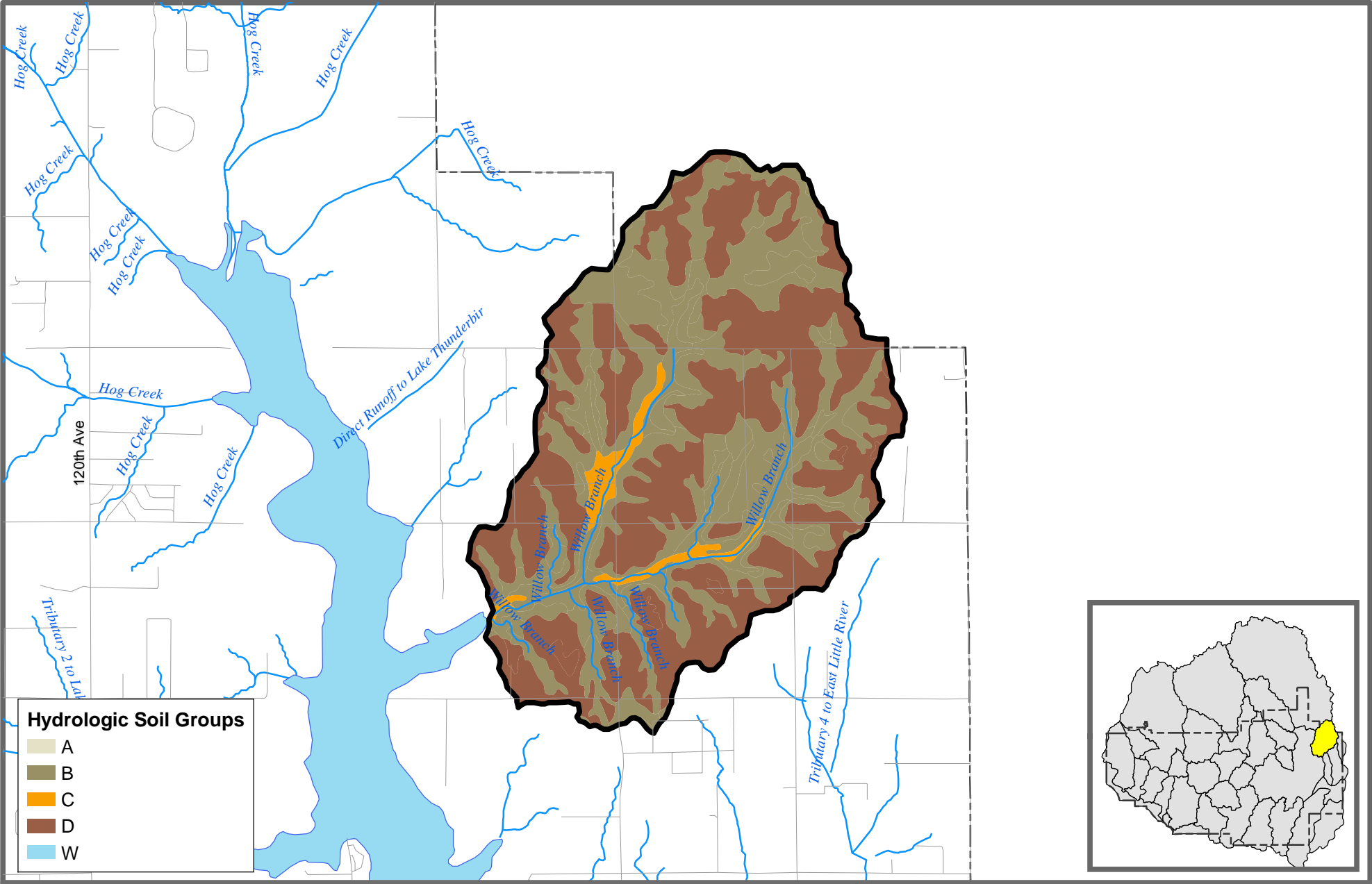


**City of Norman Stormwater Master Plan  
Willow Branch**

**FEMA Flood Zones**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



**City of Norman Stormwater Master Plan  
Willow Branch**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

**Drainage Area (sq. mi.): 5.09**

**Current Zoning**

Zoning	Percentage
A-2: Rural Agricultural	83.77%
CR: Rural Commercial	0.07%
R-1: Single Family Dwelling	11.16%
RE: Residential Estates	2.22%
ROW: Right Of Way	0.09%
T: Transportation	2.53%
TC: Tourist Commercial	0.16%

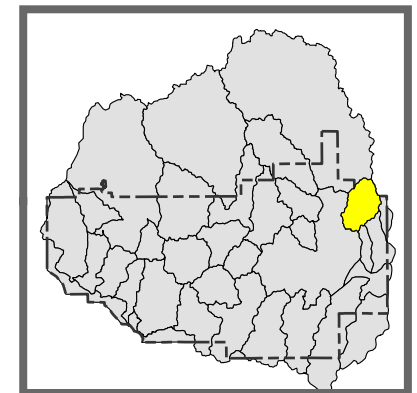
**Projected Landuse**

Landuse	Percentage
Commercial	0.22%
Country Residential	71.09%
Floodplain	3.17%
Lake/ Floodplain	0.05%
Low Density Residential	11.9%
Open	8.16%
Park	2.88%
Transportation	2.52%

Hydrologic Soil Group	Percentage
B	47.9%
C	2.8%
D	49.3%

FEMA Flood Zone	Percentage
100	6.9%
500	7.4%

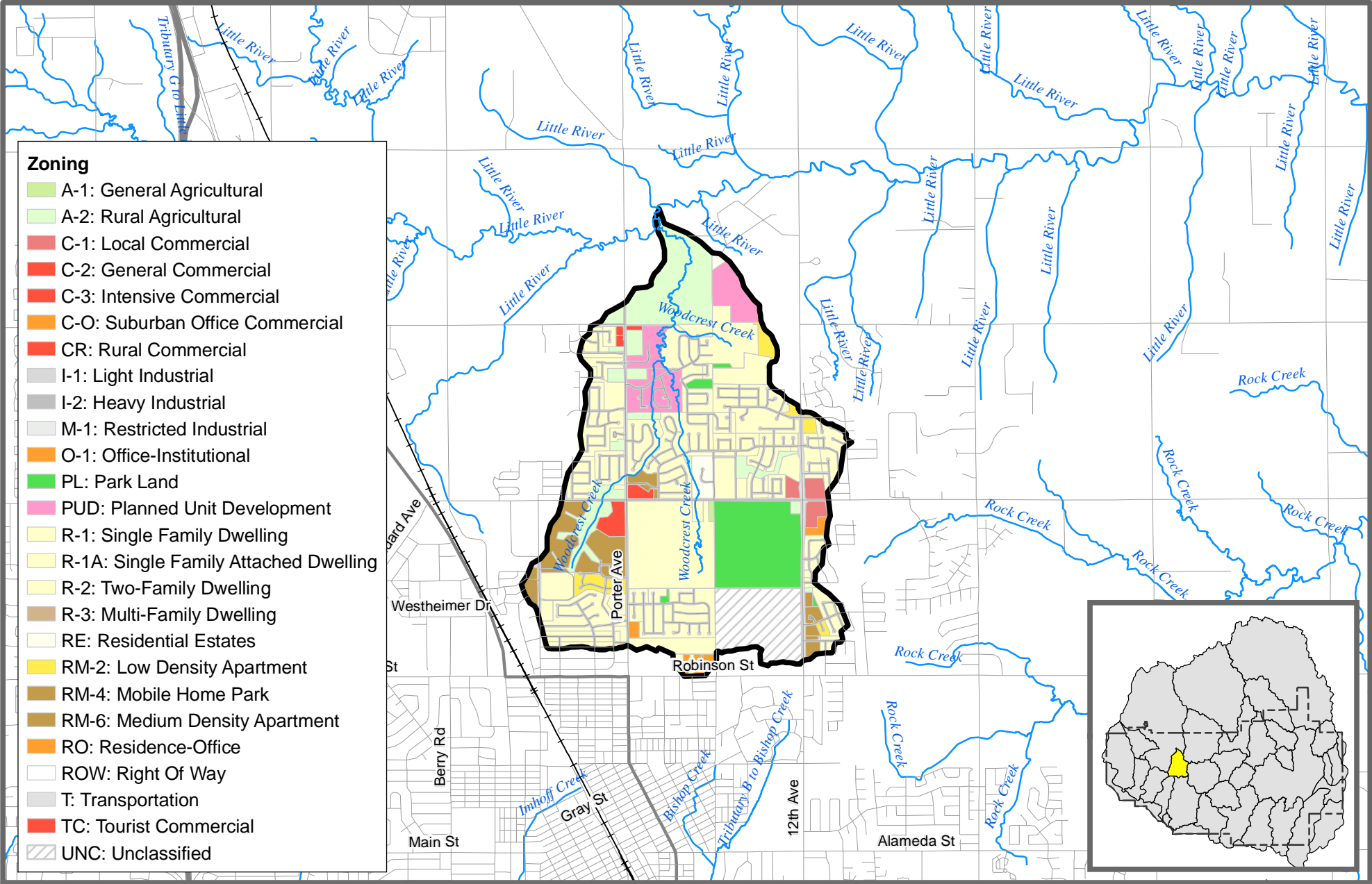
**Impervious (%): 2.3**



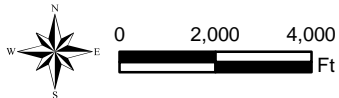
**City of Norman Stormwater Master Plan  
Willow Branch**

**Basin Statistics**

Prepared By: Vieux & Associates, Inc.



- Zoning**
- A-1: General Agricultural
  - A-2: Rural Agricultural
  - C-1: Local Commercial
  - C-2: General Commercial
  - C-3: Intensive Commercial
  - C-O: Suburban Office Commercial
  - CR: Rural Commercial
  - I-1: Light Industrial
  - I-2: Heavy Industrial
  - M-1: Restricted Industrial
  - O-1: Office-Institutional
  - PL: Park Land
  - PUD: Planned Unit Development
  - R-1: Single Family Dwelling
  - R-1A: Single Family Attached Dwelling
  - R-2: Two-Family Dwelling
  - R-3: Multi-Family Dwelling
  - RE: Residential Estates
  - RM-2: Low Density Apartment
  - RM-4: Mobile Home Park
  - RM-6: Medium Density Apartment
  - RO: Residence-Office
  - ROW: Right Of Way
  - T: Transportation
  - TC: Tourist Commercial
  - UNC: Unclassified

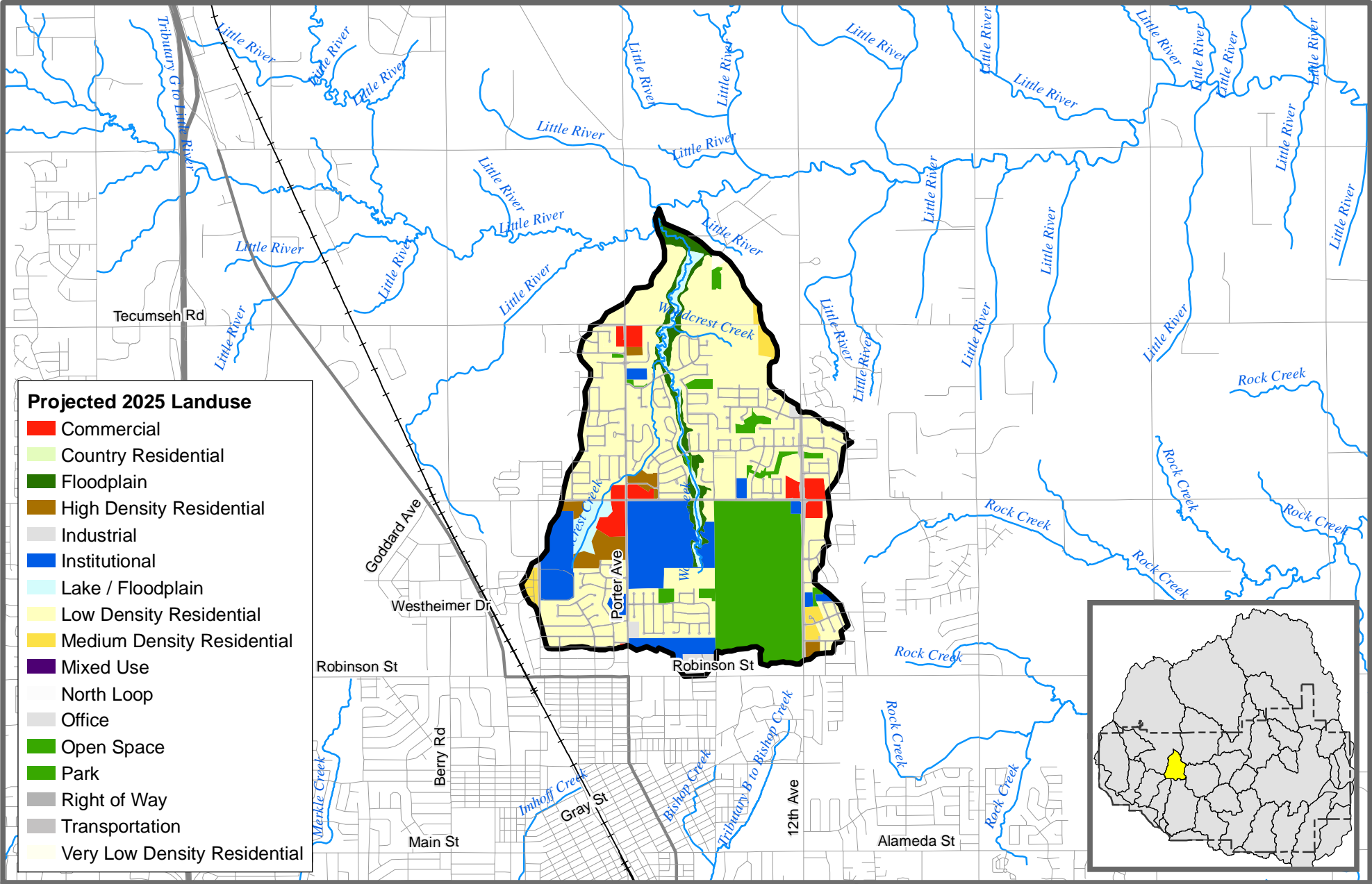


**City of Norman Stormwater Master Plan  
Woodcrest Creek**

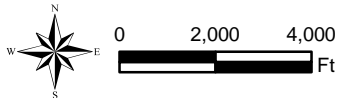
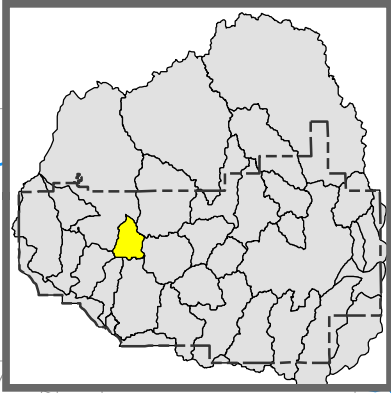
**Current Zoning**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.



- Projected 2025 Landuse**
- Commercial
  - Country Residential
  - Floodplain
  - High Density Residential
  - Industrial
  - Institutional
  - Lake / Floodplain
  - Low Density Residential
  - Medium Density Residential
  - Mixed Use
  - North Loop
  - Office
  - Open Space
  - Park
  - Right of Way
  - Transportation
  - Very Low Density Residential

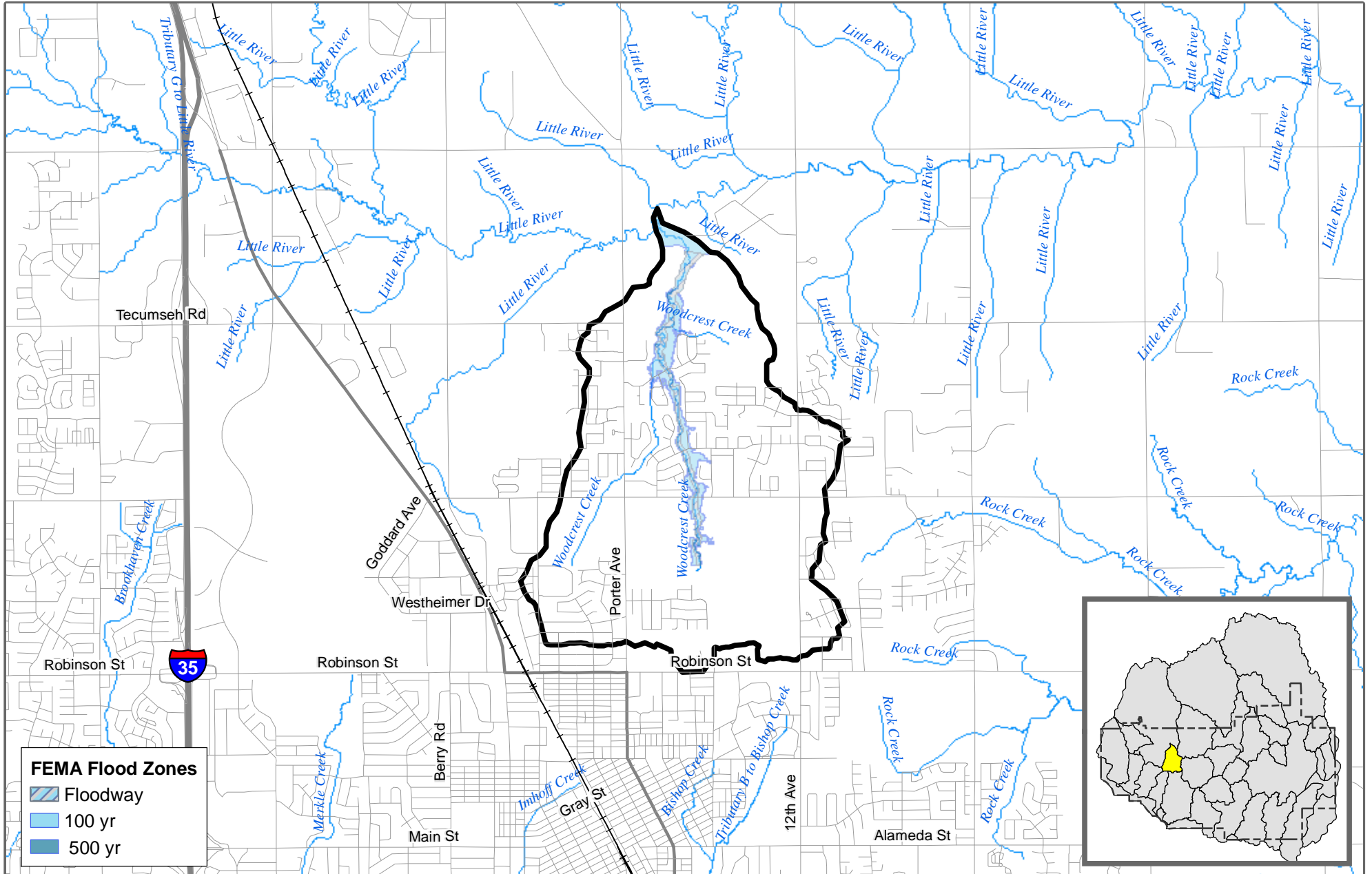


**City of Norman Stormwater Master Plan  
Woodcrest Creek**




**Projected 2025 Landuse**

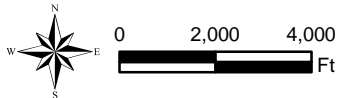
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Prepared By: Vieux & Associates, Inc.



**FEMA Flood Zones**

-  Floodway
-  100 yr
-  500 yr



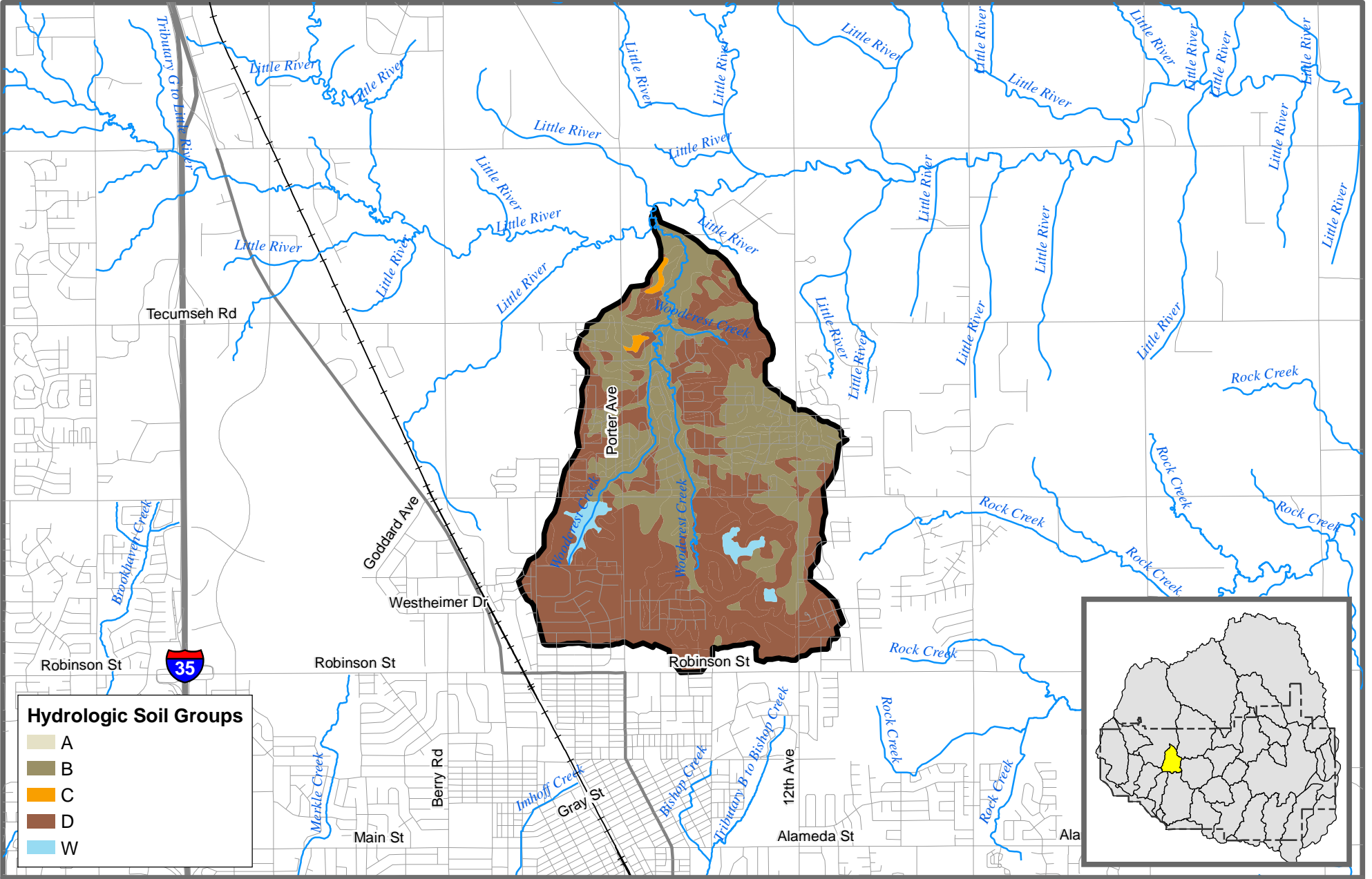
**City of Norman Stormwater Master Plan  
Woodcrest Creek**

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**FEMA Flood Zones**

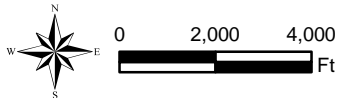
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Scale: 1:48,000      Prepared By: Vieux & Associates, Inc.



**Hydrologic Soil Groups**

	A
	B
	C
	D
	W



**City of Norman Stormwater Master Plan  
Woodcrest Creek**

**Hydrologic Soil Groups**

Scale: 1:48,000

Prepared By: Vieux & Associates, Inc.

Drainage Area (sq. mi.): 3.01

### Current Zoning

Zoning	Percentage
A-1: General Agricultural	0.12%
A-2: Rural Agricultural	10.94%
C-1: Local Commercial	1.22%
C-2: General Commercial	1.25%
C-3: Intensive Commercial	0.02%
C-O: Suburban Office Commercial	0.8%
M-1: Restricted Industrial	0.03%
O-1: Office-Institutional	0.18%
PL: Park Land	8.39%
PUD: Planned Unit Development	5.07%
R-1: Single Family Dwelling	45.33%
R-1A: Single Family Attached Dwelling	0.38%
RE: Residential Estates	1.08%
RM-2: Low Density Apartment	1.89%
RM-4: Mobile Home Park	0.47%
RM-6: Medium Density Apartment	4.82%
T: Transportation	11.6%
TC: Tourist Commercial	0.07%
UNC: Unclassified	6.32%

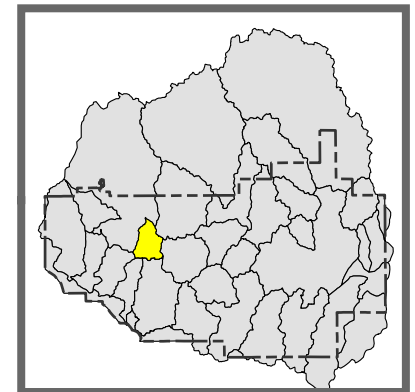
### Projected Landuse

Landuse	Percentage
Commercial	2.91%
Floodplain	3.38%
High Density Residential	2.37%
Industrial	0.03%
Institutional	11.33%
Lake/ Floodplain	3.12%
Low Density Residential	46.11%
Medium Density Residential	1.62%
Office	0.91%
Open	0.83%
Park	15.53%
Transportation	11.7%
Very Low Density Residential	0.17%

Hydrologic Soil Group	Percentage
B	38.4%
C	0.5%
D	59.1%
W	2.0%

FEMA Flood Zone	Percentage
100	5.2%
500	5.4%
Floodway	2.0%

Impervious (%): 20.9



## City of Norman Stormwater Master Plan Woodcrest Creek

### Basin Statistics

Prepared By: Vieux & Associates, Inc.



A serene landscape photograph of a sunset over a calm body of water. The sun is a bright, glowing orb on the horizon, partially obscured by a dark silhouette of a forested shoreline. The sky is a gradient of warm colors, from pale yellow near the sun to a soft blue-grey at the top. The water's surface is still, reflecting the sun and the sky, creating a shimmering path of light. A small, dark vertical post or marker is visible in the water on the left side. The overall mood is peaceful and natural.

# STORM WATER MASTER PLAN

**Storm Water Master Plan  
City of Norman  
Cleveland County, Oklahoma**

**October 2009**

**Appendix F**

**Hydrologic and Hydraulic Modeling Support Data**





## MEMORANDUM

**To:** Shawn O'Leary, Bob Hanger, Pat Copeland  
**From:** Duke Altman, Paul Morales, Karl McArthur  
**Date:** 6/12/08  
**Subject:** Norman SWMP – Imhoff Creek Hydrology Subarea Discrepancies

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The purpose of this memo is to document discrepancies found regarding subareas missing in the hydrologic (HEC-1) model provided to PBS&J for the SWMP project. Figure 1 shows the full watershed subarea delineation for Imhoff Creek and identifies two subareas that are missing in the hydrologic model. The situation is somewhat confusing since watershed subbasins have been subdivided and renamed differently with the various related reports. We have worked through the confusion as much as we can but please realize that some confusing numbering may remain when considering one report's naming scheme versus another's.

The primary subarea issues identified in the 2001/2006 LOMR model provided by the City to PBS&J for use in the SWMP Project are as follows:

1. Subarea I-10A as identified in the 2001/2006 LOMR model and attached watershed map (primarily the area north of Lindsey – this corresponds to the combination of subareas of I-10A1, I-10A2A, I-10A2B, and I-10A2C used in PBS&J's modeling for solutions as shown in Figures 1 and 2) is missing approximately 27.7 acres that should be included based on the subarea delineation and comparison with the 1997 Baldischwiler report (see attached). This missing subarea probably corresponds to the area I-10A1 identified in the Baldischwiler report (and as included in the revised PBS&J delineation) as being rerouted to drain into Merkle Creek as per Phase II of the Baldischwiler report. This area is shown on the attached Figures 1 and 2.
2. Subarea I-11 (approximately 5.4 acres and a ) as shown in Figures 1 and 2 as well as the watershed map for the 2001/2006 LOMR (see attached) is not included in the corresponding HEC-1 2001/2006 LOMR model provided to PBS&J for the SWMP project. This subarea is actually a remnant from a larger Subarea I-11 from the 1997 LOMR model that was subdivided into areas I-11A and I-11 in the 1997 Baldischwiler report and further subdivided into areas H, I, J, K, L, M, N and O in the 2001/2006 LOMR model.

The following is a more detailed discussion of our evaluations related to these issues.

The 1997 LOMR HEC-1 model has areas of 241.28, 141.31 and 127.17 acres for subareas I-10A (north of Lindsey), I-10B (south of Lindsey) and I-11 respectively.

Subarea I-10A in the LOMR model corresponds to a combination of subareas I-10A1 and I-10A2 from the Baldischwiler Phase I and II/III models and area I-10A in the model provided to PBS&J by the City. However, the combination of areas I-10A1 (37.63ac) and I-10A2 (241.37ac) from the Phase I and II/III models yield a total area of 279 acres, which is greater than the I-10A area (241.28) in the LOMR and City models by 37.72 acres (close to the area

Baldischwiler sends to Merkle Creek in their Phase II/III model). Our GIS layer gives a total area of 276.47 acres for the area corresponding to I-10A which is close to the Baldischwiler numbers. Since we have been using the model sent to us by the City, our PBS&J model currently has an area of 248.82 which excludes 27.7 acres that would drain to Merkle Creek under the Baldischwiler Phase II plan. We believe that we will need to modify our subarea acreages to more closely compare to the Baldischwiler and PBS&J GIS determinations but want your concurrence.

Subarea I-11 (127.17ac) in the 1997 LOMR model corresponds to subareas I-11A (43.2ac) and I-11B (84.42ac) in the Baldischwiler Phase I and II/III models. These areas match within 0.5 acres. Subarea I-11 is roughly equivalent to subareas H, I, J, K, L (I-11A) and M, N, O (I-11B) in the model provided by the City. The GIS watershed layer for this model includes a small remnant of subarea I-11 (5.4 acres) that is still labeled as I-11. This remnant subarea does not appear to be included in the HEC-1 model provided by the City.

### Total Drainage Areas

1997 LOMR Model = 3.37 square miles (2156.8 acres)  
Baldischwiler Phase I = 3.39 square miles (2169.6 acres)  
Baldischwiler Phase II/III = 3.39 square miles (2169.6 acres)  
City Model (2001/2006 LOMR) = 3.33 square miles (2129.45.2 acres)  
PBS&J Model = 3.34 square miles (2136.19 acres)  
GIS Layer = 3.37 square miles (2159.6 acres)

Based on our discovery of missing subareas within the hydrologic model provided by the City, it is our recommendation that the existing model be revised to include the additional identified areas (subareas I-10A1 and I-11). Due to the increase in runoff to Imhoff Creek, our flooding solutions will have to be based on the revised hydrologic model rather than effective FEMA hydrologic model. Please let us know if you concur with our recommendations.

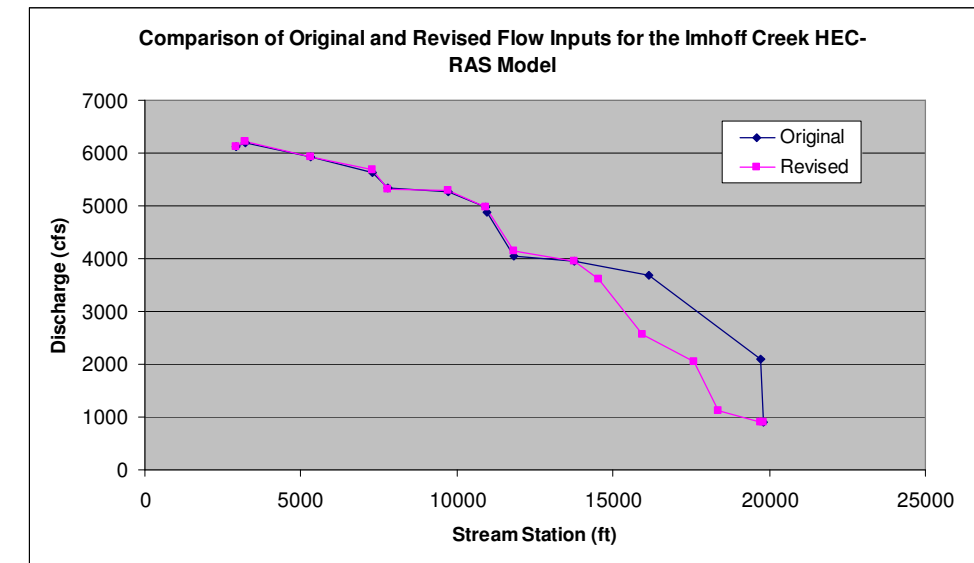


## MEMORANDUM

**To:** Shawn O'Leary, Bob Hanger, Pat Copeland  
**From:** Duke Altman, Paul Morales, Karl McArthur  
**Date:** 6/10/08  
**Subject:** Norman SWMP – Imhoff Creek HEC-RAS Model Revisions

The purpose of this memo is to document a number of issues that were identified with the Imhoff Creek HEC-RAS model during the development of solutions. The identified issues and the model modifications in order to address them are described below.

1. The 2006 LOMR hydraulic model for the articulated block improvements was a truncated portion of the total stream model that only extended a short distance beyond the upstream and downstream limits of the improvements.
  - a. The 2006 LOMR model geometry was merged with the 1997 LOMR geometry in order to produce an existing condition model for the entire length of Imhoff Creek.
2. The downstream boundary condition in the flow file was set based on an assumed water surface elevation that was significantly lower than normal depth.
  - a. The downstream boundary condition was changed from a known water surface elevation to normal depth.
3. Overbank n-values were generally too low through out the creeks lengths as were channel n-values in the lower, natural reaches of the creek.
  - a. The overbank and channel n-values were modified to better represent more standard roughness conditions. The need for these modifications was discussed with the City on May 6, 2008 during a conference call.
  - b. A comparison of the original and revised roughness coefficients is shown in Table 1.
4. The HEC-1 peak flow input locations in the original HEC-RAS model were overly conservative. In addition, the HEC-1 basins were further subdivided in order to model the proposed improvements. This subdivision led to further refinements of the HEC-1 flow input locations.
  - a. The flow inputs, primarily in the portion of Imhoff Creek upstream of Boyd, were modified based on revisions of the combination points and the subdivision of catchment I-2 in the HEC-1 model.
  - b. The difference in flows is shown in the following figure.



5. The culvert length under Main Street and the location of the school footbridge downstream of Main Street were incorrect in the model as received from the City. These structures, as modeled in the LOMR model produced crossing water surface profiles.
  - a. Cross sections 16756, 16645, 16617, 16565, and 16155 in the combined LOMR model were replaced with new sections 16606, 16453, 16306, 16294, and 15927 derived from the 2007 topographic data.
  - b. The Main Street culvert length was increased to 265 feet from the incorrect 126 feet value in the original model received from the City. This length includes the driveway culvert that is slightly separated from the main culvert at the downstream end.
  - c. The school footbridge was added back to the model between sections 16306 and 16294.
  - d. The revised modeling eliminated crossing profiles at this location.
6. The LOMR model included set water surface elevations at cross section 11840.
  - a. These set elevations were cleared from the flow file for the model.
7. The road deck for Flood was incorrectly modeled in the LOMR model. The bridge deck had essentially no thickness. This produced crossing profiles at this location.
  - a. The deck for Flood was modified based on photographs of the structure and the 2007 topographic data. This modification resolved the crossing profiles.
8. The combined LOMR model had unnecessary ineffective areas set for sections upstream of Lindsey.
  - a. These ineffective settings (probably representing houses) are better modeled with the increased overbank n-values.
  - b. Ineffective settings were added to the upstream and downstream faces of Lindsey and the cross section immediately upstream to model the contraction and expansion of flow through the crossing.
  - c. These changes removed an area of drawdown upstream of Lindsey that was present in the original model.

9. The combined LOMR model did not adequately account for the presence of buildings in the overbanks between Main Street and Tonhawa.
  - a. Ineffective flow settings were added to directly reflect the influence of the large commercial buildings in this area.
  
10. The downstream reach lengths at sections 18915 and 18263 were incorrect in the model. These issues were originally identified through a comparison of the River Stations in the RAS model with the cumulative reach lengths from the upstream face of a structure to the upstream face of the next downstream structure. The discrepancies were confirmed by measurements on the aerial photographs for the area.
  - a. Section 18915 – The downstream reach lengths were corrected from 338 feet to 169 feet (LOB, Channel and ROB).
  - b. Section 18072 – The downstream reach lengths were corrected from 103 feet to 189 feet (LOB, Channel and ROB).
  
11. The original model forced the selection of inlet control at a majority of the modeled culvert crossings (Lindsey specified as outlet control, the remainder were specified as inlet control). This was producing artificially high water surface elevations in most cases.
  - a. The modeling option was switched to the selection of the highest energy answer (inlet or outlet control) since many of the crossings are controlled by the impacts of downstream backwater rather than the inlet capacity of the culvert.
  
12. The original model used a weir coefficient of 1 for the roadway at a majority of the crossings (Imhoff, SH 9 and Bridge #1 have coefficients of 2.6 or 3.0, the remainder had coefficients of 1). These overly conservative coefficients caused water to back up higher behind the crossings in the model than would realistically occur.
  - a. The weir coefficient for the roadways was changed to a more typical value of 2.6.
  
13. The ground elevations in the cross section at the most downstream end of the original model do not appear to be extended correctly on the right overbank. Also, several of these cross sections show a low area on the left overbank which should not convey flow and be modeled as a blocked obstruction.
  - a. The cross sections that were extended using the 2007 topographic data are RS 2011, 2001, 1450, 1200, and 850.

Based on a comparison of the effective model WSEL to our revised model WSEL (see Table 2), the change in WSEL ranged from a maximum decrease of 1.8 feet to a maximum increase of 2.5 feet. The maximum increase occurred approximately 1,880 feet upstream of Imhoff Road and the 100-year WSEL is contained within the banks of Imhoff Creek and does not impact and adjacent buildings. The differences in water surface elevation and top width are summarized in Table 2. Due to the number of modeling issues we encountered during the development of solutions, it is our recommendation that we base our flooding solutions on our revised hydraulic model rather than effective FEMA hydraulic model. Please let us know if you concur.

Table 1: Revision of Mannings n-values for the Imhoff Creek HEC-RAS Model

Mannings n-values from the composite LOMR model (1997 and 2006)							Revised n-values		
	Reach	River Station	Frctn (n/K)	n #1	n #2	n #3	n #1	n #2	n #3
1	Imhoff Creek	19798	n	0.04	0.015	0.04	0.045	0.015	0.05
2	Imhoff Creek	19780.5	Culvert	A.T.S.F Railroad					
3	Imhoff Creek	19763	n	0.04	0.015	0.04	0.045	0.015	0.05
4	Imhoff Creek	19723	n	0.04	0.015	0.04	0.045	0.015	0.05
5	Imhoff Creek	19209	n	0.04	0.015	0.04	0.045	0.015	0.05
6	Imhoff Creek	19198.5	Bridge	Foot Bridge					
7	Imhoff Creek	19189	n	0.04	0.015	0.04	0.045	0.015	0.05
8	Imhoff Creek	19179	n	0.04	0.015	0.04	0.045	0.015	0.05
9	Imhoff Creek	19096	n	0.04	0.015	0.04	0.045	0.015	0.05
10	Imhoff Creek	18915	n	0.04	0.015	0.04	0.045	0.015	0.05
11	Imhoff Creek	18746	n	0.04	0.015	0.04	0.045	0.015	0.05
12	Imhoff Creek	18739.5	Bridge	Webster					
13	Imhoff Creek	18720	n	0.04	0.015	0.04	0.06	0.015	0.05
14	Imhoff Creek	18627	n	0.04	0.015	0.04	0.06	0.015	0.05
15	Imhoff Creek	18502	n	0.04	0.015	0.04	0.06	0.015	0.05
16	Imhoff Creek	18495.5	Bridge	Park					
17	Imhoff Creek	18476	n	0.04	0.015	0.04	0.06	0.015	0.08
18	Imhoff Creek	18382	n	0.04	0.015	0.04	0.06	0.015	0.08
19	Imhoff Creek	18288	n	0.04	0.015	0.04	0.06	0.015	0.08
20	Imhoff Creek	18281.7	Culvert	University					
21	Imhoff Creek	18263	n	0.04	0.015	0.04	0.06	0.015	0.08
22	Imhoff Creek	18072	n	0.04	0.015	0.04	0.06	0.015	0.08
23	Imhoff Creek	18062	Culvert	Daws					
24	Imhoff Creek	18032	n	0.04	0.015	0.04	0.08	0.015	0.08
25	Imhoff Creek	17571	n	0.04	0.015	0.04	0.08	0.015	0.08
26	Imhoff Creek	17558.5	Culvert	Tonhawa					
27	Imhoff Creek	17521	n	0.04	0.015	0.04	0.08	0.015	0.08
28	Imhoff Creek	17450	n	0.04	0.015	0.04	0.08	0.015	0.08
29	Imhoff Creek	17380	n	0.04	0.015	0.04	0.08	0.015	0.06
30	Imhoff Creek	17356.5	Culvert	Lahoma					
31	Imhoff Creek	17333	n	0.04	0.015	0.04	0.04	0.015	0.06
32	Imhoff Creek	17323	n	0.04	0.015	0.04	0.04	0.015	0.06
33	Imhoff Creek	17182	n	0.04	0.015	0.04	0.04	0.015	0.06
34	Imhoff Creek	17139.5	Culvert	Gray					
35	Imhoff Creek	17097	n	0.04	0.015	0.04	0.04	0.015	0.04
36	Imhoff Creek	16883	n	0.04	0.015	0.04	0.04	0.015	0.04
37	Imhoff Creek	16819.5	Culvert	Main					
38	Imhoff Creek	16756	n	0.04	0.015	0.04	0.04	0.015	0.04
39	Imhoff Creek	16645	n	0.04	0.015	0.04	0.04	0.015	0.04
40	Imhoff Creek	16631	Bridge	Bridge #11					
41	Imhoff Creek	16617	n	0.04	0.015	0.04	0.04	0.015	0.04
42	Imhoff Creek	16565	n	0.04	0.015	0.04	0.05	0.015	0.05
43	Imhoff Creek	16155	n	0.04	0.015	0.04	0.08	0.015	0.05
44	Imhoff Creek	15578	n	0.04	0.015	0.04	0.08	0.015	0.08
45	Imhoff Creek	15483	n	0.04	0.015	0.04	0.08	0.015	0.08
46	Imhoff Creek	15463.5	Culvert	Symmec					
47	Imhoff Creek	15444	n	0.04	0.015	0.04	0.08	0.015	0.08
48	Imhoff Creek	15243	n	0.04	0.015	0.04	0.08	0.015	0.08
49	Imhoff Creek	15066	n	0.04	0.015	0.04	0.08	0.015	0.08
50	Imhoff Creek	15051	n	0.04	0.015	0.04	0.08	0.015	0.08

Table 1, cont'd

Mannings n-values from the composite LOMR model (1997 and 2006)							Revised n-values		
	Reach	River Station	Frctn (n/K)	n #1	n #2	n #3	n #1	n #2	n #3
51	Imhoff Creek	15016.5	Culvert	Flood					
52	Imhoff Creek	14982	n	0.04	0.015	0.04	0.05	0.015	0.05
53	Imhoff Creek	14972	n	0.04	0.015	0.04	0.05	0.015	0.05
54	Imhoff Creek	14551	n	0.04	0.015	0.04	0.05	0.015	0.05
55	Imhoff Creek	14533	Culvert	McNamee					
56	Imhoff Creek	14516	n	0.04	0.015	0.04	0.05	0.015	0.04
57	Imhoff Creek	14407	n	0.04	0.015	0.04	0.05	0.015	0.04
58	Imhoff Creek	14235	n	0.04	0.015	0.04	0.05	0.015	0.04
59	Imhoff Creek	14059	n	0.04	0.015	0.04	0.05	0.015	0.04
60	Imhoff Creek	14040.5	Culvert	Pickard					
61	Imhoff Creek	14023	n	0.04	0.015	0.04	0.06	0.015	0.05
62	Imhoff Creek	13801	n	0.04	0.015	0.04	0.06	0.015	0.05
63	Imhoff Creek	13800	n	0.04	0.015	0.04	0.06	0.015	0.05
64	Imhoff Creek	13786.5	Culvert	Boyd					
65	Imhoff Creek	13772	n	0.04	0.015	0.04	0.06	0.015	0.05
66	Imhoff Creek	13758	n	0.04	0.015	0.04	0.06	0.015	0.05
67	Imhoff Creek	13468	n	0.04	0.015	0.04	0.05	0.015	0.05
68	Imhoff Creek	13458	n	0.04	0.015	0.04	0.06	0.015	0.05
69	Imhoff Creek	12980	n	0.04	0.015	0.04	0.06	0.015	0.05
70	Imhoff Creek	12500	n	0.04	0.015	0.04	0.06	0.015	0.08
71	Imhoff Creek	12375	n	0.04	0.015	0.04	0.06	0.015	0.08
72	Imhoff Creek	12351	Bridge	Brooks					
73	Imhoff Creek	12327	n	0.04	0.015	0.04	0.08	0.015	0.08
74	Imhoff Creek	12244	n	0.04	0.015	0.04	0.08	0.015	0.08
75	Imhoff Creek	11840	n	0.035	0.015	0.035	0.08	0.015	0.08
76	Imhoff Creek	10994	n	0.03	0.015	0.03	0.08	0.015	0.07
77	Imhoff Creek	10960	n	0.03	0.015	0.03	0.08	0.015	0.07
78	Imhoff Creek	10944	Culvert	Lindsey					
79	Imhoff Creek	10928	n	0.03	0.015	0.03	0.05	0.015	0.05
80	Imhoff Creek	10876	n	0.03	0.013	0.03	0.05	0.015	0.05
81	Imhoff Creek	10649	n	0.03	0.013	0.03	0.05	0.015	0.05
82	Imhoff Creek	10220	n	0.03	0.013	0.03	0.05	0.015	0.05
83	Imhoff Creek	9825	n	0.03	0.013	0.03	0.05	0.024	0.05
84	Imhoff Creek	9800	n	0.03	0.024	0.03	0.05	0.024	0.05
85	Imhoff Creek	9700	n	0.03	0.024	0.03	0.05	0.024	0.05
86	Imhoff Creek	9600	n	0.03	0.024	0.03	0.05	0.024	0.05
87	Imhoff Creek	9500	n	0.03	0.024	0.03	0.05	0.024	0.05
88	Imhoff Creek	9400	n	0.03	0.024	0.03	0.05	0.024	0.05
89	Imhoff Creek	9300	n	0.03	0.024	0.03	0.05	0.024	0.05
90	Imhoff Creek	9200	n	0.03	0.024	0.03	0.05	0.024	0.05
91	Imhoff Creek	9100	n	0.03	0.024	0.03	0.05	0.024	0.05
92	Imhoff Creek	9000	n	0.03	0.024	0.03	0.05	0.024	0.08
93	Imhoff Creek	8900	n	0.03	0.024	0.03	0.05	0.024	0.08
94	Imhoff Creek	8800	n	0.03	0.024	0.03	0.08	0.024	0.08
95	Imhoff Creek	8700	n	0.03	0.024	0.03	0.08	0.024	0.08
96	Imhoff Creek	8600	n	0.03	0.024	0.03	0.08	0.024	0.08
97	Imhoff Creek	8500	n	0.03	0.024	0.03	0.08	0.024	0.08
98	Imhoff Creek	8400	n	0.03	0.024	0.03	0.08	0.024	0.08

Table 1, cont'd

Mannings n-values from the composite LOMR model (1997 and 2006)							Revised n-values			
	Reach	River Station	Frctn (n/K)	n #1	n #2	n #3		n #1	n #2	n #3
99	Imhoff Creek	8300	n	0.03	0.024	0.03		0.08	0.024	0.08
100	Imhoff Creek	8200	n	0.03	0.024	0.03		0.08	0.024	0.08
101	Imhoff Creek	8180	n	0.03	0.024	0.03		0.08	0.024	0.08
102	Imhoff Creek	8100	n	0.03	0.024	0.03		0.08	0.024	0.08
103	Imhoff Creek	8000	n	0.03	0.024	0.03		0.08	0.024	0.08
104	Imhoff Creek	7900	n	0.03	0.024	0.03		0.08	0.024	0.08
105	Imhoff Creek	7880	n	0.03	0.024	0.03		0.08	0.024	0.08
106	Imhoff Creek	7800	n	0.03	0.024	0.03		0.08	0.024	0.08
107	Imhoff Creek	7700	n	0.03	0.024	0.03		0.08	0.024	0.08
108	Imhoff Creek	7600	n	0.03	0.024	0.03		0.08	0.024	0.08
109	Imhoff Creek	7500	n	0.03	0.024	0.03		0.08	0.024	0.08
110	Imhoff Creek	7400	n	0.03	0.024	0.03		0.08	0.024	0.08
111	Imhoff Creek	7340	n	0.03	0.024	0.03		0.08	0.024	0.08
112	Imhoff Creek	7300	n	0.03	0.024	0.03		0.08	0.024	0.08
113	Imhoff Creek	7200	n	0.03	0.025	0.03		0.08	0.024	0.08
114	Imhoff Creek	7100	n	0.03	0.025	0.03		0.08	0.045	0.08
115	Imhoff Creek	6686	n	0.03	0.025	0.03		0.08	0.045	0.06
116	Imhoff Creek	6000	n	0.05	0.025	0.05		0.08	0.045	0.06
117	Imhoff Creek	5721	n	0.05	0.025	0.05		0.08	0.045	0.06
118	Imhoff Creek	5334	n	0.03	0.014	0.03		0.08	0.045	0.08
119	Imhoff Creek	5320	n	0.03	0.014	0.03		0.08	0.045	0.08
120	Imhoff Creek	5302	Culvert	Imhoff						
121	Imhoff Creek	5284	n	0.03	0.014	0.03		0.08	0.045	0.07
122	Imhoff Creek	5200	n	0.045	0.025	0.045		0.08	0.045	0.07
123	Imhoff Creek	4196	n	0.05	0.025	0.05		0.08	0.045	0.07
124	Imhoff Creek	3300	n	0.05	0.025	0.05		0.08	0.045	0.07
125	Imhoff Creek	3194	n	0.05	0.025	0.05		0.08	0.045	0.07
126	Imhoff Creek	3144	n	0.03	0.014	0.03		0.08	0.045	0.07
127	Imhoff Creek	3044	Culvert	S.H. 9						
128	Imhoff Creek	2944	n	0.03	0.014	0.03		0.06	0.045	0.07
129	Imhoff Creek	2890	n	0.04	0.025	0.04		0.06	0.045	0.07
130	Imhoff Creek	2765	n	0.04	0.025	0.04		0.06	0.045	0.07
131	Imhoff Creek	2690	n	0.04	0.025	0.04		0.06	0.045	0.07
132	Imhoff Creek	2205	n	0.04	0.025	0.04		0.06	0.045	0.07
133	Imhoff Creek	2011	n	0.04	0.025	0.04		0.06	0.045	0.045
134	Imhoff Creek	2006	Bridge	Bridge #1						
135	Imhoff Creek	2001	n	0.04	0.025	0.04		0.06	0.045	0.045
136	Imhoff Creek	2000	n	0.04	0.025	0.04		0.06	0.045	0.045
137	Imhoff Creek	1450	n	0.04	0.025	0.04		0.06	0.045	0.045
138	Imhoff Creek	1200	n	0.04	0.025	0.04		0.06	0.045	0.045
139	Imhoff Creek	850	n	0.04	0.025	0.04		0.06	0.045	0.045



**Table 2: Comparison of Results between Original and Revised HEC-RAS Models**

River Sta	Combined 1997 and 2006 LOMR Models					Revised Models for Master Plan Solutions					Differences	
	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	WSEL	Top Width
	(cfs)	(ft)	(ft)	(ft/s)	(ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
19798	893	1163.2	1173.39	0.7	2107.85	892	1163.2	1173.96	0.63	2168.58	0.57	60.73
19780.5 A.T.S.F Railroad						Culvert						
19763	893	1163	1171.37	2.73	562.02	892	1163	1169.82	4.59	177.1	-1.55	-384.92
19723	2095	1162.6	1170	13.27	280.22	892	1162.6	1168.98	9.96	178.18	-1.02	-102.04
19209	2095	1158.9	1166.19	5.32	497.33	892	1158.9	1164.93	0	438.28	-1.26	-59.05
19198.5 Foot Bridge						Bridge						
19189	2095	1158.9	1165.48	7.78	459.77	892	1158.9	1164.8	6.32	433.22	-0.68	-26.55
19179	2095	1158.8	1165.08	11.11	368.48	892	1158.8	1164.53	8.22	351.25	-0.55	-17.23
19096	2095	1158.4	1164.8	7.03	373.39	892	1158.4	1163.74	6.77	329.77	-1.06	-43.62
18915	2095	1157.7	1164.58	7.27	364.86	892	1157.7	1163.12	8.82	301.66	-1.46	-63.2
18746	2095	1156.8	1164.49	4.63	706.87	892	1156.8	1162.98	4.76	435.34	-1.51	-271.53
18739.5 Webster						Bridge						
18720	2095	1156.8	1164.19	5.89	657.76	892	1156.8	1162.57	8.22	400.66	-1.62	-257.1
18627	2095	1156.3	1164.17	4.92	757.27	892	1156.3	1162.64	5.56	434.34	-1.53	-322.93
18502	2095	1155.86	1164.01	6.33	652.61	892	1155.86	1162.17	7.8	284.49	-1.84	-368.12
18495.5 Park						Bridge						
18476	2095	1155.6	1162.77	10.94	421.08	892	1155.6	1161.89	9.01	254.17	-0.88	-166.91
18382	2095	1155.1	1161.83	10.75	438.22	1122	1155.1	1161.58	9.36	403.69	-0.25	-34.53
18288	2095	1154.4	1161.82	6.01	1018.28	1122	1154.4	1161.45	5.7	827.47	-0.37	-190.81
18281.7 University						Culvert						
18263	2095	1154.4	1161.53	7.12	868.26	1122	1154.4	1161.44	5.75	818.35	-0.09	-49.91
18072	2095	1152.8	1161.04	9.33	858.8	1122	1152.8	1160.72	8.35	744.31	-0.32	-114.49
18062 Daws						Culvert						
18032	2095	1152.5	1160.76	9.46	849.22	1122	1152.5	1160.55	8.42	771.59	-0.21	-77.63
17571	2095	1150.8	1158.44	3.1	1120.49	2049	1150.8	1158.79	4.56	1144.88	0.35	24.39
17558.5 Tonhawa						Culvert						
17521	2095	1150.7	1157.93	8.98	1090.37	2049	1150.7	1158.32	9.65	1150.61	0.39	60.24
17450	2095	1150.5	1157.9	3.09	1182.12	2049	1150.5	1157.99	5.21	1198.47	0.09	16.35
17380	2095	1149.44	1157.74	5.94	721.04	2049	1149.44	1157.34	10.05	679.4	-0.4	-41.64
17356.5 Lahoma						Culvert						
17333	2095	1149.2	1157.53	4.09	1025.8	2049	1149.2	1157.54	4.78	1028.03	0.01	2.23
17323	2095	1146.4	1157.52	3.96	1023.03	2049	1146.4	1156.67	9.7	811.38	-0.85	-211.65
17182	2095	1146.2	1157.54	2.44	874.69	2049	1146.2	1156.7	8.18	805.93	-0.84	-68.76
17139.5 Gray						Culvert						
17097	2095	1146.19	1157.52	2.7	913.38	2049	1146.19	1156.67	7.95	789.33	-0.85	-124.05
16883	2095	1145.1	1157.51	2.2	894.49	2049	1145.1	1156.66	6.03	783.73	-0.85	-110.76
16819.5 Main						Culvert						
16756	2095	1144.9	1157.43	3.91	715.6							
16645	2095	1144.6	1156.23	10.31	275.6							
16631	Foot Bridge											
16617	2095	1144.59	1156.19	10.42	273.26							
16606						2049	1144.54	1155.97	7.55	427.75		

Table 2, cont'd

River Sta	Combined 1997 and 2006 LOMR Models					Revised Models for Master Plan Solutions					Differences	
	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	WSEL	Top Width
	(cfs)	(ft)	(ft)	(ft/s)	(ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
16565	2095	1144.4	1154.49	9.94	409.08			1155.02	11.19	289.28		
16453						2049	1144.22	1153.92	8.34	303.67		
16306						2049	1143.6					
16300 Foot Bridge						Bridge						
16294						2049	1143.5	1152.79	12.16	254.95		
16155	3678	1143.6	1153.41	8.6	398.55							
15927						2567	1143	1152.58	11.15	419.9		
15578	3678	1142	1152.9	8.98	559.36	2567	1142	1151.58	13.18	315.17	-1.32	-244.19
15483	3678	1141.7	1152.78	8.18	347.52	2567	1141.7	1151.31	11.27	265.07	-1.47	-82.45
15463.5 Symmes						Culvert						
15444	3678	1141.6	1151.43	11.12	273.33	2567	1141.6	1151.48	10.61	275.28	0.05	1.95
15243	3678	1141.2	1151.57	7.74	450.65	2567	1141.2	1151.62	8.04	453.92	0.05	3.27
15066	3678	1140.65	1150.92	10.65	501.54	2567	1140.65	1150.69	11.03	485.98	-0.23	-15.56
15051	3678	1140.6	1151.16	8.58	433.38	2567	1140.6	1149.83	12.19	343.7	-1.33	-89.68
15016.5 Flood						Culvert						
14982	3678	1140.4	1150.96	9.06	425.82	2567	1140.4	1150.56	8.07	396.7	-0.4	-29.12
14972	3678	1140	1149.93	12.62	241.84	2567	1140	1150.3	8.96	256.9	0.37	15.06
14551	3678	1139	1150.23	8.19	702.91	3618	1139	1150	10.13	650	-0.23	-52.91
14533 McNamee						Culvert						
14516	3678	1138.9	1150.19	7.31	665.24	3618	1138.9	1150.38	7.03	675.38	0.19	10.14
14407	3678	1138.7	1150.14	7.09	613	3618	1138.7	1150.32	7.1	613	0.18	0
14235	3678	1138.1	1149.6	10.56	534.47	3618	1138.1	1149.48	11.93	517.1	-0.12	-17.37
14059	3678	1137.7	1149.6	8.89	441.53	3618	1137.7	1149.53	9.87	434.4	-0.07	-7.13
14040.5 Pickard						Culvert						
14023	3678	1137.7	1149.42	8.64	724.44	3618	1137.7	1149.42	10.42	724.59	0	0.15
13801	3678	1137	1149.46	5.74	655.74	3618	1137	1149.52	7.02	660.18	0.06	4.44
13800	3678	1136.9	1149.32	7.24	588.65	3618	1136.9	1149.28	8.8	583.68	-0.04	-4.97
13786.5 Boyd						Culvert						
13772	3678	1136.8	1148.35	9.37	423.22	3618	1136.8	1148.93	8.99	471.15	0.58	47.93
13758	3954	1136.9	1148.05	10.52	398.39	3940	1136.9	1148.7	9.98	446.71	0.65	48.32
13468	3954	1136.2	1147.95	9.88	332.39	3940	1136.2	1148.6	9.51	367.99	0.65	35.6
13458	3954	1136.1	1146.95	13.36	277.16	3940	1136.1	1147.26	13.82	294.03	0.31	16.87
12980	3954	1134.4	1145.43	13.79	227.14	3940	1134.4	1145.72	14.43	238.96	0.29	11.82
12500	3954	1133.7	1145.42	10.68	422.39	3940	1133.7	1145.68	12.65	454.03	0.26	31.64
12375	3954	1133.2	1145.67	7.76	528.09	3940	1133.2	1146.29	8.32	577.39	0.62	49.3
12351 Brooks						Bridge						
12327	3954	1133	1144.3	10.85	429.04	3940	1133	1144.37	12.15	435.24	0.07	6.2
12244	3954	1132.8	1142.34	13.78	273.73	3940	1132.8	1143.3	14.65	324.06	0.96	50.33
11840	4050	1131.6	1141.97	11.32	303.9	4156	1131.6	1142.65	14.45	317.99	0.68	14.09
11417						4156	1131	1142.02	13.8	280.45		280.45
10994	4050	1130.35	1142.74	4.49	495.17	4156	1130.35	1142.5	8.85	484.94	-0.24	-10.23
10960	4890	1130.25	1142.59	5.81	542.06	4156	1130.25	1142.37	8.19	527.46	-0.22	-14.6

Table 2, cont'd

River Sta	Combined 1997 and 2006 LOMR Models					Revised Models for Master Plan Solutions					Differences	
	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	WSEL	Top Width
	(cfs)	(ft)	(ft)	(ft/s)	(ft)	(cfs)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
10944 Lindsey						Culvert						
10928	4966	1129.89	1141.78	7.66	500.14	4976	1129.89	1142.38	8.51	534.55	0.6	34.41
10876	4966	1129.5	1140.74	11.96	355.85	4976	1129.5	1141.99	10.47	399.5	1.25	43.65
10649	4966	1128.86	1141.33	7.23	420.39	4976	1128.86	1142.26	7.96	479.69	0.93	59.3
10220	4966	1127.57	1139.05	15.36	207.42	4976	1127.57	1139.68	15.85	235.62	0.63	28.2
9825	4966	1127	1136.11	15.36	257.35	4976	1127	1137.03	11.32	275.34	0.92	17.99
9800	4966	1126.63	1135.74	10.79	256.91	4976	1126.63	1136.69	10.67	275.55	0.95	18.64
9700	5265	1125.2	1135.71	9.85	261.08	5288	1125.2	1136.61	10.16	280.82	0.9	19.74
9600	5265	1124.8	1135.6	9.59	270.08	5288	1124.8	1136.52	9.87	292.83	0.92	22.75
9500	5265	1124.4	1134.58	12.52	213.13	5288	1124.4	1136.01	11.12	281.94	1.43	68.81
9400	5265	1124	1134.28	11.34	265.66	5288	1124	1136.23	8.95	341.01	1.95	75.35
9300	5265	1123.6	1134.68	7.56	323.64	5288	1123.6	1136.38	7.06	372.98	1.7	49.34
9200	5265	1123.2	1134.49	8.14	303.82	5288	1123.2	1136.24	7.49	370.66	1.75	66.84
9100	5265	1122.8	1134.47	7.51	319.69	5288	1122.8	1136.23	7.01	387.13	1.76	67.44
9000	5265	1122.4	1133.81	10.06	242.33	5288	1122.4	1135.23	10.76	342.26	1.42	99.93
8900	5265	1122	1134.04	7.62	268.98	5288	1122	1135.55	8.2	370.2	1.51	101.22
8800	5265	1121.6	1133.98	7.34	311.65	5288	1121.6	1135.24	8.92	359.71	1.26	48.06
8700	5265	1121.2	1133.16	9.87	286.26	5288	1121.2	1134.97	8.99	407.49	1.81	121.23
8600	5265	1120.8	1133.02	10.37	180.58	5288	1120.8	1133.72	12.73	218.29	0.7	37.71
8500	5265	1120.4	1131.82	13.34	168.45	5288	1120.4	1132.36	15.16	193.35	0.54	24.9
8400	5265	1119.93	1130.74	13.07	172.86	5288	1119.93	1131.45	14.96	191.89	0.71	19.03
8300	5265	1119.13	1129.99	12.96	209.38	5288	1119.13	1130.78	13.74	280.55	0.79	71.17
8200	5265	1118.33	1129.41	12.31	177.25	5288	1118.33	1130.44	12.25	264.24	1.03	86.99
8180	5265	1117.62	1129.15	12.49	173.49	5288	1117.62	1130.57	11.48	272.85	1.42	99.36
8100	5265	1116.98	1128.83	12.68	196.32	5288	1116.98	1129.32	14.43	223.23	0.49	26.91
8000	5265	1116.18	1128.97	11.13	223.37	5288	1116.18	1128.71	14.4	210.44	-0.26	-12.93
7900	5265	1115.38	1128.51	11.39	198.19	5288	1115.38	1128.94	12.34	243.34	0.43	45.15
7880	5265	1114.67	1127.59	13.57	134.75	5288	1114.67	1127.55	15.2	133.74	-0.04	-1.01
7800	5337	1114.03	1126.49	14.8	104.18	5327	1114.03	1126.41	16.11	102.4	-0.08	-1.78
7700	5337	1113.23	1125.39	15.38	75.19	5327	1113.23	1125.41	15.61	75.58	0.02	0.39
7600	5337	1112.35	1124.48	16.23	54.82	5327	1112.35	1124.5	16.48	54.96	0.02	0.14
7500	5337	1111.4	1123.71	15.61	55.02	5327	1111.4	1123.6	16.25	54.38	-0.11	-0.64
7400	5337	1110.45	1123.51	13.68	119.89	5327	1110.45	1122.86	15.6	102.54	-0.65	-17.35
7340	5337	1109.81	1121.02	12.51	80.58	5327	1109.81	1121.01	13.15	80.3	-0.01	-0.28
7300	5639	1109.15	1119.58	15.22	68.67	5676	1109.15	1119.41	16.05	67.29	-0.17	-1.38
7200	5639	1107.5	1116.88	15.5	55.07	5676	1107.5	1117.14	15.22	55.88	0.26	0.81
7100	5639	1105	1115.54	13.71	63.17	5676	1105	1118.04	10.68	72.01	2.5	8.84
6686	5639	1103.02	1113.67	13.91	67.73	5676	1103.02	1114.79	11.72	73.82	1.12	6.09
6000	5639	1097.7	1113.53	4.99	101.82	5676	1097.7	1114.9	4.55	119.86	1.37	18.04
5721	5639	1097.38	1111.79	10.85	51.24	5676	1097.38	1113.35	9.43	62.83	1.56	11.59
5334	5639	1096.1	1112.97	2.61	149.76	5676	1096.1	1114.08	2.44	152.13	1.11	2.37
5320	5925	1097.76	1110.54	12.2	38	5932	1097.76	1112.17	10.83	38	1.63	0

Table 2, cont'd

River Sta	Combined 1997 and 2006 LOMR Models						Revised Models for Master Plan Solutions					Differences	
	Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width		Q Total	Min Ch El	W.S. Elev	Vel Chnl	Top Width	WSEL	Top Width
	(cfs)	(ft)	(ft)	(ft/s)	(ft)		(cfs)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
5302 Imhoff							Culvert						
5284	5925	1097.7	1106.93	16.9	38		5932	1097.7	1108.72	14.17	38	1.79	0
5200	5925	1095.25	1107.26	14.41	63.71		5932	1095.25	1107.24	14.47	63.62	-0.02	-0.09
4196	5925	1087.76	1101.96	5.51	127.33		5932	1087.76	1103.61	4.74	330.96	1.65	203.63
3300	5925	1087.67	1101.69	4.98	167.15		5932	1087.67	1103.01	4.28	391.53	1.32	224.38
3194	6193	1087.7	1101.62	5.13	161.94		6219	1087.7	1102.89	4.36	334.13	1.27	172.19
3144	6193	1087.95	1101.74	4.16	293.68		6219	1087.95	1102.97	3.34	350.22	1.23	56.54
3044 S.H. 9							Culvert						
2944	6116	1087.35	1098.61	6.73	188.76		6132	1087.35	1100.26	5.28	259.29	1.65	70.53
2890	6116	1087.3	1098.02	8.98	141.51		6132	1087.3	1099.83	7.11	297.57	1.81	156.06
2765	6116	1087.3	1096.86	11.46	89.61		6132	1087.3	1098.97	8.75	101.09	2.11	11.48
2690	6116	1087.1	1096.23	12.19	84.78		6132	1087.1	1098.65	8.54	116.82	2.42	32.04
2205	6116	1085.8	1094.99	10.7	88.2		6132	1085.8	1095.39	10.14	91.37	0.4	3.17
2011	6116	1084.2	1096.06	3.8	610.78		6132	1084.2	1096.29	2.69	530.71	0.23	-80.07
2006 Bridge #1							Bridge						
2001	6116	1084.2	1096.02	3.82	610.3		6132	1084.2	1096.28	2.68	530.7	0.26	-79.6
2000	6116	1084.2	1096.03	3.76	610.32		6132	1084.2	1096.28	2.64	530.7	0.25	-79.62
1450	6116	1084	1095.98	2.98	779.38		6132	1084	1096.18	1.89	890.15	0.2	110.77
1200	6116	1082.3	1095.91	3.83	669.75		6132	1082.3	1096.1	2.93	775.68	0.19	105.93
850	6116	1082.2	1094.26	11.64	406.22		6132	1082.2	1095.86	4.16	582.69	1.6	176.47
												Minimum Difference =	-1.8
												Maximum Difference =	2.5

**Summary of Subbasin Parameters for Level 1 Hydrologic Models**

Subbasin Name	Subbasin Area (Sq. Miles)	Existing Conditions				Norman 2025 (Future/Baseline) Conditions		
		CN	Impervious Percentage (%)	Composite CN*	Lag time (min)	CN	Impervious Percentage (%)**	Lag time (min)
<b>LITTLE RIVER</b>								
LR1248-W33	2.51	70.6	5.0	72.0	74.6	78.8	0.0	67.0
LR1248-W34	0.55	67.3	6.0	69.1	45.4	74.3	0.0	43.4
LR1248-W35	1.44	68.2	6.0	70.0	61.3	72.4	0.0	61.3
LR1248-W36	1.10	67.0	3.0	67.9	62.7	73.3	0.0	62.7
LR1248-W39	0.14	61.0	1.4	61.5	26.0	62.9	0.0	26.0
LR1248-W40	0.48	64.2	3.9	65.5	33.4	66.4	0.0	33.4
LR1248-W43	0.04	65.6	1.9	66.2	54.3	68.5	0.0	54.3
LR1248-W44	0.94	67.8	3.9	69.0	46.3	70.3	0.0	46.3
LR1248-W46	1.85	70.9	10.0	73.6	95.4	76.8	0.0	91.5
LR1248-W49	0.14	65.3	1.0	65.6	45.3	67.1	0.0	45.3
LR1248-W50	0.66	71.6	1.3	71.9	47.9	74.8	0.0	47.9
LR1248-W51	0.22	66.8	2.5	67.6	45.7	68.8	0.0	45.7
LR1248-W53	0.40	68.4	2.0	69.0	30.8	70.5	0.0	30.8
LR1248-W54	0.60	68.8	4.3	70.1	43.5	71.8	0.0	43.5
LR1248-W55	0.02	63.6	0.1	63.6	18.1	64.9	0.0	18.1
LR1248-W56	0.79	67.7	4.1	68.9	43.3	75.9	0.0	43.3
LR1248-W58	0.07	60.4	5.4	62.4	23.1	62.5	0.0	23.1
LR1248-W59	0.04	59.8	2.8	60.9	34.7	61.4	0.0	34.7
LR1248-W63	0.07	64.0	6.1	66.1	43.1	67.1	0.0	43.1
LR1248-W64	0.12	63.7	4.6	65.3	24.1	66.2	0.0	24.1
LR1248-W68	0.06	62.6	3.1	63.7	26.1	65.3	0.0	26.1
LR1248-W69	0.21	63.5	1.6	64.1	32.6	65.0	0.0	32.6
LR1248-W99	0.20	65.4	2.0	66.1	28.4	67.8	0.0	22.5
LR-W401	3.35	74.1	5.0	75.3	120.9	85.2	0.0	105.2
LR-W475	2.89	78.8	25.0	83.6	86.0	88.3	0.0	86.0
LR-W486	4.02	74.9	25.0	80.7	129.7	84.6	0.0	108.5
LR-W523	4.64	73.9	8.0	75.8	75.5	82.5	0.0	74.3
LR-W558	2.08	75.7	20.0	80.2	88.2	84.8	0.0	73.9
LR-W580	0.45	77.6	11.2	79.9	52.2	89.9	0.0	52.2
LR-W584	3.42	78.8	20.0	82.6	84.4	90.1	0.0	84.4
LR-W588	1.28	77.7	10.0	79.7	61.9	88.0	0.0	61.9
LR-W615	0.22	66.1	3.5	67.2	68.3	68.1	0.0	68.3
LR-W615A	3.53	70.9	5.0	72.3	70.4	78.3	0.0	70.4
LR-W632	0.83	78.2	5.0	79.2	46.1	85.6	0.0	46.1
LR-W634	0.34	79.7	8.2	81.2	48.2	86.9	0.0	39.1

**Summary of Subbasin Parameters for Level 1 Hydrologic Models, cont'd**

Subbasin Name	Subbasin Area (Sq. Miles)	Existing Conditions				Norman 2025 (Future/Baseline) Conditions		
		CN	Impervious Percentage (%)	Composite CN*	Lag time (min)	CN	Impervious Percentage (%)**	Lag time (min)
LR-W635	0.21	69.5	9.4	72.2	34.2	80.2	0.0	29.1
LR-W642	0.27	81.0	8.0	82.4	68.6	90.4	0.0	53.5
LR-W642A	0.36	79.8	2.2	80.2	60.0	88.3	0.0	47.9
LR-W651	0.19	74.3	6.4	75.8	33.0	78.0	0.0	26.3
LR-W656	0.44	76.0	10.6	78.3	67.8	90.0	0.0	54.6
LR-W657	0.65	65.1	2.8	66.0	83.4	68.2	0.0	83.4
LR-W665	0.71	77.0	1.8	77.4	100.3	85.1	0.0	80.0
LR-W668	0.93	74.6	3.0	75.3	59.4	77.7	0.0	52.6
LR-W674	0.13	74.0	3.9	74.9	40.3	87.4	0.0	40.0
LR-W678	0.69	71.5	4.9	72.8	59.5	75.0	0.0	59.5
LR-W679	0.52	74.7	3.5	75.5	70.6	83.2	0.0	65.9
LR-W685	0.28	78.9	16.0	82.0	52.0	84.0	0.0	52.0
LR-W689	0.10	65.9	6.4	68.0	24.6	69.7	0.0	24.6
LR-W698	0.28	69.5	4.1	70.7	39.4	77.0	0.0	39.4
LR-W698A	0.41	74.4	12.7	77.4	42.8	89.3	0.0	34.5
LR-W701	0.38	67.8	3.6	68.9	25.4	74.3	0.0	21.3
LR-W709	0.70	63.9	4.6	65.5	40.8	71.0	0.0	40.8
LR-W710	0.11	68.8	4.3	70.1	22.8	75.9	0.0	18.2
LR-W723	0.68	77.4	16.3	80.8	66.1	87.1	0.0	62.8
LR-W725	1.55	77.1	8.6	78.9	82.8	90.9	0.0	68.3
LR-W730	0.41	69.6	2.5	70.3	33.7	82.1	0.0	29.4
LR-W734	0.93	74.9	25.7	80.8	56.5	88.0	0.0	44.8
LR-W751	2.13	76.4	7.7	78.1	100.1	88.7	0.0	86.6
LR-W765	0.54	78.6	17.4	82.0	41.5	85.0	0.0	33.5
LR-W776	0.30	66.8	26.9	75.2	26.9	81.0	0.0	22.3
LR-W776A	0.39	66.8	26.9	75.2	41.4	81.0	0.0	32.4
LR-W777	0.37	73.9	5.4	75.2	45.3	84.5	0.0	45.3
<b>ROCK CREEK AND TRIBUTARIES</b>								
RC-W102	0.18	65.5	6.0	67.5	23.2	70.5	0.0	23.24
RC-W103	0.19	69.4	9.0	72.0	23.3	77	0.0	18.63
RC-W107	0.16	67.4	2.6	68.2	23.2	70.7	0.0	23.16
RC-W108	0.31	78.8	1.5	79.1	31.8	81.2	0.0	31.78
RC-W112	0.11	63.1	5.0	64.8	20.6	66	0.0	20.64
RC-W113	0.29	66.3	2.2	67.0	33.3	70.3	0.0	33.25
RC-W117	1.03	72.1	2.7	72.8	46.4	74.8	0.0	46.38
RC-W118	0.97	73.9	12.1	76.8	37.6	81.7	0.0	31.21

**Summary of Subbasin Parameters for Level 1 Hydrologic Models, cont'd**

Subbasin Name	Subbasin Area (Sq. Miles)	Existing Conditions				Norman 2025 (Future/Baseline) Conditions		
		CN	Impervious Percentage (%)	Composite CN*	Lag time (min)	CN	Impervious Percentage (%)**	Lag time (min)
RC-W58	0.10	61.9	0.0	61.9	23.1	64.6	0.0	23.06
RC-W61	0.09	65.3	5.3	67.0	24.2	66.5	0.0	24.2
RC-W62	0.33	72.0	3.5	72.9	27.1	73.3	0.0	27.1
RC-W64	0.10	62.3	6.7	64.7	18.1	65.9	0.0	18.14
RC-W67	0.26	70.3	2.7	71.0	29.4	75.6	0.0	29.4
RC-W68	0.06	66.6	4.7	68.1	22.7	69.7	0.0	22.65
RC-W69	0.16	66.6	4.2	67.9	21.3	69.5	0.0	21.28
RC-W71	0.08	63.4	5.1	65.2	24.5	66.5	0.0	24.54
RC-W72	0.02	73.5	0.4	73.6	14.4	75	0.0	14.44
RC-W75	0.60	72.2	27.7	79.3	39.6	84.8	0.0	32.78
RC-W77	0.18	72.8	1.1	73.1	28.0	75.9	0.0	28.02
RC-W82	0.09	76.1	2.8	76.7	18.2	85.1	0.0	14.01
RC-W86	0.08	70.1	1.8	70.6	24.5	73	0.0	24.47
RC-W88	0.10	72.1	1.3	72.4	20.3	75.9	0.0	20.29
RC-W92	0.07	64.0	1.2	64.4	22.9	81.2	0.0	18.35
RC-W93	0.57	73.6	12.7	76.7	66.1	90.6	0.0	52.02
RC-W97	0.07	68.1	1.1	68.4	18.9	84.4	0.0	14.58
RC-W98	0.57	77.5	16.2	80.8	30.6	88.4	0.0	30.63
<b>DAVE BLUE CREEK AND TRIBUTARIES</b>								
DBC-W190	0.77	76.3	11.9	78.9	53.9	85.3	0.0	46.74
DBC-W200	0.40	76.4	3.5	77.2	35.5	85.1	0.0	30.3
DBC-W230	0.11	64.7	3.4	65.8	26.1	70.2	0.0	26.08
DBC-W260	0.37	63.7	0.5	63.9	43.3	66.3	0.0	43.33
DBC-W290	0.81	64.4	2.2	65.1	42.3	67.6	0.0	42.29
DBC-W300	0.41	66.0	3.6	67.2	42.9	71.1	0.0	42.93
DBC-W320	0.10	68.5	2.1	69.1	24.3	70.3	0.0	24.28
DBC-W340	1.02	67.7	1.6	68.2	47.5	74.5	0.0	47.48
DBC-W350	0.83	68.9	2.4	69.6	46.4	71.8	0.0	46.44
DBC-W430	0.51	64.5	1.9	65.1	32.0	87.7	0.0	26.46
DBC-W470	0.36	63.5	1.1	63.9	35.1	67.8	0.0	35.05
DBC-W540	0.51	64.8	1.0	65.1	35.2	72.1	0.0	35.18
DBC-W620	0.78	66.3	4.2	67.6	40.3	70.3	0.0	35.17
DBC-W680	0.54	71.6	7.2	73.5	31.7	84	0.0	27.39
DBC-W720	0.62	64.5	1.5	65.0	57.8	71.1	0.0	57.8
DBC-W780	0.76	71.0	9.2	73.5	52.4	84.1	0.0	44.27
DBC-W820	0.20	65.9	1.1	66.3	24.0	71.7	0.0	23.99

**Summary of Subbasin Parameters for Level 1 Hydrologic Models, cont'd**

Subbasin Name	Subbasin Area (Sq. Miles)	Existing Conditions				Norman 2025 (Future/Baseline) Conditions		
		CN	Impervious Percentage (%)	Composite CN*	Lag time (min)	CN	Impervious Percentage (%)**	Lag time (min)
DBC-W890	0.66	66.4	3.4	67.5	34.7	70.9	0.0	34.65
DBC-W970	0.11	66.9	4.4	68.3	31.8	72	0.0	31.82
DBC-W970A	0.18	75.5	1.9	75.9	23.1	79.8	0.0	23.06
DBC-W990	0.11	76.6	2.8	77.2	27.7	80.1	0.0	27.66
TtDBC-W119	0.06	68.7	2.6	69.5	26.5	73.5	0.0	26.52
TtDBC-W120	0.05	77.7	2.7	78.2	24.0	81.8	0.0	24.02
TtDBC-W21	0.04	64.9	6.1	66.9	30.0	70.2	0.0	30.01
TtDBC-W24	0.06	65.7	9.1	68.6	21.7	68.9	0.0	21.7
TtDBC-W26	0.05	63.4	1.4	63.9	23.5	66.8	0.0	23.52
TtDBC-W27	0.11	77.6	0.4	77.7	19.1	81.8	0.0	15.1
TtDBC-W28	0.02	73.5	3.2	74.3	15.5	77.3	0.0	15.53
TtDBC-W30	0.08	73.1	3.3	73.9	26.2	76.5	0.0	26.19
TtDBC-W40	0.04	72.5	2.0	73.0	15.7	73.7	0.0	15.67

\* Composite CN calculated for comparison with the composite CN used for future/baseline condition.

\*\* The impervious percentage was incorporated directly into the curve number for the future/baseline condition.





**Storm Water Master Plan  
City of Norman  
Cleveland County, Oklahoma**

**October 2009**

**Appendix G**

**Storm Water Quality Assessment**



## Appendix G Storm Water Quality Assessment



The Storm Water Master Plan study for the City of Norman (City) includes a general storm water quality assessment utilizing previous studies and investigations. The focus of the assessment is to generally estimate the likely impact that urban storm water, originating from the watersheds in the City, has on water quality in local streams and Lake Thunderbird.

Storm water from the City drains to the Canadian River some of which flows through Lake Thunderbird (the Lake), which is the City's major source of drinking water. A drainage boundary that runs through the City from northwest to southeast determines whether storm water goes to the Lake or directly to the Canadian River. The western and southern parts of the City's urban core drain to the Canadian River, while eastern and northern parts drain to the Lake. The Lake also receives runoff from Oklahoma City, the City of Moore, Del City, and unincorporated areas. Completed in 1965, the Lake was created by the construction of Norman Dam, and supplies drinking water to Moore, Del City and Norman. The Lake Thunderbird watershed is located in Oklahoma and Cleveland counties. The surface area of the Lake is 8.5 mi<sup>2</sup>, with a drainage area of 256 mi<sup>2</sup> (664 km<sup>2</sup>). The City of Norman contributes about fifty percent of the drainage area to Lake Thunderbird. Lake water quality is a concern because Water Quality Standards

(WQS) are often exceeded in the Lake, raising the issue of pollutants from the contributing drainage areas. The following sections provide an overview from previous national and local water quality studies and assessments of storm water impacts from urban areas.

### Introduction

Urban storm water runoff is a natural hydrologic process that has been affected by human activities including the alteration of natural drainage patterns, increased impervious cover, the generation of pollutant loads that collectively adversely impact the water quality of rivers, lakes, and streams. Numerous studies have shown urban runoff to be a significant source of water pollution, causing declines in water quality and impairment of waterbodies for one or more designated beneficial uses. Increased runoff flow rate, volume, and velocity are experienced in areas that are converted from natural to urban land uses. Urban runoff in this context includes all flows discharged from urban land uses into storm water conveyance systems and receiving waters primarily during wet weather. In terms of historical precedent, control of storm water focused mainly on the quantity, i.e. drainage and flood control, with limited emphasis on the quality of the storm water such as nutrients, organic compounds, sediment and erosion control. More recently, federal, state, and local programs have been established throughout the country to reduce pollutants discharged in storm water, and in particular, from urban areas.

### Nationwide Water Quality Studies

The U.S. Environmental Protection Agency (EPA), Office of Water established the collection and evaluation of storm water data from a portion of the National Pollutant Discharge Elimination System (NPDES) called the Municipal Separate Storm Sewer System (MS4). The City is now subject to the MS4 regulations and has a program to meet these requirements. The National Storm Water Quality Database (NSQD) provides useful information on contaminants and concentrations that are likely to be found in urban storm water derived from various land use classifications. This database is a major source of information on pollutants found in storm water with updated information published by the USEPA (1993). The first effort to gather comprehensive information on storm water quality was the Nationwide Urban Runoff Program (NURP) published in the benchmark report, USEPA (1983). Phase I of the federal storm water permit program, published in the Federal Register by the EPA in 1987, was initially applied to large cities (>100,000 in population), while Phase II of the storm water permit program was applied to all urban areas since 2003. See the Acronyms section in the Attachment for constituents and other acronyms.

The number of cities and geographic distribution represented in the NSQD database is expanded from those contained in the NURP data. Maestra and Pitt (2005) examine the database that contains about 3,765 events from 360 sites in 65 communities from

throughout the U.S. While Oklahoma is not currently represented in the NSQD database, Texas and Kansas are. The major differences in water quality found in NURP and NSQD databases are due to differences in geographical areas represented by each database (Maestra and Pitt, 2005). The NURP and NSQD results are similar for all constituents in storm water, except for lead and zinc. The most significant reductions in concentration between the NURP and NSQD database were found for lead (7.9 times larger for NURP) followed by copper (7.9 times larger for NURP) and zinc (1.6 times large for NURP).

The NSQD water quality data reveals important relationships between land use and other conditions and expected storm water quality. Analysis of the NSQD data indicates that nutrients and total suspended solids among other pollutants increase with urbanization along with increased runoff volume and flow rates.

Results from this database are summarized by EPA Rain Zones that group areas with similar rainfall statistics. Oklahoma is in the same EPA Rain Zone as Texas, Zone 5 as shown in Figure G-1. Rainfall statistics such as antecedent dry period, average intensity and depth can have important effects on constituents in storm water runoff. Some statistical analyses of the NSQD are not possible where insufficient data was available within the EPA Rain Zone.

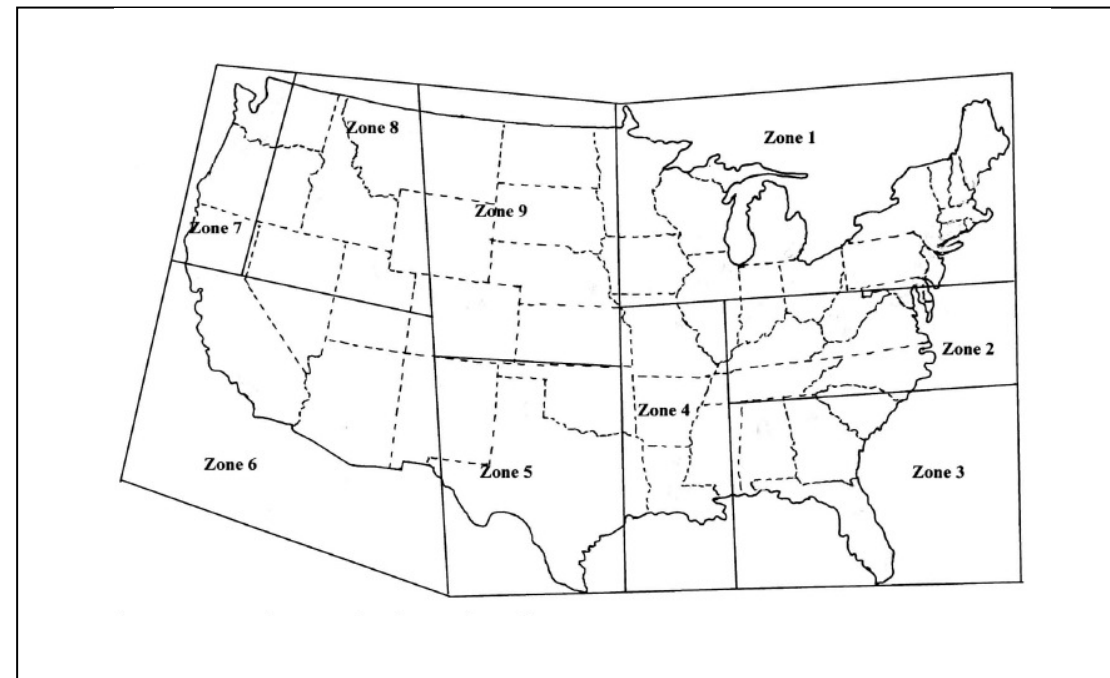


Figure G-1 EPA Rain Zones

Major findings from analysis of the NSQD reported by Maestra and Pitt (2005) are summarized as follows.

**Runoff Coefficients and Impervious Cover** – The reported volumetric runoff coefficients were closely related to the percentage of impervious cover. Again, the database cannot separate the directly connected impervious areas from the partially connected areas, so there is some expected variation in this relationship. Given the broad range of sites and rainfall zones contained in the NSQD database, correlation

between runoff concentrations and impervious area was not possible from the database. As seen in Figure G-2, the relation between volumetric runoff coefficient and impervious area is essentially a 1:1 relationship. The relationship between the impervious area and runoff is one of the strongest correlations from available storm water data contained in the NSQD.

**Storm Water Controls** – There is a significant reduction in Total Suspended Solids (TSS), nitrite-nitrate, total phosphorus (T-P), total copper, and total zinc concentration at sites having wet detention ponds, the control practice having the largest concentration reductions. No reductions in Total Kjeldahl Nitrogen (TKN) concentrations were found using wet ponds, but TKN seems to be reduced by dry ponds. Locations with detention storage facilities had smaller reductions of TSS, Biochemical Oxygen Demand 5-day (BOD5), Chemical Oxygen Demand (COD), total lead, and total zinc concentrations compared to wet pond sites. While grass swales are known to be beneficial, unfortunately, there were few sites in the database having grass swales that could be compared with data from sites having curbs and gutters.

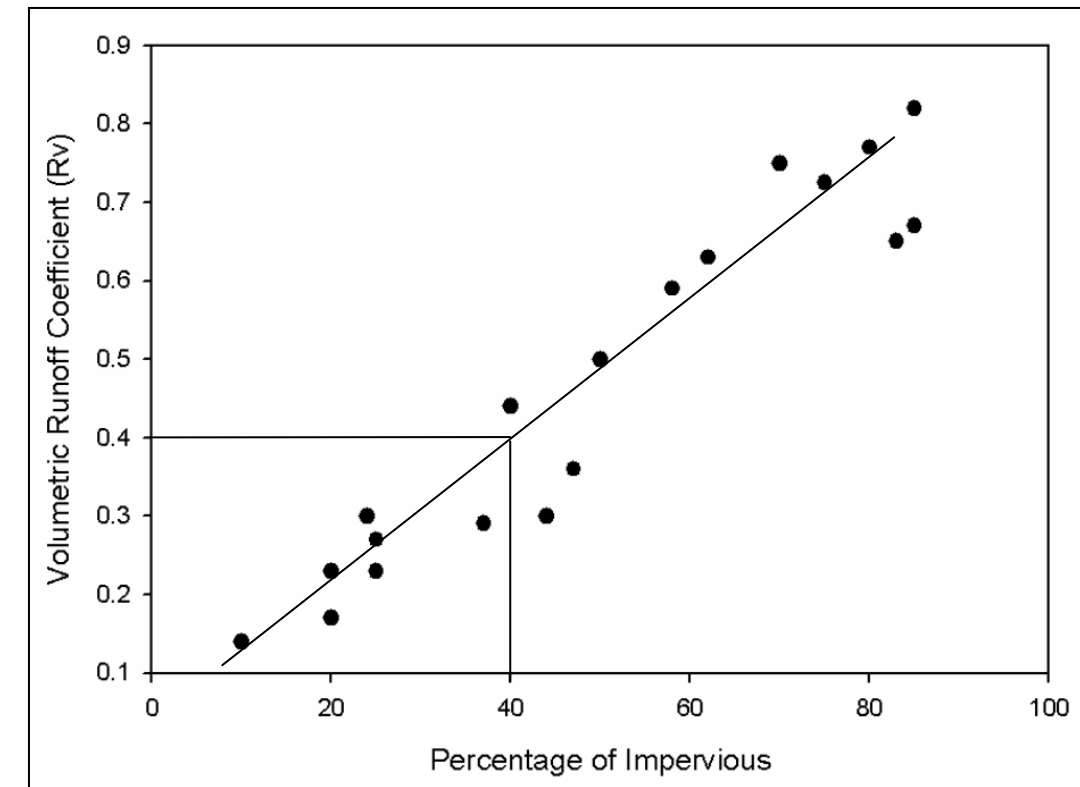


Figure G-2 Relation between runoff coefficient and percent impervious area, NSQD (Maestra and Pitt, 2005, p. 210)

**Effects of Antecedent Dry Periods** – Antecedent dry periods before sampling were found to have a significant effect for BOD5, COD, ammonia, nitrates, TKN, dissolved phosphorus and T-P concentrations at residential land use sites. As the number of days increased, there was an increase in the concentrations of the storm water constituents. This relationship was not observed for freeway sites. In residential land uses, 7 out of 12 constituents indicated that antecedent dry period

had a significant effect on the median concentrations. As the number of days having no rain increased, the concentrations also increased.

**First Flush Effect** – A statistically significant effect was found where the median concentration of samples taken during the first flush is about 1.4 times greater than at other sample times. Groups of constituents showed different behaviors for different land uses. All the heavy metals evaluated showed higher concentrations at the beginning of the event in the commercial land use category. Similarly, all the nutrients showed higher initial concentrations in residential land use areas, except for total nitrogen and ortho-phosphorus. This phenomenon was not found in the bacteria analyses. None of the land uses showed a higher population of bacteria at the beginning of the event. Conventional constituents showed elevated concentrations in commercial, residential and institutional land uses.

**Land Use and Geographical Area Interactions** – EPA Rain Zones 4, 6 and 9 have higher TSS values for the land uses noted. If there is a significant correlation with land use, the concentration for the individual land use should be used, otherwise, the overall summary database values should be used instead of those for designated land use classifications. The correlation of constituents to land use is as follows:

- Constituents that should clearly be separated by land use: copper, lead, and zinc.
- Constituents that clearly did not have any significant differences for different land use categories, therefore use overall values: pH, temperature (obvious seasonal effects), TDS, and TKN.
- Constituents where residential data should be separated from commercial plus industrial area data: TSS (possible) and nitrates plus nitrites.
- Constituents where it is not clear; conflicts in phosphorus values when comparing different combinations of land uses: hardness, oil and grease, BOD5, COD, ammonia, T-P, and dissolved phosphorus.

Summary information derived from the NSQD v1.1 database for Texas and Kansas provides some guidance on what to expect for Oklahoma. Table G-1 presents mean values for selected constituents for land use areas. Differentiation is not made between developed or undeveloped areas in computing these averages. Note that Lead and Fecal coliform were not tested for at the Kansas sites (shown as N/A). Concentrations tend to be higher in Kansas (Rain Zone 9) than in Texas (Rain Zone 5), such as 1.05 mg/l T-P compared to 0.25 mg/l, respectively. Given the geographic location of Oklahoma between the two states, reported mean concentrations could be projected to fall between the two.

**Table G-1 Selected mean constituents for Texas and Kansas storm Water (NSQD v1.1)**

State	TSS (mg/l)	Fecal Coliform (per100ml)	NO <sub>2</sub> +NO <sub>3</sub> (mg/l)	T-P (mg/l)	Lead Total (µg/l)	Zinc Total (µg/l)	Copper Total (µg/l)
TX	224.43	9646	0.70	0.25	28.00	103.07	32.71
KS	658.66	N/A	0.93	1.05	N/A	1,141.30	98.92

A summary of the NSQD v1.1 constituents according to land use classification is contained in the Attachment derived from Maestra and Pitt (2005).

Increased runoff from impervious areas affects TSS in storm water runoff as well as increasing stream channel degradation and erosion. Stream enlargement and degradation, also known as downcutting or incising, and increased sediment transport are often experienced due to urbanizing of the watershed because runoff rates and volumes increase the velocities of water and total amount of flow that in turn accelerates erosion of the stream channel. Implementation of watershed protection and site development management measures can help mitigate the impacts from new development through runoff treatment and management measures.

The impact of urbanization on runoff volume and rates affects aquatic habitats. Burton and Pitt (2002) suggest that with urbanization, flow changes can be dramatic, with excessive flows occurring during wet periods and significantly reduced flows occurring during dry months. Effects of rainfall on runoff constituents were found from data collected. Small rains less than about 0.5 inch comprise the majority of runoff events and frequently exceed heavy metal and bacteria objectives, although these events account for only a small fraction of annual pollutant discharges. Intermediate-sized rains from about 0.5 to 1.5 inches account for the majority of the pollutant discharges and subject the receiving waters to frequent high pollutant loads and moderate-to-high flow rates. Larger rains, 1.5 to 3 inches, produce relatively small amounts of the annual pollutant discharges, but produce the most damaging flows in terms of flooding and aquatic habitat destruction. In general, USEPA (2005) summarizes expected impacts from urbanization as:

1. **Nutrients and sediment** – Nutrients and sediments are expected to increase in developed areas compared with open areas.
2. **Other pollutants** – Oil and grease, pesticides, and heavy metals will increase in developed versus undeveloped open areas.
3. **Hydrologic effects** – Baseflow during dry weather often decreases due to reduced infiltration in areas of increased imperviousness. Peak flow rate and volume increase with increased imperviousness.

While the NSQD database can provide expected constituent concentrations by region or land use classification, more accurate estimates can be made where local data is available from sampling programs.

### **Prior Local Studies**

Prior local studies concerning water quality that are reviewed here include the Rock Creek watershed study for the Central Oklahoma Master Conservancy District (COMCD, 2006); a Lake Thunderbird Watershed modeling and analysis for the Oklahoma Conservation Commission (Vieux, 2007); an ongoing watershed plan developed by the Oklahoma Department of Environmental Quality for Lake Thunderbird (ODEQ, 2008a); and the recently completed Canadian River Bacteria TMDL (ODEQ, 2008b). The major findings from each study are reviewed below.

**Rock Creek Watershed Study**

Previous studies conducted in the Lake Thunderbird watershed include the Rock Creek watershed analysis and water quality evaluation performed by Vieux and Associates, Inc. for the Central Oklahoma Master Conservancy District (COMCD, 2006). This study was undertaken by COMCD to quantify the impact of land use changes in Rock Creek on nutrient and sediment loading from storm water runoff to Lake Thunderbird. Rock Creek, with an area of 11.9 mi<sup>2</sup>, drains to the Little River arm of the Lake, located entirely within the corporate limits of the City and the Lake Thunderbird watershed. COMCD supplies drinking water derived from the reservoir to the City and two other communities, Del City and Midwest City. Sampling of the water quality in the Lake was conducted and reported by OWRB (2001, 2002, 2004a, 2004b, and 2005) in fulfillment of state water quality programs and for COMCD. Lake eutrophication caused by persistent nutrient loading and consequent algae proliferation is a serious concern because the water body is designated as a sensitive water supply (SWS) by the State of Oklahoma. The Lake exceeds the SWS Chlorophyll-a (Chl-a) water quality standard (WQS), 10 µg/l, by as much as three fold due to algae growth. Some species of algae found in the Lake can produce toxins. Though toxins have not been found in the Lake as reported by OWRB (2004), incidence of toxins produced by these species is known to increase as Chl-a concentrations exceed the WQS of 10 µg/l (Downing et al., 2001). Besides the risk of toxins in the finished drinking water, excessive algae production also leads to taste and odor complaints about the finished water product.

In support of the COMCD (2006) study, local sampling of tributary runoff in Rock Creek was performed by the OWRB in conformance with EPA standards. The constituents and concentrations were monitored and used to assess the impacts from urbanization within Rock Creek where there is a range of undeveloped to highly developed land use. This study revealed significant differences between locally sampled data and NSQD constituent concentrations. In general, nutrients and TSS were elevated significantly in comparison to expected values in the NSQD database based on land use. Table G-2 shows the locally sampled data for four events in Rock Creek. Site 2 is not shown as it did not have sufficient flow during the sample events to be included in the mean. Impervious area decreases from Site 1 (Commercial Area) through Site 5 (Rural Open Area) in numeric order. Total Phosphorus (T-P) is highest at 0.71 (mg/l) for Site 3 which is predominantly residential, and the lowest at 0.14 mg/l for the rural open area, Site 5. Site 1 is sampled at the outlet of a dry detention basin draining a parking lot and commercial building, and has the highest TSS and second highest TKN and T-P concentrations for the events sampled.

**Table G-2 Mean sample concentration for events in Rock Creek (COMCD 2006)**

Site	Alkalinity	TSS	NH3	NO2	NO3	TKN	T-P	Ortho-P	T-N
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	154	164	0.15	0.08	0.62	2.44	0.58	0.27	3.13
3	117	106	0.51	0.17	0.49	2.94	0.71	0.29	3.48
4	293	63	0.09	0.13	0.12	1.23	0.25	0.10	1.41
5	315	40	0.06	<0.05	0.08	0.69	0.14	0.04	3.27

Evaluating the constituents found in runoff derived from different land uses and degree of urbanization in Rock Creek found that T-P, T-N and TSS concentrations were higher than NSQD values by several fold. For low density residential, the T-N, T-P, and TSS concentrations estimated from NSQD are 2.92, 0.43, and 68.2 mg/l, whereas sampled concentrations were 5.32, 1.37, and 79.4 mg/l, respectively. For commercial land use, the sampled T-N concentrations were 2.6 times greater than the NSQD concentration, T-P concentrations were 3.2 times, and TSS concentrations were 4.5 times higher than the NSQD values for comparable land use classifications. For the majority of events, the most highly developed areas in Rock Creek, Sites 1 and 3, show the highest constituent concentration in water samples including suspended solids, nitrogen and phosphorus. Urban development through conversion of natural or open areas to residential or commercial uses causes an increase in impervious area and higher loading of nutrients and sediment to Lake Thunderbird.

Modeling studies reported in the COMCD (2006) were used to project the impact on runoff of urbanization in Rock Creek. A distributed continuous model, Vflo, was setup and run for a ten-year period and for precipitation return periods. The purpose of the modeling was to identify impacts of projected urban development scenarios on runoff volume and nutrient loading. The increase in runoff volume is greater with more impervious area, such that the development scenarios considered show the increase in volume is 2.07 times the increase in impervious area with a 2-year rainfall event and 0.76 and 0.51 times the increase in impervious area with the 5- and 10-year rainfall events, respectively. For the 2-year rainfall, the increase in peak discharge is 1.17 times the increase in impervious area, exceeding a 1:1 relationship. In Rock Creek, the increase in runoff as a function of imperviousness is nearly a 1:1 relationship, which is similar to the NSQD results reported by Maestra and Pitt (2005). Increased runoff for smaller events, e.g., the 2-yr event, mirrored the findings of previous studies confirming that smaller events are affected most by urbanization and contribute the most volume of runoff and constituent loading (Maestra and Pitt, 2005; and USEPA, 2005).

**OCC Lake Thunderbird Watershed Study**

Water quality in Lake Thunderbird does not currently meet water quality standards for Chl-a and turbidity. The Oklahoma Conservation Commission launched a study to target management practices within the watershed that would reduce loading from nonpoint source pollution and achieve water quality standards established for this Sensitive Water Supply. Watershed modeling and analyses for the OCC was performed using the Soil Water Assessment Tool (SWAT) and reported by Vieux (2007). Both baseline (2000 conditions) and projected (2030 conditions) water quality impacts were modeled to assess the impacts of land use conversion through urban development. The major findings can be summarized as follows:

- Both runoff and constituent concentration affects the annual load of nutrients or suspended solids that storm water conveys to the Lake. Increase in runoff is partially driven by impervious cover. The percent imperviousness for watersheds that drain to Lake Thunderbird is shown in Figure G-3.

- Algae growth in Lake Thunderbird is increased by nutrients, in particular, phosphorus. T-P loadings were determined to increase with urban land development. Algae growth and Chlorophyll-a. concentrations are a major concern of ODEQ, OCC, COMCD and the water supply users. Since T-P is a limiting nutrient for algae growth and resulting concentrations of Chlorophyll-a., increases in T-P would very likely exacerbate those problems. Export of T-P during wet periods produces the annual load projected for 2030 is shown in Figure G-4 (Vieux, 2007).
- T-N is a source of nutrients that can also accelerate algal growth in the Lake, but is not considered a limiting nutrient. Export of T-N during wet periods produces the annual load shown in Figure G-5 for conditions in 2030 (Vieux, 2007).
- Projections for TSS during wet periods is shown in Figure G-6 (Vieux, 2007).

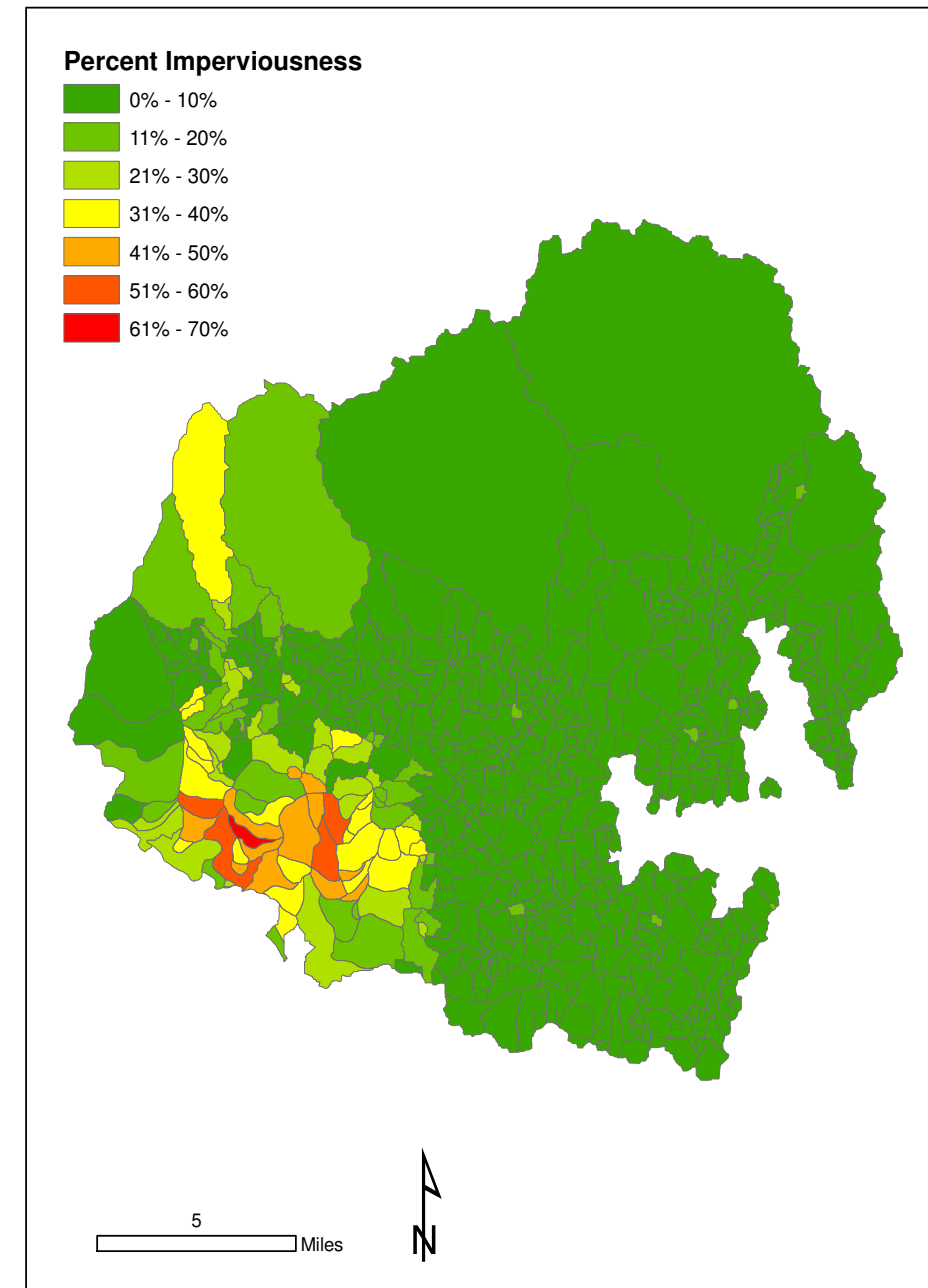


Figure G-3 Percent imperviousness for City of Norman watersheds



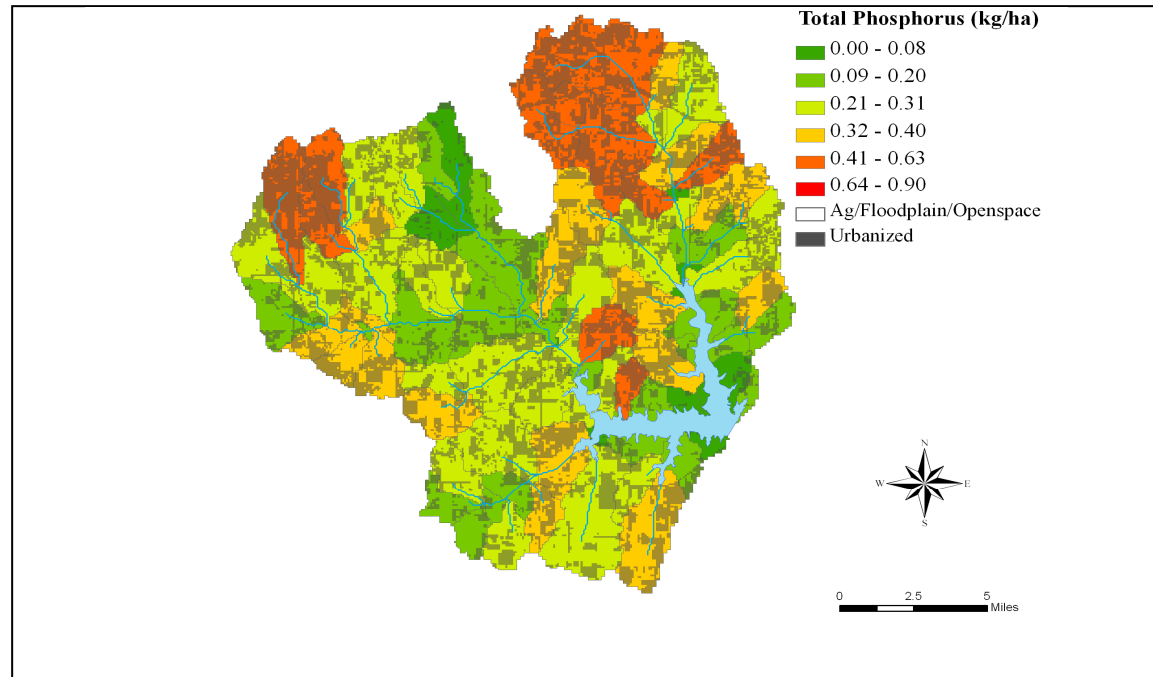


Figure G-4 Annual loading for total phosphorus T-P (kg/ha)

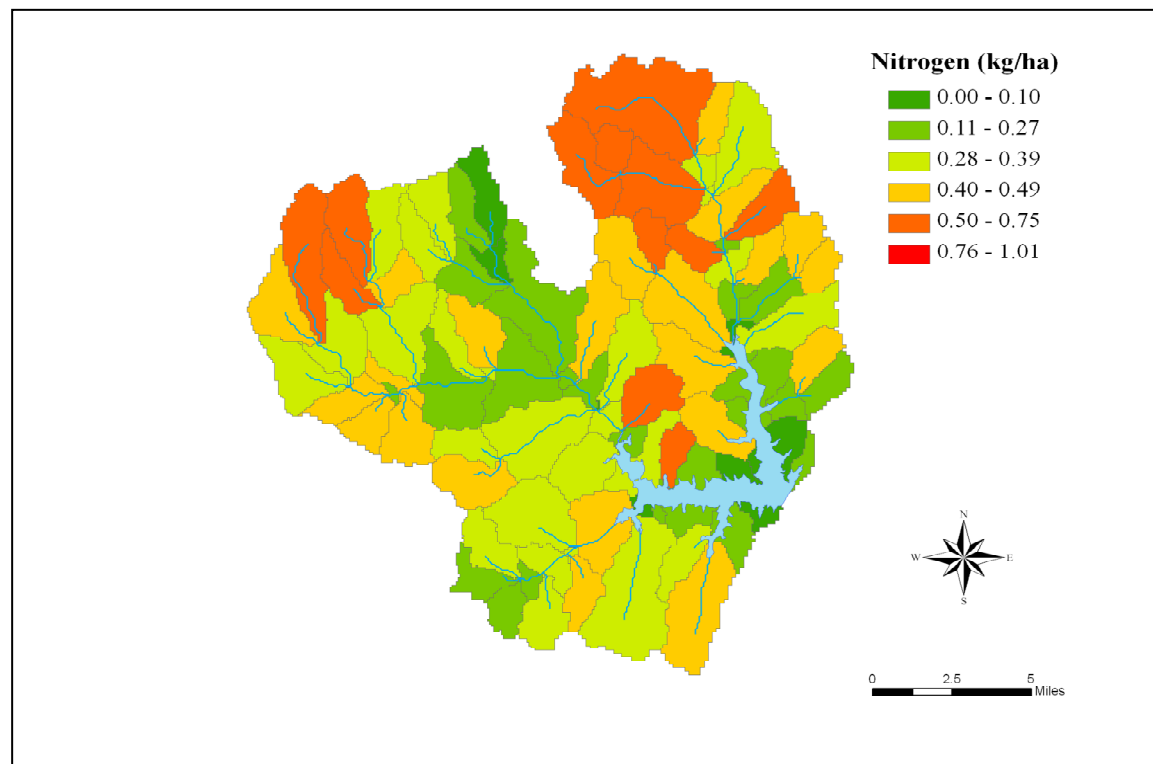


Figure G-5 Annual loading for total nitrogen T-N (kg/ha)

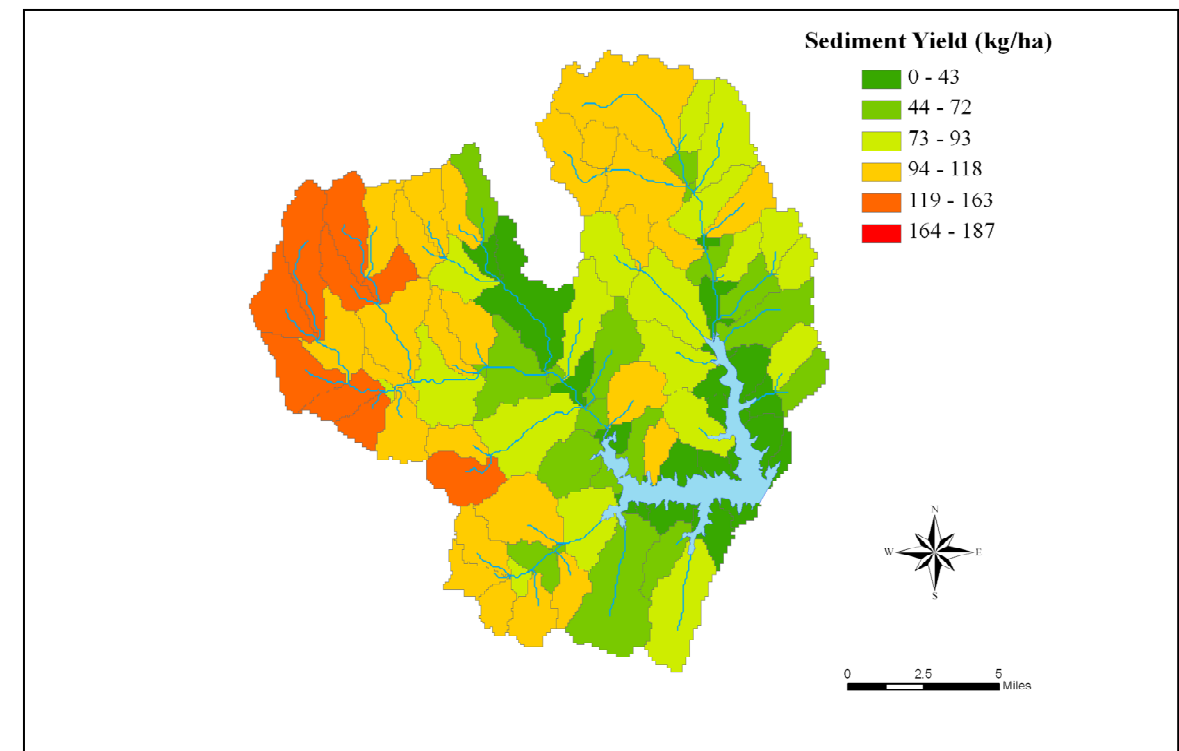


Figure G-6 Annual loading for sediment yield TSS (kg/ha)

### *ODEQ Lake Thunderbird Study*

An ongoing study by the Oklahoma Department of Environmental Quality (ODEQ, 2008a) is developing a watershed plan that assesses the water quality in watershed tributaries, as well as, the impacts of nutrient and sediment loading on water quality in the Lake. Lake Thunderbird is listed on the State's 2006 303(d) list for impaired uses of aesthetics and warm water aquatic community. The causes of the impairments are low dissolved oxygen (DO) and high turbidity. The draft 2008 303(d) awaits EPA approval, but does list Lake Thunderbird as being impaired for Chl-a, DO, and turbidity. The sources of these impairments are listed as "unknown." While there are no permitted point sources of discharge, nutrients and sediment loadings from nonpoint sources discharging during runoff events through tributary streams are believed to be the major cause of the impairments. Another factor, though of lesser importance, is good agricultural practices in rural areas that can affect the Lake's water quality. The goal of the watershed study is to determine acceptable loading rates for nutrients and suspended solids that will help allow the intended beneficial use of Lake Thunderbird to be achieved. In light of the unique challenges associated with reducing nonpoint source contributions, ODEQ intends to use a watershed-based plan in lieu of a TMDL for Lake Thunderbird.

Several agencies are cooperating in the development of this watershed plan. The partner agency/organization that ODEQ will work with to develop the plan are the Oklahoma Conservation Commission (OCC) and the COMCD. OCC is the state's main agency for nonpoint source pollution control, and COMCD is the lake's managing organization. OCC will perform watershed stream monitoring in its Priority Watershed Program, and COMCD will fund the data collection effort in the lake through their ongoing contractual agreement with the Oklahoma Water Resources Board (OWRB). ODEQ will perform the modeling work using the data collected by OCC and OWRB.

Monitoring for the watershed plan, including in-lake monitoring, will be a 12-month project at five locations in the watershed. ODEQ will provide funding for laboratory analysis of samples collected by OCC during the first 12 months of monitoring, which coincides with in-lake monitoring intended for the development of the watershed management plan. The monitoring started in April 2008 (FY 2008) and runs through April 2009. Monitoring data from the lake's tributary streams will provide information on pollutant loadings from the watershed and establish baseline conditions for model calibration.

Two water models form the scientific foundation for the watershed plan development: the Environmental Fluid Dynamics Code (EFDC) model for the lake, and the Hydrologic Simulation Program-FORTRAN (HSPF) model for water quality from the contributing watershed. The models will be used to establish key nutrient (phosphorus and nitrogen) and turbidity reduction goals for the watershed. The models will also provide information on sources of loadings and potential management options implemented in the watershed. When the ODEQ establishes the watershed management plan, the cities of Oklahoma City and Norman could be required to implement management practices to reduce nutrients and sediment in storm water runoff that drains to the lake.

### *ODEQ Bacteria TMDL for the Canadian River*

Recently, the Oklahoma Department of Environmental Quality (ODEQ, 2008b) completed a Total Maximum Daily Loads (TMDL) study for the Canadian River. Elevated levels of pathogen indicator bacteria in aquatic environments indicate that receiving water is contaminated with human or animal feces and that there is a potential health risk for individuals exposed to the water. Establishment of pollutant load allocations is made for indicator bacteria in the Canadian River. Waterbodies in the study area are listed on the ODEQ 2004 303(d) list because there is evidence of nonsupport of primary body contact recreation (PBCR), resulting in the development of a TMDL for the Canadian River and certain tributaries including Bishop Creek. Bishop Creek failed to support PBCR due to fecal coliform (FC) concentrations. Seventy-five percent of samples collected at Bishop Creek and Jenkins Avenue exceeded permissible FC concentrations for single samples. The MS4 permit for small communities in Oklahoma became effective on February 8, 2005. Two such MS4 permit holders discharge to Bishop Creek; they are the City of Norman and the University of Oklahoma. The major contribution of FC to Bishop Creek is believed to be from nonpoint sources, though point sources have been identified from sanitary sewer overflows (SSOs) that have occurred in Bishop Creek. The estimated FC loads for the four major nonpoint source categories, which contribute to elevated bacteria concentrations in Bishop Creek are estimated to be Commercially Raised Farm Animals (82.26%), Pets (17.66%), Deer (0.04%), and Septic Tanks (0.04%) (ODEQ, 2008b, pg. 3-20 ff).

Compliance with the TMDL under the MS4 program will require that holders develop strategies designed to achieve progress toward meeting the established reduction goals. The City of Norman and the University of Oklahoma may be required to participate in a coordinated monitoring program or develop their own for purposes of documenting the effectiveness of the selected BMPs and for demonstrating progress toward attainment of water quality standards. Reporting requirements include documentation of actions taken by the permittee that affect MS4 storm water discharges to the impaired waterbody segment (ODEQ, 2008b).

## Summary

Storm water runoff quality is affected by human activities, land use changes, and the alteration of natural drainage patterns. Urban runoff has been shown to be a significant source of water pollution in locations throughout the country, causing declines in water quality and impairment of waterbodies as is the case for Lake Thunderbird. Examination of national storm water quality data and local studies reveals that nutrients and total suspended solids (as well as other water quality parameters), runoff volumes, and flow rates increase with urbanization and increased impervious area. The major findings of this review of prior studies are summarized as follows.

A local study in the Rock Creek tributary of Lake Thunderbird showed that total phosphorus, total nitrogen and total suspended solids concentrations were higher in areas with higher imperviousness. For low-density residential areas, the T-N, T-P, and TSS concentrations estimated from NSQD are 2.92, 0.43, and 68.2 mg/l, whereas locally sampled concentrations were 5.32, 1.37, and 79.4 mg/l, respectively. For commercial land use, the sampled T-N concentrations were 2.6 times greater than the NSQD concentration, T-P concentrations were 3.2 times, and TSS concentrations were 4.5 times higher than the NSQD values for comparable land use classifications. For the majority of events, the most highly developed areas (highest impervious area) in Rock Creek had the highest concentrations of suspended solids, nitrogen and phosphorus, and contributed the greatest annual loading rates to the Lake.

ODEQ is concerned that urban development, without appropriate mitigation of its environmental impact, will exacerbate the water quality problems currently experienced by the Lake. The watershed management plan being established by ODEQ will identify implementation of management practices in the Lake Thunderbird watershed to help achieve beneficial uses of water in the Lake. This watershed management plan could require that the City of Norman develop a program and/or make modifications to its land development policies and ordinances to reduce pollutant loadings commonly associated with urban development. Other cities, agencies, and entities that make land use changes within the watershed will also be required to follow provisions of the watershed management plan.

Under the TMDL process for the Canadian River, ODEQ has identified Norman and the University of Oklahoma as contributors to non-attainment of water quality standards in Bishop Creek, a local tributary to the Canadian River. Bishop Creek failed to support the designated water use due to FC concentrations, and thus actions must be taken to meet the water quality standard. Where the TMDL has been developed, additional sampling becomes part of the implementation requirements for regulated MS4 discharges such as those from the City of Norman. Significant monitoring and reporting of water quality and implementation of best management practices in Bishop Creek are expected to result.

In summary, water quality standards are not being met in two major watersheds that are contained or are partially contained within the city limits of Norman; these are Bishop Creek and the Lake Thunderbird watersheds. Current land conversion to urban uses in the Lake Thunderbird watershed has resulted in increased impervious area and higher nutrient and total suspended solids concentrations, which impact the lake water quality.

Because the Lake does not meet water quality standards, ODEQ is developing a watershed management plan in lieu of a TMDL for Lake Thunderbird that may require additional monitoring and implementation of management practices. Another drainage area, Bishop Creek falls within the City limits but is a tributary to the Canadian River, and is subject to a final TMDL. Point sources of pollution in Bishop Creek include sanitary sewer overflows, while nonpoint sources contributions are principally from farm animals and pets, and only minor amounts from deer or septic tanks. As the two MS4 storm water permit holders discharging to Bishop Creek, the City of Norman and the University of Oklahoma will be required by ODEQ to establish monitoring plans and to implement management practices to improve water quality by reducing fecal coliform.

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## Acronyms

BOD5, COD	Biochemical Oxygen Demand 5-day, Chemical Oxygen Demand
COMCD	Central Oklahoma Conservancy District
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollution Discharge Elimination System
NSQD	National Storm Water Quality Database
NURP	Nationwide Urban Runoff Program
Ortho-P	Orthophosphate
OWRB	Oklahoma Water Resources Board
TKN	Total Kjeldahl Nitrogen
T-N	Total Nitrogen
T-P	Total Phosphorus
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency

Table A-1. Summary of Available Storm Water Data Included in NSQD, version 1.1

	Area (acres)	% Impervious	Precipitation Depth (in)	Runoff Depth (in)	Conductivity ( $\mu$ S/cm @25°C)	Hardness (mg/l CaCO3)	Oil and Grease (mg/l)	pH	Tempe- rature (C)	TDS (mg/l)	TSS (mg/l)	BOD <sub>5</sub> (mg/l)	COD (mg/l)
<b>Overall Summary (3765)</b>													
Number of observations	3765	2209	3316	1495	685	1082	1834	1665	861	2956	3493	3105	2750
% of samples above detection	100	100	100	100	100	98.7	66.1	100	100	99.0	97.9	96.2	98.4
Median	57.3	50.0	0.48	0.15	121	38.0	4.3	7.5	16.5	80	59	8.6	53
Coefficient of variation	3.7	0.4	1.0	1.9	1.6	1.4	9.7	0.1	0.4	3.4	1.8	7.4	1.1
<b>Residential (1042)</b>													
Number of observations	1042	614	919	372	104	215	483	286	181	814	978	908	748
% of samples above detection	100	100	100	100	100	100	54.9	100	100	99.1	98.3	97.1	98.7
Median	57.3	37.0	0.48	0.10	102	32.0	4.0	7.2	17.0	72.0	49	9.0	54.5
Coefficient of variation	4.8	0.4	1.0	1.5	1.6	1.1	7.8	0.1	0.4	1.1	1.8	1.5	0.93
<b>Mixed Residential (611)</b>													
Number of observations	611	278	491	262	105	168	283	333	137	491	582	549	465
% of samples above detection	100	100	100	100	100	98.2	70.3	100	100	99.2	98.3	94.2	99.6
Median	150.8	44.9	0.53	0.12	112	40.0	4.0	7.50	15.5	86	66	7.8	43
Coefficient of variation	2.1	0.3	0.8	1.3	1.2	1.1	2.6	0.1	0.3	5.2	1.6	1.3	1.2
<b>Commercial (527)</b>													
Number of observations	527	284	462	146	78	156	331	191	98	418	503	452	393
% of samples above detection	100	100	100	100	100	100	71.9	100	100	99.5	95.2	97.6	98.5
Median	38.8	84.5	0.42	0.29	107	36.5	4.6	7.4	16.0	72	43	11.0	58
Coefficient of variation	1.2	0.1	1.0	1.0	1.0	1.1	3.0	0.1	0.4	1.9	2.0	1.1	1.0
<b>Mixed Commercial (324)</b>													
Number of observations	324	237	305	118	59	98	134	156	98	265	297	277	267
% of samples above detection	100	100	100	100	100	99.0	79.9	100	100	99.6	99.7	98.9	99.6
Median	75.0	60.0	0.47	0.28	100	36.0	5.0	7.60	14.5	69.5	54.5	9.0	60
Coefficient of variation	1.4	0.3	1.0	0.9	0.8	1.8	2.9	0.1	0.4	1.9	1.3	1.7	1.0
<b>Industrial (566)</b>													
Number of observations	566	292	482	215	102	132	315	248	140	431	521	455	386
% of samples above detection	100	100	100	100	100	96.2	64.8	100	100	99.5	97.7	95.4	99.0
Median	39.5	75.0	0.50	0.16	139	39.0	4.8	7.50	17.9	86	81	9.0	58.6
Coefficient of variation	1.1	0.3	0.9	1.2	1.3	1.5	11.8	0.1	0.3	3.6	1.6	10.0	1.2

Table A-1. Summary of Available Storm Water Data Included in NSQD, version 1.1 – *Continued*

	Area (acres)	% Impervious	Precipitation Depth (in)	Runoff Depth (in)	Conductivity ( $\mu$ S/cm @25°C)	Hardness (mg/l CaCO3)	Oil and Grease (mg/l)	pH	Tempe- rature (C)	TDS (mg/l)	TSS (mg/l)	BOD <sub>5</sub> (mg/l)	COD (mg/l)
<b>Mixed Industrial (218)</b>													
Number of observations	218	118	193	117	56	75	72	152	57	186	207	178	175
% of samples above detection	100	100	100	100	100	93.3	80.6	100	100	99.5	100	95.5	98.9
Median	168.0	44.0	0.45	0.29	126	29.3	9.0	7.70	18.0	90	82	7.5	39.9
Coefficient of variation	1.8	0.3	0.9	1.2	0.8	0.6	1.8	0.1	0.3	0.8	1.4	1.8	1.2
<b>Institutional (18)</b>													
Number of observations	18	18	17	14						18	18	18	18
% of samples above detection	100	100	100	100						100	94.4	88.9	88.9
Median	36.0	45.0	0.18	0.00						52.5	17	8.5	50
Coefficient of variation	0	0	0.9	2.1						0.7	0.83	0.7	0.9
<b>Freeways (185)</b>													
Number of observations	185	154	182	144	86	127	60	111	31	97	134	26	67
% of samples above detection	100	100	100	100	100	100	71.7	100	100	99.0	99.3	84.6	98.5
Median	1.6	80.0	0.54	0.41	99	34.0	8.0	7.10	14.0	77.5	99	8	100
Coefficient of variation	1.4	0.13	1.1	1.7	1.0	1.9	0.6	0.1	0.4	0.8	2.6	1.3	1.1
<b>Mixed Freeways (26)</b>													
Number of observations	26		26		21	12	20	17	17	15	23	23	15
% of samples above detection	100		100		100	100	100	100	100	100	100	100.0	100.0
Median	63.1		0.47		353	83	4.5	7.7	16.0	177	88	8.2	47
Coefficient of variation	0.7		0.8		0.6	0.3	1.8	0.1	0.3	0.4	1.1	1.2	0.5
<b>Open Space (49)</b>													
Number of observations	49	37	41	11	2	8	19	19	2	45	44	44	43
% of samples above detection	100	100	100	100	100	100	36.8	100	100	97.8	95.5	86.4	76.74
Median	85	2.0	0.52	0.05	113	150	1.3	7.70	14.6	125	48.5	5.4	42.1
Coefficient of variation	1.5	1.0	1.2	1.4	0.5	0.6	0.7	0.08	0.7	0.7	1.5	0.7	1.5
<b>Mixed Open Space (168)</b>													
Number of observations	168	131	167	93	65	70	90	128	76	148	153	145	145
% of samples above detection	100	100	100	100	100	100	60.0	100	100	99.3	97.4	96.6	96.6
Median	115.4	33.0	0.51	0.10	215	64.2	8.5	7.9	16.0	109	78.0	6.0	34
Coefficient of variation	0.8	0.4	0.8	1.2	1.7	1.3	1.5	0.1	0.3	2.2	1.6	2.7	1.6

Table A-1. Summary of Available Storm Water Data Included in NSQD, version 1.1 – *Continued*

	Fecal Coliform (mpn/100 mL)	Fecal Streptococcus (mpn/100 mL)	Total Coliform (mpn/100 mL)	Total E. Coli (mpn/100 mL)	NH3 (mg/l)	N02+N03 (mg/l)	Nitrogen, Total Kjeldahl (mg/l)	Phosphorus, filtered (mg/l)	Phosphorus, total (mg/l)	Sb, total (µg/L)	As, total (µg/L)	As, filtered (µg/L)	Be, total (µg/L)
<b>Overall Summary (3765)</b>													
Number of observations	1704	1141	83	67	1908	3075	3191	2477	3285	874	1507	210	947
% of samples above detection	91.2	94.0	90.4	95.5	71.3	97.3	95.6	85.1	96.5	7.2	49.9	27.1	7.7
Median	5091	17000	12000	1750	0.44	0.60	1.4	0.13	0.27	3.0	3.0	1.5	0.4
Coefficient of variation	4.6	3.8	2.4	2.3	1.4	0.97	1.2	1.6	1.5	1.7	2.6	1.0	2.5
<b>Residential (1042)</b>													
Number of observations	402	257		14	572	889	922	690	926		395		282
% of samples above detection	87.8	87.9		100	82.2	97.6	96.5	83.5	96.8		40.8		7.8
Median	7000	24300		700	0.31	0.60	1.5	0.18	0.31		3.0		0.5
Coefficient of variation	5.2	1.7		1.6	1.1	1.1	1.1	0.9	1.1		2.2		2.5
<b>Mixed Residential (611)</b>													
Number of observations	336	178	26	11	282	531	517	430	552		158		97
% of samples above detection	94.3	97.8	84.6	90.9	58.5	97.9	95.0	83.3	96.2		65.9		11.3
Median	11210	27500	5667	1050	0.39	0.57	1.4	0.13	0.28		3.0		0.3
Coefficient of variation	3.2	2.1	1.3	2.1	1.6	0.78	1.7	1.1	1.7		3.9		2.7
<b>Commercial (527)</b>													
Number of observations	253	201			300	445	469	343	466		235		
% of samples above detection	88.9	92.5			83.3	98.0	97.4	81.0	95.9		33.6		
Median	4600	12000			0.50	0.6	1.5	0.11	0.22		2.3		
Coefficient of variation	3.0	2.7			1.2	1.1	0.9	1.3	1.2		2.9		
<b>Mixed Commercial (324)</b>													
Number of observations	116	95			173	284	276	221	290	89	139		
% of samples above detection	94.8	98.9			67.1	96.8	96.0	93.7	98.6	11.9	45.5		
Median	5400	11900			0.60	0.58	1.4	0.12	0.26	15.0	2.0		
Coefficient of variation	3.0	2.6			1.0	0.7	0.9	2.1	1.5	1.0	1.0		
<b>Industrial (566)</b>													
Number of observations	315	189			272	461	483	344	478	152	255		197
% of samples above detection	87.3	93.7			78.3	96.3	96.3	88.1	96.2	14.5	52.9		10.7
Median	2400	12000			0.42	0.69	1.4	0.10	0.25	3.7	4.0		0.38
Coefficient of variation	5.7	7.0			1.3	0.92	1.1	1.2	1.4	1.4	1.4		2.5

Table A-1. Summary of Available Storm Water Data Included in NSQD, version 1.1 – *Continued*

	Fecal Coliform (mpn/100 mL)	Fecal Streptococcus (mpn/100 mL)	Total Coliform (mpn/100 mL)	Total E. Coli (mpn/100 mL)	NH3 (mg/l)	N02+NO3 (mg/l)	Nitrogen, Total Kjeldahl (mg/l)	Phosphorus, filtered (mg/l)	Phosphorus, total (mg/l)	Sb, total (µg/L)	As, total (µg/L)	As, filtered (µg/L)	Be, total (µg/L)
<b>Mixed Industrial (218)</b>													
Number of observations	79	59	14		99	173	160	179	177		93		
% of samples above detection	98.7	96.9	71.4		30.3	98.8	92.5	84.4	95.5		88.2		
Median	3033	11000	2467		0.58	0.59	1.1	0.08	0.20		3.5		
Coefficient of variation	2.5	2.5	1.5		0.8	0.7	1.5	2.3	1.6		0.9		
<b>Institutional (18)</b>													
Number of observations					18	18	18	17	17				
% of samples above detection					88.9	100	100	82.4	94.1				
Median					0.31	0.6	1.35	0.13	0.18				
Coefficient of variation					0.5	0.6	0.5	0.5	1.0				
<b>Freeways (185)</b>													
Number of observations	49	25	16	13	79	25	125	22	128		61	72	
% of samples above detection	100	100	100	100	87.3	96.0	96.8	95.5	99.2		55.7	50.0	
Median	1700	17000	50000	1900	1.07	0.28	2.0	0.20	0.25		2.4	1.4	
Coefficient of variation	2.0	1.2	1.5	2.2	1.3	1.2	1.4	2.1	1.8		0.7	2.0	
<b>Mixed Freeways (26)</b>													
Number of observations	20	16				22	22	11	22		15		
% of samples above detection	85.0	93.8				100	100	100	100		80		
Median	2600	19000				0.9	2.3	0.03	0.34		3.0		
Coefficient of variation	2.3	1.1				0.7	1.3	0.9	0.7		0.7		
<b>Open Space (68)</b>													
Number of observations	23	22			32	44	45	44	46		19		
% of samples above detection	91.3	90.9			18.8	84.1	71.1	79.6	84.8		31.6		
Median	7200	24900			0.18	0.59	0.74	0.13	0.31		4.0		
Coefficient of variation	1.1	1.0			1.24	0.9	0.9	0.9	3.5		0.4		
<b>Mixed Open Space (168)</b>													
Number of observations	86	75			71	152	123	148	152		88		
% of samples above detection	97.7	100			22.5	97.4	90.2	85.8	96.1		44.3		
Median	3000	21000			0.51	0.7	1.1	0.09	0.25		3.0		
Coefficient of variation	2.3	2.4			1.2	0.8	0.9	1.1	1.1		0.9		



Table A-1. Summary of Available Storm Water Data Included in NSQD, version 1.1 – *Continued*

	Cd, total (µg/L)	Cd, filtered (µg/L)	Cr, total (µg/L)	Cr, filtered (µg/L)	Cu, total (µg/L)	Cu, filtered (µg/L)	Pb, total (µg/L)	Pb, filtered (µg/L)	Hg, total (µg/L)	Ni, total (µg/L)	Ni, filtered (µg/L)	Zn, total (µg/L)	Zn, filtered (µg/L)
<b>Overall Summary (3765)</b>													
Number of observations	2574	389	1598	261	2722	411	2949	446	1014	1430	246	3007	381
% of samples above detection	40.6	30.3	70.2	60.5	87.4	83	77.7	49.8	10.2	59.8	64.2	96.6	96.3
Median	1.0	0.50	7.0	2.1	16	8.0	17.0	3.0	0.20	8.0	4.0	116	52
Coefficient of variation	3.7	1.1	1.5	0.7	2.2	1.6	1.8	2.0	2.5	1.2	1.5	3.3	3.9
<b>Residential (1042)</b>													
Number of observations	695		404		771	90	762	108	275	392	25	784	87
% of samples above detection	31.1		53.2		83.1	63.3	69.4	33.3	6.9	44.1	44.0	96.2	89.7
Median	0.5		4.5		12	7.0	12.0	3.0	0.20	5.6	2.0	73	31.5
Coefficient of variation	3.4		1.2		1.8	2.0	1.9	1.9	0.9	1.2	0.5	1.3	0.8
<b>Mixed Residential (611)</b>													
Number of observations	420	30	193	21	432	29	500	30	115	150	25	515	28
% of samples above detection	34.5	40.0	81.3	52.4	83.8	72.4	78.4	46.7	15.7	60	72.0	92.6	100
Median	0.9	0.30	7.0	2.0	16	5.5	16	3.0	0.20	7.8	5.5	95	48
Coefficient of variation	3.6	0.6	1.5	0.8	1.2	0.9	1.4	0.7	0.8	0.8	0.9	0.9	0.9
<b>Commercial (527)</b>													
Number of observations	379	47	257	27	408	48	399	59	170	242	23	414	49
% of samples above detection	41.7	23.4	60.7	40.7	92.9	79.2	85.5	52.5	6.5	60.3	47.8	99.0	100
Median	0.96	0.30	6.0	2.0	17	7.57	18.0	5.0	0.20	7.0	3.0	150	59
Coefficient of variation	2.7	1.3	1.3	0.6	1.5	0.8	1.6	1.6	0.8	1.2	0.8	1.2	1.4
<b>Mixed Commercial (324)</b>													
Number of observations	188	41	128	27	191	41	244	41		102	26	243	39
% of samples above detection	49.5	34.1	88.3	66.7	93.2	80.5	88.1	63.4		78.4	69.2	98.8	100
Median	0.9	0.35	5.0	2.5	17.5	10	17.0	3.5		5.1	3.5	131.4	73
Coefficient of variation	1.1	0.8	1.1	0.7	3.0	0.6	1.4	0.8		1.3	0.6	1.7	0.8
<b>Industrial (566)</b>													
Number of observations	435	42	250	36	455	42	452	51	199	237	36	473	42
% of samples above detection	49.0	54.8	72.0	55.6	88.6	90.5	75.0	52.9	13.9	61.6	58.3	98.9	95.2
Median	2.0	0.60	12.0	3.0	20.8	8.0	24.9	5.0	0.20	14.0	5.0	199	112
Coefficient of variation	2.2	1.1	1.2	0.7	2.0	0.7	1.9	1.6	2.7	1.0	1.4	1.5	3.6

Table A-1. Summary of Available Storm Water Data Included in NSQD, version 1.1 – *Continued*

	Cd, total (µg/L)	Cd, filtered (µg/L)	Cr, total (µg/L)	Cr, filtered (µg/L)	Cu, total (µg/L)	Cu, filtered (µg/L)	Pb, total (µg/L)	Pb, filtered (µg/L)	Hg, total (µg/L)	Ni, total (µg/L)	Ni, filtered (µg/L)	Zn, total (µg/L)	Zn, filtered (µg/L)
<b>Mixed Industrial (218)</b>													
Number of observations	145	25	109	15	150	24	213	25	58	74	15	212	24
% of samples above detection	60.7	92.0	92.7	66.7	90.0	100.0	82.6	92.0	22.4	83.8	100.0	98.6	95.8
Median	1.6	0.60	8.0	2.0	23	6.0	20.0	5.0	0.3	12	5.0	172	2100
Coefficient of variation	1.9	0.6	1.7	0.7	0.8	0.6	1.4	1.0	0.6	0.8	0.6	3.1	1.2
<b>Institutional (18)</b>													
Number of observations							18					18	
% of samples above detection							77.8					100	
Median							5.75					305	
Coefficient of variation							0.8					0.8	
<b>Freeways (185)</b>													
Number of observations	95	114	76	101	97	130	107	126		99	95	93	105
% of samples above detection	71.6	26.3	98.7	78.2	99.0	99.2	100	50.0		89.9	67.4	96.8	99.1
Median	1.0	0.68	8.3	2.3	34.7	10.9	25	1.8		9.0	4.0	200	51
Coefficient of variation	0.9	1.0	0.7	0.7	1.0	1.5	1.5	1.7		0.9	1.4	1.0	1.9
<b>Mixed Freeways (26)</b>													
Number of observations	23		15		23		23					23	
% of samples above detection	56.5		100		100		56.5					100	
Median	0.5		6.0		14		10.0					130	
Coefficient of variation	2.2		1.0		1.0		1.3					0.9	
<b>Open Space (68)</b>													
Number of observations	38		36		39		45					45	
% of samples above detection	55.3		36.1		74.4		42.2					71.1	
Median	0.38		5.4		10		10.0					40	
Coefficient of variation	1.9		1.7		2.0		1.7					1.3	
<b>Mixed Open Space (168)</b>													
Number of observations	107		88		108		155		27	51		156	
% of samples above detection	18.7		81.8		89.8		74.2		14.8	72.5		98.1	
Median	2.0		6.0		9.0		10		0.15	8.0		80	
Coefficient of variation	1.4		1.3		1.0		2.3		0.4	1.1		1.1	

Table A-2 Water quality results for sampled events in the Rock Creek watershed (COMCD, 2006)

Date	Site	Alkalinity mg/l	TSS mg/l	NH <sub>3</sub> mg/l	NO <sub>2</sub> mg/l	NO <sub>3</sub> mg/l	TKN mg/l	T-P mg/l	Ortho-P mg/l	Chloride mg/l	Sulfate mg/l	Total Nitrogen TKN+NO <sub>3</sub> +NO <sub>2</sub>	Dissolved N NH <sub>3</sub> +NO <sub>3</sub> +NO <sub>2</sub>
10/31/2005	1	81.9	111	0.1	0.06	0.77	2.93	0.895	0.641	23.1		3.76	0.93
10/31/2005	3	R	300	0.84	0.4	<0.05	5.55	1.05	0.075	<10		5.95	1.24
10/31/2005	4	264	20	0.09	0.05	0.05	2.00	0.3	0.132	22.9		2.10	0.19
10/31/2005	5	310	22	0.06	<0.05	0.12	0.94	0.185	0.059	11.9		1.06	0.18
3/9/2006	1	132	236	0.29	0.12	0.71	3.29	0.65	0.091	61.2	90.5	4.12	1.12
3/9/2006	3	81.1	58	0.17	0.17	0.98	2.97	0.95	0.597	10	55.1	4.12	1.32
3/9/2006	4	437	40	<0.05	<0.05	<0.05	0.76	0.19	0.072	17.6	22.8	0.76	0
3/9/2006	5	356	26	<0.05	<0.05	<0.05	0.6	0.135	0.032	10.1	13.1	0.60	0
3/19/2006	1	155	204	0.05	<0.05	0.96	1.82	0.409	0.246	40.2		2.78	1.01
3/19/2006	3	66.1	27	<0.05	0.05	0.07	1.45	0.52	0.324	10		1.57	0.12
3/19/2006	4	416	16	<0.05	<0.05	0.05	0.68	0.131	0.071	17.9		0.86	0.05
3/19/2006	5	321	39	<0.05	<0.05	0.05	0.44	0.085	0.036	10		10.61	0.05
3/21/2006	1	247	105	<0.05	0.06	0.05	1.73	0.362	0.087	50.5	98.7	1.84	0.11
3/21/2006	2	203	37	<0.05	0.05	0.42	1.79	0.303	0.17	45.2	60.2	2.26	0.47
3/21/2006	3	157	22	<0.05	<0.05	0.43	0.81	0.123	0.052	19.7	42.2	1.24	0.43
3/21/2006	4	56.3	176	0.08	0.21	0.25	1.47	0.373	0.118	19.1	75.5	1.93	0.54
3/21/2006	5	272	72	<0.05	<0.05	0.06	0.76	0.136	0.047	16.4	19.1	0.82	0.06

**Storm Water Master Plan  
City of Norman  
Cleveland County, Oklahoma**

**October 2009**

**Appendix H**

**Conceptual Solution Cost Estimates**



APPENDIX H  
CONCEPTUAL SOLUTION COST ESTIMATES

City of Norman Storm Water Master Plan  
Probable Cost Estimate

BC-1: Bishop Creek - Bank Erosion Upstream of HWY 9

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Protect parking lot &amp; trail 700 LF US of HWY 9</b>					
1	Mobilization	1	LS	15%	\$31,350
2	Preparing Right of Way	1	LS	4%	\$8,360
3	Utility Relocation	1	LS	5%	\$10,450
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$6,270
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$14,630
6	Mechanical Stabilized Embankment (MSE)	4,500	SF	\$ 35.00	\$157,500
7	Rock Bendway Weir Structures	5	EA	\$ 5,000.00	\$25,000
8	Rock Toe Protection Trenches	100	CY	\$ 80.00	\$8,000
9	Dewatering	1	LS	\$ 10,000.00	\$10,000
10	Construction Exit	1	EA	\$ 2,000.00	\$2,000
11	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
12	Trench Safety Protection	300	LF	\$ 5.00	\$1,500
SUBTOTAL					\$280,060
20% CONTINGENCY					\$56,012
CONSTRUCTION TOTAL					\$336,072
Design Engineering and Permitting			LS	20%	\$67,214.40
City Project Management			LS	10%	\$33,607.20
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$436,894</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

City of Norman Storm Water Master Plan  
Probable Cost Estimate

BC-2: Bishop Creek - Bank Erosion South of Confluence with Trib. C to Bishop Creek

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Bank Stabilization on Bishop Creek South of Trib C confluence</b>					
1	Mobilization	1	LS	15%	\$23,100
2	Preparing Right of Way	1	LS	4%	\$6,160
3	Utility Relocation	1	LS	5%	\$7,700
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$4,620
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$10,780
6	Mechanical Stabilized Embankment (MSE)	3,250	SF	\$ 35.00	\$113,750
7	Rock Rip Rap w/ Filter Fabric (D50=18in.)	167	SY	\$ 80.00	\$13,333
8	Rock Toe Protection Trenches	83	CY	\$ 80.00	\$6,667
9	Dewatering	1	LS	\$ 10,000.00	\$10,000
10	Construction Exit	2	EA	\$ 2,000.00	\$4,000
11	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
12	Trench Safety Protection	250	LF	\$ 5.00	\$1,250
SUBTOTAL					\$206,360
20% CONTINGENCY					\$41,272
CONSTRUCTION TOTAL					\$247,632
Purchase Drainage Easement (Commercial)		9,000	SF	\$ 3.50	\$31,500
Design Engineering and Permitting			LS	20%	\$49,526.40
City Project Management			LS	10%	\$24,763.20
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$353,422</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-3: Bishop Creek - Channel Conveyance Improvements Just Downstream of Alameda Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$23,345
2	Preparing Right of Way	1	LS	4%	\$6,225
3	Utility Relocation	1	LS	5%	\$7,782
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$4,669
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$10,894
6	Channel Excavation (difficult)	2,893	CY	\$ 30.00	\$86,790
7	Concrete (6 IN) Remove & Replacement	490	SY	\$ 70.00	\$34,300
8	Mechanical Stabilized Embankment (MSE)	504	SF	\$ 35.00	\$17,640
9	Rock Rip Rap w/ Filter Fabric (D50=18in.)	30	SY	\$ 80.00	\$2,400
10	Dewatering	1	LS	\$ 10,000.00	\$10,000
11	Construction Exit	1	EA	\$ 2,000.00	\$2,000
12	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
SUBTOTAL					\$208,544
20% CONTINGENCY					\$41,709
CONSTRUCTION TOTAL					\$250,253
Purchase Drainage Easement (Commercial)		35,000	SF	\$ 3.50	\$122,500
Design Engineering and Permitting			LS	20%	\$50,050.61
City Project Management			LS	10%	\$25,025.30
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$447,829</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-4: Bishop Creek - Buyout Structures in the Future 10-Year Floodplain Upstream of Alameda**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
	Property/Structure Buyout	15	LS	\$1,846,598.00	\$1,846,598.00
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$1,846,598</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate**

**BC-5: Bishop Creek - Bed and Bank Erosion Downstream of Constitution on Trib. A to Bishop Creek**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Fill Scour, Replace Riprap Immediately D/S of Constitution on Trib A</b>					
1	Mobilization	1	LS	15%	\$25,698
2	Preparing Right of Way	1	LS	4%	\$6,853
3	Utility Relocation	1	LS	5%	\$8,566
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$5,140
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$11,992
6	Channel Excavation (difficult)	44	CY	\$ 30.00	\$1,333
7	Mechanical Stabilized Embankment (MSE)	4,250	SF	\$ 35.00	\$148,750
9	Rock Toe Protection Trenches	47	CY	\$ 80.00	\$3,733
10	Dewatering	1	LS	\$ 10,000.00	\$10,000
11	Construction Exit	1	EA	\$ 2,000.00	\$2,000
12	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
13	Trench Safety Protection	100	LF	\$ 5.00	\$500
SUBTOTAL					\$229,564
20% CONTINGENCY					\$45,913
CONSTRUCTION TOTAL					\$275,477
Purchase Drainage Easement (Commercial)		4,550	SF	\$ 3.50	\$15,925
Design Engineering and Permitting			LS	20%	\$55,095.44
City Project Management			LS	10%	\$27,547.72
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$374,045</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-6: Bishop Creek - Flood Protect Apartments**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$39,375
2	Preparing Right of Way	1	LS	4%	\$10,500
3	Utility Relocation	1	LS	5%	\$13,125
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$15,750
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$18,375
6	RCP - 18"	30	LF	\$ 65.00	\$1,950
7	Flap Gate	2	EA	\$ 15,000.00	\$30,000
8	Sidewalk Removal & Replacement	13	SY	\$ 20.00	\$267
9	Curb and Gutter Removal & Replacement	200	LF	\$ 30.00	\$6,000
10	Driveway Removal & Replacement	419	SY	\$ 50.00	\$20,968
11	Construction Exit	1	EA	\$ 2,000.00	\$2,000
12	Retaining Wall (Flood)	3,355	SF	\$ 60.00	\$201,315
SUBTOTAL					\$359,625
20% CONTINGENCY					\$71,925
CONSTRUCTION TOTAL					\$431,550
<hr/>					
	Purchase Drainage Easement (Commercial)	8,600	SF	\$3.50	\$30,100
	Design Engineering		LS	15%	\$64,733
	City Project Management		LS	10%	\$43,155
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$569,538</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate**

**BC-7: Bishop Creek - Outfall Failure Near 12th Ave NW**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Tributary A, Failed Storm Drain Outfall Near 12th Street</b>					
1	Mobilization	1	LS	15%	\$1,188
2	Preparing Right of Way	1	LS	4%	\$317
3	Utility Relocation	1	LS	5%	\$396
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$238
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$554
6	Headwall Removal	1	EA	\$ 500.00	\$500
7	RCP - 24"	30	LF	\$ 80.00	\$2,400
8	Headwall - Small <5ft.	1	EA	\$ 7,000.00	\$7,000
9	Channel Excavation (difficult)	20	CY	\$ 30.00	\$600
10	Rock Rip Rap w/ Filter Fabric (D50=18in.)	33	SY	\$ 80.00	\$2,667
11	Construction Exit	1	EA	\$ 2,000.00	\$2,000
12	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
13	Trench Safety Protection	30	LF	\$ 5.00	\$150
SUBTOTAL					\$20,508
20% CONTINGENCY					\$4,102
CONSTRUCTION TOTAL					\$24,610
<hr/>					
	Purchase Drainage Easement (Commercial)	7,500	SF	\$ 3.50	\$26,250
	Design Engineering and Permitting		LS	20%	\$4,922.00
	City Project Management		LS	10%	\$2,461.00
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$58,243</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.



APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-8: Bishop Creek Tributary A - Lindsey Street Culvert Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$32,897
2	Preparing Right of Way	1	LS	4%	\$8,773
3	Utility Relocation	1	LS	5%	\$10,966
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$13,159
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$15,352
6	Excavation (easy)	889	CY	\$ 5.00	\$4,445
7	Concrete Box Culverts - 10 x 6	200	LF	\$ 650.00	\$130,000
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Culvert Removal	2	EA	\$ 3,000.00	\$6,000
10	Headwall Removal	2	EA	\$ 500.00	\$1,000
11	Pavement Removal & Replacement	222	SY	\$ 80.00	\$17,760
12	Sidewalk Removal & Replacement	67	SY	\$ 20.00	\$1,340
13	Concrete (6 IN) Remove & Replacement	109	SY	\$ 70.00	\$7,630
14	Curb and Gutter Removal & Replacement	100	LF	\$ 30.00	\$3,000
15	Rock Rip Rap w/ Filter Fabric (D50=18in.)	133	SY	\$ 80.00	\$10,640
16	Dewatering	1	LS	\$ 10,000.00	\$10,000
17	Construction Exit	1	EA	\$ 2,000.00	\$2,000
18	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
19	Trench Safety Protection	100	LF	\$ 5.00	\$500
SUBTOTAL					\$300,462
20% CONTINGENCY					\$60,092
CONSTRUCTION TOTAL					\$360,554
<hr/>					
Design Engineering			LS	15%	\$54,083
City Project Management			LS	10%	\$36,055
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$450,692</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate**

**BC-9: Bishop Creek - Bank Erosion Upstream of Lindsey Road on Trib. A**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Tributary A, Toe Protection 400 ft U/S of Lindsey</b>					
1	Mobilization	1	LS	15%	\$1,188
2	Preparing Right of Way	1	LS	4%	\$317
3	Utility Relocation	1	LS	5%	\$396
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$238
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$554
6	Rock Toe Protection Trenches	67	CY	\$ 80.00	\$5,333
7	Dewatering	1	LS	\$ 10,000.00	\$10,000
8	Construction Exit	1	EA	\$ 2,000.00	\$2,000
9	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
10	Trench Safety Protection		LF	\$ 5.00	\$0
SUBTOTAL					\$22,525
20% CONTINGENCY					\$4,505
CONSTRUCTION TOTAL					\$27,030
<hr/>					
Purchase Drainage Easement (Commercial)		8,000	SF	\$ 3.50	\$28,000
Design Engineering and Permitting			LS	20%	\$5,406.00
City Project Management			LS	10%	\$2,703.00
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$63,139</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

City of Norman Storm Water Master Plan  
Probable Cost Estimate

BC-10: Bishop Creek - Beaumont Road & Sinclair Road Crossing Improvements and Channel Improvements

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$113,513
2	Preparing Right of Way	1	LS	4%	\$30,270
3	Utility Relocation	1	LS	5%	\$37,838
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$45,405
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$52,973
6	Excavation (easy)	544	CY	\$ 5.00	\$2,722
7	Channel Excavation (easy)	20,440	CY	\$ 25.00	\$511,000
8	Concrete Box Culverts - 10 x 6	35	LF	\$ 650.00	\$22,750
9	Concrete Box Culverts - 12 x 5	100	LF	\$ 980.00	\$98,000
10	Headwall - Large >5ft.	4	EA	\$ 10,000.00	\$40,000
11	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
12	Headwall Removal	4	EA	\$ 500.00	\$2,000
13	Pavement Removal & Replacement	300	SY	\$ 80.00	\$24,000
14	Sidewalk Removal & Replacement	147	SY	\$ 20.00	\$2,933
15	Concrete (6 IN) Remove & Replacement	98	SY	\$ 70.00	\$6,844
16	Curb and Gutter Removal & Replacement	120	LF	\$ 30.00	\$3,600
17	Rock Rip Rap w/ Filter Fabric (D50=18in.)	30	SY	\$ 80.00	\$2,400
18	Dewatering	1	LS	\$ 10,000.00	\$10,000
19	Construction Exit	1	EA	\$ 2,000.00	\$2,000
20	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
21	Trench Safety Protection	100	LF	\$ 5.00	\$500
22	Remove and Replace Footbridge	1	EA	\$ 20,000.00	\$20,000
SUBTOTAL					\$1,036,748
20% CONTINGENCY					\$207,350
CONSTRUCTION TOTAL					\$1,244,097
<hr/>					
Purchase Drainage Easement (Commercial)	24,700	SF	\$ 3.50	\$86,450	
Design Engineering and Permitting		LS	20%	\$248,819	
City Project Management		LS	10%	\$124,410	
<hr/>					
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$1,703,776</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

City of Norman Storm Water Master Plan  
Probable Cost Estimate

BC-11: Bishop Creek - Trib. C to Bishop Creek Bank Erosion

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Tributary C, 400 Ft U/S of Main Channel: MSE &amp; Grade Controls</b>					
1	Mobilization	1	LS	15%	\$35,628
2	Preparing Right of Way	1	LS	4%	\$9,501
3	Utility Relocation	1	LS	5%	\$11,876
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$7,126
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$16,626
6	Channel Excavation (difficult)	293	CY	\$ 30.00	\$8,800
7	Mechanical Stabilized Embankment (MSE)	2,400	SF	\$ 35.00	\$84,000
8	Rock Grade Control Structures	4	EA	\$ 25,000.00	\$100,000
9	Rock Toe Protection Trenches	293	CY	\$ 80.00	\$23,467
10	Dewatering	1	LS	\$ 10,000.00	\$10,000
11	Construction Exit	2	EA	\$ 2,000.00	\$4,000
12	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
13	Trench Safety Protection	450	LF	\$ 5.00	\$2,250
SUBTOTAL					\$318,272
20% CONTINGENCY					\$63,654
CONSTRUCTION TOTAL					\$381,927
<hr/>					
Purchase Drainage Easement (Commercial)	10,000	SF	\$ 3.50	\$35,000	
Design Engineering and Permitting		LS	20%	\$76,385.36	
City Project Management		LS	10%	\$38,192.68	
<hr/>					
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$531,505</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-12: Bishop Creek Tributary C - Brooks Street Culvert Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$22,062
2	Preparing Right of Way	1	LS	4%	\$5,883
3	Utility Relocation	1	LS	5%	\$7,354
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$8,825
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$10,295
6	Excavation (difficult)	415	CY	\$ 10.00	\$4,148
7	Concrete Box Culverts - 10 x 5	80	LF	\$ 550.00	\$44,000
8	RCP - 36"	30	LF	\$ 105.00	\$3,150
9	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
10	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
11	Headwall Removal	2	EA	\$ 500.00	\$1,000
12	Pavement Removal & Replacement	267	SY	\$ 80.00	\$21,333
13	Curb and Gutter Removal & Replacement	120	LF	\$ 30.00	\$3,600
14	Driveway Removal & Replacement	133	SY	\$ 50.00	\$6,667
15	Mechanical Stabilized Embankment (MSE)	600	SF	\$ 35.00	\$21,000
16	Rock Rip Rap w/ Filter Fabric (D50=18in.)	56	SY	\$ 80.00	\$4,480
17	Dewatering	1	LS	\$ 10,000.00	\$10,000
18	Construction Exit	1	EA	\$ 2,000.00	\$2,000
19	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
20	Trench Safety Protection	40	LF	\$ 5.00	\$200
SUBTOTAL					\$201,497
20% CONTINGENCY					\$40,299
CONSTRUCTION TOTAL					\$241,796
<hr/>					
	Purchase Drainage Easement (Commercial)	4,297	SF	\$ 3.50	\$15,040
	Design Engineering and Permitting		LS	20%	\$48,359
	City Project Management		LS	10%	\$24,180
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$329,375</b>

Notes:  
 1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
 2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-13: Bishop Creek - Anatole Detention Pond Expansion**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$16,156
2	Preparing Right of Way	1	LS	4%	\$4,308
3	Utility Relocation	1	LS	5%	\$5,385
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$6,463
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$7,540
6	Excavation (easy)	15,094	CY	\$ 5.00	\$75,468
7	Pipe Removal	423	LF	\$ 25.00	\$10,575
8	Concrete (6 IN) Removal	146	SY	\$ 12.00	\$1,747
9	Concrete (6 IN)	299	SY	\$ 60.00	\$17,920
10	Construction Exit	1	EA	\$ 2,000.00	\$2,000
SUBTOTAL					\$147,562
20% CONTINGENCY					\$29,512
CONSTRUCTION TOTAL					\$177,074
<hr/>					
	Property Buyout	1	LS	\$ 171,392.00	\$171,392
	Design Engineering and Permitting		LS	20%	\$35,415
	City Project Management		LS	10%	\$17,707
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$401,588</b>

Notes:  
 1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
 2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-14: Bishop Creek - Channel Conveyance NW of Tahoe St. and 24th SE St.**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Channel Conveyance for area NW of Tahoe St. and 24th SE St.	1	LS	\$ 20,000.00	\$20,000
SUBTOTAL					\$20,000
20% CONTINGENCY					\$4,000
CONSTRUCTION TOTAL					\$24,000
<hr/>					
	Design Engineering		LS	15%	\$3,600.00
	City Project Management		LS	10%	\$2,400.00
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$30,000</b>

Notes:  
 1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
 2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-15: Bishop Creek - George/Stinson Channel Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$16,211
2	Preparing Right of Way	1	LS	4%	\$4,323
3	Utility Relocation	1	LS	5%	\$5,404
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$6,484
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$7,565
6	Excavation (easy)	203	CY	\$ 5.00	\$1,013
7	Channel Excavation (difficult)	1,035	CY	\$ 30.00	\$31,040
8	RCP - 36"	152	LF	\$ 105.00	\$15,960
9	Headwall - Large >5ft.	1	EA	\$ 10,000.00	\$10,000
10	Manhole/Junction Box	1	EA	\$ 3,000.00	\$3,000
11	Headwall Removal	1	EA	\$ 500.00	\$500
12	Concrete (6 IN)	517	SY	\$ 30.00	\$15,520
13	Chain Link Fence	1,552	LF	\$ 15.00	\$23,280
14	Construction Exit	1	EA	\$ 2,000.00	\$2,000
15	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
16	Trench Safety Protection	152	LF	\$ 5.00	\$760
SUBTOTAL					\$148,060
20% CONTINGENCY					\$29,612
CONSTRUCTION TOTAL					\$177,673
Purchase Drainage Easement (Residential)		31,000	SF	\$ 2.00	\$62,000
Design Engineering and Permitting			LS	20%	\$35,535
City Project Management			LS	10%	\$17,767
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$292,974</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-16: Bishop Creek - Lindsey/College Storm Sewer Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Clearing and Grubbing	1	LS	\$ 10,000.00	\$10,000
2	Excavation	850	CY	\$ 6.00	\$5,100
3	Temporary Siltation Screen	3,500	LF	\$ 2.50	\$8,750
4	Solid Slab Sodding	3,475	SY	\$ 2.50	\$8,688
5	Watering	30	M-GAL	\$ 50.00	\$1,500
6	Fertilizing (10-20-10)	0.25	TON	\$ 500.00	\$125
7	Aggregate Base	1,350	TON	\$ 35.00	\$47,250
8	Tack Coat	850	GAL	\$ 1.00	\$850
9	Prime Coat	2,750	GAL	\$ 1.25	\$3,438
10	Asphalt Concrete Type A (See Alternates Below)	620	TON	\$ 40.00	\$24,800
11	Asphalt Concrete Type B (See Alternates Below)	1,400	TON	\$ 40.00	\$56,000
12	Combined Curb and Gutter	4,150	LF	\$ 15.00	\$62,250
13	Manhole Frame and Grate	10	EA	\$ 350.00	\$3,500
14	Cici Inlet (Des 2) W/Grates and Throats	18	EA	\$ 3,000.00	\$54,000
15	Junction Box	10	EA	\$ 8,000.00	\$80,000
16	18" RCP CL. III	270	LF	\$ 35.00	\$9,450
17	48" RCP CL. III	184	LF	\$ 160.00	\$29,440
18	54" RCP CL. III	619	LF	\$ 280.00	\$173,320
19	6' X 4' RCB (Precast)	3,099	LF	\$ 375.00	\$1,162,125
20	Special Headwall	1	EA	\$ 8,000.00	\$8,000
21	Trench Excavation	37,300	CY	\$ 6.00	\$223,800
22	Standard Bedding Material	1,500	CY	\$ 25.00	\$37,500
23	Removal of Asphalt Pavement	5,500	SY	\$ 5.00	\$27,500
24	Removal of Curbs	4,150	LF	\$ 6.00	\$24,900
25	Removal of Pipe	270	LF	\$ 10.00	\$2,700
26	Sawing Pavement	3,500	LF	\$ 5.00	\$17,500
27	Field Office	1	LS	\$ 15,000.00	\$15,000
28	Mobilization	1	LS	\$ 95,000.00	\$95,000
29	Staking	1	LS	\$ 30,000.00	\$30,000
30	Traffic Control	1	LS	\$ 10,000.00	\$10,000
31	Extend CIP project 350' to College St. (9% of existing CIP length)	1	LS	\$ 186,523.65	\$186,524
SUBTOTAL					\$2,419,009
20% CONTINGENCY					\$483,802
CONSTRUCTION TOTAL					\$2,902,810
Design Engineering			LS	15%	\$435,421.56
City Project Management			LS	10%	\$290,281.04
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$3,628,513</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BC-17: Bishop Creek - Culvert Improvement at Mockingbird Lane**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$25,757
2	Preparing Right of Way	1	LS	4%	\$6,868
3	Utility Relocation	1	LS	5%	\$8,586
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$10,303
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$12,020
6	Excavation (difficult)	321	CY	\$ 10.00	\$3,215
7	Embankment (difficult)	444	CY	\$ 17.00	\$7,556
8	Channel Excavation (difficult)	690	CY	\$ 30.00	\$20,700
9	Concrete Box Culverts - 8 x 5	93	LF	\$ 340.00	\$31,620
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	Culvert Removal	2	EA	\$ 3,000.00	\$6,000
12	Headwall Removal	2	EA	\$ 500.00	\$1,000
13	Pavement Removal & Replacement	689	SY	\$ 80.00	\$55,111
14	Curb and Gutter Removal & Replacement	320	LF	\$ 30.00	\$9,600
15	Driveway Removal & Replacement	89	SY	\$ 50.00	\$4,444
16	Dewatering	1	LS	\$ 5,000.00	\$5,000
17	Construction Exit	1	EA	\$ 2,000.00	\$2,000
18	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
19	Trench Safety Protection	93	LF	\$ 5.00	\$465
SUBTOTAL					\$235,244
20% CONTINGENCY					\$47,049
CONSTRUCTION TOTAL					\$282,293
Design Engineering and Permitting			LS	20%	\$56,459
City Project Management			LS	10%	\$28,229
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$366,981</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-1: Brookhaven Creek - Main Street Crossing Improvement (Culvert) & 2000 LF  
of Channel Improvements and Stabilization Downstream of Main Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$192,931
2	Preparing Right of Way	1	LS	4%	\$51,448
3	Utility Relocation	1	LS	5%	\$64,310
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$77,173
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$90,035
6	Excavation (easy)	1,825	CY	\$ 5.00	\$9,126
7	Embankment (difficult)	389	CY	\$ 17.00	\$6,611
8	Channel Excavation (difficult)	8,000	CY	\$ 30.00	\$240,000
9	Concrete Box Culverts - 12 x 8	256	LF	\$ 1,175.00	\$300,800
10	RCP - 24"	20	LF	\$ 80.00	\$1,600
11	RCP - 30"	20	LF	\$ 95.00	\$1,900
12	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
13	Culvert Removal	2	EA	\$ 3,000.00	\$6,000
14	Headwall Removal	2	EA	\$ 500.00	\$1,000
15	Pavement Removal & Replacement	956	SY	\$ 80.00	\$76,444
16	Sidewalk Removal & Replacement	80	SY	\$ 20.00	\$1,600
17	Concrete (6 IN) Remove & Replacement	56	SY	\$ 70.00	\$3,889
18	Curb and Gutter Removal & Replacement	280	LF	\$ 30.00	\$8,400
19	Mechanical Stabilized Embankment (MSE)	10,700	SF	\$ 35.00	\$374,500
20	Rock Rip Rap w/ Filter Fabric (D50=18in.)	1,545	SY	\$ 80.00	\$123,573
21	Dewatering	1	LS	\$ 10,000.00	\$10,000
22	Construction Exit	2	EA	\$ 2,000.00	\$4,000
23	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
24	Trench Safety Protection	1,225	LF	\$ 5.00	\$6,125
25	Rock Toe Protection Trenches	383	CY	\$ 80.00	\$30,640
26	Rock Grade Control Structures	2	EA	\$ 25,000.00	\$50,000
SUBTOTAL					\$1,762,106
20% CONTINGENCY					\$352,421
CONSTRUCTION TOTAL					\$2,114,527
Purchase Drainage Easement (Residential)		125,740	SF	\$ 2.00	\$251,480
Property/Structure Buyout		10	EA	\$ 25,000.00	\$250,000
Design Engineering and Permitting			LS	20%	\$422,905
City Project Management			LS	10%	\$211,453
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$3,250,365</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-2: Brookhaven Creek - Bank Erosion between Main St. and Beaver Dam**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Graded 3:1 Slope Both Banks, Between Main St &amp; Beaver Dam</b>					
1	Mobilization	1	LS	15%	\$5,785
2	Preparing Right of Way	1	LS	4%	\$1,543
3	Utility Relocation	1	LS	5%	\$1,928
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$1,157
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$2,700
6	Channel Excavation (difficult)	240	CY	\$ 30.00	\$7,200
7	Rock Rip Rap w/ Filter Fabric (D50=18in.)	133	SY	\$ 80.00	\$10,667
8	Rock Toe Protection Trenches	40	CY	\$ 80.00	\$3,200
9	Dewatering	1	LS	\$ 10,000.00	\$10,000
10	Construction Exit	1	EA	\$ 2,000.00	\$2,000
11	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
12	Trench Safety Protection	100	LF	\$ 5.00	\$500
SUBTOTAL					\$51,679
20% CONTINGENCY					\$10,336
CONSTRUCTION TOTAL					\$62,015
<hr/>					
	Purchase Drainage Easement (Commercial)	6,000	SF	\$ 3.50	\$21,000
	Design Engineering and Permitting		LS	20%	\$12,403.04
	City Project Management		LS	10%	\$6,201.52

**TOTAL CAPITAL PROJECT COST** **\$101,620**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-3: Brookhaven Creek - Bank Erosion upstream of Willow Branch Road**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>400 ft u/s of Willow Branch, ID 33</b>					
1	Mobilization	1	LS	15%	\$11,203
2	Preparing Right of Way	1	LS	4%	\$2,987
3	Utility Relocation	1	LS	5%	\$3,734
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$2,241
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$5,228
6	Channel Excavation (difficult)	220	CY	\$ 30.00	\$6,600
7	Mechanical Stabilized Embankment (MSE)	1,000	SF	\$ 35.00	\$35,000
8	Rock Rip Rap w/ Filter Fabric (D50=18in.)	37	SY	\$ 80.00	\$2,933
9	Rock Toe Protection Trenches	70	CY	\$ 80.00	\$5,600
10	Outfall Treatment	1	EA	\$ 9,000.00	\$9,000
11	Dewatering	1	LS	\$ 10,000.00	\$10,000
12	Construction Exit	1	EA	\$ 2,000.00	\$2,000
13	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
14	Trench Safety Protection	210	LF	\$ 5.00	\$1,050
SUBTOTAL					\$100,076
20% CONTINGENCY					\$20,015
CONSTRUCTION TOTAL					\$120,091
<hr/>					
	Design Engineering and Permitting		LS	20%	\$24,018.16
	City Project Management		LS	10%	\$12,009.08

**TOTAL CAPITAL PROJECT COST** **\$156,118**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-4: Brookhaven Creek - Bank Erosion downstream of 36th Ave NW**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>740 LF D/S of 36th, ID 37-41</b>					
1	Mobilization	1	LS	15%	\$41,701
2	Preparing Right of Way	1	LS	4%	\$11,120
3	Utility Relocation	1	LS	5%	\$13,900
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$8,340
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$19,460
7	Channel Excavation (difficult)	1,740	CY	\$ 30.00	\$52,200
8	Mechanical Stabilized Embankment (MSE)	2,480	SF	\$ 35.00	\$86,800
9	Rock Rip Rap w/ Filter Fabric (D50=18in.)	387	SY	\$ 80.00	\$30,933
10	Rock Toe Protection Trenches	495	CY	\$ 80.00	\$39,573
11	Outfall Repair	3	EA	\$ 9,000.00	\$27,000
12	Dewatering	2	LS	\$ 10,000.00	\$20,000
13	Construction Exit	2	EA	\$ 2,000.00	\$4,000
14	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
15	Trench Safety Protection	1,500	LF	\$ 5.00	\$7,500
SUBTOTAL					\$372,529
20% CONTINGENCY					\$74,506
CONSTRUCTION TOTAL					\$447,035
Purchase Drainage Easement (Residential)		6,000	SF	\$ 2.00	\$12,000
Design Engineering and Permitting			LS	20%	\$89,406.94
City Project Management			LS	10%	\$44,703.47
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$593,145</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-5: Brookhaven Creek - Channel Constriction Due to Concrete  
Riprap Underneath Robinson Road**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Remove Concrete Underneath Robinson Road	1	LS	\$50,000.00	\$50,000
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$50,000</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-6: Brookhaven Creek - Rock Creek Crossing Improvement (Brookhaven Creek)**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$19,005
2	Preparing Right of Way	1	LS	4%	\$5,068
3	Utility Relocation	1	LS	5%	\$6,335
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$3,801
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$8,869
6	Excavation (easy)	805	CY	\$ 5.00	\$4,025
7	RCP - 60"	315	LF	\$ 230.00	\$72,450
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Headwall Removal	2	EA	\$ 500.00	\$1,000
10	Pavement Removal & Replacement	128	SY	\$ 80.00	\$10,240
11	Sidewalk Removal & Replacement	13	SY	\$ 20.00	\$260
12	Curb and Gutter Removal & Replacement	40	LF	\$ 30.00	\$1,200
13	Dewatering	1	LS	\$ 10,000.00	\$10,000
14	Construction Exit	1	EA	\$ 2,000.00	\$2,000
15	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
16	Trench Safety Protection	105	LF	\$ 5.00	\$525
SUBTOTAL					\$169,778
20% CONTINGENCY					\$33,956
CONSTRUCTION TOTAL					\$203,734
Design Engineering			LS	15%	\$30,560.04
City Project Management			LS	10%	\$20,373.36
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$254,667</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-7: Brookhaven Creek - Pendleton Road Crossing Improvement (Trib. A to Brookhaven)**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$7,889
2	Preparing Right of Way	1	LS	4%	\$2,104
3	Utility Relocation	1	LS	5%	\$2,630
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$1,578
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$3,682
6	Excavation (easy)	109	CY	\$ 5.00	\$545
7	RCP - 48"	46	LF	\$ 160.00	\$7,360
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Headwall Removal	2	EA	\$ 500.00	\$1,000
10	Pavement Removal & Replacement	41	SY	\$ 80.00	\$3,280
11	Sidewalk Removal & Replacement	9	SY	\$ 20.00	\$180
12	Curb and Gutter Removal & Replacement	20	LF	\$ 30.00	\$600
13	Rock Rip Rap w/ Filter Fabric (D50=18in.)	30	SY	\$ 80.00	\$2,400
14	Dewatering	1	LS	\$ 10,000.00	\$10,000
15	Construction Exit	1	EA	\$ 2,000.00	\$2,000
16	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
17	Trench Safety Protection	46	LF	\$ 5.00	\$230
SUBTOTAL					\$70,477
20% CONTINGENCY					\$14,095
CONSTRUCTION TOTAL					\$84,573
<hr/>					
Design Engineering			LS	15%	\$12,685.91
City Project Management			LS	10%	\$8,457.28
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$105,716</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-8: Brookhaven Creek - Rock Creek Crossing Improvement (Trib. A to Brookhaven)**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$19,329
2	Preparing Right of Way	1	LS	4%	\$5,154
3	Utility Relocation	1	LS	5%	\$6,443
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$3,866
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$9,020
6	Excavation (easy)	650	CY	\$ 5.00	\$3,250
7	RCP - 72"	260	LF	\$ 275.00	\$71,500
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Headwall Removal	2	EA	\$ 500.00	\$1,000
10	Pavement Removal & Replacement	107	SY	\$ 80.00	\$8,560
12	Curb and Gutter Removal & Replacement	70	LF	\$ 30.00	\$2,100
14	Rock Rip Rap w/ Filter Fabric (D50=18in.)	60	SY	\$ 80.00	\$4,800
15	Dewatering	1	LS	\$ 10,000.00	\$10,000
16	Construction Exit	1	EA	\$ 2,000.00	\$2,000
17	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
18	Trench Safety Protection	130	LF	\$ 5.00	\$650
SUBTOTAL					\$172,672
20% CONTINGENCY					\$34,534
CONSTRUCTION TOTAL					\$207,207
<hr/>					
Design Engineering			LS	15%	\$31,081.03
City Project Management			LS	10%	\$20,720.69
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$259,009</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.



APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-9: Brookhaven Creek - Rambling Oaks/Tall Oaks Storm Sewer Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$22,939
2	Preparing Right of Way	1	LS	4%	\$6,117
3	Utility Relocation	1	LS	5%	\$7,646
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$9,176
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$10,705
6	Excavation (difficult)	1,241	CY	\$ 10.00	\$12,415
7	RCP - 60"	419	LF	\$ 235.00	\$98,465
8	Headwall - Large >5ft.	1	EA	\$ 10,000.00	\$10,000
9	Manhole/Junction Box	2	EA	\$ 3,000.00	\$6,000
10	Headwall Removal	1	EA	\$ 500.00	\$500
11	Sidewalk Removal & Replacement	13	SY	\$ 20.00	\$267
12	Chain Link Fence	419	LF	\$ 15.00	\$6,285
13	Channel Cleaning	200	LF	\$ 50.00	\$10,000
14	Rock Rip Rap w/ Filter Fabric (D50=18in.)	30	SY	\$ 80.00	\$2,400
15	Construction Exit	1	EA	\$ 2,000.00	\$2,000
16	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
17	Trench Safety Protection	419	LF	\$ 5.00	\$2,095
SUBTOTAL					\$209,509
20% CONTINGENCY					\$41,902
CONSTRUCTION TOTAL					\$251,411
Design Engineering					LS 15% \$37,712
City Project Management					LS 10% \$25,141
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$314,264</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
BHC-10: Brookhaven Creek - Rambling Oaks/Havenbrook Storm Sewer Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$66,766
2	Preparing Right of Way	1	LS	4%	\$17,804
3	Utility Relocation	1	LS	5%	\$22,255
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$26,707
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$31,158
6	Excavation (easy)	3,269	CY	\$ 5.00	\$16,347
7	RCP - 24"	1,057	LF	\$ 80.00	\$84,560
8	RCP - 60"	641	LF	\$ 235.00	\$150,635
9	Headwall - Large >5ft.	1	EA	\$ 10,000.00	\$10,000
10	Manhole/Junction Box	1	EA	\$ 3,000.00	\$3,000
11	5' Inlet	4	EA	\$ 3,500.00	\$14,000
12	Pipe Removal	641	LF	\$ 15.00	\$9,615
13	Headwall Removal	1	EA	\$ 500.00	\$500
14	Pavement Removal & Replacement	961	SY	\$ 80.00	\$76,844
15	Sidewalk Removal & Replacement	1,049	SY	\$ 20.00	\$20,973
16	Curb and Gutter Removal & Replacement	1,477	LF	\$ 30.00	\$44,310
17	Driveway Removal & Replacement	67	SY	\$ 50.00	\$3,333
18	Trench Safety Protection	1,698	LF	\$ 5.00	\$8,490
19	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
SUBTOTAL					\$609,798
20% CONTINGENCY					\$121,960
CONSTRUCTION TOTAL					\$731,758
Design Engineering					LS 15% \$109,764
City Project Management					LS 10% \$73,176
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$914,698</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
CC-1: Clear Creek - Culvert and Roadway Improvements at 120th Avenue SE**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$130,951
2	Preparing Right of Way	1	LS	4%	\$34,920
3	Utility Relocation	1	LS	5%	\$43,650
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$52,380
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$61,110
6	Excavation (difficult)	1,615	CY	\$ 10.00	\$16,148
7	Embankment (difficult)	5,185	CY	\$ 17.00	\$88,148
8	Concrete Box Culverts - 10 x 4	80	LF	\$ 525.00	\$42,000
9	Concrete Box Culverts - 10 x 5	390	LF	\$ 550.00	\$214,500
10	Headwall - Large >5ft.	4	EA	\$ 10,000.00	\$40,000
11	Concrete (6 IN) Remove & Replacement	183	SY	\$ 70.00	\$12,841
12	Pipe Removal	600	LF	\$ 25.00	\$15,000
13	Headwall Removal	2	EA	\$ 500.00	\$1,000
14	Pavement Removal & Replacement	4,667	SY	\$ 80.00	\$373,333
15	Driveway Removal & Replacement	654	SY	\$ 50.00	\$32,683
16	Dewatering	1	LS	\$ 5,000.00	\$5,000
17	Construction Exit	2	EA	\$ 2,000.00	\$4,000
18	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
19	Rock Riprap w/ Filter Fabric (D50=18in.)	200	SY	\$ 80.00	\$16,000
20	Trench Safety Protection	470	LF	\$ 5.00	\$2,350
SUBTOTAL					\$1,196,016
20% CONTINGENCY					\$239,203
CONSTRUCTION TOTAL					\$1,435,219
Design Engineering					LS 15% \$215,283
City Project Management					LS 10% \$143,522
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$1,794,023</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
CR-1: Canadian River - Westbrooke Terrace/Havenbrook Intersection Flooding Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$29,244
2	Preparing Right of Way	1	LS	4%	\$7,798
3	Utility Relocation	1	LS	5%	\$9,748
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$11,698
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$13,647
6	Excavation (easy)	967	CY	\$ 5.00	\$4,837
7	Concrete Box Culverts - 7 x 2	215	LF	\$ 225.00	\$48,375
8	RCP - 36"	427	LF	\$ 105.00	\$44,835
9	5' Inlet	5	EA	\$ 3,500.00	\$17,500
10	Box Removal	215	LF	\$ 40.00	\$8,600
11	Pipe Removal	73	LF	\$ 25.00	\$1,825
12	Pavement Removal & Replacement	524	SY	\$ 80.00	\$41,884
13	Sidewalk Removal & Replacement	120	SY	\$ 20.00	\$2,400
14	Curb and Gutter Removal & Replacement	485	LF	\$ 30.00	\$14,550
15	Driveway Removal & Replacement	89	SY	\$ 50.00	\$4,444
16	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
17	Trench Safety Protection	642	LF	\$ 5.00	\$3,210
SUBTOTAL					\$267,097
20% CONTINGENCY					\$53,419
CONSTRUCTION TOTAL					\$320,516
Design Engineering					LS 15% \$48,077
City Project Management					LS 10% \$32,052
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$400,645</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
DBC-1: Dave Blue Creek - 48th Ave SE Road Crossing Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$115,122
2	Preparing Right of Way	1	LS	4%	\$30,699
3	Utility Relocation	1	LS	5%	\$38,374
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$23,024
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$53,724
6	Excavation (easy)	1,056	CY	\$ 5.00	\$5,280
7	Embankment (easy)	8,000	CY	\$ 6.00	\$48,000
8	Concrete Box Culverts - 13 x 11	369	LF	\$ 1,600.00	\$590,400
9	Headwall - Large >5ft.	4	EA	\$ 10,000.00	\$40,000
10	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
11	Headwall Removal	4	EA	\$ 500.00	\$2,000
12	Pavement Removal & Replacement	440	SY	\$ 80.00	\$35,200
13	Rock Rip Rap w/ Filter Fabric (D50=18in.)	100	SY	\$ 80.00	\$8,000
14	Dewatering	2	LS	\$ 10,000.00	\$20,000
15	Construction Exit	2	EA	\$ 2,000.00	\$4,000
16	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
17	Trench Safety Protection	120	LF	\$ 5.00	\$600
SUBTOTAL					\$1,028,423
20% CONTINGENCY					\$205,685
CONSTRUCTION TOTAL					\$1,234,108
Design Engineering					LS 15% \$185,116.18
City Project Management					LS 10% \$123,410.78
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$1,542,635</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
DBC-2: Dave Blue Creek - 48th Ave SE Road Crossing Improvement (Tributary to DBC)**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$18,216
2	Preparing Right of Way	1	LS	4%	\$4,858
3	Utility Relocation	1	LS	5%	\$6,072
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$3,643
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$8,501
6	Excavation (easy)	400	CY	\$ 5.00	\$2,000
7	Concrete Box Culverts - 10 x 6	90	LF	\$ 650.00	\$58,500
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
10	Pavement Removal & Replacement	183	SY	\$ 80.00	\$14,667
11	Rock Rip Rap w/ Filter Fabric (D50=18in.)	50	SY	\$ 80.00	\$4,000
12	Dewatering	1	LS	\$ 10,000.00	\$10,000
13	Construction Exit	2	EA	\$ 2,000.00	\$4,000
14	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
15	Trench Safety Protection	55	LF	\$ 5.00	\$275
SUBTOTAL					\$162,732
20% CONTINGENCY					\$32,546
CONSTRUCTION TOTAL					\$195,278
Design Engineering					LS 15% \$29,291.73
City Project Management					LS 10% \$19,527.82
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$244,098</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

City of Norman Storm Water Master Plan  
 Probable Cost Estimate  
 IC-1: Imhoff Creek - Bank Stabilization (Erosion) south of HWY 9

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Lower Imhoff South of Highway 9</b>					
1	Mobilization	1	LS	15%	\$10,650
2	Preparing Right of Way	1	LS	4%	\$2,840
3	Utility Relocation	1	LS	5%	\$3,550
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$2,130
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$4,970
6	Channel Excavation (difficult)	400	CY	\$ 30.00	\$12,000
7	Rock Toe Protection Trenches	400	CY	\$ 80.00	\$32,000
8	Dewatering	1	LS	\$ 10,000.00	\$10,000
9	Construction Exit	2	EA	\$ 2,000.00	\$4,000
10	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
11	Trench Safety Protection	600	LF	\$ 5.00	\$3,000
SUBTOTAL					\$95,140
20% CONTINGENCY					\$19,028
CONSTRUCTION TOTAL					\$114,168
<hr/>					
	Purchase Drainage Easement	30,000	SF	\$ 3.50	\$105,000
	Design Engineering and Permitting		LS	20%	\$22,833.60
	City Project Management		LS	10%	\$11,416.80
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$253,418</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

City of Norman Storm Water Master Plan  
 Probable Cost Estimate  
 IC-2: Imhoff Creek - Bank Stabilization (Erosion) from HWY 9 upstream to ACB Channel Section

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>SH 9 - Imhoff Road</b>					
1	Mobilization	1	LS	15%	\$170,520
2	Preparing Right of Way	1	LS	4%	\$45,472
3	Utility Relocation	1	LS	5%	\$56,840
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$34,104
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$79,576
6	Channel Excavation (difficult)	1,890	CY	\$ 30.00	\$56,700
7	Mechanical Stabilized Embankment (MSE)	19,000	SF	\$ 35.00	\$665,000
8	Rock Rip Rap w/ Filter Fabric (D50=18in.)	2,500	SY	\$ 80.00	\$200,000
9	Rock Grade Control Structures	3	EA	\$ 25,000.00	\$75,000
10	Rock Toe Protection Trenches	945	CY	\$ 80.00	\$75,600
11	Dewatering	2	LS	\$ 10,000.00	\$20,000
12	Construction Exit	5	EA	\$ 2,000.00	\$10,000
13	Rock Filter Dam	8	EA	\$ 2,500.00	\$20,000
14	Trench Safety Protection	2,900	LF	\$ 5.00	\$14,500
SUBTOTAL					\$1,523,312
20% CONTINGENCY					\$304,662
CONSTRUCTION TOTAL					\$1,827,974
<hr/>					
	Purchase Drainage Easement	80,747	SF	\$ 3.50	\$282,613
	Design Engineering and Permitting		LS	20%	\$365,594.88
	City Project Management		LS	10%	\$182,797.44
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$2,658,980</b>

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Imhoff Road to Articulated Block Channel (approx. 2,000 ft. upstream of Imhoff Road)</b>					
1	Mobilization	1	LS	15%	\$238,958
2	Preparing Right of Way	1	LS	4%	\$63,722
3	Utility Relocation	1	LS	5%	\$79,653
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$47,792
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$111,514
6	Channel Excavation (difficult)	8,250	CY	\$ 30.00	\$247,500
7	Mechanical Stabilized Embankment (MSE)	32,000	SF	\$ 35.00	\$1,120,000
8	Rock Rip Rap w/ Filter Fabric (D50=18in.)	750	SY	\$ 80.00	\$60,000
9	Rock Grade Control Structures	2	EA	\$ 25,000.00	\$50,000
10	Rock Toe Protection Trenches	710	CY	\$ 80.00	\$56,800
11	Dewatering	2	LS	\$ 10,000.00	\$20,000
12	Construction Exit	4	EA	\$ 2,000.00	\$8,000
13	Rock Filter Dam	8	EA	\$ 2,500.00	\$20,000
14	Trench Safety Protection	2,150	LF	\$ 5.00	\$10,750
SUBTOTAL					\$2,134,687
20% CONTINGENCY					\$426,937
CONSTRUCTION TOTAL					\$2,561,624
<hr/>					
	Purchase Drainage Easement	164,000	SF	\$ 3.50	\$574,000
	Design Engineering and Permitting		LS	20%	\$512,324.88
	City Project Management		LS	10%	\$256,162.44
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$3,904,112</b>
<b>GRAND TOTAL CAPITAL PROJECT COST</b>					<b>\$6,563,091</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3A: Imhoff Creek - Channel Improvement Elmwood Drive to Madison Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$166,880
2	Preparing Right of Way	1	LS	4%	\$44,501
3	Utility Relocation	1	LS	5%	\$55,627
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$66,752
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$77,877
6	Excavation (easy)	233	CY	\$ 5.00	\$1,167
7	Channel Excavation (difficult)	11,274	CY	\$ 30.00	\$338,220
8	RCP - 18"	35	LF	\$ 65.00	\$2,275
9	RCP - 24"	15	LF	\$ 80.00	\$1,200
10	RCP - 33"	15	LF	\$ 100.00	\$1,500
11	RCP - 42"	15	LF	\$ 115.00	\$1,725
12	Pipe Removal	60	LF	\$ 25.00	\$1,500
13	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
14	Headwall Removal	2	EA	\$ 500.00	\$1,000
15	Pavement Removal & Replacement	1,250	SY	\$ 80.00	\$100,000
16	Concrete (6 IN) Removal	2,488	SY	\$ 12.00	\$29,856
17	Driveway Removal & Replacement	267	SY	\$ 50.00	\$13,333
18	Prestressed Concrete Box Beam (W=5') (D=20")	360	LF	\$ 175.00	\$63,000
19	Remove and Replace Footbridge	1	EA	\$ 20,000.00	\$20,000
20	Dewatering	1	LS	\$ 5,000.00	\$5,000
21	Construction Exit	2	EA	\$ 2,000.00	\$4,000
22	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
23	Trench Safety Protection	30	LF	\$ 5.00	\$150
24	Articulated Block-Trapezoidal Channel	7,908	SY	\$ 50.00	\$395,417
25	Concrete Channel (6 IN)	1,311	SY	\$ 60.00	\$78,667
26	Vertical Rock Wall Channel	295	SY	\$ 95.00	\$28,025
27	Outfall Structure	3	EA	\$ 5,000.00	\$15,000
SUBTOTAL					\$1,524,172
20% CONTINGENCY					\$304,834
CONSTRUCTION TOTAL					\$1,829,006
Drainage Easement Purchase (Residential)		117,750	SF	\$ 2.00	\$235,500
Design Engineering and Permitting			LS	20%	\$365,801
City Project Management			LS	10%	\$182,901
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$2,613,208</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3B: Imhoff Creek - Channel Improvement Madison Street to 150 LF Downstream of Boyd Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$230,006
2	Preparing Right of Way	1	LS	4%	\$61,335
3	Utility Relocation	1	LS	5%	\$76,669
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$92,003
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$107,336
6	Excavation (easy)	213	CY	\$ 5.00	\$1,067
7	Channel Excavation (difficult)	7,493	CY	\$ 30.00	\$224,790
8	RCP - 15"	15	LF	\$ 55.00	\$825
9	RCP - 18"	15	LF	\$ 65.00	\$975
10	RCP - 24"	15	LF	\$ 80.00	\$1,200
11	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
12	Bridge Removal (assume 30ft. span)	1	EA	\$ 5,000.00	\$5,000
13	Pavement Removal & Replacement	320	SY	\$ 80.00	\$25,600
14	Sidewalk Removal & Replacement	80	SY	\$ 20.00	\$1,600
15	Concrete (6 IN) Removal	5,028	SY	\$ 12.00	\$60,336
16	Curb and Gutter Removal & Replacement	80	LF	\$ 30.00	\$2,400
17	Driveway Removal & Replacement	89	SY	\$ 50.00	\$4,444
18	Prestressed Concrete Box Beam (W=5') (D=20")	500	LF	\$ 175.00	\$87,500
19	Remove and Replace Footbridge	1	EA	\$ 20,000.00	\$20,000
20	Dewatering	1	LS	\$ 5,000.00	\$5,000
21	Construction Exit	2	EA	\$ 2,000.00	\$4,000
22	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
23	Trench Safety Protection	48	LF	\$ 5.00	\$240
24	Articulated Block-Trapezoidal Channel	18,098	SY	\$ 50.00	\$904,889
25	Concrete Channel (6 IN)	1,593	SY	\$ 60.00	\$95,600
26	Vertical Rock Wall Channel	478	SY	\$ 95.00	\$45,410
27	Outfall Structure	4	EA	\$ 5,000.00	\$20,000
SUBTOTAL					\$2,100,725
20% CONTINGENCY					\$420,145
CONSTRUCTION TOTAL					\$2,520,870
Drainage Easement Purchase (Residential)		222,500	SF	\$ 2.00	\$445,000
Design Engineering and Permitting			LS	20%	\$504,174
City Project Management			LS	10%	\$252,087
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$3,722,131</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3C: Imhoff Creek - Channel Improvement 150 LF Downstream of Boyd Street  
to Downstream of McNamee Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$217,531
2	Preparing Right of Way	1	LS	4%	\$58,008
3	Utility Relocation	1	LS	5%	\$72,510
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$87,013
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$101,515
6	Excavation (easy)	568	CY	\$ 5.00	\$2,839
7	Channel Excavation (difficult)	5,359	CY	\$ 30.00	\$160,770
8	Concrete Box Culverts - 10 x 6	140	LF	\$ 650.00	\$91,000
9	RCP - 24"	15	LF	\$ 80.00	\$1,200
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	Pipe Removal	15	LF	\$ 25.00	\$375
12	Culvert Removal	2	EA	\$ 3,000.00	\$6,000
13	Headwall Removal	4	EA	\$ 500.00	\$2,000
14	Pavement Removal & Replacement	6,167	SY	\$ 80.00	\$493,333
15	Concrete (6 IN) Removal	2,186	SY	\$ 12.00	\$26,232
16	Curb and Gutter Removal & Replacement	3,700	LF	\$ 30.00	\$111,000
17	Driveway Removal & Replacement	1,067	SY	\$ 50.00	\$53,333
18	Prestressed Concrete Box Beam (W=5') (D=20")	300	LF	\$ 175.00	\$52,500
19	Remove and Replace Footbridge	1	EA	\$ 20,000.00	\$20,000
20	Dewatering	1	LS	\$ 5,000.00	\$5,000
21	Construction Exit	2	EA	\$ 2,000.00	\$4,000
22	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
23	Trench Safety Protection	65	LF	\$ 5.00	\$325
24	Vertical Rock Wall Channel	1,093	SY	\$ 95.00	\$103,835
25	Concrete Channel (6 IN)	4,858	SY	\$ 60.00	\$291,467
SUBTOTAL					\$1,986,787
20% CONTINGENCY					\$397,357
CONSTRUCTION TOTAL					\$2,384,144
<hr/>					
Drainage Easement Purchase (Residential)	29,380	SF	\$ 2.00	\$58,760	
Design Engineering and Permitting		LS	20%	\$476,829	
City Project Management		LS	10%	\$238,414	

**TOTAL CAPITAL PROJECT COST \$3,158,147**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3D: Imhoff Creek - Channel Improvement Downstream of McNamee  
Street to Upstream of Symmes Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$166,756
2	Preparing Right of Way	1	LS	4%	\$44,468
3	Utility Relocation	1	LS	5%	\$55,585
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$66,702
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$77,819
6	Excavation (easy)	792	CY	\$ 5.00	\$3,958
7	Channel Excavation (difficult)	3,687	CY	\$ 30.00	\$110,610
8	Concrete Box Culverts - 10 x 6	451	LF	\$ 650.00	\$293,150
9	RCP - 30"	15	LF	\$ 95.00	\$1,425
10	Headwall - Large >5ft.	6	EA	\$ 10,000.00	\$60,000
11	Pipe Removal	15	LF	\$ 25.00	\$375
12	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
13	Headwall Removal	6	EA	\$ 500.00	\$3,000
14	Pavement Removal & Replacement	2,641	SY	\$ 80.00	\$211,289
15	Sidewalk Removal & Replacement	854	SY	\$ 20.00	\$17,080
16	Concrete (6 IN) Removal	2,000	SY	\$ 12.00	\$24,000
17	Curb and Gutter Removal & Replacement	1,530	LF	\$ 30.00	\$45,900
18	Driveway Removal & Replacement	711	SY	\$ 50.00	\$35,556
19	Dewatering	1	LS	\$ 5,000.00	\$5,000
20	Construction Exit	2	EA	\$ 2,000.00	\$4,000
21	Rock Filter Dam	3	EA	\$ 2,500.00	\$7,500
22	Trench Safety Protection	139	LF	\$ 5.00	\$695
23	Vertical Rock Wall Channel	833	SY	\$ 95.00	\$79,167
24	Concrete Channel (6 IN)	3,333	SY	\$ 60.00	\$200,000
SUBTOTAL					\$1,523,034
20% CONTINGENCY					\$304,607
CONSTRUCTION TOTAL					\$1,827,641
<hr/>					
Property/Structure Buyout	4	LS	\$ 789,352.00	\$ 789,352.00	
Drainage Easement Purchase (Residential)	12,910	SF	\$ 2.00	\$25,820	
Design Engineering and Permitting		LS	20%	\$365,528	
City Project Management		LS	10%	\$182,764	

**TOTAL CAPITAL PROJECT COST \$3,191,106**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3E: Imhoff Creek - Channel Improvement Upstream of Symmes Street  
to Downstream of Main Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$84,002
2	Preparing Right of Way	1	LS	4%	\$22,401
3	Utility Relocation	1	LS	5%	\$28,001
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$33,601
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$39,201
6	Excavation (easy)	27	CY	\$ 5.00	\$133
7	Channel Excavation (difficult)	5,115	CY	\$ 30.00	\$153,450
8	Sidewalk Removal & Replacement	40	SY	\$ 20.00	\$800
9	Concrete (6 IN) Removal	2,450	SY	\$ 12.00	\$29,400
10	Prestressed Concrete Box Beam (W=5') (D=20")	30	LF	\$ 175.00	\$5,250
11	Remove and Replace Footbridge	1	EA	\$ 20,000.00	\$20,000
12	Dewatering	1	LS	\$ 5,000.00	\$5,000
13	Construction Exit	2	EA	\$ 2,000.00	\$4,000
14	Vertical Rock Wall Channel	1,021	SY	\$ 95.00	\$96,979
15	Concrete Channel (6 IN)	4,083	SY	\$ 60.00	\$245,000
SUBTOTAL					\$767,217
20% CONTINGENCY					\$153,443
CONSTRUCTION TOTAL					\$920,661
<hr/>					
Property/Structure Buyout	12	LS	\$ 2,151,492.00	\$	2,151,492.00
Drainage Easement Purchase (Commercial)	31,800	SF	\$ 3.50		\$111,300
Design Engineering and Permitting		LS	20%		\$184,132
City Project Management		LS	10%		\$92,066
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$3,459,651</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3F: Imhoff Creek - Channel Improvement Just Downstream of Main Street  
to Just Upstream of Main Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$112,408
2	Preparing Right of Way	1	LS	4%	\$29,975
3	Utility Relocation	1	LS	5%	\$37,469
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$44,963
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$52,457
6	Excavation (easy)	1,178	CY	\$ 5.00	\$5,889
7	Channel Excavation (difficult)	1,561	CY	\$ 30.00	\$46,830
8	Concrete Box Culverts - 10 x 6	795	LF	\$ 650.00	\$516,750
9	RCP - 36"	15	LF	\$ 105.00	\$1,575
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
12	Headwall Removal	2	EA	\$ 500.00	\$1,000
13	Pavement Removal & Replacement	1,031	SY	\$ 80.00	\$82,444
14	Sidewalk Removal & Replacement	120	SY	\$ 20.00	\$2,400
15	Concrete (6 IN) Removal	360	SY	\$ 12.00	\$4,320
16	Curb and Gutter Removal & Replacement	70	LF	\$ 30.00	\$2,100
17	Dewatering	1	LS	\$ 5,000.00	\$5,000
18	Construction Exit	2	EA	\$ 2,000.00	\$4,000
19	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
20	Trench Safety Protection	265	LF	\$ 5.00	\$1,325
21	Vertical Rock Wall Channel	150	SY	\$ 95.00	\$14,250
22	Concrete Channel (6 IN)	600	SY	\$ 60.00	\$36,000
SUBTOTAL					\$1,026,655
20% CONTINGENCY					\$205,331
CONSTRUCTION TOTAL					\$1,231,986
<hr/>					
Drainage Easement Purchase (Commercial)	12,450	SF	\$ 3.50		\$43,575
Design Engineering and Permitting		LS	20%		\$246,397
City Project Management		LS	10%		\$123,199
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$1,645,157</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3G: Imhoff Creek - Channel Improvement Upstream of Main Street  
to Upstream of Tonhawa Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$94,203
2	Preparing Right of Way	1	LS	4%	\$25,121
3	Utility Relocation	1	LS	5%	\$31,401
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$37,681
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$43,961
6	Excavation (easy)	610	CY	\$ 5.00	\$3,051
7	Channel Excavation (difficult)	3,007	CY	\$ 30.00	\$90,210
8	Concrete Box Culverts - 7 x 5	147	LF	\$ 300.00	\$44,100
9	Concrete Box Culverts - 9 x 5	384	LF	\$ 460.00	\$176,640
10	RCP - 12"	15	LF	\$ 50.00	\$750
11	Headwall - Large >5ft.	6	EA	\$ 10,000.00	\$60,000
12	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
13	Headwall Removal	6	EA	\$ 500.00	\$3,000
14	Pavement Removal & Replacement	375	SY	\$ 80.00	\$30,027
15	Sidewalk Removal & Replacement	80	SY	\$ 20.00	\$1,600
16	Concrete (6 IN) Removal	1,318	SY	\$ 12.00	\$15,816
17	Curb and Gutter Removal & Replacement	60	LF	\$ 30.00	\$1,800
18	Driveway Removal & Replacement	44	SY	\$ 50.00	\$2,222
19	Dewatering	1	LS	\$ 5,000.00	\$5,000
20	Construction Exit	2	EA	\$ 2,000.00	\$4,000
21	Rock Filter Dam	3	EA	\$ 2,500.00	\$7,500
22	Trench Safety Protection	177	LF	\$ 5.00	\$885
23	Vertical Rock Wall Channel	510	SY	\$ 95.00	\$48,450
24	Concrete Channel (6 IN)	2,066	SY	\$ 60.00	\$123,967
SUBTOTAL					\$860,384
20% CONTINGENCY					\$172,077
CONSTRUCTION TOTAL					\$1,032,461
<hr/>					
Property/Structure Buyout	3	LS	\$ 316,776.00	\$	316,776.00
Design Engineering and Permitting		LS	20%		\$206,492
City Project Management		LS	10%		\$103,246

**TOTAL CAPITAL PROJECT COST \$1,658,975**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-3H: Imhoff Creek - Channel Improvement Upstream of Tonhawa Street to  
Upstream of Webster Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$90,341
2	Preparing Right of Way	1	LS	4%	\$24,091
3	Utility Relocation	1	LS	5%	\$30,114
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$36,136
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$42,159
6	Excavation (easy)	183	CY	\$ 5.00	\$917
7	Channel Excavation (difficult)	2,873	CY	\$ 30.00	\$86,190
8	Concrete Box Culverts - 7 x 3	78	LF	\$ 250.00	\$19,500
9	Concrete Box Culverts - 7 x 4	189	LF	\$ 275.00	\$51,975
10	RCP - 12"	15	LF	\$ 50.00	\$750
11	RCP - 15"	15	LF	\$ 55.00	\$825
12	RCP - 18"	15	LF	\$ 65.00	\$975
13	Headwall - Small <5ft.	2	EA	\$ 7,000.00	\$14,000
14	Headwall - Large >5ft.	4	EA	\$ 10,000.00	\$40,000
15	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
16	Headwall Removal	6	EA	\$ 500.00	\$3,000
17	Pavement Removal & Replacement	225	SY	\$ 80.00	\$18,000
18	Concrete (6 IN) Removal	2,250	SY	\$ 12.00	\$27,000
19	Curb and Gutter Removal & Replacement	100	LF	\$ 30.00	\$3,000
20	Driveway Removal & Replacement	89	SY	\$ 50.00	\$4,444
21	Remove and Replace Footbridge	2	EA	\$ 20,000.00	\$40,000
22	Remove Footbridge	1	EA	\$ 7,000.00	\$7,000
23	Dewatering	1	LS	\$ 5,000.00	\$5,000
24	Construction Exit	2	EA	\$ 2,000.00	\$4,000
25	Rock Filter Dam	3	EA	\$ 2,500.00	\$7,500
26	Trench Safety Protection	89	LF	\$ 5.00	\$445
27	Vertical Rock Wall Channel	750	SY	\$ 95.00	\$71,250
28	Concrete Channel (6 IN)	3,125	SY	\$ 60.00	\$187,500
SUBTOTAL					\$825,111
20% CONTINGENCY					\$165,022
CONSTRUCTION TOTAL					\$990,134
<hr/>					
Property/Structure Buyout	2	LS	\$ 156,578.00	\$	156,578.00
Drainage Easement Purchase (Residential)	15,165	SF	\$ 2.00		\$30,330
Design Engineering and Permitting		LS	20%		\$198,027
City Project Management		LS	10%		\$99,013

**TOTAL CAPITAL PROJECT COST \$1,474,082**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.



APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-4: Imhoff Creek - Andrews Park Detention Pond**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$119,026
2	Preparing Right of Way	1	LS	4%	\$31,740
3	Utility Relocation	1	LS	5%	\$39,675
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$47,610
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$63,035
6	Excavation (easy)	70,383	CY	\$ 5.00	\$351,915
7	Embankment (easy)	2,756	CY	\$ 6.00	\$16,533
8	RCP - 36"	1,400	LF	\$ 105.00	\$147,000
9	Jack and Bore Reinforced Concrete Pipe	90	LF	\$ 120.00	\$10,800
10	Headwall - Small <5ft.	7	EA	\$ 5,000.00	\$35,000
11	Manhole/Junction Box	2	EA	\$ 3,000.00	\$6,000
12	Inlet/Headwall for Flow Diversion	1	EA	\$ 10,000.00	\$10,000
13	Flap Gate	2	EA	\$ 15,000.00	\$30,000
14	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
15	Headwall Removal	2	EA	\$ 500.00	\$1,000
16	Pavement Removal & Replacement	110	SY	\$ 80.00	\$8,800
17	Pavement Removal	756	SY	\$ 30.00	\$22,667
18	Sidewalk Removal & Replacement	76	SY	\$ 20.00	\$1,511
19	Concrete (6 IN) Remove & Replacement	773	SY	\$ 70.00	\$54,133
20	Concrete (6 IN)	808	SY	\$ 60.00	\$48,467
21	Chain Link Fence	900	LF	\$ 15.00	\$13,500
22	Rock Rip Rap w/ Filter Fabric (D50=18in.)	11	SY	\$ 80.00	\$880
23	Dewatering	1	LS	\$ 10,000.00	\$10,000
24	Construction Exit	2	EA	\$ 2,000.00	\$4,000
25	Rock Filter Dam	3	EA	\$ 2,500.00	\$7,500
26	Trench Safety Protection	960	LF	\$ 5.00	\$4,800
27	Removal of Abandoned Water Storage Tank	1	LS	\$ 100,000.00	\$100,000
28	Remove Footbridge	1	EA	\$ 7,000.00	\$7,000
SUBTOTAL					\$1,201,593
20% CONTINGENCY					\$240,319
CONSTRUCTION TOTAL					\$1,441,911
Property/Structure Buyout	5	LS	\$ 251,764	\$ 251,764	
Design Engineering and Permitting		LS	20%	\$288,382	
City Project Management		LS	10%	\$144,191	

**TOTAL CAPITAL PROJECT COST \$2,126,249**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-4A: Imhoff Creek - Andrews Park Detention Pond Plus North of Acres Road**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$194,602
2	Preparing Right of Way	1	LS	4%	\$51,894
3	Utility Relocation	1	LS	5%	\$64,867
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$77,841
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$90,814
6	Excavation (easy)	131,469	CY	\$ 5.00	\$657,345
7	Embankment (easy)	4,422	CY	\$ 6.00	\$26,533
8	RCP - 24"	875	LF	\$ 80.00	\$70,000
9	RCP - 36"	1,400	LF	\$ 105.00	\$147,000
10	Jack and Bore Reinforced Concrete Pipe	90	LF	\$ 120.00	\$10,800
11	Headwall - Small <5ft.	11	EA	\$ 7,000.00	\$77,000
12	Manhole/Junction Box	2	EA	\$ 3,000.00	\$6,000
13	Inlet/Headwall for Flow Diversion	1	EA	\$ 10,000.00	\$10,000
14	Flap Gate	2	EA	\$ 15,000.00	\$30,000
15	5' Inlet	4	EA	\$ 3,500.00	\$14,000
16	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
17	Headwall Removal	2	EA	\$ 500.00	\$1,000
18	Pavement Removal & Replacement	402	SY	\$ 80.00	\$32,133
19	Pavement Removal	756	SY	\$ 30.00	\$22,667
20	Sidewalk Removal & Replacement	116	SY	\$ 20.00	\$2,311
21	Concrete (6 IN) Remove & Replacement	773	SY	\$ 70.00	\$54,133
22	Concrete (6 IN)	1,314	SY	\$ 60.00	\$78,867
23	Curb and Gutter Removal & Replacement	50	LF	\$ 30.00	\$1,500
24	Chain Link Fence	900	LF	\$ 15.00	\$13,500
25	Rock Rip Rap w/ Filter Fabric (D50=18in.)	11	SY	\$ 80.00	\$880
26	Dewatering	1	LS	\$ 10,000.00	\$10,000
27	Construction Exit	3	EA	\$ 2,000.00	\$6,000
28	Rock Filter Dam	3	EA	\$ 2,500.00	\$7,500
29	Trench Safety Protection	1,835	LF	\$ 5.00	\$9,175
30	Removal of Abandoned Water Storage Tank	1	LS	\$ 100,000.00	\$100,000
31	Remove Footbridge	2	EA	\$ 7,000.00	\$14,000
SUBTOTAL					\$1,891,362
20% CONTINGENCY					\$378,272
CONSTRUCTION TOTAL					\$2,269,635
Property/Structure Buyout	8	LS	\$ 566,576.00	\$ 566,576.00	
Design Engineering and Permitting		LS	20%	\$453,927	
City Project Management		LS	10%	\$226,963	

**TOTAL CAPITAL PROJECT COST \$3,517,101**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
IC-5: Imhoff Creek - Lindsey/McGee 10-Year Diversion without Detention**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$874,585
2	Preparing Right of Way	1	LS	4%	\$233,223
3	Utility Relocation	1	LS	5%	\$291,528
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$349,834
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$408,140
6	Excavation (easy)	103,141	CY	\$ 5.00	\$515,704
7	Concrete Box Culverts - 4 x 4	1,200	LF	\$ 112.00	\$134,400
8	Concrete Box Culverts - 4 x 5	1,100	LF	\$ 128.00	\$140,800
9	Concrete Box Culverts - 4 x 6	900	LF	\$ 140.00	\$126,000
10	Concrete Box Culverts - 5 x 5	600	LF	\$ 164.00	\$98,400
11	Concrete Box Culverts - 6 x 5	300	LF	\$ 192.00	\$57,600
12	Concrete Box Culverts - 6 x 7	1,350	LF	\$ 220.00	\$297,000
13	Concrete Box Culverts - 7 x 5	1,075	LF	\$ 240.00	\$258,000
14	Concrete Box Culverts - 7 x 7	3,750	LF	\$ 300.00	\$1,125,000
15	RCP - 30"	500	LF	\$ 76.00	\$38,000
16	RCP - 36"	900	LF	\$ 84.00	\$75,600
17	RCP - 42"	650	LF	\$ 96.00	\$62,400
18	RCP - 48"	1,350	LF	\$ 128.00	\$172,800
19	RCP - 54"	500	LF	\$ 160.00	\$80,000
20	Jack and Bore 8' x 8' Reinforced Concrete Box	240	LF	\$ 1,300.00	\$312,000
21	Headwall - Large >5ft.	4	EA	\$ 10,000.00	\$40,000
22	Manhole/Junction Box	35	EA	\$ 3,000.00	\$105,000
23	Flap Gate	1	EA	\$ 15,000.00	\$15,000
24	5' Inlet	61	EA	\$ 3,500.00	\$213,500
25	Grate Inlet	50	EA	\$ 5,000.00	\$250,000
26	Headwall Removal	3	EA	\$ 500.00	\$1,500
27	Pavement Removal & Replacement	14,275	SY	\$ 80.00	\$1,142,000
28	Sidewalk Removal & Replacement	4,815	SY	\$ 20.00	\$96,293
29	Curb and Gutter Removal & Replacement	8,475	LF	\$ 30.00	\$254,250
30	Driveway Removal & Replacement	1,639	SY	\$ 50.00	\$81,944
31	Rock Rip Rap w/ Filter Fabric (D50=18in.)	200	SY	\$ 80.00	\$16,000
32	Dewatering	4	LS	\$ 10,000.00	\$40,000
33	Construction Exit	1	EA	\$ 2,000.00	\$2,000
34	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
35	Trench Safety Protection	13,875	LF	\$ 5.00	\$69,375
SUBTOTAL					\$7,987,876
20% CONTINGENCY					\$1,597,575
CONSTRUCTION TOTAL					\$9,585,451
Design Engineering and Permitting		LS	20%	\$1,917,090	
City Project Management		LS	10%	\$958,545	
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$12,461,087</b>

Notes:  
1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
LR-1: Little River - Bank Stabilization**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>Bendway Weir to Control Meander Migration into Suburban Tract</b>					
1	Mobilization	1	LS	15%	\$8,875
2	Preparing Right of Way	1	LS	4%	\$2,367
3	Utility Relocation	1	LS	5%	\$2,958
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$1,775
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$4,142
6	Rock Bendway Weir Structures	7	EA	\$ 5,000.00	\$35,000
7	Rock Toe Protection Trenches	83	CY	\$ 80.00	\$6,667
8	Dewatering	1	LS	\$ 10,000.00	\$10,000
9	Construction Exit	1	EA	\$ 2,000.00	\$2,000
10	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
11	Trench Safety Protection	100	LF	\$ 5.00	\$500
SUBTOTAL					\$79,283
20% CONTINGENCY					\$15,857
CONSTRUCTION TOTAL					\$95,140
Design Engineering and Permitting			LS	20%	\$19,028.00
City Project Management			LS	10%	\$9,514.00
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$123,682</b>

Notes:  
1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
LR-2: Little River - Buyout 40 Mobile Homes Near Indian Hill Road and the BNSF Railroad**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Property/Structure Buyout	40	LS	\$305,232.60	\$305,232.60
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$305,233</b>

Notes:  
1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
TGLR-1: Trib. G to Little River - Franklin Road Crossing Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$74,043
2	Preparing Right of Way	1	LS	4%	\$19,745
3	Utility Relocation	1	LS	5%	\$24,681
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$14,809
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$34,554
6	Excavation (easy)	1,864	CY	\$ 5.00	\$9,320
7	Embankment (easy)	1,958	CY	\$ 6.00	\$11,748
8	Concrete Box Culverts - 10 x 10	305	LF	\$ 850.00	\$259,250
9	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
10	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
11	Headwall Removal	2	EA	\$ 500.00	\$1,000
12	Pavement Removal & Replacement	1,958	SY	\$ 80.00	\$156,640
13	Rock Rip Rap w/ Filter Fabric (D50=18in.)	167	SY	\$ 80.00	\$13,360
14	Dewatering	1	LS	\$ 10,000.00	\$10,000
15	Construction Exit	2	EA	\$ 2,000.00	\$4,000
16	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
17	Trench Safety Protection	61	LF	\$ 5.00	\$305
SUBTOTAL					\$661,455
20% CONTINGENCY					\$132,291
CONSTRUCTION TOTAL					\$793,746
Design Engineering					LS 15% \$119,061.87
City Project Management					LS 10% \$79,374.58
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$992,182</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
WC-1A: Woodcrest Creek - Detention Pond Upstream of Rock Creek Road**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$117,828
2	Preparing Right of Way	1	LS	4%	\$31,421
3	Utility Relocation	1	LS	5%	\$39,276
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$23,566
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$54,986
6	Embankment (difficult)	42,667	CY	\$ 17.00	\$725,333
7	RCP - 72"	30	LF	\$ 275.00	\$8,250
8	Headwall - Small >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Dewatering	1	LS	\$ 10,000.00	\$10,000
10	Construction Exit	1	EA	\$ 2,000.00	\$2,000
11	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
12	Concrete (6 IN)	249	SY	\$ 60.00	\$14,933
SUBTOTAL					\$1,052,592
20% CONTINGENCY					\$210,518
CONSTRUCTION TOTAL					\$1,263,111
Purchase Drainage Easement (Agricultural)					1,763,739 SF \$ 0.35 \$ 617,308.65
Purchase Drainage Easement (Residential)					120,966 SF \$ 2.00 \$ 241,932.00
Design Engineering and Permitting					LS 20% \$252,622.16
City Project Management					LS 10% \$126,311.08
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$2,501,285</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
WC-1B: Woodcrest Creek - Channel Improvements Downstream of Sequoyah Street**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$34,895
2	Preparing Right of Way	1	LS	4%	\$9,305
3	Utility Relocation	1	LS	5%	\$11,632
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$6,979
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$16,284
6	Channel Excavation (difficult)	7,121	CY	\$ 30.00	\$213,630
7	Dewatering	1	LS	\$ 10,000.00	\$10,000
8	Construction Exit	2	EA	\$ 2,000.00	\$4,000
9	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
SUBTOTAL					\$311,724
20% CONTINGENCY					\$62,345
CONSTRUCTION TOTAL					\$374,069
Purchase Drainage Easement (Residential)		19,500	SF	\$ 2.00	\$39,000
Design Engineering and Permitting			LS	20%	\$74,813.81
City Project Management			LS	10%	\$37,406.90
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$525,290</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
WC-2: Woodcrest Creek - Sequoyah Trail Culvert Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$10,492
2	Preparing Right of Way	1	LS	4%	\$2,798
3	Utility Relocation	1	LS	5%	\$3,497
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$2,098
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$4,896
6	Excavation (easy)	106	CY	\$ 5.00	\$529
7	Concrete Box Culverts - 8 x 7	55	LF	\$ 360.00	\$19,800
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Headwall Removal	2	EA	\$ 500.00	\$1,000
10	Pavement Removal & Replacement	58	SY	\$ 80.00	\$4,667
11	Sidewalk Removal & Replacement	150	SF	\$ 20.00	\$3,000
12	Curb and Gutter Removal & Replacement	60	LF	\$ 30.00	\$1,800
13	Rock Rip Rap w/ Filter Fabric (D50=18in.)	30	SY	\$ 80.00	\$2,400
14	Dewatering	1	LS	\$ 10,000.00	\$10,000
15	Construction Exit	2	EA	\$ 2,000.00	\$4,000
16	Rock Filter Dam	1	EA	\$ 2,500.00	\$2,500
17	Trench Safety Protection	50	LF	\$ 5.00	\$250
SUBTOTAL					\$93,727
20% CONTINGENCY					\$18,745
CONSTRUCTION TOTAL					\$112,472
Design Engineering			LS	15%	\$16,870.87
City Project Management			LS	10%	\$11,247.25
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$140,591</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
WC-3: Woodcrest Bank Stabilization Upstream of Sequoyah Trail**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
<b>graded 3:1 slope on one bend, WC-6</b>					
1	Mobilization	1	LS	15%	\$7,963
2	Preparing Right of Way	1	LS	4%	\$2,123
3	Utility Relocation	1	LS	5%	\$2,654
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$1,593
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$3,716
6	Channel Excavation (difficult)	300	CY	\$ 30.00	\$9,000
7	Rock Rip Rap w/ Filter Fabric (D50=18in.)	167	SY	\$ 80.00	\$13,333
8	Rock Toe Protection Trenches	50	CY	\$ 80.00	\$4,000
9	Outfall Repair	1	EA	\$ 9,000.00	\$9,000
10	Dewatering	1	LS	\$ 10,000.00	\$10,000
11	Construction Exit	1	EA	\$ 2,000.00	\$2,000
12	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
13	Trench Safety Protection	150	LF	\$ 5.00	\$750
SUBTOTAL					\$71,132
20% CONTINGENCY					\$14,226
CONSTRUCTION TOTAL					\$85,358
Design Engineering and Permitting			LS	20%	\$17,071.60
City Project Management			LS	10%	\$8,535.80
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$110,965</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
MC-1: Merkle Creek - 24th Ave NW Crossing Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$46,632
2	Preparing Right of Way	1	LS	4%	\$12,435
3	Utility Relocation	1	LS	5%	\$15,544
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$9,326
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$21,762
6	Excavation (easy)	539	CY	\$ 5.00	\$2,696
7	Channel Excavation (easy)	1,765	CY	\$ 25.00	\$44,125
8	Concrete Box Culverts - 10 x 11	80	LF	\$ 975.00	\$78,000
9	RCP - 24"	60	LF	\$ 80.00	\$4,800
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	5' Inlet	2	EA	\$ 3,500.00	\$7,000
12	Headwall Removal	2	EA	\$ 500.00	\$1,000
13	Pavement Removal & Replacement	462	SY	\$ 80.00	\$36,978
14	Sidewalk Removal & Replacement	253	SY	\$ 20.00	\$5,067
15	Concrete (Channel) (6 IN) Remove & Replacement	67	SY	\$ 70.00	\$4,667
16	Curb and Gutter Removal & Replacement	100	LF	\$ 30.00	\$3,000
17	Chain Link Fence	30	LF	\$ 15.00	\$450
18	Mechanical Stabilized Embankment (MSE)	1,320	SF	\$ 35.00	\$46,200
19	Dewatering	1	LS	\$ 10,000.00	\$10,000
20	Construction Exit	2	EA	\$ 2,000.00	\$4,000
21	Rock Filter Dam	5	EA	\$ 2,500.00	\$12,500
22	Trench Safety Protection	80	LF	\$ 5.00	\$400
23	Floodproofing	3	EA	\$ 10,000.00	\$30,000
SUBTOTAL					\$416,582
20% CONTINGENCY					\$83,316
CONSTRUCTION TOTAL					\$499,899
Design Engineering and Permitting			LS	20%	\$99,980
City Project Management			LS	10%	\$49,990
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$649,869</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
MC-2: Merkle Creek - Main Street Crossing Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$257,739
2	Preparing Right of Way	1	LS	4%	\$68,730
3	Utility Relocation	1	LS	5%	\$85,913
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$103,096
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$120,278
6	Excavation (easy)	1,099	CY	\$ 5.00	\$5,496
7	Channel Excavation (difficult)	6,574	CY	\$ 30.00	\$197,220
8	Concrete Box Culverts - 12 x 12	795	LF	\$ 1,475.00	\$1,172,625
9	RCP - 24"	40	LF	\$ 80.00	\$3,200
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	5' Inlet	2	EA	\$ 3,500.00	\$7,000
12	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
13	Headwall Removal	2	EA	\$ 500.00	\$1,000
14	Pavement Removal & Replacement	2,532	SY	\$ 80.00	\$202,578
15	Sidewalk Removal & Replacement	53	SY	\$ 20.00	\$1,067
16	Concrete (Channel) (6 IN) Remove & Replacement	556	SY	\$ 70.00	\$38,889
17	Curb and Gutter Removal & Replacement	412	LF	\$ 30.00	\$12,360
18	Dewatering	2	LS	\$ 10,000.00	\$20,000
19	Construction Exit	2	EA	\$ 2,000.00	\$4,000
20	Rock Filter Dam	9	EA	\$ 2,500.00	\$22,500
21	Trench Safety Protection	265	LF	\$ 5.00	\$1,325
SUBTOTAL					\$2,354,016
20% CONTINGENCY					\$470,803
CONSTRUCTION TOTAL					\$2,824,819
<hr/>					
Property/Structure Buyout		4	Parcels	\$2,394,668.00	\$2,394,668
Design Engineering and Permitting			LS	20%	\$564,964
City Project Management			LS	10%	\$282,482
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$6,066,932</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
MC-2A: Merkle Creek - Crestmont Street Crossing Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$41,513
2	Preparing Right of Way	1	LS	4%	\$11,070
3	Utility Relocation	1	LS	5%	\$13,838
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$8,303
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$19,373
6	Excavation (easy)	119	CY	\$ 5.00	\$593
7	Embankment (easy)	216	CY	\$ 6.00	\$1,298
8	Concrete Box Culverts - 12 x 8	120	LF	\$ 1,175.00	\$141,000
9	RCP - 18"	70	LF	\$ 65.00	\$4,550
10	RCP - 24"	40	LF	\$ 80.00	\$3,200
11	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
12	Culvert Removal	3	EA	\$ 3,000.00	\$9,000
13	Headwall Removal	2	EA	\$ 500.00	\$1,000
14	Pavement Removal & Replacement	649	SY	\$ 80.00	\$51,911
15	Driveway Removal & Replacement	133	SY	\$ 50.00	\$6,667
16	Rock Rip Rap w/ Filter Fabric (D50=18in.)	167	SY	\$ 80.00	\$13,333
17	Dewatering	1	LS	\$ 10,000.00	\$10,000
18	Construction Exit	2	EA	\$ 2,000.00	\$4,000
19	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
20	Trench Safety Protection	40	LF	\$ 5.00	\$200
SUBTOTAL					\$370,847
20% CONTINGENCY					\$74,169
CONSTRUCTION TOTAL					\$445,016
<hr/>					
Purchase Drainage Easement (Residential)		3,600	SF	\$ 2.00	\$7,200
Property/Structure Buyout		2	Parcels	\$ 1,188,600.00	\$ 1,188,600.00
Design Engineering			LS	15%	\$66,752
City Project Management			LS	10%	\$44,502
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$1,752,070</b>

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
MC-2B: Merkle Creek - Iowa Street Crossing Improvement**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$28,932
2	Preparing Right of Way	1	LS	4%	\$7,715
3	Utility Relocation	1	LS	5%	\$9,644
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$5,786
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$13,502
6	Excavation (easy)	107	CY	\$ 5.00	\$533
7	Embankment (easy)	235	CY	\$ 6.00	\$1,410
8	Concrete Box Culverts - 11 x 6	135	LF	\$ 875.00	\$118,125
9	RCP - 18"	30	LF	\$ 65.00	\$1,950
10	RCP - 24"	20	LF	\$ 80.00	\$1,600
11	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
12	Culvert Removal	2	EA	\$ 3,000.00	\$6,000
13	Headwall Removal	2	EA	\$ 500.00	\$1,000
14	Sidewalk Removal & Replacement	94	SY	\$ 20.00	\$1,880
15	Driveway Removal & Replacement	44	SY	\$ 50.00	\$2,222
16	Chain Link Fence	40	LF	\$ 15.00	\$600
17	Rock Rip Rap w/ Filter Fabric (D50=18in.)	167	SY	\$ 80.00	\$13,333
18	Dewatering	1	LS	\$ 10,000.00	\$10,000
19	Construction Exit	2	EA	\$ 2,000.00	\$4,000
20	Rock Filter Dam	4	EA	\$ 2,500.00	\$10,000
21	Trench Safety Protection	45	LF	\$ 5.00	\$225
SUBTOTAL					\$258,458
20% CONTINGENCY					\$51,692
CONSTRUCTION TOTAL					\$310,149
Design Engineering					LS 15% \$46,522
City Project Management					LS 10% \$31,015

**TOTAL CAPITAL PROJECT COST \$387,687**

- Notes:  
 1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
 2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
RC-1: Rock Creek - Robinson Street Crossing Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$83,909
2	Preparing Right of Way	1	LS	4%	\$22,376
3	Utility Relocation	1	LS	5%	\$27,970
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$16,782
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$39,157
6	Channel Excavation (difficult)	6,106	CY	\$ 30.00	\$183,180
7	Concrete Box Culverts - 14 x 11	150	LF	\$ 2,000.00	\$300,000
8	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
9	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
10	Headwall Removal	2	EA	\$ 500.00	\$1,000
11	Pavement Removal & Replacement	312	SY	\$ 80.00	\$24,960
12	Rock Rip Rap w/ Filter Fabric (D50=18in.)	100	SY	\$ 80.00	\$8,000
13	Dewatering	1	LS	\$ 10,000.00	\$10,000
14	Construction Exit	2	EA	\$ 2,000.00	\$4,000
15	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
16	Trench Safety Protection	50	LF	\$ 5.00	\$250
SUBTOTAL					\$749,583
20% CONTINGENCY					\$149,917
CONSTRUCTION TOTAL					\$899,499
Design Engineering and Permitting					LS 20% \$179,899.82
City Project Management					LS 10% \$89,949.91

**TOTAL CAPITAL PROJECT COST \$1,169,349**

- Notes:  
 1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.  
 2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
RC-2: Rock Creek - 36th Ave NE Crossing Improvements (Rock Creek)**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$75,886
2	Preparing Right of Way	1	LS	4%	\$20,236
3	Utility Relocation	1	LS	5%	\$25,295
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$15,177
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$35,413
6	Embankment (easy)	2,449	CY	\$ 6.00	\$14,694
7	Channel Excavation (easy)	3,268	CY	\$ 25.00	\$81,700
8	Channel Embankment (easy)	24	CY	\$ 26.00	\$624
9	Concrete Box Culverts - 10 x 10	200	LF	\$ 850.00	\$170,000
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
12	Headwall Removal	2	EA	\$ 500.00	\$1,000
13	Pavement Removal & Replacement	2,276	SY	\$ 80.00	\$182,080
14	Driveway Removal & Replacement	111	SY	\$ 50.00	\$5,556
15	Rock Rip Rap w/ Filter Fabric (D50=18in.)	100	SY	\$ 80.00	\$8,000
16	Dewatering	1	LS	\$ 10,000.00	\$10,000
17	Construction Exit	2	EA	\$ 2,000.00	\$4,000
18	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
19	Trench Safety Protection	50	LF	\$ 5.00	\$250
SUBTOTAL					\$677,911
20% CONTINGENCY					\$135,582
CONSTRUCTION TOTAL					\$813,493

Design Engineering and Permitting	LS	20%	\$162,698.58
City Project Management	LS	10%	\$81,349.29

**TOTAL CAPITAL PROJECT COST \$1,057,541**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
RC-3: Rock Creek - 36th Ave NE Crossing Improvements (Trib. C to Rock Creek)**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$62,085
2	Preparing Right of Way	1	LS	4%	\$16,556
3	Utility Relocation	1	LS	5%	\$20,695
4	Barricades, Signs, and Traffic Handling	1	LS	3%	\$12,417
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	7%	\$28,973
6	Embankment (easy)	1,448	CY	\$ 6.00	\$8,688
7	Channel Excavation (easy)	1,793	CY	\$ 25.00	\$44,825
8	Channel Embankment (easy)	2,337	CY	\$ 26.00	\$60,762
9	RCP - 72"	153	LF	\$ 275.00	\$42,075
10	Headwall - Large >5ft.	2	EA	\$ 10,000.00	\$20,000
11	Headwall Removal	2	EA	\$ 500.00	\$1,000
12	Pavement Removal & Replacement	2,301	SY	\$ 80.00	\$184,080
13	Driveway Removal & Replacement	444	SY	\$ 50.00	\$22,222
14	Rock Rip Rap w/ Filter Fabric (D50=18in.)	100	SY	\$ 80.00	\$8,000
15	Dewatering	1	LS	\$ 10,000.00	\$10,000
16	Construction Exit	2	EA	\$ 2,000.00	\$4,000
17	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
18	Trench Safety Protection	50	LF	\$ 5.00	\$250
19	Culvert Removal	1	EA	\$ 3,000.00	\$3,000
SUBTOTAL					\$554,629
20% CONTINGENCY					\$110,926
CONSTRUCTION TOTAL					\$665,555

Purchase Drainage Easement (Residential)	22,000	SF	\$ 2.00	\$44,000
Design Engineering and Permitting		LS	20%	\$133,110.95
City Project Management		LS	10%	\$66,555.48

**TOTAL CAPITAL PROJECT COST \$909,221**

Notes:

- Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
- Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.



APPENDIX H, cont'd

**City of Norman Storm Water Master Plan  
Probable Cost Estimate  
TMF-1: Ten Mile Flat Creek - Cambridge Channel Improvements**

Item No.	Item Description	Quantity	Unit	Unit Cost	Item Total
1	Mobilization	1	LS	15%	\$17,536
2	Preparing Right of Way	1	LS	4%	\$4,676
3	Utility Relocation	1	LS	5%	\$5,845
4	Barricades, Signs, and Traffic Handling	1	LS	6%	\$7,014
5	Site Stabilization (ECB, topsoil, watering,)	1	LS	10%	\$11,691
6	Channel Excavation (easy)	3,663	CY	\$ 25.00	\$91,574
7	Sidewalk Removal & Replacement	817	SY	\$ 20.00	\$16,333
8	Construction Exit	2	EA	\$ 2,000.00	\$4,000
9	Rock Filter Dam	2	EA	\$ 2,500.00	\$5,000
SUBTOTAL					\$163,670
20% CONTINGENCY					\$32,734
CONSTRUCTION TOTAL					\$196,404
Design Engineering and Permitting			LS	20%	\$39,281
City Project Management			LS	10%	\$19,640
<b>TOTAL CAPITAL PROJECT COST</b>					<b>\$255,326</b>

Notes:

1. Unit costs developed from recent City of Norman and Oklahoma City bid tabs and average price history from ODOT.
2. Mobilization, Preparing ROW, Utility Relocation, Barricades and Traffic Handling, and Site Stabilization are estimated to be a percentage of the sum of the construction cost items.

**Storm Water Master Plan  
City of Norman  
Cleveland County, Oklahoma**

**October 2009**

**Appendix I**

**Problem/Solution Prioritization Scoring**



**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 1**

**BC - 2**

**BC - 3**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Stream Stabilization US of Hwy. 9		Stream Stabilization DS confluence with Trib. C		Creek Modifications DS of Alameda St.	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	2	8	2	8	2	8
Flood, erosion, and water quality significance	4	3	12	3	12	3	12	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8	2	8	2	8
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9	2	6
Environmental enhancement	3	3	9	3	9	3	9	2	6
Funding sources (leverage of participants available funds)	2	3	6	1	2	1	2	2	4
Beneficial neighborhood impacts	2	3	6	1	2	2	4	2	4
Degree of economic impact on local businesses	2	3	6	0	0	0	0	3	6
Dependency on other projects	1	3	3	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1	1	1	2	2
Mobility or effects on transportation system	1	3	3	0	0	0	0	3	3
Time to implement or construct	1	3	3	3	3	3	3	2	2
Ease of permitting	1	3	3	2	2	2	2	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>71</b>		<b>73</b>		<b>74</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 4**

**BC - 5**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Structure Buyouts Between Eufaula St. and Main St		Stream Stabilization DS of Constitution - Trib. A	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	1	4
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	2	8	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	3	12	1	4
Sustainability or low operations & maintenance cost	3	3	9	2	6	3	9
Environmental enhancement	3	3	9	2	6	2	6
Funding sources (leverage of participants available funds)	2	3	6	2	4	2	4
Beneficial neighborhood impacts	2	3	6	3	6	0	0
Degree of economic impact on local businesses	2	3	6	1	2	0	0
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	0	0
Mobility or effects on transportation system	1	3	3	0	0	0	0
Time to implement or construct	1	3	3	2	2	3	3
Ease of permitting	1	3	3	3	3	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>78</b>		<b>55</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 6**

**BC - 7**

**BC - 8**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Floodwall North of Classen/12th Ave. SE - Trib. A		Outfall Structure Repair Near 12th Ave SE - Trib. A		Culvert Upgrade Lindsey St. - Trib. A	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	2	8	1	4	3	12
Flood, erosion, and water quality significance	4	3	12	2	8	1	4	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	2	8	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0	0	0	0	0
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9	3	9
Environmental enhancement	3	3	9	0	0	2	6	0	0
Funding sources (leverage of participants available funds)	2	3	6	1	2	1	2	2	4
Beneficial neighborhood impacts	2	3	6	3	6	1	2	3	6
Degree of economic impact on local businesses	2	3	6	3	6	1	2	3	6
Dependency on other projects	1	3	3	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	1	1	2	2
Mobility or effects on transportation system	1	3	3	0	0	1	1	3	3
Time to implement or construct	1	3	3	3	3	3	3	3	3
Ease of permitting	1	3	3	3	3	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>58</b>		<b>52</b>		<b>75</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 9**

**BC - 10**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Stream Stabilization US Lindsey St. - Trib. A		Creek Modifications/Culvert Upgrades Sinclar Rd. and Beaumont Rd.	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	1	4	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0	2	8
Sustainability or low operations & maintenance cost	3	3	9	3	9	2	6
Environmental enhancement	3	3	9	3	9	2	6
Funding sources (leverage of participants available funds)	2	3	6	1	2	2	4
Beneficial neighborhood impacts	2	3	6	2	4	3	6
Degree of economic impact on local businesses	2	3	6	2	4	1	2
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1	1	1
Mobility or effects on transportation system	1	3	3	0	0	3	3
Time to implement or construct	1	3	3	3	3	3	3
Ease of permitting	1	3	3	2	2	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>65</b>		<b>80</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 11**

**BC - 12**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Stream Stabilization US Confluence with Main Branch - Trib. C		Culvert Upgrade/Creek Modifications Brooks St. - Trib. C	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	2	8	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8	2	8
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9
Environmental enhancement	3	3	9	3	9	1	3
Funding sources (leverage of participants available funds)	2	3	6	1	2	2	4
Beneficial neighborhood impacts	2	3	6	2	4	3	6
Degree of economic impact on local businesses	2	3	6	0	0	2	4
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1	2	2
Mobility or effects on transportation system	1	3	3	0	0	3	3
Time to implement or construct	1	3	3	3	3	2	2
Ease of permitting	1	3	3	2	2	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>73</b>		<b>74</b>

\* Project Specific Scores can be 0, 1, 2, or 3



**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 13**

**BC - 14**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		SW Detention Facility SE of 12th Ave. SE and Alameda St.		Two Ditch Conveyance Modifications Near 24th Ave. SE and Tahoe St.	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	0	0
Flood, erosion, and water quality significance	4	3	12	3	12	1	4
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	0	0
Sustainability or low operations & maintenance cost	3	3	9	2	6	3	9
Environmental enhancement	3	3	9	1	3	0	0
Funding sources (leverage of participants available funds)	2	3	6	1	2	0	0
Beneficial neighborhood impacts	2	3	6	3	6	1	2
Degree of economic impact on local businesses	2	3	6	3	6	1	2
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1	2	2
Mobility or effects on transportation system	1	3	3	2	2	0	0
Time to implement or construct	1	3	3	2	2	3	3
Ease of permitting	1	3	3	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>74</b>		<b>36</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 15**

**BC - 16**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Ditch Conveyance/Storm Sewer Modifications Between Stinson Rd. and Fleetwood Rd.		Storm Sewer System Along Lindsey St. from College Ave. to Trib. C	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	2	8	3	12
Flood, erosion, and water quality significance	4	3	12	2	8	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0	0	0
Sustainability or low operations & maintenance cost	3	3	9	2	6	3	9
Environmental enhancement	3	3	9	1	3	0	0
Funding sources (leverage of participants available funds)	2	3	6	1	2	3	6
Beneficial neighborhood impacts	2	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	1	2	3	6
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	3	3
Mobility or effects on transportation system	1	3	3	0	0	3	3
Time to implement or construct	1	3	3	3	3	2	2
Ease of permitting	1	3	3	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>58</b>		<b>77</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BISHOP CREEK**

**BC - 17**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade Mockingbird Lane	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0
Sustainability or low operations & maintenance cost	3	3	9	3	9
Environmental enhancement	3	3	9	1	3
Funding sources (leverage of participants available funds)	2	3	6	2	4
Beneficial neighborhood impacts	2	3	6	3	6
Degree of economic impact on local businesses	2	3	6	1	2
Dependency on other projects	1	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2
Mobility or effects on transportation system	1	3	3	3	3
Time to implement or construct	1	3	3	3	3
Ease of permitting	1	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>74</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BROOKHAVEN CREEK**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		BHC - 1 Culvert Upgrade/DS Creek Modifications Main Street		BHC - 2 Stream Stabilization North of Main Street		BHC - 3 Stream Stabilization US of Willow Branch Rd.	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
		Public safety	4	3	12	3	12	1	4
Flood, erosion, and water quality significance	4	3	12	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8	2	8	2	8
Sustainability or low operations & maintenance cost	3	3	9	2	6	3	9	3	9
Environmental enhancement	3	3	9	3	9	3	9	3	9
Funding sources (leverage of participants available funds)	2	3	6	2	4	1	2	1	2
Beneficial neighborhood impacts	2	3	6	3	6	2	4	2	4
Degree of economic impact on local businesses	2	3	6	1	2	0	0	0	0
Dependency on other projects	1	3	3	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	3	3	1	1	1	1
Mobility or effects on transportation system	1	3	3	3	3	0	0	0	0
Time to implement or construct	1	3	3	2	2	3	3	3	3
Ease of permitting	1	3	3	2	2	2	2	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>84</b>		<b>69</b>		<b>69</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BROOKHAVEN CREEK**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		BHC - 4 Stream Stabilization DS of 36th Ave. NW		BHC - 5 Remove Bridge Flow Constriction Robinson Ave.		BHC - 6 Culvert Upgrade Rock Creek Rd.	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	1	4	1	4	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	1	4	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8	2	8	1	4
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9	3	9
Environmental enhancement	3	3	9	3	9	1	3	0	0
Funding sources (leverage of participants available funds)	2	3	6	1	2	2	4	2	4
Beneficial neighborhood impacts	2	3	6	2	4	3	6	3	6
Degree of economic impact on local businesses	2	3	6	0	0	1	2	1	2
Dependency on other projects	1	3	3	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1	1	1	2	2
Mobility or effects on transportation system	1	3	3	0	0	2	2	3	3
Time to implement or construct	1	3	3	3	3	3	3	2	2
Ease of permitting	1	3	3	2	2	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>69</b>		<b>64</b>		<b>70</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BROOKHAVEN CREEK**

**BHC - 7**

**BHC - 8**

**BHC - 9**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade Trib. A - Pendleton Rd.		Culvert Upgrade Trib. A - Rock Creek Rd.		Extend Storm Sewer System Near Rambling Oaks/Tall Oaks	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	2	8	2	8	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	1	4	0	0
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9	3	9
Environmental enhancement	3	3	9	0	0	0	0	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4	2	4	0	0
Beneficial neighborhood impacts	2	3	6	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	0	0	1	2	2	4
Dependency on other projects	1	3	3	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	2	2	2	2
Mobility or effects on transportation system	1	3	3	2	2	3	3	1	1
Time to implement or construct	1	3	3	3	3	2	2	1	1
Ease of permitting	1	3	3	3	3	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>68</b>		<b>70</b>		<b>61</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - BROOKHAVEN CREEK**

**BHC - 10**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score			Extend Storm Sewer System Near Rambling Oaks/Havenbrook	
		Project Specific Score	Project Specific Weighted Score		Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12		3	12
Flood, erosion, and water quality significance	4	3	12		3	12
Engineering economy (good benefit/cost relationship)	4	3	12		3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12		0	0
Sustainability or low operations & maintenance cost	3	3	9		3	9
Environmental enhancement	3	3	9		0	0
Funding sources (leverage of participants available funds)	2	3	6		0	0
Beneficial neighborhood impacts	2	3	6		3	6
Degree of economic impact on local businesses	2	3	6		3	6
Dependency on other projects	1	3	3		3	3
Improve economic development/redevelopment potential	1	3	3		2	2
Mobility or effects on transportation system	1	3	3		1	1
Time to implement or construct	1	3	3		1	1
Ease of permitting	1	3	3		3	3
<b>Project Total Specific Score</b>			<b>99</b>			<b>67</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - CANADIAN RIVER**

**CR- 1**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Local Storm Sewer System Westbrooke Terrace/Hollywood	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0
Sustainability or low operations & maintenance cost	3	3	9	2	6
Environmental enhancement	3	3	9	0	0
Funding sources (leverage of participants available funds)	2	3	6	1	2
Beneficial neighborhood impacts	2	3	6	3	6
Degree of economic impact on local businesses	2	3	6	0	0
Dependency on other projects	1	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1
Mobility or effects on transportation system	1	3	3	3	3
Time to implement or construct	1	3	3	3	3
Ease of permitting	1	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>59</b>

\* Project Specific Scores can be 0, 1, 2, or 3



**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - CLEAR CREEK**

**CC-1**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade West 120th Street SE	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0
Sustainability or low operations & maintenance cost	3	3	9	2	6
Environmental enhancement	3	3	9	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4
Beneficial neighborhood impacts	2	3	6	3	6
Degree of economic impact on local businesses	2	3	6	2	4
Dependency on other projects	1	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2
Mobility or effects on transportation system	1	3	3	2	2
Time to implement or construct	1	3	3	1	1
Ease of permitting	1	3	3	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>58</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - DAVE BLUE CREEK**

**DBC - 1**

**DBC - 2**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade 48th Ave SE		Culvert Upgrade Trib 1 48th Ave SE	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	2	8	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	2	8	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	1	4
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9
Environmental enhancement	3	3	9	0	0	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4	2	4
Beneficial neighborhood impacts	2	3	6	2	4	2	4
Degree of economic impact on local businesses	2	3	6	1	2	1	2
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	2	2
Mobility or effects on transportation system	1	3	3	3	3	3	3
Time to implement or construct	1	3	3	3	3	3	3
Ease of permitting	1	3	3	2	2	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>64</b>		<b>68</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - IMHOFF CREEK**

**IC - 1**

**IC - 2**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Stream Stabilization DS of Hwy 9		Stream Stabilization US Hwy 9	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8	2	8
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9
Environmental enhancement	3	3	9	3	9	3	9
Funding sources (leverage of participants available funds)	2	3	6	1	2	1	2
Beneficial neighborhood impacts	2	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	0	0	0	0
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	2	2
Mobility or effects on transportation system	1	3	3	0	0	0	0
Time to implement or construct	1	3	3	2	2	2	2
Ease of permitting	1	3	3	2	2	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>79</b>		<b>79</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - IMHOFF CREEK**

**IC - 3**

**IC - 4**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culverts/Bridges/Creek Modifications Near Andrews Park to 1000' DS of Lindsey St.		SW Detention Facility Andrews Park	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	1	4	1	4
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8	2	8
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9
Environmental enhancement	3	3	9	2	6	2	6
Funding sources (leverage of participants available funds)	2	3	6	2	4	2	4
Beneficial neighborhood impacts	2	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	3	6	3	6
Dependency on other projects	1	3	3	0	0	1	1
Improve economic development/redevelopment potential	1	3	3	3	3	3	3
Mobility or effects on transportation system	1	3	3	3	3	3	3
Time to implement or construct	1	3	3	0	0	1	1
Ease of permitting	1	3	3	1	1	1	1
<b>Project Total Specific Score</b>			<b>99</b>		<b>74</b>		<b>76</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - IMHOFF CREEK**

**IC - 4A**

**IC - 5**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		SW Detention Facility Andrews Park plus Area to North		Storm Sewer Diversion and Upgrades Lindsey/McGee Area	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	1	4	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	3	12	2	8
Sustainability or low operations & maintenance cost	3	3	9	2	6	3	9
Environmental enhancement	3	3	9	2	6	2	6
Funding sources (leverage of participants available funds)	2	3	6	2	4	3	6
Beneficial neighborhood impacts	2	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	3	6	3	6
Dependency on other projects	1	3	3	1	1	3	3
Improve economic development/redevelopment potential	1	3	3	3	3	3	3
Mobility or effects on transportation system	1	3	3	3	3	3	3
Time to implement or construct	1	3	3	1	1	1	1
Ease of permitting	1	3	3	1	1	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>77</b>		<b>89</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - LITTLE RIVER**

LR - 1

LR - 2

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Stream Stabilization West of 24th St. NE		Buyout Mobil Homes Indian Hills/BNSF RR	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	3	12
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9
Environmental enhancement	3	3	9	3	9	2	6
Funding sources (leverage of participants available funds)	2	3	6	1	2	2	4
Beneficial neighborhood impacts	2	3	6	2	4	2	4
Degree of economic impact on local businesses	2	3	6	0	0	2	4
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	2	2
Mobility or effects on transportation system	1	3	3	0	0	2	2
Time to implement or construct	1	3	3	3	3	3	3
Ease of permitting	1	3	3	2	2	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>74</b>		<b>88</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - TRIBUTARY G TO LITTLE RIVER**

**TGLR - 1**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade Franklin Road	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4
Sustainability or low operations & maintenance cost	3	3	9	3	9
Environmental enhancement	3	3	9	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4
Beneficial neighborhood impacts	2	3	6	3	6
Degree of economic impact on local businesses	2	3	6	2	4
Dependency on other projects	1	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2
Mobility or effects on transportation system	1	3	3	3	3
Time to implement or construct	1	3	3	3	3
Ease of permitting	1	3	3	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>72</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - WOODCREST CREEK (LITTLE RIVER)**

**WC - 1A**

**WC - 1B**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Regional Flood Detention US of Rock Creek Road		Stream Conveyance Modifications DS (North) of Sequoyah Trail	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	3	12	2	8
Sustainability or low operations & maintenance cost	3	3	9	1	3	2	6
Environmental enhancement	3	3	9	1	3	2	6
Funding sources (leverage of participants available funds)	2	3	6	1	2	0	0
Beneficial neighborhood impacts	2	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	1	2	0	0
Dependency on other projects	1	3	3	2	2	1	1
Improve economic development/redevelopment potential	1	3	3	1	1	1	1
Mobility or effects on transportation system	1	3	3	2	2	3	3
Time to implement or construct	1	3	3	1	1	1	1
Ease of permitting	1	3	3	0	0	1	1
<b>Project Total Specific Score</b>			<b>99</b>		<b>70</b>		<b>69</b>

\* Project Specific Scores can be 0, 1, 2, or 3



**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - WOODCREST CREEK (LITTLE RIVER)**

**WC - 2**

**WC - 3**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade Sequoyah		Stream Stabilization South of Sequoyah	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	1	4
Flood, erosion, and water quality significance	4	3	12	2	8	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	2	8
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9
Environmental enhancement	3	3	9	0	0	3	9
Funding sources (leverage of participants available funds)	2	3	6	2	4	1	2
Beneficial neighborhood impacts	2	3	6	3	6	2	4
Degree of economic impact on local businesses	2	3	6	1	2	0	0
Dependency on other projects	1	3	3	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	0	0
Mobility or effects on transportation system	1	3	3	3	3	0	0
Time to implement or construct	1	3	3	3	3	3	3
Ease of permitting	1	3	3	3	3	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>71</b>		<b>68</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - MERKLE CREEK**

**MC - 1**

**MC - 2**

**MC - 2A**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade/Remove Structures US 24th Ave NW		Culvert Upgrade/Creek Modifications Main Street		Culvert Upgrade Crestmont Street	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	3	12	3	12	3	12
Engineering economy (good benefit/cost relationship)	4	3	12	3	12	2	8	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	1	4	0	0
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9	3	9
Environmental enhancement	3	3	9	0	0	1	3	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4	3	6	2	4
Beneficial neighborhood impacts	2	3	6	3	6	3	6	3	6
Degree of economic impact on local businesses	2	3	6	1	2	3	6	1	2
Dependency on other projects	1	3	3	3	3	2	2	0	0
Improve economic development/redevelopment potential	1	3	3	2	2	3	3	2	2
Mobility or effects on transportation system	1	3	3	3	3	3	3	3	3
Time to implement or construct	1	3	3	2	2	1	1	3	3
Ease of permitting	1	3	3	2	2	2	2	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>73</b>		<b>77</b>		<b>68</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - MERKLE CREEK**

**MC - 2B**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade Iowa Street	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	3	12
Potential for recreation/open space/connectivity for linear parks	4	3	12	0	0
Sustainability or low operations & maintenance cost	3	3	9	3	9
Environmental enhancement	3	3	9	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4
Beneficial neighborhood impacts	2	3	6	3	6
Degree of economic impact on local businesses	2	3	6	1	2
Dependency on other projects	1	3	3	0	0
Improve economic development/redevelopment potential	1	3	3	2	2
Mobility or effects on transportation system	1	3	3	3	3
Time to implement or construct	1	3	3	3	3
Ease of permitting	1	3	3	3	3
<b>Project Total Specific Score</b>			<b>99</b>		<b>64</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - ROCK CREEK**

**RC - 1**

**RC - 2**

**RC - 3**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Culvert Upgrade Robinson Road		Culvert Upgrade 36th Ave NE		Culvert Upgrade Trib C 36th Ave NE	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	3	12	3	12	3	12
Flood, erosion, and water quality significance	4	3	12	2	8	2	8	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	2	8	2	8	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	1	4	1	4	0	0
Sustainability or low operations & maintenance cost	3	3	9	3	9	3	9	2	6
Environmental enhancement	3	3	9	0	0	0	0	0	0
Funding sources (leverage of participants available funds)	2	3	6	2	4	2	4	2	4
Beneficial neighborhood impacts	2	3	6	2	4	2	4	1	2
Degree of economic impact on local businesses	2	3	6	1	2	1	2	1	2
Dependency on other projects	1	3	3	2	2	2	2	3	3
Improve economic development/redevelopment potential	1	3	3	2	2	2	2	2	2
Mobility or effects on transportation system	1	3	3	3	3	3	3	3	3
Time to implement or construct	1	3	3	3	3	3	3	3	3
Ease of permitting	1	3	3	2	2	2	2	1	1
<b>Project Total Specific Score</b>			<b>99</b>		<b>63</b>		<b>63</b>		<b>54</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**APPENDIX I  
PROJECT PRIORITIZATION SCORING SHEET - TEN MILE FLAT CREEK**

**TMF - 1**

Prioritization Ranking Factors	Ranking Factor Weight	Maximum Possible Score		Channel Modifications Cambridge Addition US of Detention Pond	
		Project Specific Score	Project Specific Weighted Score	Project Specific Score	Project Specific Weighted Score
Public safety	4	3	12	1	4
Flood, erosion, and water quality significance	4	3	12	2	8
Engineering economy (good benefit/cost relationship)	4	3	12	2	8
Potential for recreation/open space/connectivity for linear parks	4	3	12	2	8
Sustainability or low operations & maintenance cost	3	3	9	2	6
Environmental enhancement	3	3	9	2	6
Funding sources (leverage of participants available funds)	2	3	6	1	2
Beneficial neighborhood impacts	2	3	6	2	4
Degree of economic impact on local businesses	2	3	6	0	0
Dependency on other projects	1	3	3	3	3
Improve economic development/redevelopment potential	1	3	3	1	1
Mobility or effects on transportation system	1	3	3	0	0
Time to implement or construct	1	3	3	3	3
Ease of permitting	1	3	3	2	2
<b>Project Total Specific Score</b>			<b>99</b>		<b>55</b>

\* Project Specific Scores can be 0, 1, 2, or 3

**Storm Water Master Plan  
City of Norman  
Cleveland County, Oklahoma**

**October 2009**

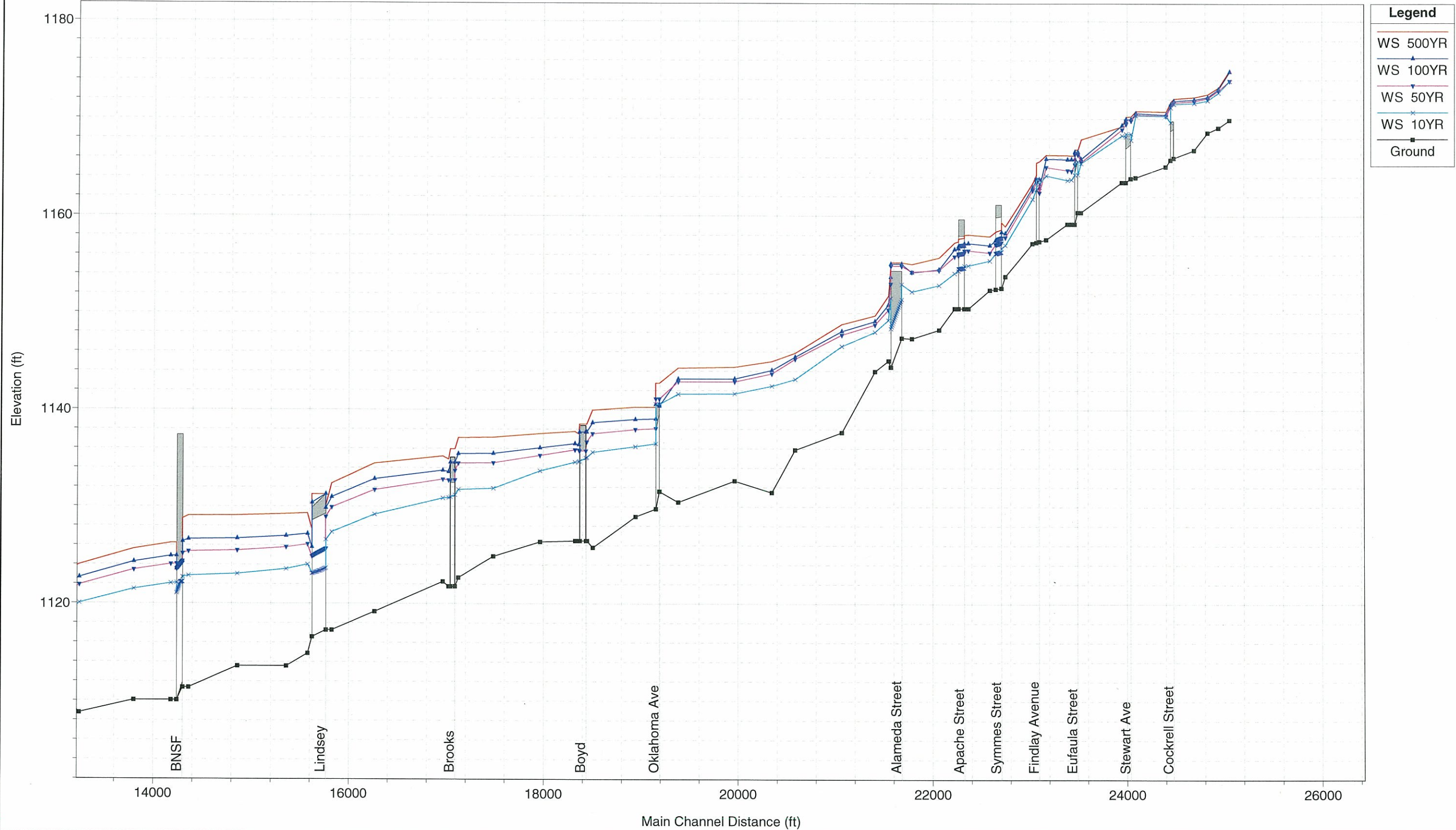
**Appendix J**

**Flood Profiles for 10-, 50-, 100-, and 500-Year  
Flood Events – Existing and Full Buildout Conditions**

**Appendix J Note:** Flood profiles for existing and future (full buildout 2025) conditions are provided in the order that the watersheds are listed below. Existing and future conditions are provided together for each individual watershed followed by profiles for both conditions in next-listed watershed.

1. Bishop Creek Mainstem – Existing Conditions
2. Bishop Creek Mainstem – Future Conditions
3. Tributary A to Bishop Creek – Existing Conditions
4. Tributary A to Bishop Creek – Future Conditions
5. Tributary B to Bishop Creek – Existing Conditions
6. Tributary B to Bishop Creek – Future Conditions
7. Tributary C to Bishop Creek – Existing Conditions
8. Tributary C to Bishop Creek – Future Conditions
9. Brookhaven Creek Mainstem – Existing Conditions
10. Brookhaven Creek Mainstem – Future Conditions
11. Tributary A to Brookhaven Creek – Existing Conditions
12. Tributary A to Brookhaven Creek – Future Conditions
13. Tributary B to Brookhaven Creek – Existing Conditions
14. Tributary B to Brookhaven Creek – Future Conditions
15. Dave Blue Creek – Existing Conditions
16. Dave Blue Creek – Future Conditions
17. Tributary A to Dave Blue Creek – Existing Conditions
18. Tributary A to Dave Blue Creek – Future Conditions
19. Tributary 1 to Dave Blue Creek – Existing Conditions
20. Tributary 1 to Dave Blue Creek – Future Conditions
21. Imhoff Creek – Existing Conditions
22. Imhoff Creek – Future Conditions
23. Little River – Existing Conditions
24. Little River – Future Conditions
25. Tributary G to Little River – Existing Conditions
26. Tributary G to Little River – Future Conditions
27. Woodcrest Creek (Little River) – Existing Conditions
28. Woodcrest Creek (Little River) – Future Conditions
29. Merkle Creek – Existing Conditions
30. Merkle Creek – Future Conditions
31. Rock Creek Mainstem – Existing Conditions
32. Rock Creek Mainstem – Future Conditions
33. Tributary A to Rock Creek – Existing Conditions
34. Tributary A to Rock Creek – Future Conditions
35. Tributary B to Rock Creek – Existing Conditions
36. Tributary B to Rock Creek – Future Conditions
37. Tributary C to Rock Creek – Existing Conditions
38. Tributary C to Rock Creek – Future Conditions
39. Tributary D to Rock Creek – Existing Conditions
40. Tributary D to Rock Creek – Future Conditions
41. Ten Mile Flat Creek – Existing Conditions
42. Ten Mile Flat Creek – Future Conditions

Bishop Creek Mainstem  
Existing Conditions

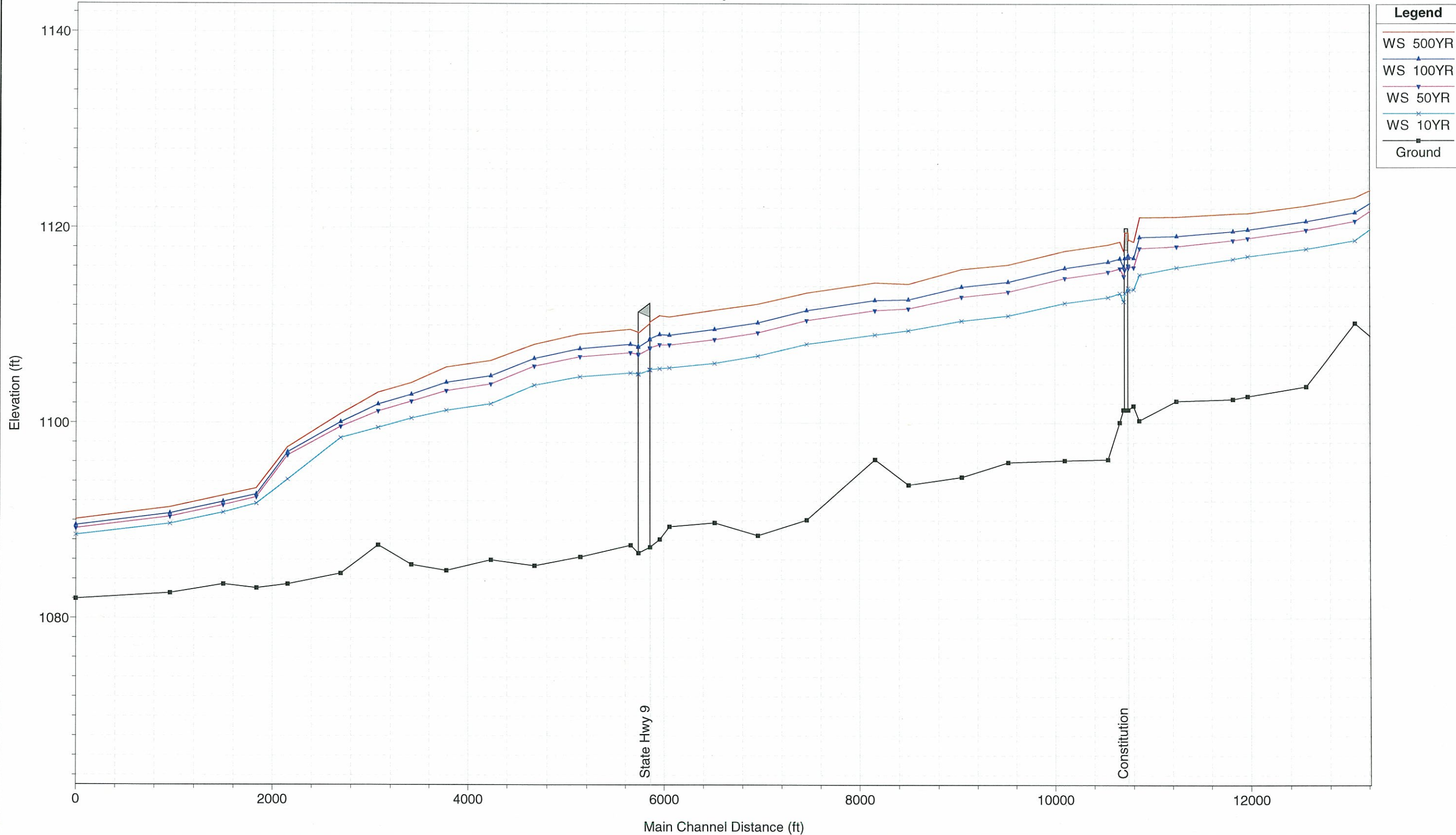


Legend	
WS 500YR	(Red line with triangle marker)
WS 100YR	(Blue line with triangle marker)
WS 50YR	(Purple line with triangle marker)
WS 10YR	(Light blue line with cross marker)
Ground	(Black line with square marker)

1 in Horiz. = 1000 ft 1 in Vert. = 10 ft



Bishop Creek Mainstem  
Existing Conditions

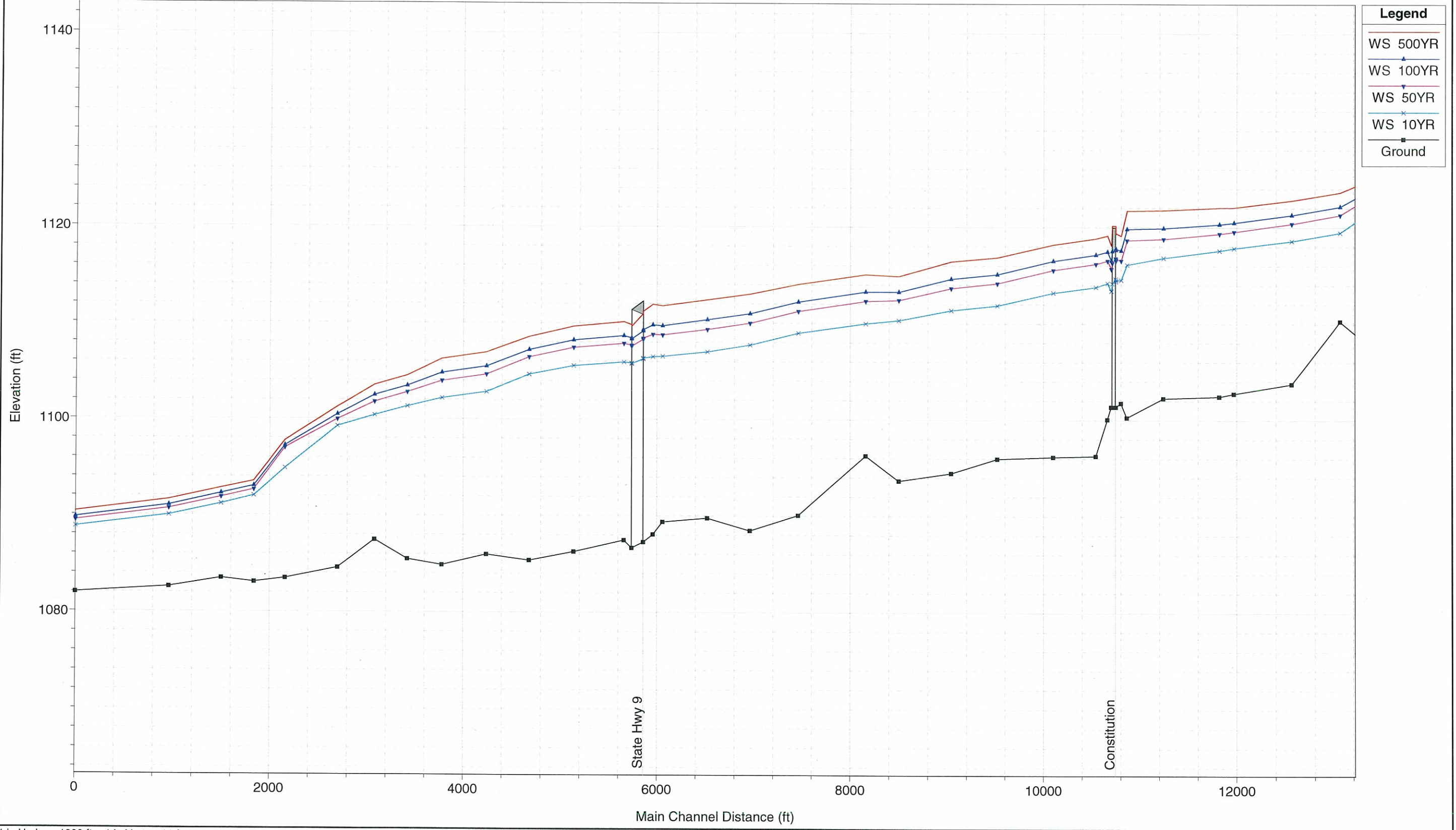


**Legend**

- WS 500YR
- WS 100YR
- WS 50YR
- WS 10YR
- Ground

1 in Horiz. = 1000 ft 1 in Vert. = 10 ft

Bishop Creek Mainstem  
Future Conditions



**Legend**

- WS 500YR
- WS 100YR
- WS 50YR
- WS 10YR
- Ground

1 in Horiz. = 1000 ft 1 in Vert. = 10 ft