April 24, 2020

Drainage Report, Phase 1

Prepared for:

Park Place Subdivision

Submitted to:
City of Broken Arrow, OK
220 S First St.
Broken Arrow, OK 74012

CT JOB NO. 18106600

Prepared by: Crafton Tull

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INDEX

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DRAINGE LETTER

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PROJECT OWNER AND DEVELOPER:

PROJECT TITLE:

The following information represents a summary drainage report for the proposed Phase 1 of the Park Place subdivision.

PROJECT LOCATION:

This project is located northeast intersection of E. 71st St. S and Midway Rd. in Broken Arrow, OK.

POEJECT DESCRIPTION:

The property consists of approximately 78 acres, with 17.8 acres dedicated to the development of the first phase of a residential subdivision composed of high-density plots. Phase 1 will consist of 60 residential lots. Currently, the land is composed of open farm land with hydrologic soil group C/D.

AREA DRAINAGE ISSUES:

There are not discovered existing drainage issues with this project.

FLOOD ZONE INFORMATION:

This project is not located within a flood zone. (FEMA map No. 40145C0110J, effective 09/30/16).

STORM DRAINAGE DESIGN:

Improvements as outlined in this report and depicted on the design drawings will not endanger life of have negative impacts on adjacent or downstream property or watersheds.

Storm sewers have been designed to convey the 100-year storm event with ease using a storm sewer sizing spreadsheet, with pipes at a junction matching crows. The 100-year storm event will be contained within the public right-of-way or drainage easement, and overflow routes will be provided for sump locations.

Hydraulic grade lines were analyzed via Bentley's StormCAD and remain at minimum of 6" below the bottom of the gutter per the City of Broken Arrow Engineering Design Criteria Manual. Storm sewers for Phase 1 will discharge into Pond 1, and storm sewers for Phases 3 and 4 will discharge into Pond 2. The remaining storm sewers will discharge into swales that will flow to the creek flowing through the center of the property. See appendix for supporting calculations and profiles.

DETENTION DESIGN:

Both ponds for the property were designed using Bentley's PondPack. Pond 1 will be constructed in Phase 1, and Pond 2 will be constructed in Phase 3. Both ponds were designed to allow post-development outflows to be less than pre-development outflows. Table 1 shows the property's outflows for pre- and post-development. Per the Broken Arrow drainage manual, outflows were to be maintained for the 5, 10, 25, 50, and 100 year storm. Pre- and post-development drainage maps are attached in the appendix.

Table 1. Pre- and Post-Development Outflows

RETURN PERIOD (YEARS)	PRE-DEVELOPMENT OUTFLOWS (CFS)	POST-DEVELOPMENT OUTFLOWS (CFS)
5	296.54	295.85
10	384.09	372.07
25	463.96	440.55
50	553.33	515.86
100	634.01	582.35

Per the Broken Arrow drainage manual, 1 foot of freeboard was required for the 500 year storm while flows did not have to be maintained. An overflow weir was graded along the creekside of Pond 1 and Pond 2 to allow the 500 year storm to discharge while maintaining freeboard requirements. The top of berm for Pond 1 is 635 ft. The top of berm for Pond 2 is 649 ft. Table 2 shows both ponds' water surface elevations for the required storms.

Table 2. Pond Water Surface Elevations

RETURN PERIOD (YEARS)	POND 1 WSE (FT)	POND 2 WSE (FT)
5	632.08	645.05
10	632.49	645.58
25	632.86	646.09
50	633.27	646.70
100	633.65	647.25
500	633.96	647.63

EROSION AND SEDIMENT CONTROL:

Erosion and sediment control will be achieved with silt fences, rip-rap, sod, curb inlet sediment filter, and diversion channels. Refer to the SWPPP and Erosion Control Plans and Details for more information. The SWPPP is located in a separate document.

CONCLUSION:

The grading for this site will be designed to convey the runoff from the 10-year and 100-year frequency storm events. Pad grading and swales will be shown to establish the final drainage paths for each inlet.

Should you have any questions or require any additional information, please feel free to contact us at your convenience.

VICINITY MAP

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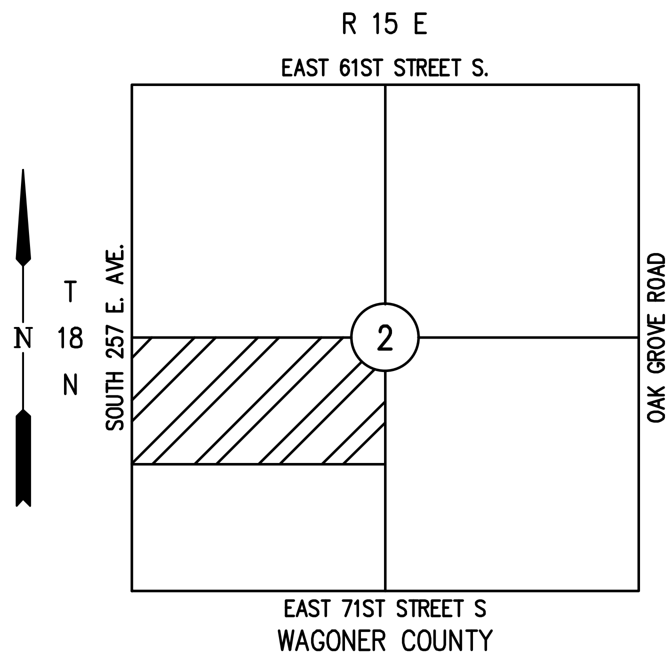

LOCATION MAP

SCALE IN FEET

0 2000

FEMA FIRM PANEL

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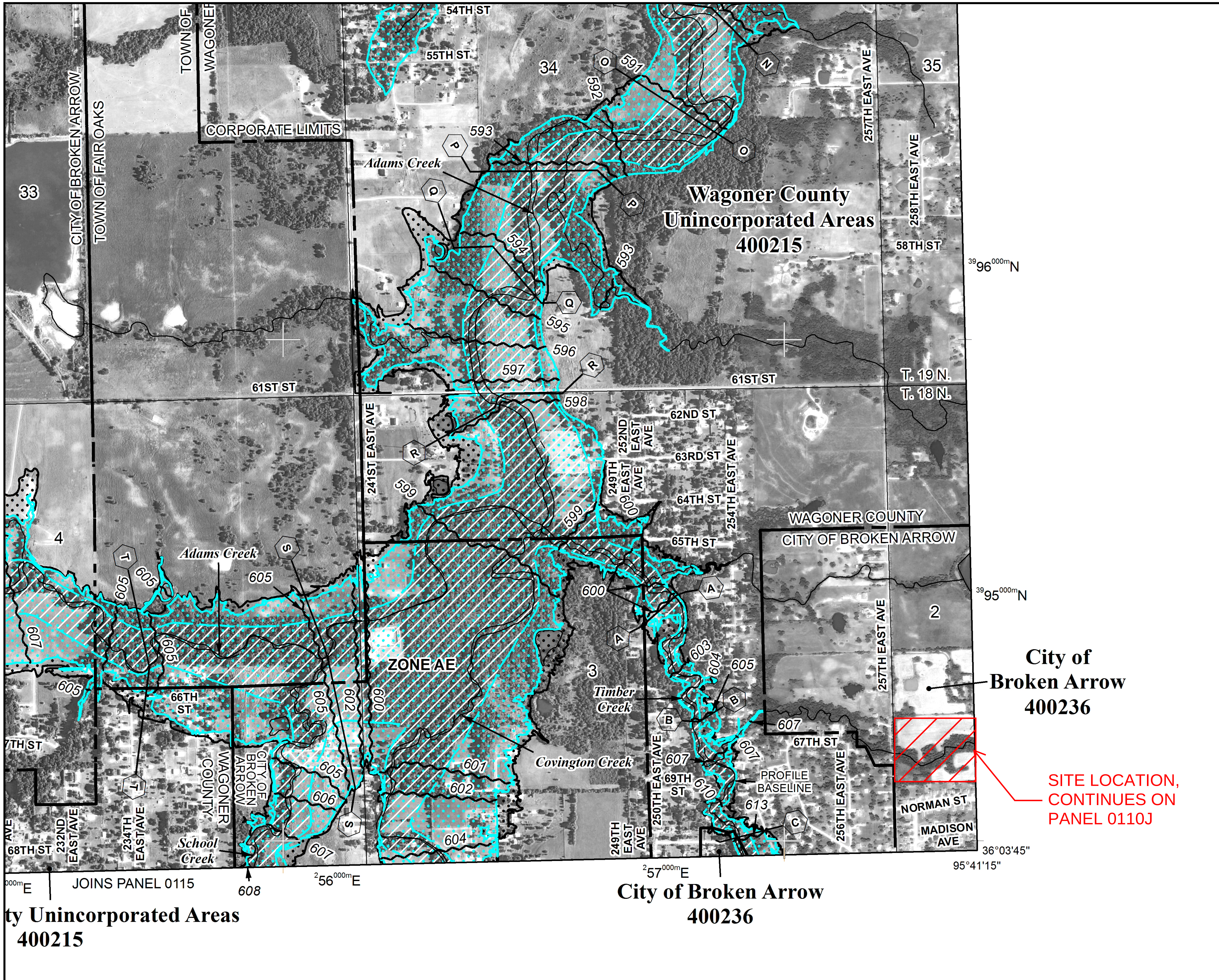


MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0105J

FIRM

FLOOD INSURANCE RATE MAP

WAGONER COUNTY, OKLAHOMA

AND INCORPORATED AREAS

PANEL 105 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

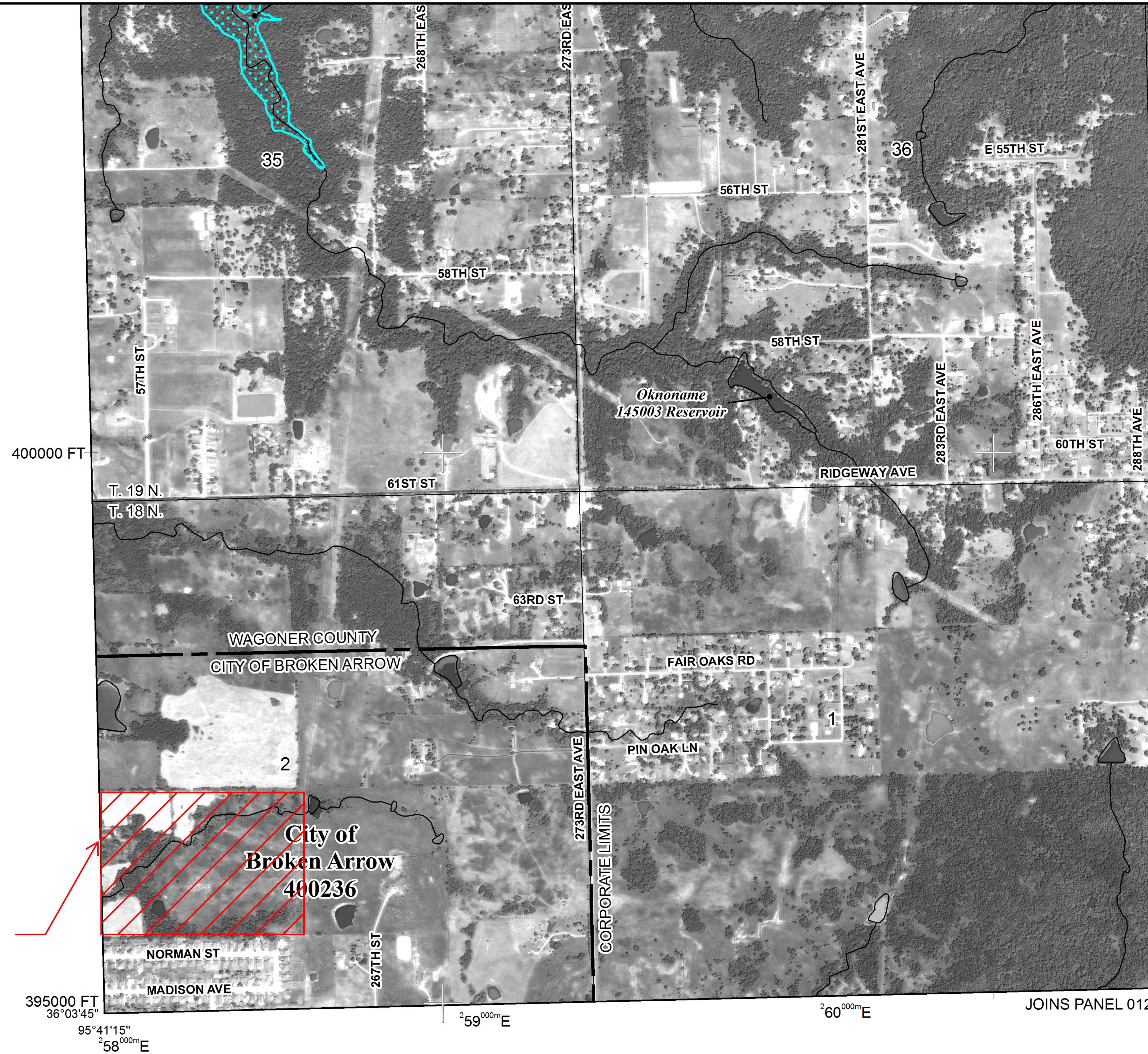
COMMUNITY	NUMBER	PANEL	SUFFIX
BROKEN ARROW, CITY OF	400236	0105	J
FAIR OAKS, TOWN OF	400509	0105	J
TULSA, CITY OF	405381	0105	J
WAGONER COUNTY	400215	0105	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

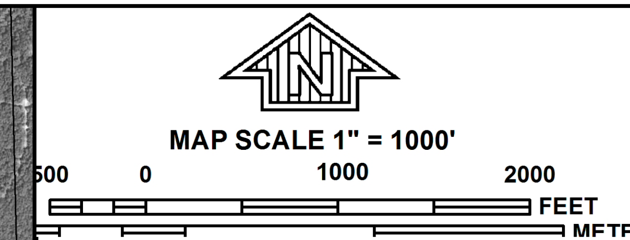
MAP NUMBER
40145C0105J

MAP REVISED
SEPTEMBER 30, 2016

Federal Emergency Management Agency



SITE LOCATION,
CONTINUES ON
PANEL 0105J



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0110J

FIRM

FLOOD INSURANCE RATE MAP

WAGONER COUNTY, OKLAHOMA

AND INCORPORATED AREAS

PANEL 110 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BROKEN ARROW, CITY OF	400236	0110	J
FAIR OAKS, TOWN OF	400509	0110	J
TULSA, CITY OF	405381	0110	J
WAGONER COUNTY	400215	0110	J

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MAP NUMBER
40145C0110J

MAP REVISED
SEPTEMBER 30, 2016

Federal Emergency Management Agency

SOIL SURVEY

Crafton Tull

United States Department of Agriculture

NRCS

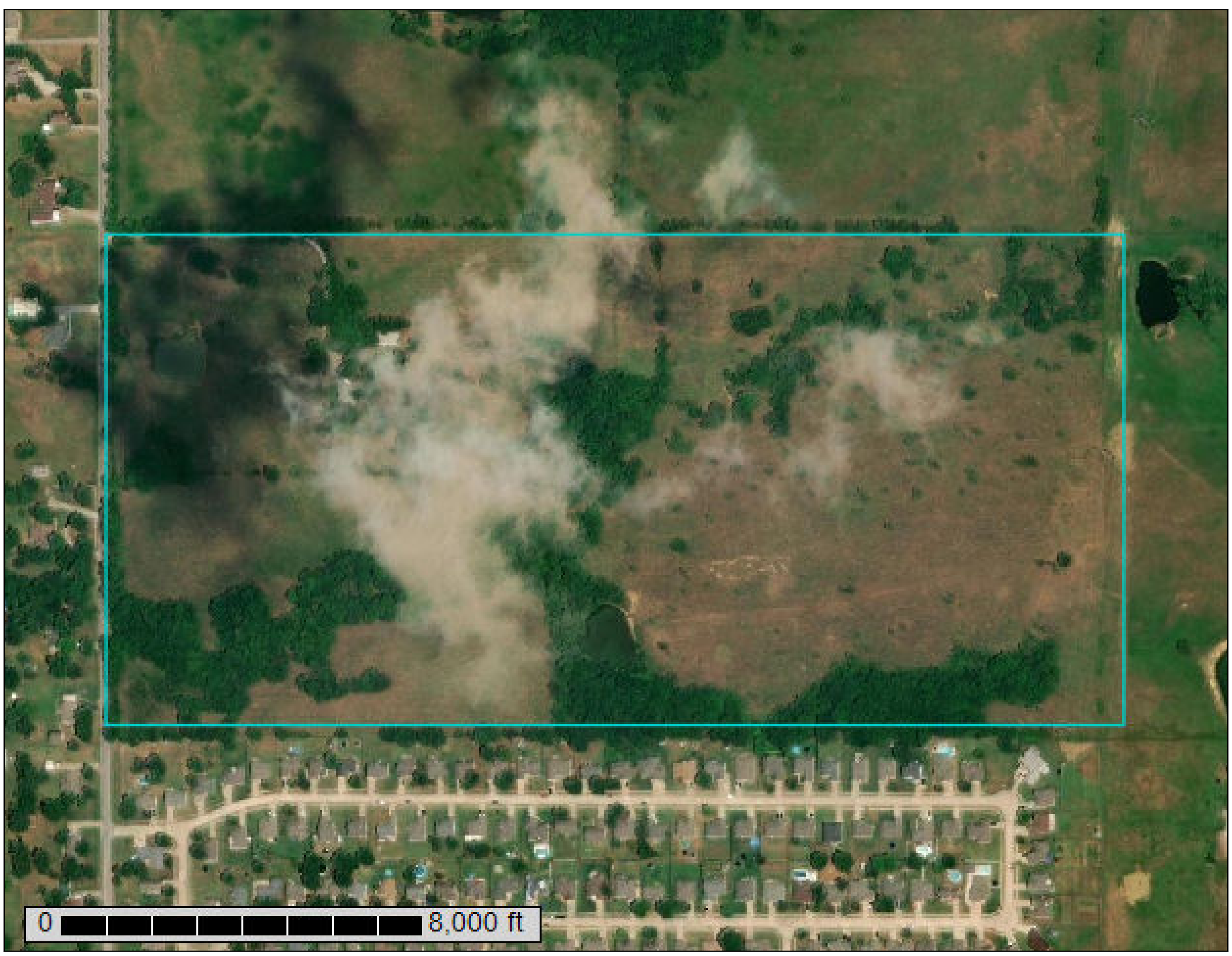
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Wagoner County, Oklahoma

Park Place



June 20, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

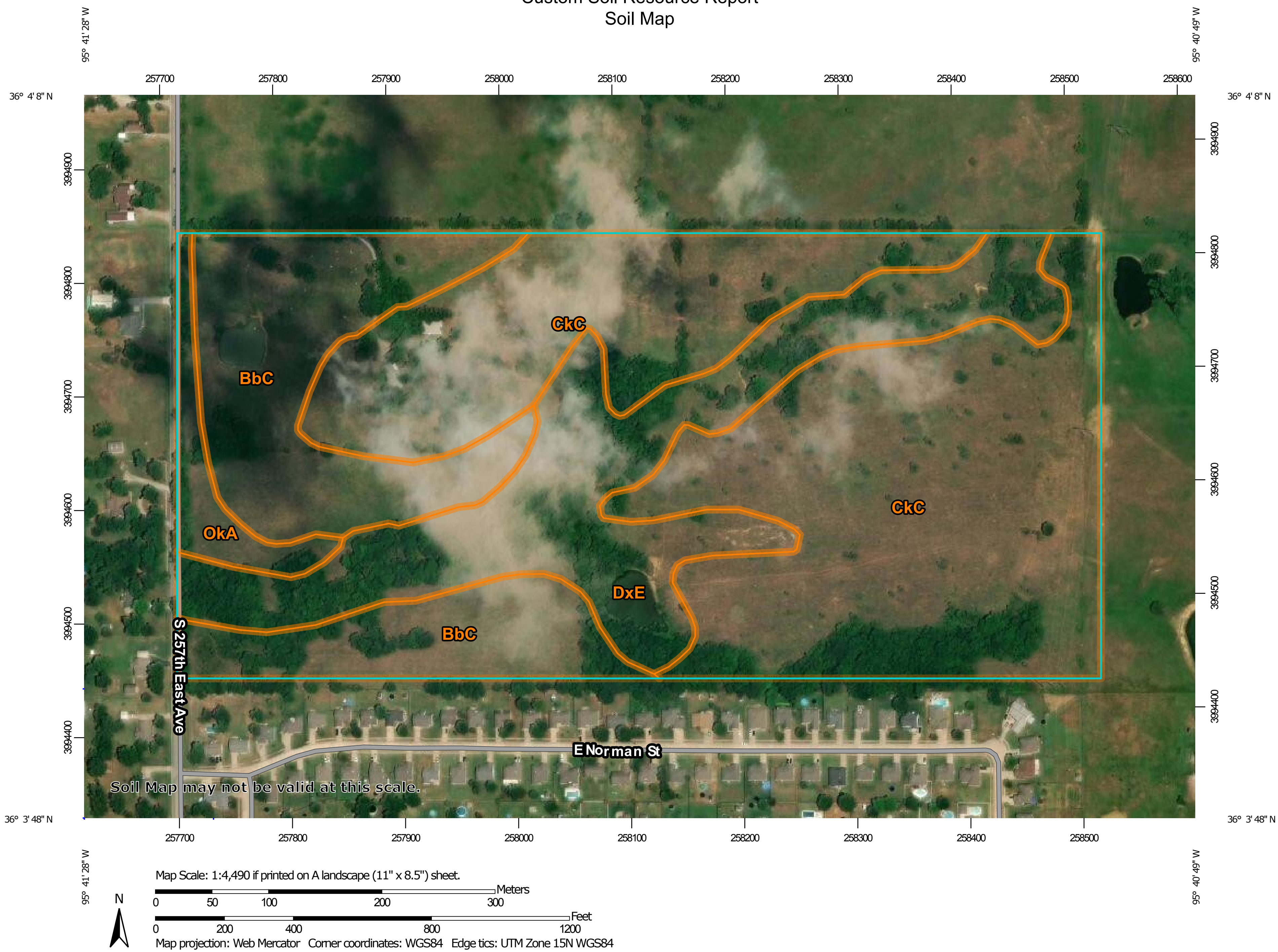
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


95° 41' 28" W
95° 40' 49" W
36° 4' 8" N
36° 3' 48" N
257700
257800
257900
258000
258100
258200
258300
258400
258500
258600
3994900
3994800
3994700
3994600
3994500
3994400
BbC
CkC
OkA
DxE
BbC
CkC
S 257th East Ave
E Norman St
Soil Map may not be valid at this scale.
Map Scale: 1:4,490 if printed on A landscape (11" x 8.5") sheet.
Meters
0
50
100
200
300
Feet
0
200
400
800
1200
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Wagoner County, Oklahoma
Survey Area Data: Version 13, Sep 19, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 9, 2015—Nov 19, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BbC	Bates fine sandy loam, 3 to 5 percent slopes	18.1	22.8%
CkC	Coweta-Bates complex, 3 to 5 percent slopes	41.2	51.8%
DxE	Dennis-Radley complex, 0 to 15 percent slopes	17.7	22.3%
OkA	Okemah silt loam, 0 to 1 percent slopes	2.4	3.1%
Totals for Area of Interest		**79.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Wagoner County, Oklahoma

BbC—Bates fine sandy loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tgtg
Elevation: 520 to 1,340 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 54 to 64 degrees F
Frost-free period: 170 to 235 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Bates and similar soils: 94 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bates

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

A - 0 to 13 inches: fine sandy loam
BA - 13 to 19 inches: loam
Bt - 19 to 35 inches: clay loam
Cr - 35 to 45 inches: bedrock

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: 28 to 38 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Loamy prairie (Northeast) PE 62-80 (R112XY059OK)
Hydric soil rating: No

Minor Components

Dennis

Percent of map unit: 3 percent
Landform: Interfluves
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Loamy Upland (Draft) (PE 35-42) (R112XY015KS)
Hydric soil rating: No

Coweta

Percent of map unit: 3 percent
Landform: Hillslopes on hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Shallow prairie (Eastern) PE 62-80 (R112XY086OK)
Hydric soil rating: No

CkC—Coweta-Bates complex, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tgt7
Elevation: 490 to 1,030 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Coweta and similar soils: 62 percent
Bates and similar soils: 32 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Coweta

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy residuum weathered from sandstone and shale

Typical profile

A - 0 to 9 inches: loam

Bw - 9 to 17 inches: gravelly loam
Cr - 17 to 27 inches: bedrock

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: 15 to 19 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: Shallow prairie (Eastern) PE 62-80 (R112XY086OK)
Hydric soil rating: No

Description of Bates

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

A - 0 to 11 inches: loam
BA - 11 to 15 inches: loam
Bt - 15 to 28 inches: clay loam
Cr - 28 to 37 inches: bedrock

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: 25 to 32 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: Loamy prairie (Northeast) PE 62-80 (R112XY059OK)

Hydric soil rating: No

Minor Components

Eram

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Loamy prairie PE 62-80 (R112XY056OK)
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Landform: Hillslopes on hills
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Dennis

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Loamy Upland (Draft) (PE 35-42) (R112XY015KS)
Hydric soil rating: No

DxE—Dennis-Radley complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2wqf9
Elevation: 480 to 790 feet
Mean annual precipitation: 41 to 45 inches
Mean annual air temperature: 59 to 63 degrees F
Frost-free period: 190 to 220 days
Farmland classification: Not prime farmland

Map Unit Composition

Dennis and similar soils: 50 percent
Radley and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dennis

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Silty and clayey residuum weathered from shale

Typical profile

A - 0 to 11 inches: silt loam
BA - 11 to 17 inches: silty clay loam
Bt1 - 17 to 22 inches: silty clay
Bt2 - 22 to 68 inches: silty clay
C - 68 to 79 inches: silty clay loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C/D
Ecological site: Loamy prairie (Northeast) PE 62-80 (R112XY059OK)
Hydric soil rating: No

Description of Radley

Setting

Landform: Drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Typical profile

Ap - 0 to 16 inches: silt loam
Bw - 16 to 41 inches: silty clay loam
C - 41 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B
Ecological site: Loamy bottomland PE 62-80 (R112XY050OK)
Hydric soil rating: No

Minor Components

Taloka

Percent of map unit: 10 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Loamy prairie (Northeast) PE 62-80 (R112XY059OK)
Hydric soil rating: No

Coweta

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Shallow prairie (Eastern) PE 62-80 (R112XY086OK)
Hydric soil rating: No

Parsons

Percent of map unit: 3 percent
Landform: Divides
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Claypan Summit Prairie (R112XY011MO)
Hydric soil rating: No

Okemah

Percent of map unit: 2 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: Loamy prairie (Northeast) PE 62-80 (R112XY059OK)
Hydric soil rating: No

OkA—Okemah silt loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2vwfz
Elevation: 610 to 920 feet
Mean annual precipitation: 37 to 46 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 190 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Okemah and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Okemah

Setting

Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey and loamy colluvium or alluvium over clayey residuum weathered from shale

Typical profile

A1 - 0 to 14 inches: silt loam
A2 - 14 to 18 inches: silty clay loam
Bt - 18 to 47 inches: silty clay
BC - 47 to 79 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1

Hydrologic Soil Group: C/D
Ecological site: Loamy prairie (Northeast) PE 62-80 (R112XY059OK)
Hydric soil rating: No

Minor Components

Pharoah

Percent of map unit: 5 percent
Landform: Paleoterraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: Claypan prairie PE 62-80 (R112XY010OK)
Hydric soil rating: No

Parsons

Percent of map unit: 5 percent
Landform: Divides
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: Claypan Summit Prairie (R112XY011MO)
Hydric soil rating: No

Summit

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, convex
Across-slope shape: Concave
Ecological site: Loamy Upland (Draft) (PE 35-42) (R112XY015KS)
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

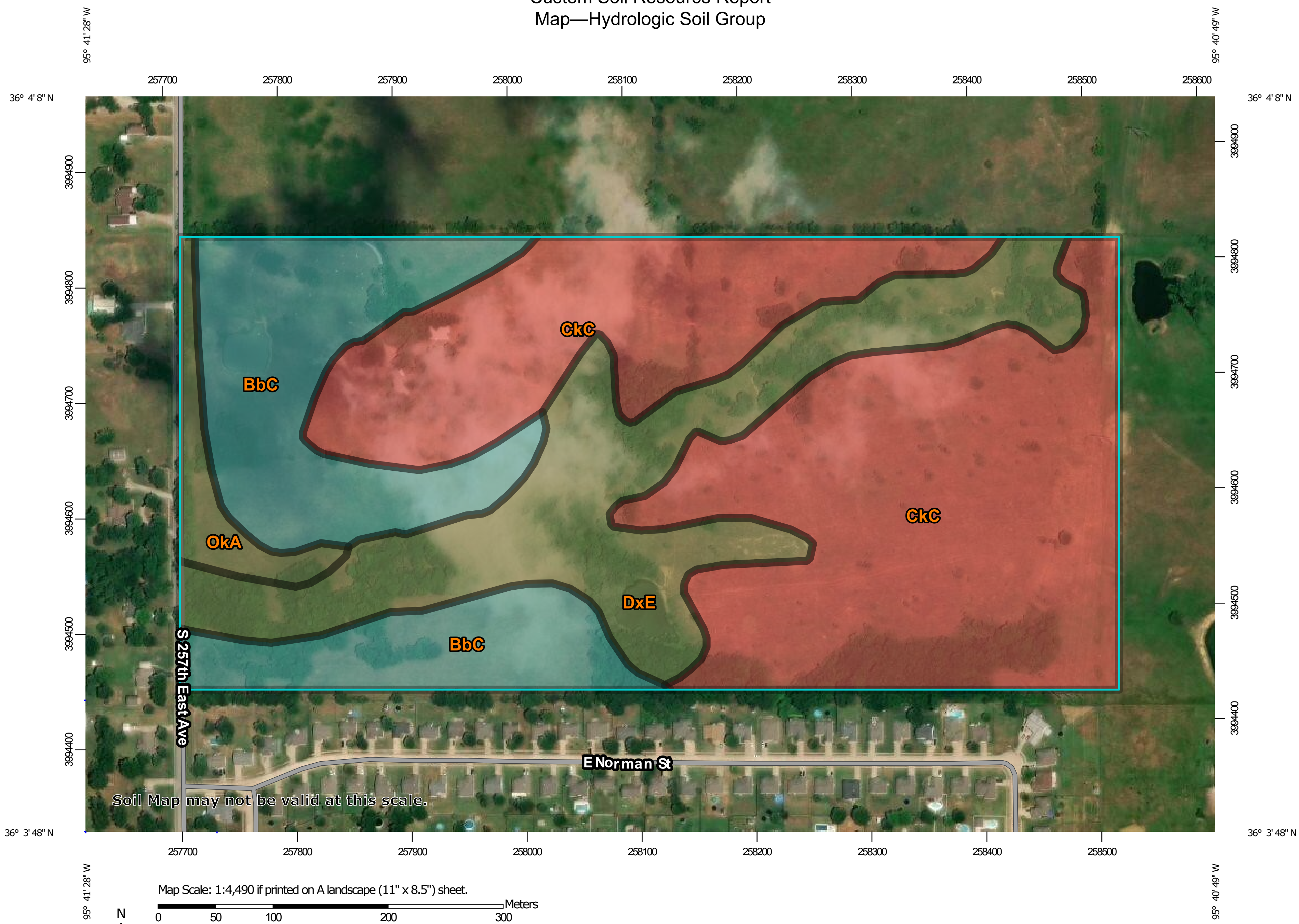
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Map—Hydrologic Soil Group



Map Scale: 1:4,490 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Wagoner County, Oklahoma
Survey Area Data: Version 13, Sep 19, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 9, 2015—Nov 19, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BbC	Bates fine sandy loam, 3 to 5 percent slopes	C	18.1	22.8%
CkC	Coweta-Bates complex, 3 to 5 percent slopes	D	41.2	51.8%
DxE	Dennis-Radley complex, 0 to 15 percent slopes	C/D	17.7	22.3%
OkA	Okemah silt loam, 0 to 1 percent slopes	C/D	2.4	3.1%
Totals for Area of Interest			**79.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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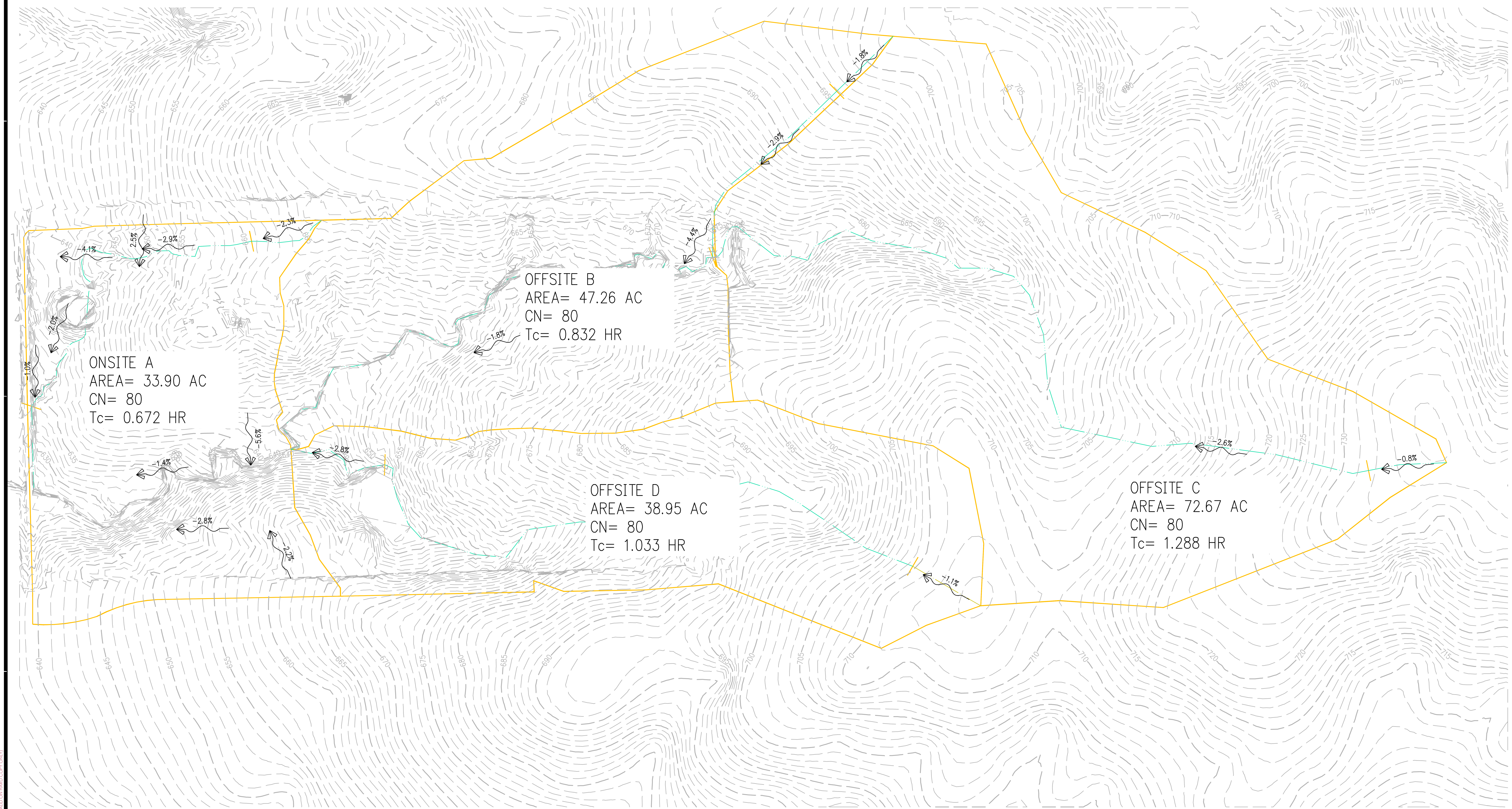
PRE-DEVELOPMENT DRIANGE MAP



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GRAPHIC SCALE IN FEET
200' 0 200'

PARK PLACE

BROKEN ARROW, OK

Key Plan

No.	Description	Date

PROJECT NO:
ISSUE DATE: 06/21/18
CONTACT: K. SEWELL
CHECKED BY:

ISSUED FOR REVIEW

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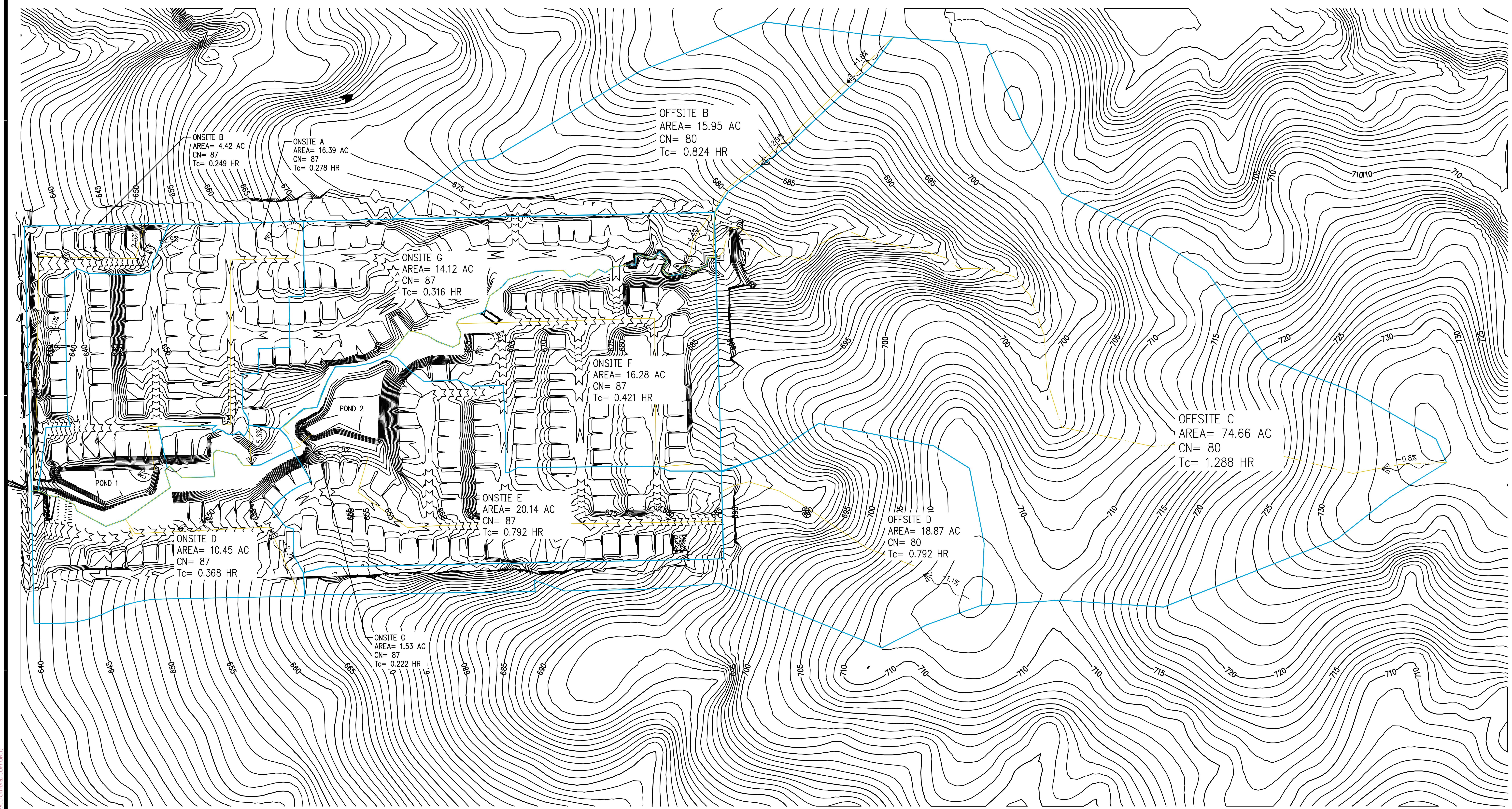
PRE-DEVELOPMENT DRAINAGE MAP

POST-DEVELOPMENT DRAINAGE MAP

Crafton Tull



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POST-DEVELOPMENT DRAINAGE MAP

MIDWAY CULVERT

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Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jun 21 2018

Circular Culvert

Invert Elev Dn (ft)	=	623.36
Pipe Length (ft)	=	29.57
Slope (%)	=	2.20
Invert Elev Up (ft)	=	624.01
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.010
Culvert Type	=	Circular Pipe, Beveled Ring Entrance
Culvert Entrance	=	33.7D bevels*
Coeff. K,M,c,Y,k	=	0.0018, 2.5, 0.0243, 0.83, 0.2

Embankment

Top Elevation (ft)	=	628.65
Top Width (ft)	=	24.00
Crest Width (ft)	=	29.57

Calculations

Qmin (cfs)	=	634.01
Qmax (cfs)	=	634.01
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	634.01
Qpipe (cfs)	=	136.10
Qovertop (cfs)	=	497.91
Veloc Dn (ft/s)	=	14.23
Veloc Up (ft/s)	=	14.39
HGL Dn (ft)	=	626.78
HGL Up (ft)	=	627.35
Hw Elev (ft)	=	631.74
Hw/D (ft)	=	2.21
Flow Regime	=	Inlet Control