Source Water Assessment Program Report for FAIRMONT, TOWN OF

Community Water System

Introduction: What is a Source Water Assessment?

The North Carolina Division of Water Resources, Public Water Supply (PWS) Section is responsible for implementing the Source Water Assessment Program (SWAP) and completing assessments for all public drinking water supplies in the state. The 1996 amendments to the Safe Drinking Water Act provided federal support and required states to conduct assessments of all public water systems. A source water assessment is a qualitative evaluation of the potential of a drinking water source to become contaminated by the identified potential contaminant sources (PCS) within the delineated area. In North Carolina there are approximately 8,000 public water supply sources that were assessed by the state. The PWS Section has gathered information for each water supply and developed a process for completing the assessments. This process is summarized in the next few pages and detailed in Section 6 of this report.

This report provides a summary of the results for the **Source Water Assessment** for your drinking water source(s).

What is the Source of Your Drinking Water?

Everyone wants clean, safe drinking water and we assume this natural resource will always be available to us. However, drinking water sources can be threatened by many potential contaminant sources, including underground storage tanks for gasoline, permitted wastewater discharges and other waste disposal sites, improper handling of hazardous materials, urban storm water runoff, or other types of non-point source contamination such as runoff produced by agricultural activities and land clearing for development. Your drinking water source(s) is listed in Table 1. Protecting your drinking water from becoming contaminated is a wise investment in public health and your community's future.

Table 1. Public Water Supply System Information

System Name	FAIRMONT, TOWN OF
City	FAIRMONT
PWS ID	NC0378025
Source Name	WELL #1
Source Name	WELL #2
Source Name	WELL #3

In addition to the sources listed in Table 1 above, this water supply system has interconnections to allow for the purchase of water from the following water system(s) or "Seller" system(s):

ROBESON COUNTY WATER SYSTEM

Please refer to the Source Water Assessment Program Report for the "Seller" system(s) to review the assessment results for the purchased water supply sources that provide drinking water for this water system.

Assessment Report Contents

This assessment report includes the following sections:

Section 1: Assessment Area Delineation

The area delineated for your well(s) for the purpose of this assessment is the contributing area for the well(s). When a well is pumped, it begins to influence groundwater that is flowing through the subsurface and towards the well. The pumping of the well creates a contributing area around the well that supplies water to the well. This is the area through which contaminants, if released to the environment, can be reasonably expected to move through the ground and reach the well.

Section 2: Potential Contaminant Source Inventory and Map

The potential contaminant source inventory map shows the delineated area for your drinking water source(s). This is the area where potential contaminant sources, if released to the environment, could reasonably be expected to be a risk or a potential for contamination of your drinking water supply. A PCS in this assessment report is a facility or site regulated under a state or federal regulatory program. These facilities are identified in electronic databases that contain location information for each facility. Only databases that include statewide information were used for this source water assessment. Included in this report are:

1) A table of any PCS identified within the delineated assessment area; and
2) A map of the delineated assessment area showing PCSs, roads, jurisdictional boundaries and other pertinent information.

It is important to note that the PCSs identified in this report are only potential sources of contamination to your drinking water source. Environmental contamination is not likely to occur if harmful contaminants are managed properly.

Section 3: What is a Susceptibility Rating?

In North Carolina the susceptibility of any drinking water source is based on two components, a contaminant rating and an inherent vulnerability rating. Your drinking water source(s) was assigned a qualitative susceptibility rating of higher, moderate or lower based on the results of the contaminant rating and inherent vulnerability rating process as described in the following paragraphs.

Susceptibility Rating

The final susceptibility rating for your drinking water source(s) is determined by combining the contaminant rating and the inherent vulnerability rating. More detailed information on the susceptibility rating process can be found in Section 6 of this report.

Contaminant Rating

The contaminant rating for your drinking water source(s) was determined based on the number and location of PCSs within the delineated area. Each PCS identified within the delineated area was assigned a risk rating of higher, moderate

or lower. The number of PCSs that occur within the delineated area was determined and a contaminant rating of higher, moderate, or lower was assigned to your drinking water source(s).

Inherent Vulnerability Rating

The inherent vulnerability rating of your well(s) refers to the geologic characteristics or existing conditions of the well and its delineated assessment area. These characteristics include aquifer rating, unsaturated zone rating and well integrity/well construction rating. The aquifer rating is an assessment of the water transmitting characteristics of the aquifer. The unsaturated zone rating is an assessment of the likelihood that contaminants from surface and shallow sources will follow the path of aquifer recharge and reach the water table. The well integrity/construction rating is an assessment of the quality of the construction of the well. An inherent vulnerability rating of higher, moderate or lower was assigned to your well(s).

Table 2. SWAP Results Summary

Source Name	Inherent Vulnerability Rating	Contaminant Rating	Susceptibility Rating
WELL #1	Lower	Lower	Lower
WELL #2	Lower	Moderate	Moderate
WELL #3	Lower	Higher	Moderate

It is important to understand that a susceptibility rating of higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated by the identified PCSs within the assessment area.

Table 3. Well Information

Source Name	Well Yield (Gallons/Min)	Well Depth (Feet)
WELL #1	500	275
WELL #2	900	280
WELL #3	500	320

Section 4: Reviewing Your SWAP Results

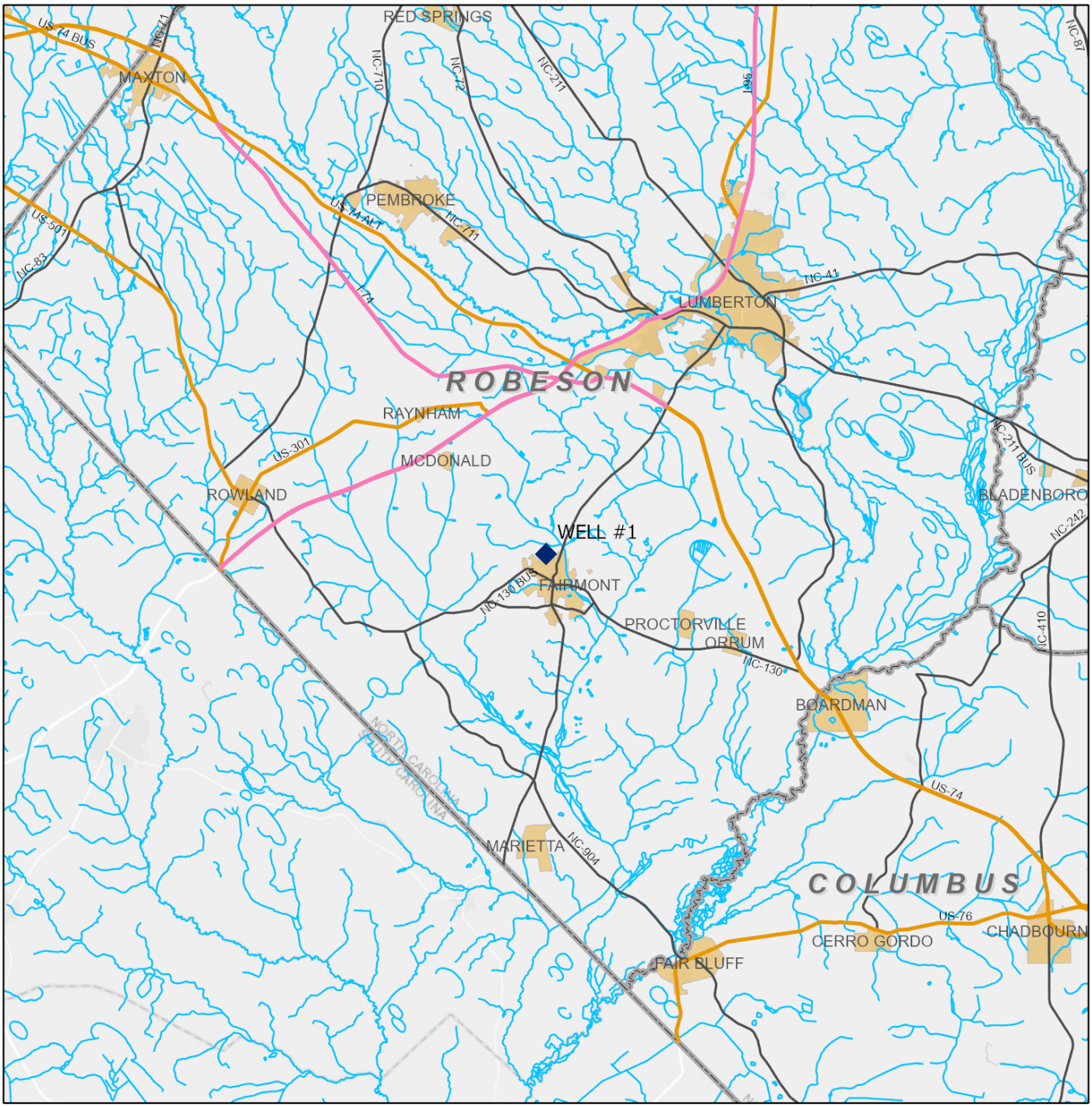
Please review the information on your drinking water source(s) provided in this report. If you believe any of this information is incorrect please contact the Public Water Supply Section by e-mail at the following address: **SWAP@ncdenr.gov** or you may submit comments to us at:

SWAP
Public Water Supply Section
1634 Mail Service Center
Raleigh, NC 27699-1634

Or you may contact the Source Water Assessment staff by phone at 919-707-9098.

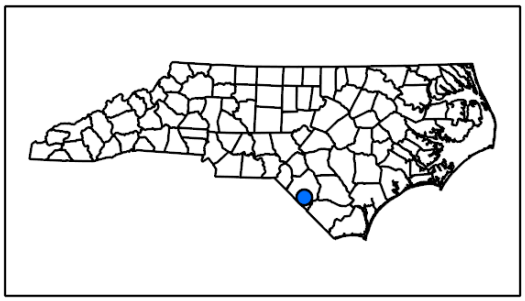
Section 5: Maps, Tables and Figures for Your Drinking Water Source(s)

Maps, tables and figures specific to your drinking water source(s) are included in this report in the following pages and are listed below.



MAP 1. LOCATION MAP

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1



Major Roads
- Interstate
- US Route
- NC Route
- Rivers and Streams

Major Hydrology
Municipal Boundaries
County Boundaries

0 5 10 Miles

MAP 2. DELINEATED AREA AND PCS MAP

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

N
W
E
S

PCS Types
- Animal Operations
- CERCLA-Fed. Remediation
- Hazardous Waste Sites
- Inactive Hazardous Waste Sites
- Non Discharge Permits
- NPDES Permits
- PCB Sites
- Pollution Incidents
- Septage Disposal Sites
- Soil Remediation Sites
- Solid Waste Facilities
- Tier II Sites
- Old Landfill Sites
- UIC Permits
- UST Permits

Major Roads
- Interstate
- US Route
- NC Route
- Rivers and Streams
- Major Hydrology
- Municipal Boundaries
- Ground Water Assessment Area - Delineated Area
- Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000 Feet

Table 4. Potential Contaminant Source Attributes
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #1

PCS Name	PCS ID	PCS Type	PCS Risk Rating	Street Address	City	Zip	County
Fairmont 115KV Substation	6399035	Tier II Sites	Higher	1882 Marion Stage Rd	Fairmont	28340	Robeson

Table 5. Inherent Vulnerability Rating
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #1

Ground Water Source Characteristics	Vulnerability
Aquifer Rating	Lower
Unsaturated Zone Rating	Moderate
Well Integrity/Construction Rating	Higher

Inherent Vulnerability Rating: Lower

Table 6. Unsaturated Zone Rating Calculation
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #1

Unsaturated Zone Score	59.2

Notes:

1. Unsaturated Zone Score for each cell (CS):

CS = [3 x (vertical hydraulic conductance score)] + [2 x (land surface slope score)] + [3 x (land use score)] + [2 x (land cover score)]

2. Unsaturated Zone Score (S) for the entire assessment area is the mean of the cell scores (CS) calculated as:

The sum of all cell unsaturated zone scores (CS) divided by the number of cells (N) within the assessment area: $S = (\Sigma CS) / N$

3. The USGS publication "Methods of ranking unsaturated zone and watershed characteristics of public water supplies in North Carolina", by J. L. Eimers, J. C. Weaver, S. Terziotti, and R. W. Midgette, 1999, provides a detailed discussion of the methods used to determine unsaturated zone ratings.

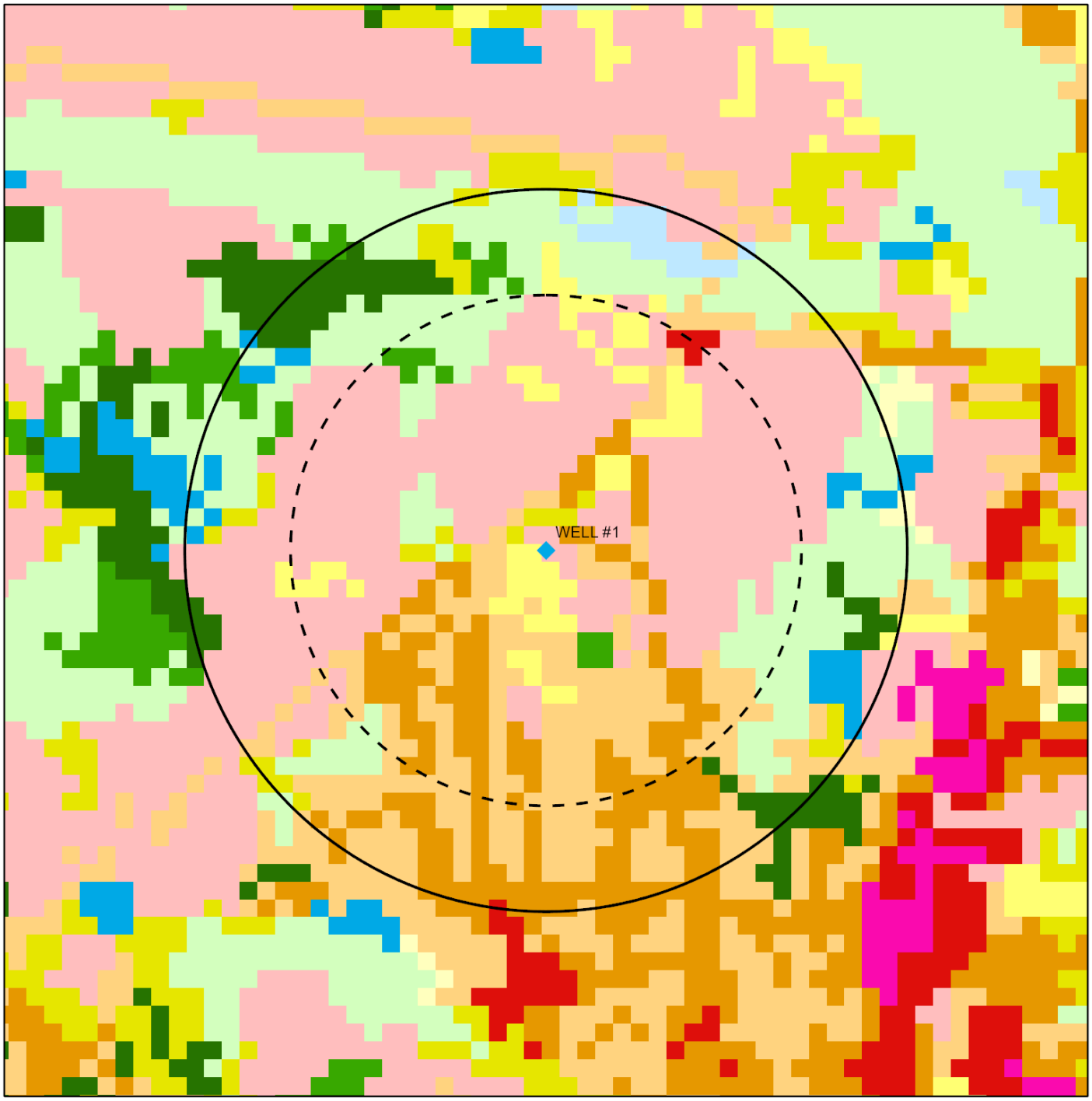


FIGURE 1. LAND USE/LAND COVER CATEGORIES

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

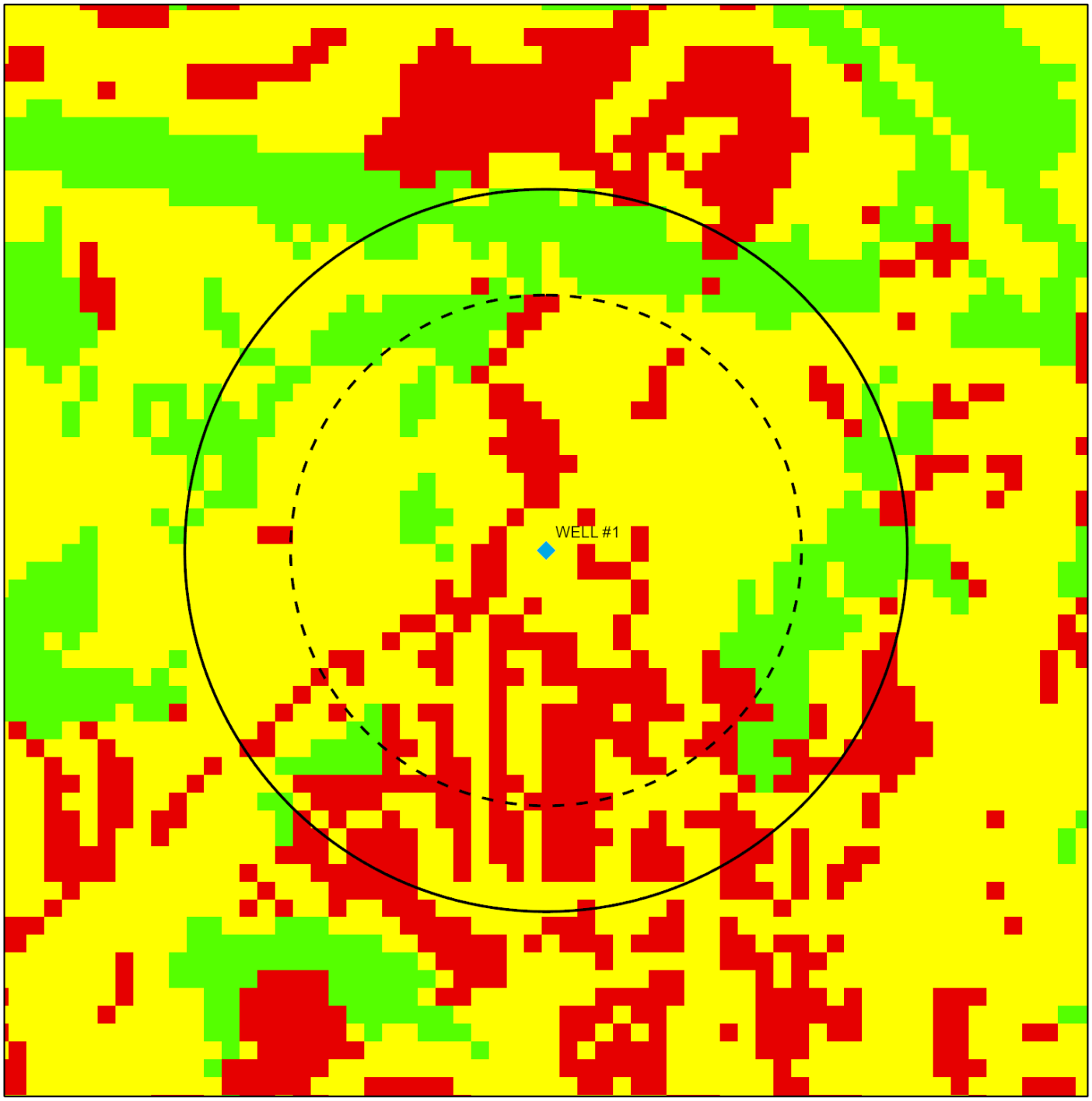


FIGURE 2. UNSATURATED ZONE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

Lower <= 50

Moderate > 50 to 65

Higher > 65

Ground Water Assessment Area - Delineated Area

Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000

Feet

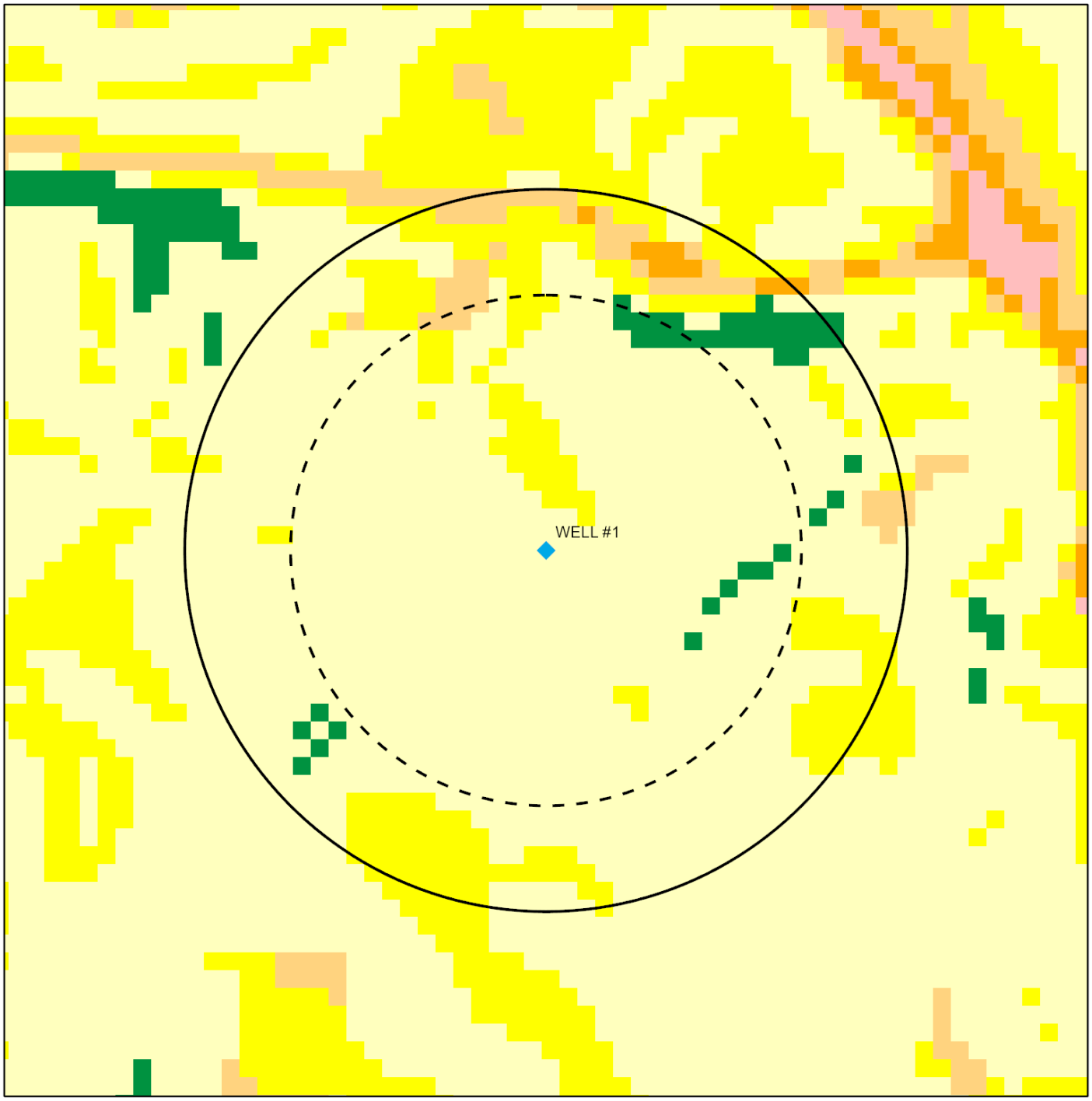


FIGURE 3. VERTICAL HYDRAULIC CONDUCTANCE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

N
W
E
S

1 (<= 5 sq. ft./day)
2 (>5 to 10 sq. ft./day)
3 (>10 to 20 sq. ft./day)
4 (> 20 to 40 sq. ft./day)
5 (> 40 to 80 sq. ft./day)
6 (> 80 to 160 sq. ft./day)
7 (> 160 to 320 sq. ft./day)
8 (> 320 to 640 sq. ft./day)
9 (> 640 to 1,280 sq. ft./day)
10 (> 1,280 sq. ft./day)
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

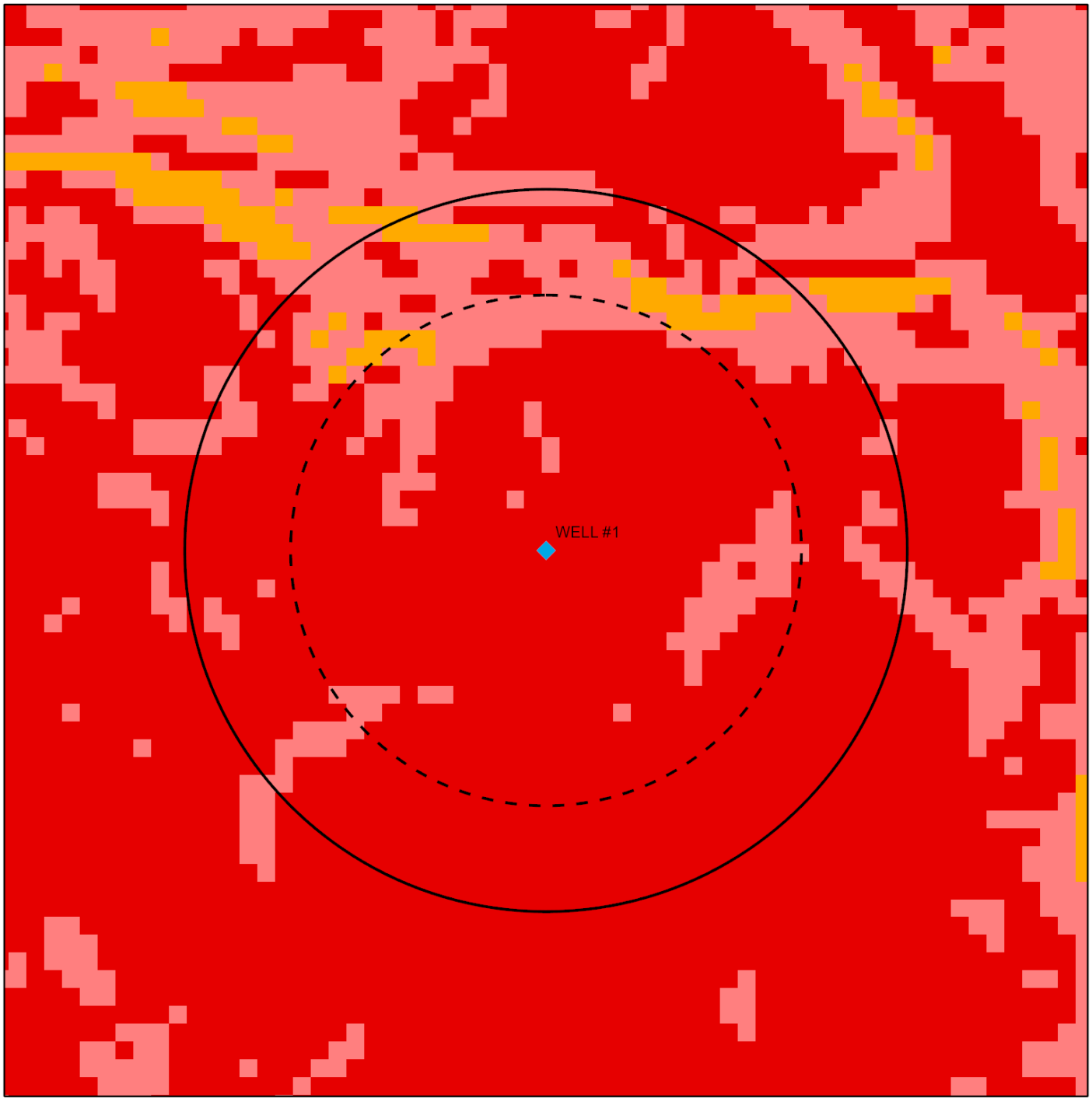


FIGURE 4. LAND SURFACE SLOPE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

1 (> 50 percent)
3 (> 20 to 50 percent)
5 (> 10 to 20 percent)
7 (> 5 to 10 percent)
9 (> 2 to 5 percent)
10 (<= 2 percent)
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

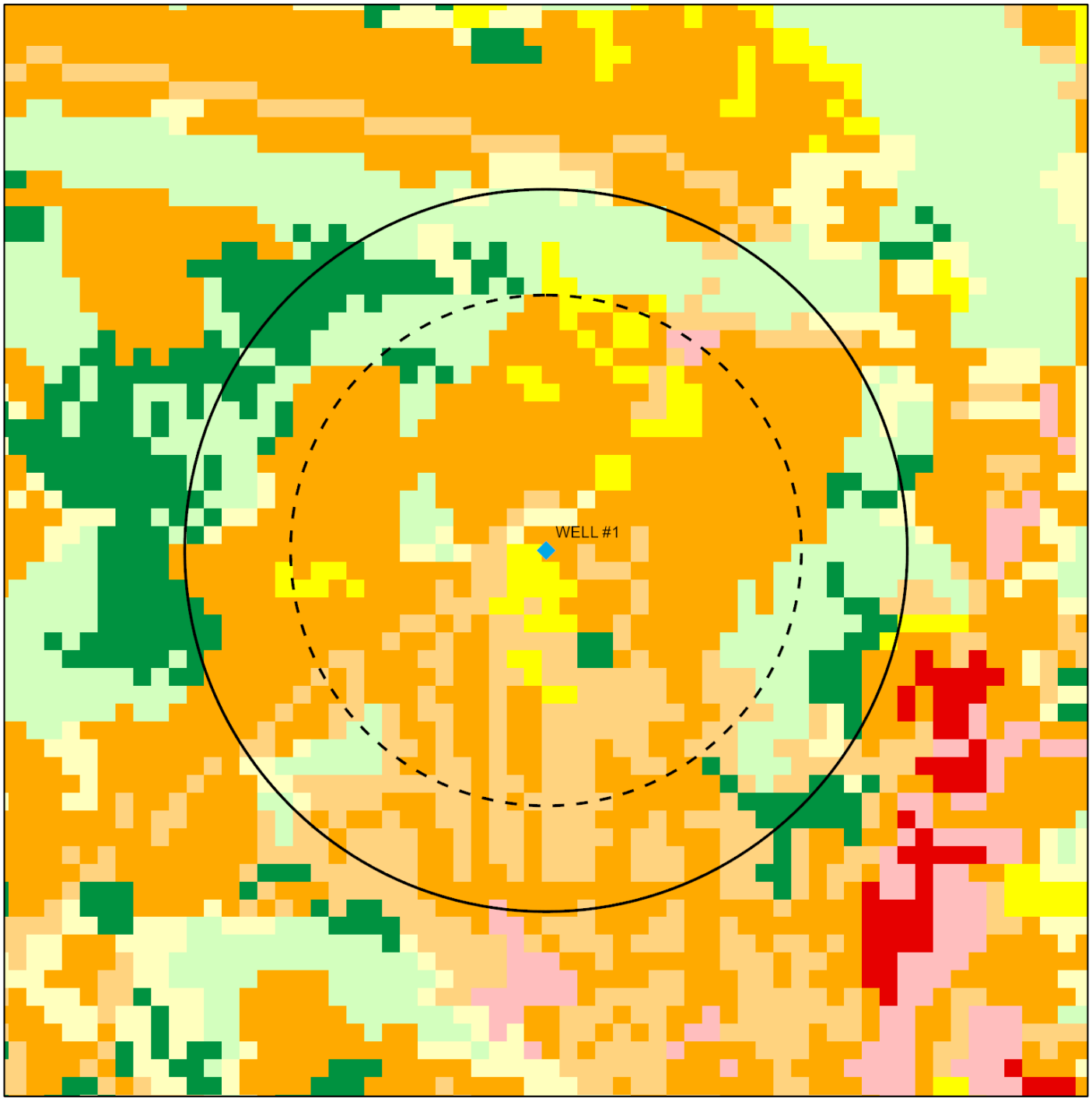


FIGURE 5. LAND USE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

N
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1 Water, Wetlands (Woody and Herbaceous)
2 Barren Land (Rock/Sand/Clay)
3 Forest (Deciduous, Evergreen, Mixed)
4 Grassland/Herbaceous; Shrub/Scrub
5 Pasture/Hay
6 Developed, Open Space
7 Developed, Low Intensity; Cultivated Crops
8 Developed, Medium Intensity
10 Developed, High Intensity
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

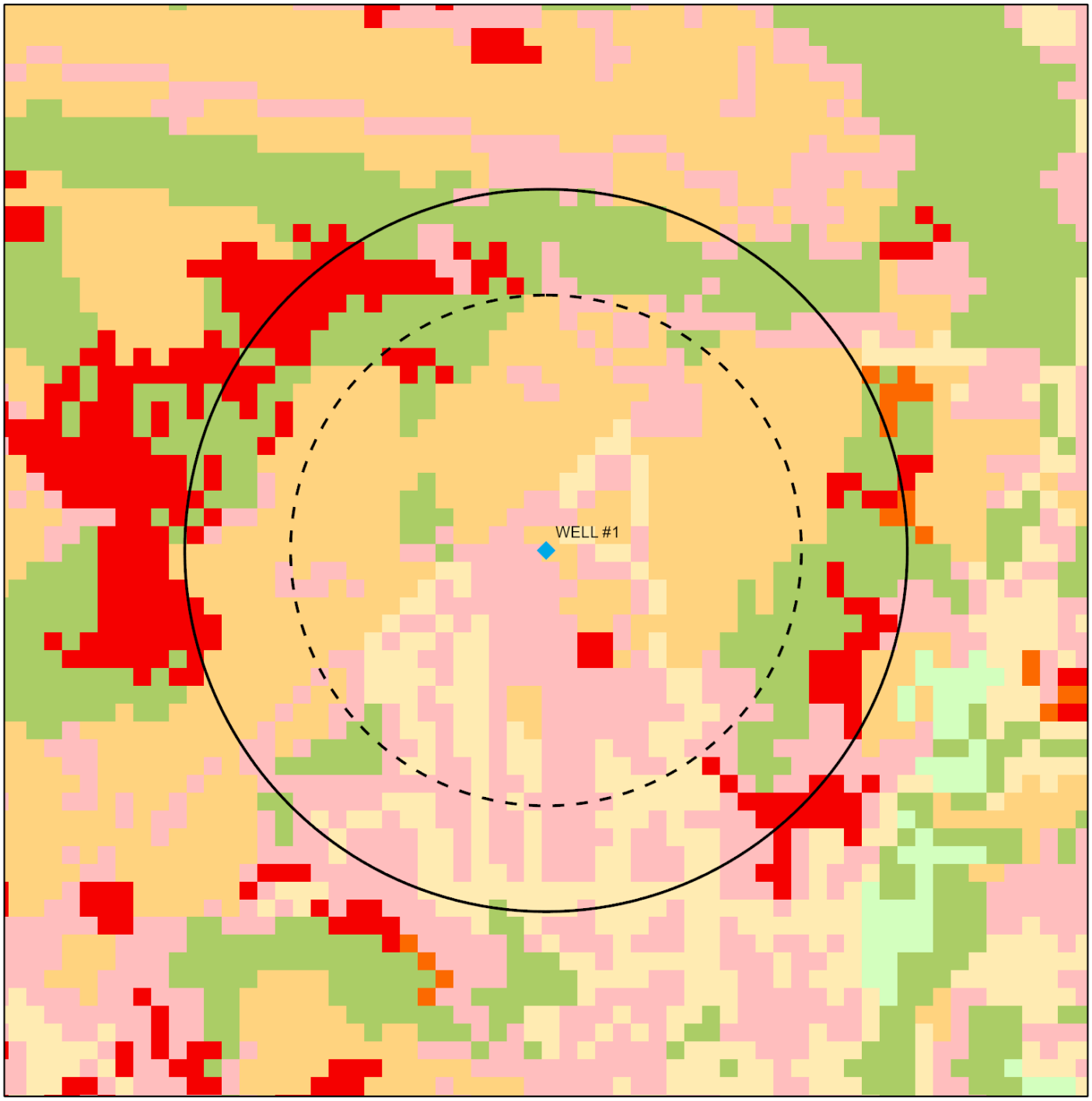

FIGURE 6. LAND COVER RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #1

N
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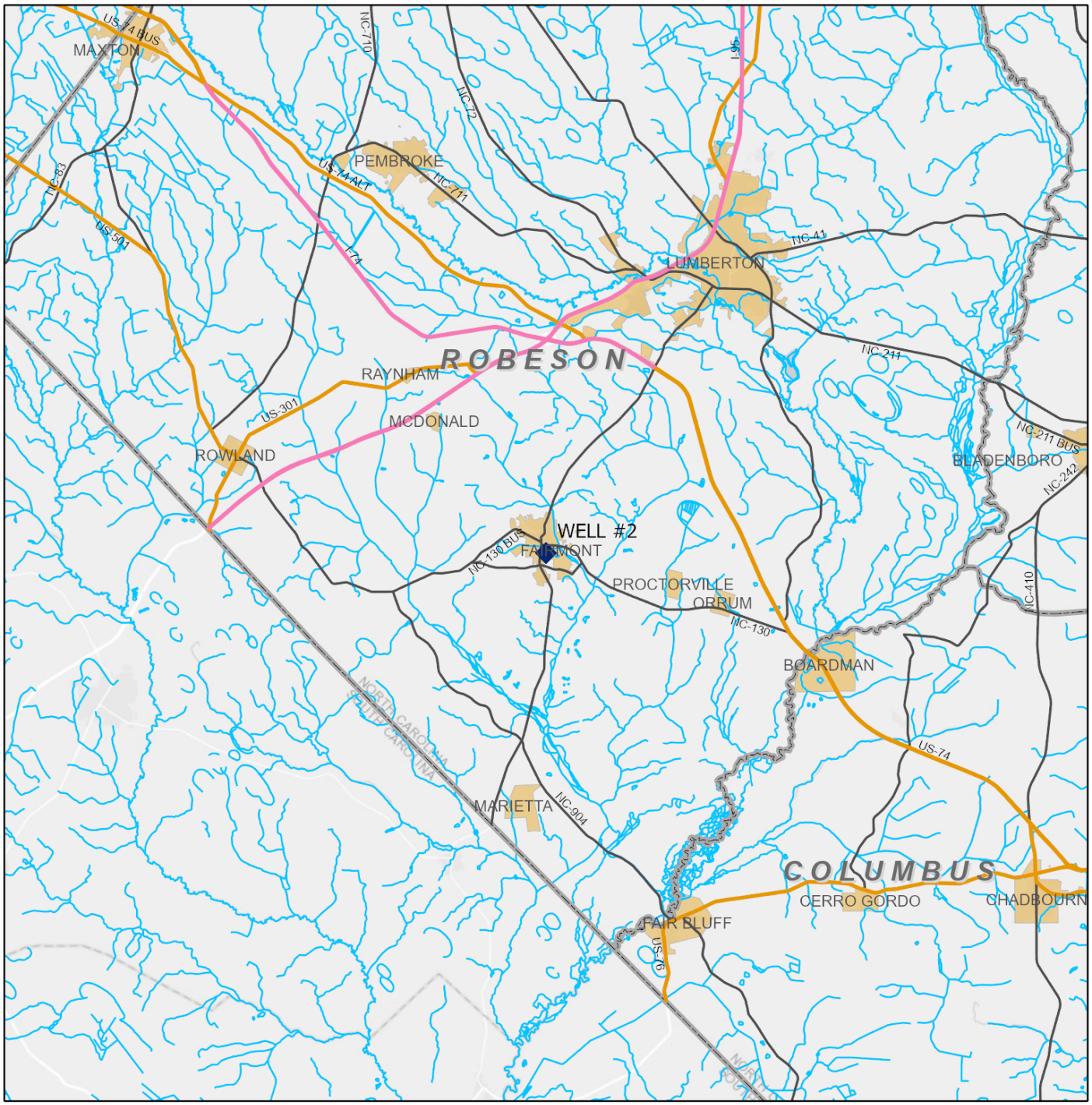
S

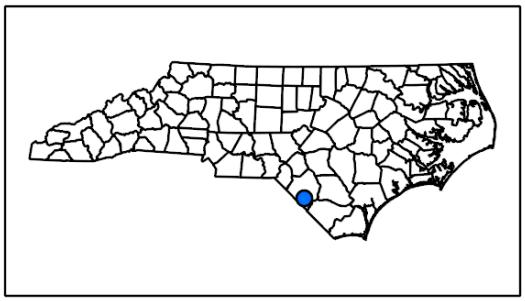
1 Developed, High Intensity
2 Water; Wetlands; Developed, Medium Intensity
4 Developed, Low Intensity
6 Barren Land (Rock, Sand, Clay); Cultivated Crops
8 Grassland/Herbaceous; Pasture/Hay; Developed, Open Space
9 Shrub/Scrub
10 Deciduous, Evergreen and Mixed Forest
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet



MAP 1. LOCATION MAP

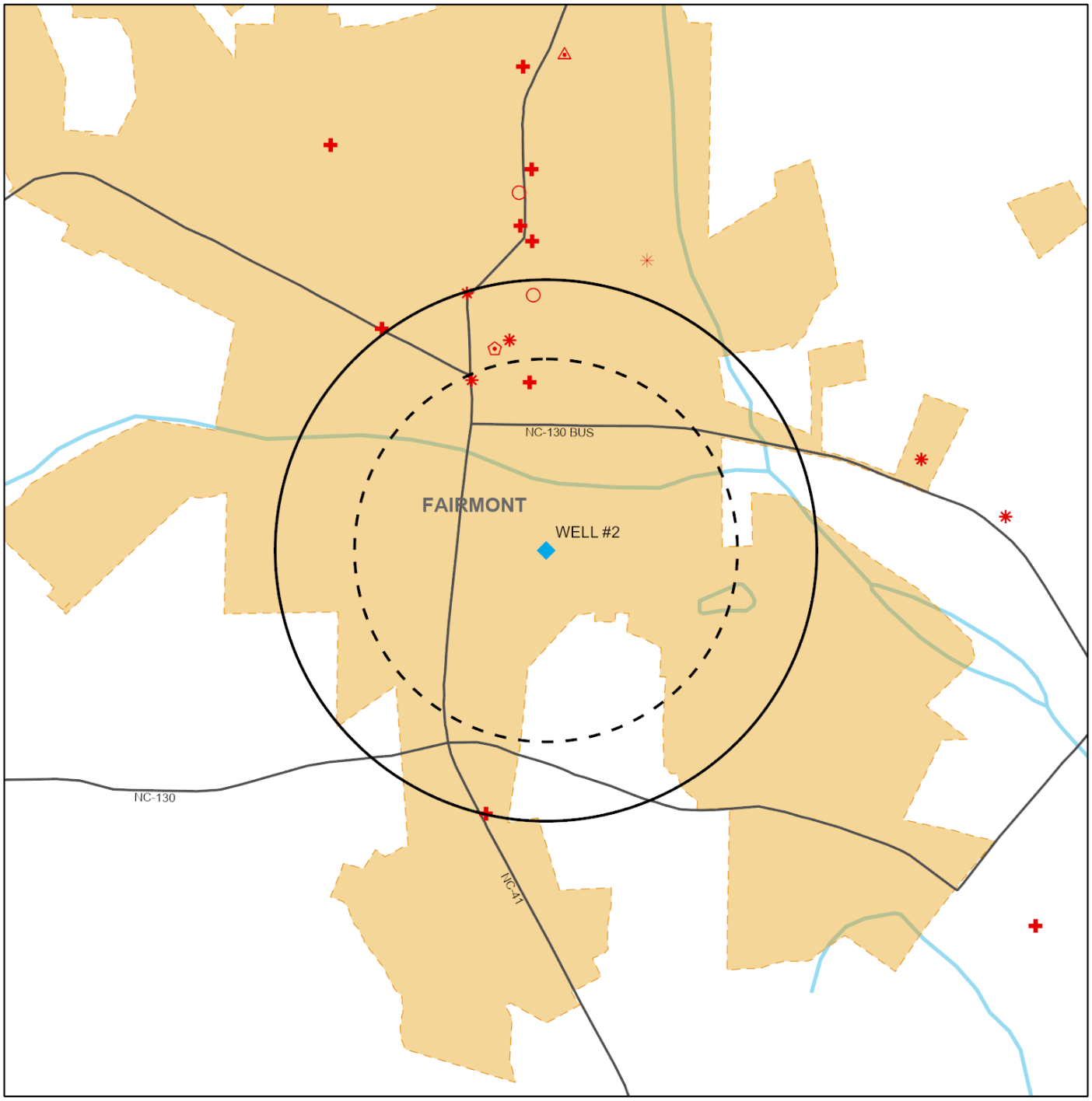
FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2



Major Roads
- Interstate
- US Route
- NC Route
- Rivers and Streams

Major Hydrology
Municipal Boundaries
County Boundaries

0 5 10 Miles



MAP 2. DELINEATED AREA AND PCS MAP

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

PCS Types
- Animal Operations
- CERCLA-Fed. Remediation
- Hazardous Waste Sites
- Inactive Hazardous Waste Sites
- Non Discharge Permits
- NPDES Permits
- PCB Sites
- Pollution Incidents
- Septage Disposal Sites
- Soil Remediation Sites
- Solid Waste Facilities
- Tier II Sites
- Old Landfill Sites
- UIC Permits
- UST Permits

Major Roads
- Interstate
- US Route
- NC Route
- Rivers and Streams
- Major Hydrology
- Municipal Boundaries
- Ground Water Assessment Area - Delineated Area
- Ground Water Assessment Area - Zone A

N W E S

0 1,000 3,000 5,000 8,000 Feet

Table 4. Potential Contaminant Source Attributes
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #2

PCS Name	PCS ID	PCS Type	PCS Risk Rating	Street Address	City	Zip	County
L & M CONVENIENT MART	00-0-0000019016	UST Permits	Higher	1309 Lake View Road	Fairmont	28340	Robeson
ED HODGES INC STA 5	00-0-0000019862	UST Permits	Higher	207 S. Walnut St	Fairmont	28340	Robeson
Marietta POP	6413579	Tier II Sites	Higher	15620 Highway 41 S.	Fairmont	28340	Robeson
STEVENS CLEANERS	NONCD0002542	Inactive Hazardous Sites	Higher	Iona And Main Street	Fairmont		Robeson
Nutrien Ag Solutions 282	6385083	Tier II Sites	Higher	200 Center Street	Fairmont	28340	Robeson
G'S CORNER MART	42168	Pollution Incidents	Higher	102 North Walnut Street	Fairmont	28340	Robes
BellSouth - 21807	6373584	Tier II Sites	Higher	104 N Main St	Fairmont	28340	Robeson

Table 5. Inherent Vulnerability Rating
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #2

Ground Water Source Characteristics	Vulnerability
Aquifer Rating	Lower
Unsaturated Zone Rating	Moderate
Well Integrity/Construction Rating	Higher

Inherent Vulnerability Rating: Lower

Table 6. Unsaturated Zone Rating Calculation
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #2

Unsaturated Zone Score	**61.7**

Notes:

1. Unsaturated Zone Score for each cell (CS):

CS = [3 x (vertical hydraulic conductance score)] + [2 x (land surface slope score)] + [3 x (land use score)] + [2 x (land cover score)]

2. Unsaturated Zone Score (S) for the entire assessment area is the mean of the cell scores (CS) calculated as:

The sum of all cell unsaturated zone scores (CS) divided by the number of cells (N) within the assessment area: $S = (\Sigma CS) / N$

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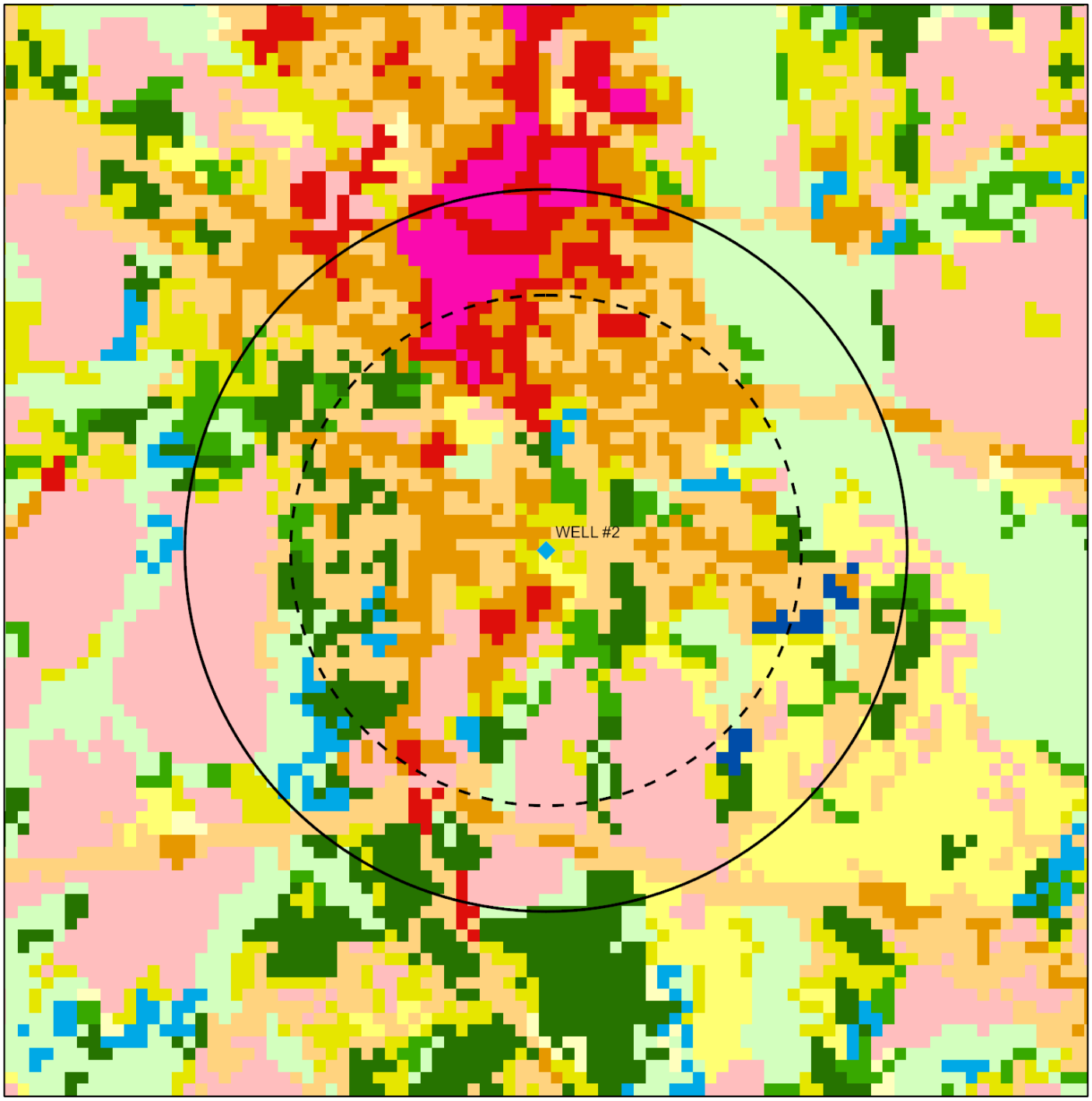

FIGURE 1. LAND USE/LAND COVER CATEGORIES

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

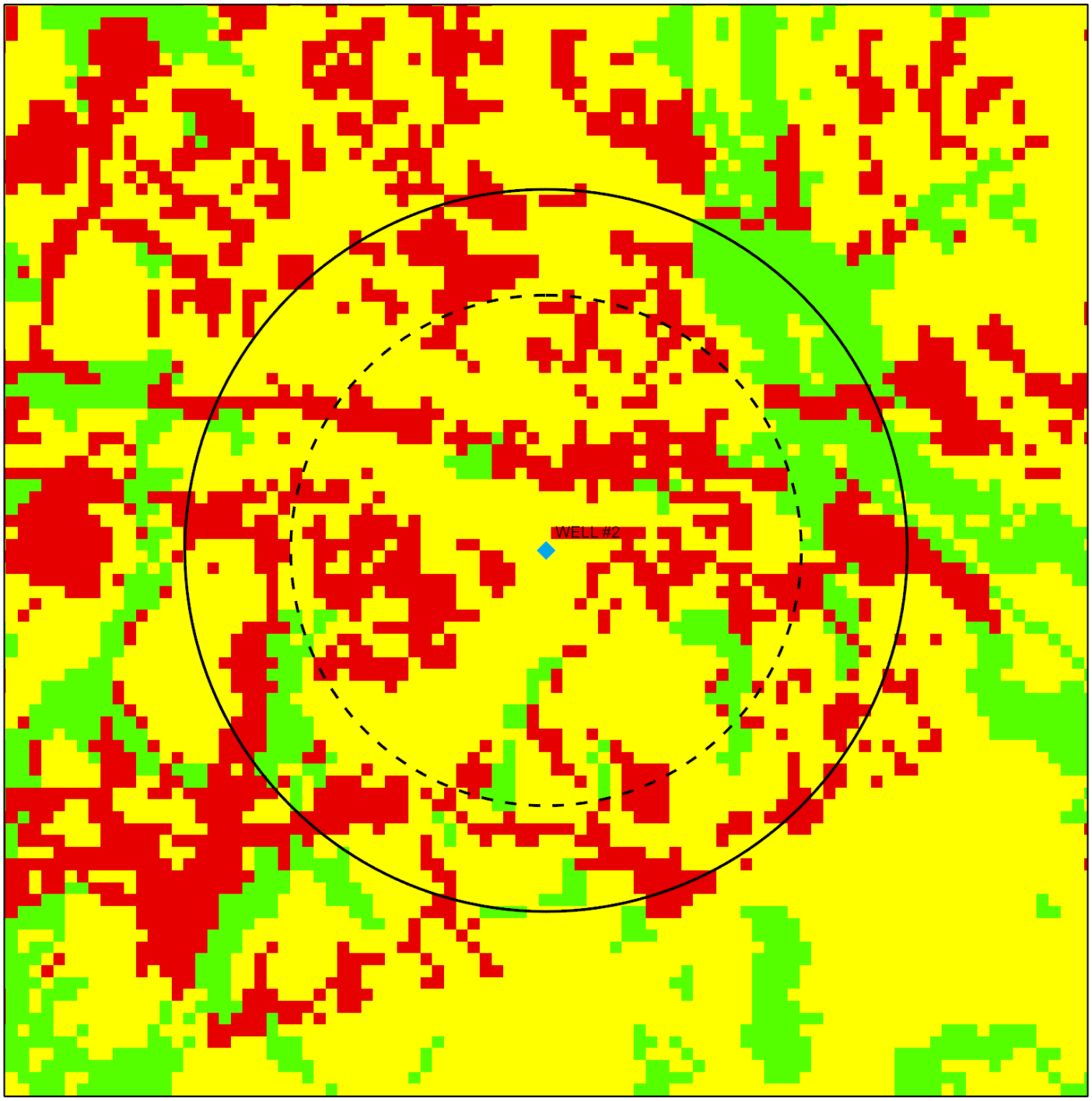

FIGURE 2. UNSATURATED ZONE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

Lower <= 50

Moderate > 50 to 65

Higher > 65

Ground Water Assessment Area - Delineated Area

Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000 Feet

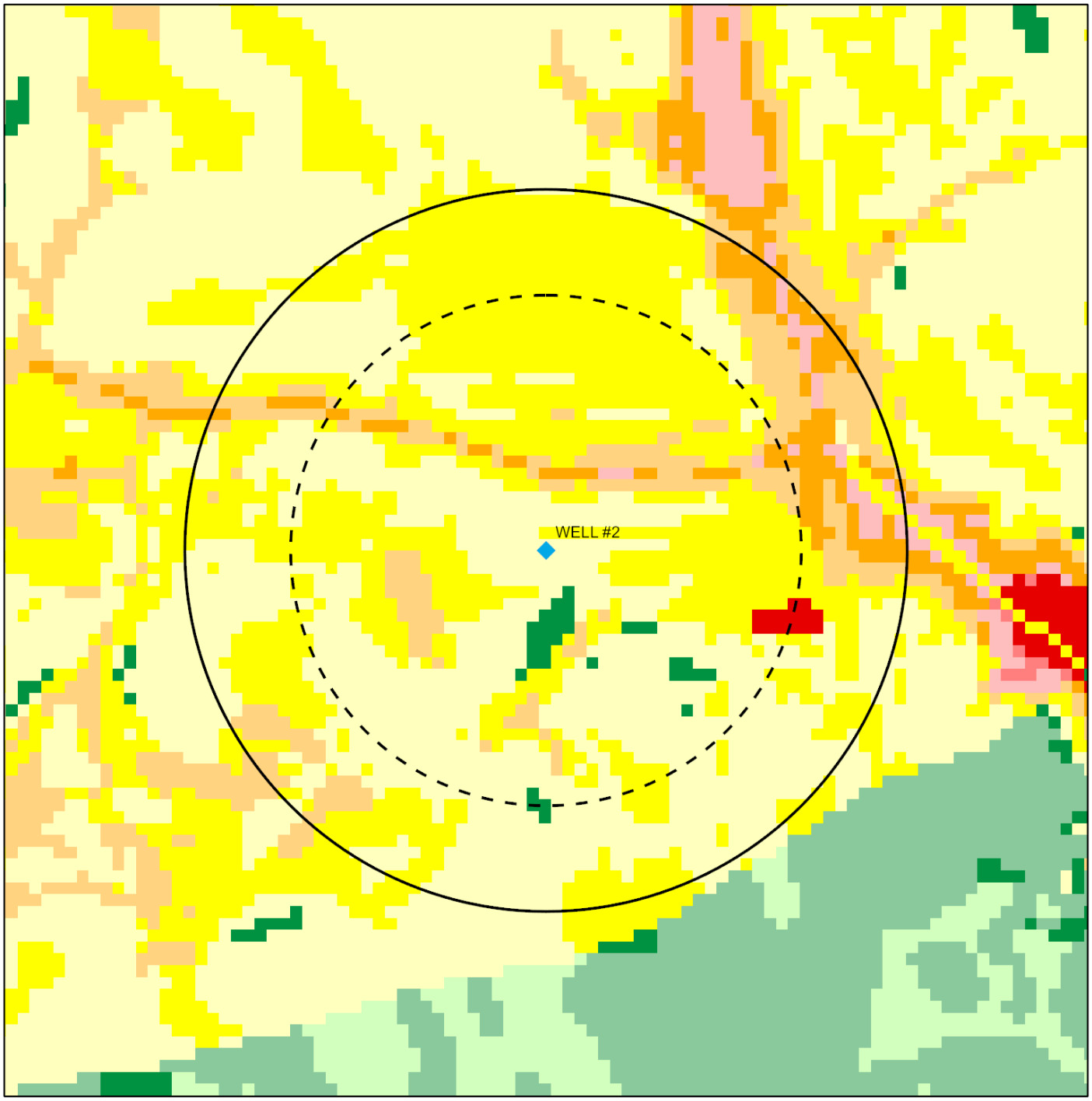

FIGURE 3. VERTICAL HYDRAULIC CONDUCTANCE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

N
W
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1 (<= 5 sq. ft./day)
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Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

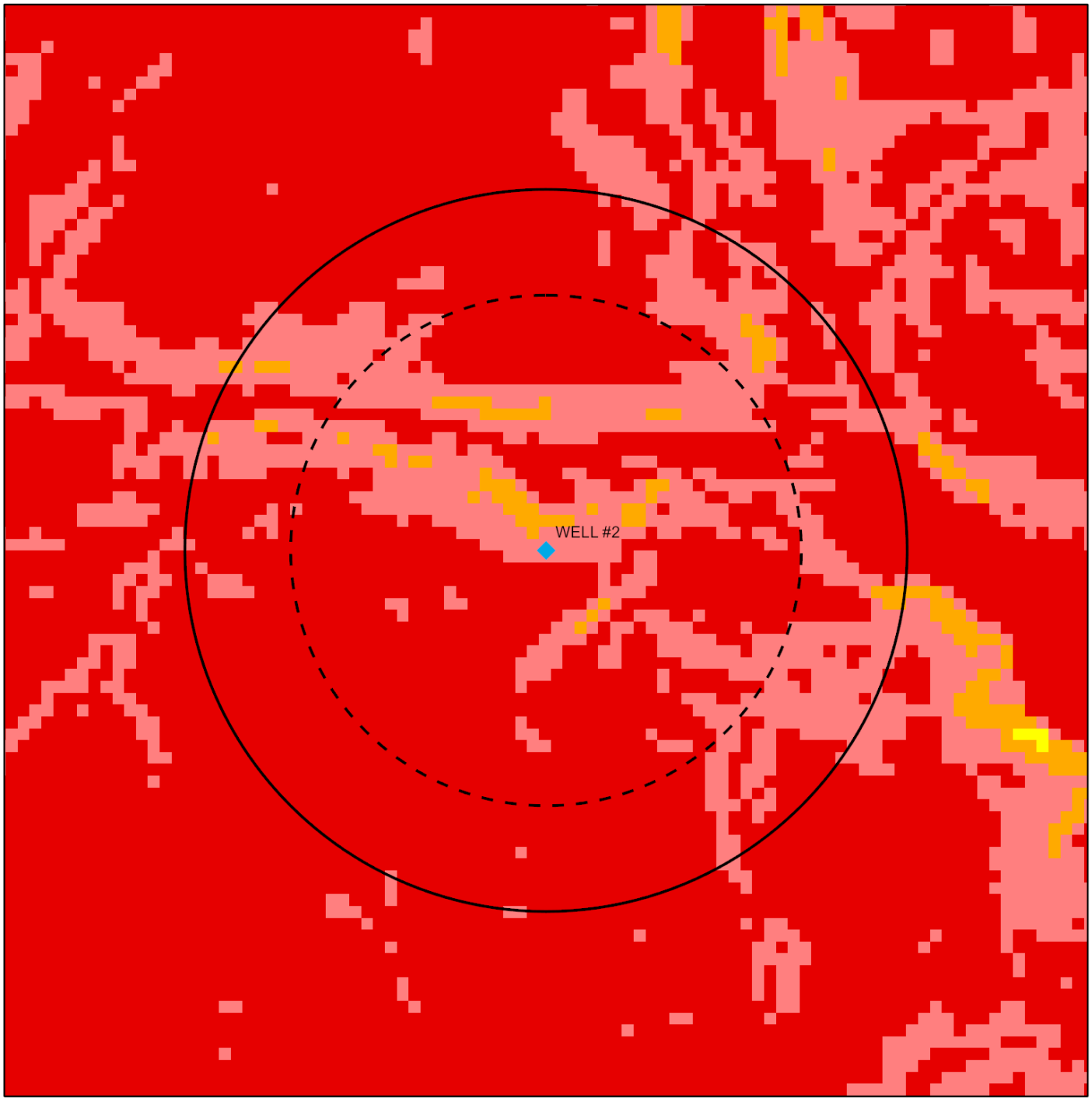

FIGURE 4. LAND SURFACE SLOPE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

1 (> 50 percent)
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Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000 Feet

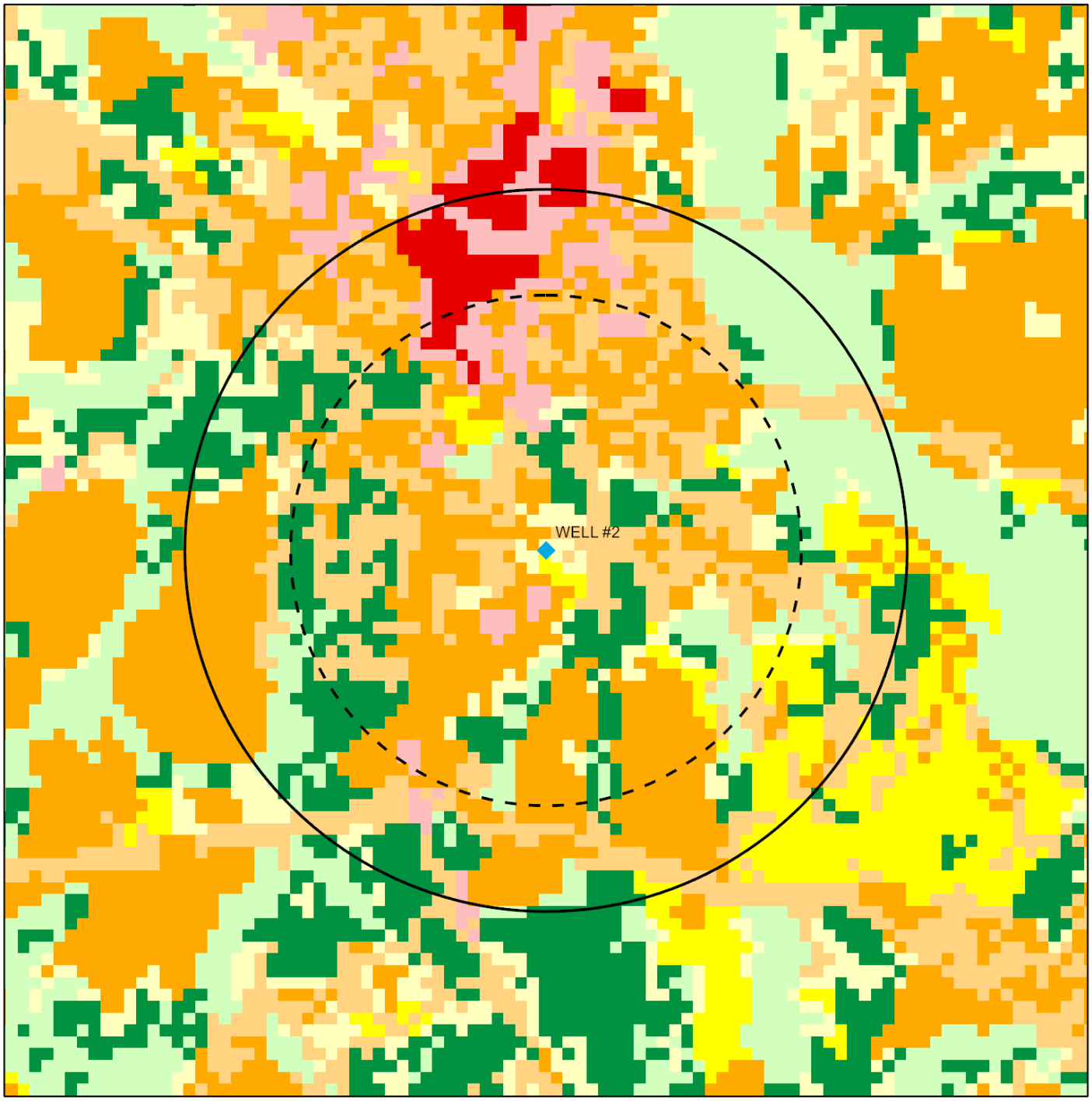

FIGURE 5. LAND USE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

N
W
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S

1 Water, Wetlands (Woody and Herbaceous)
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Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000 Feet

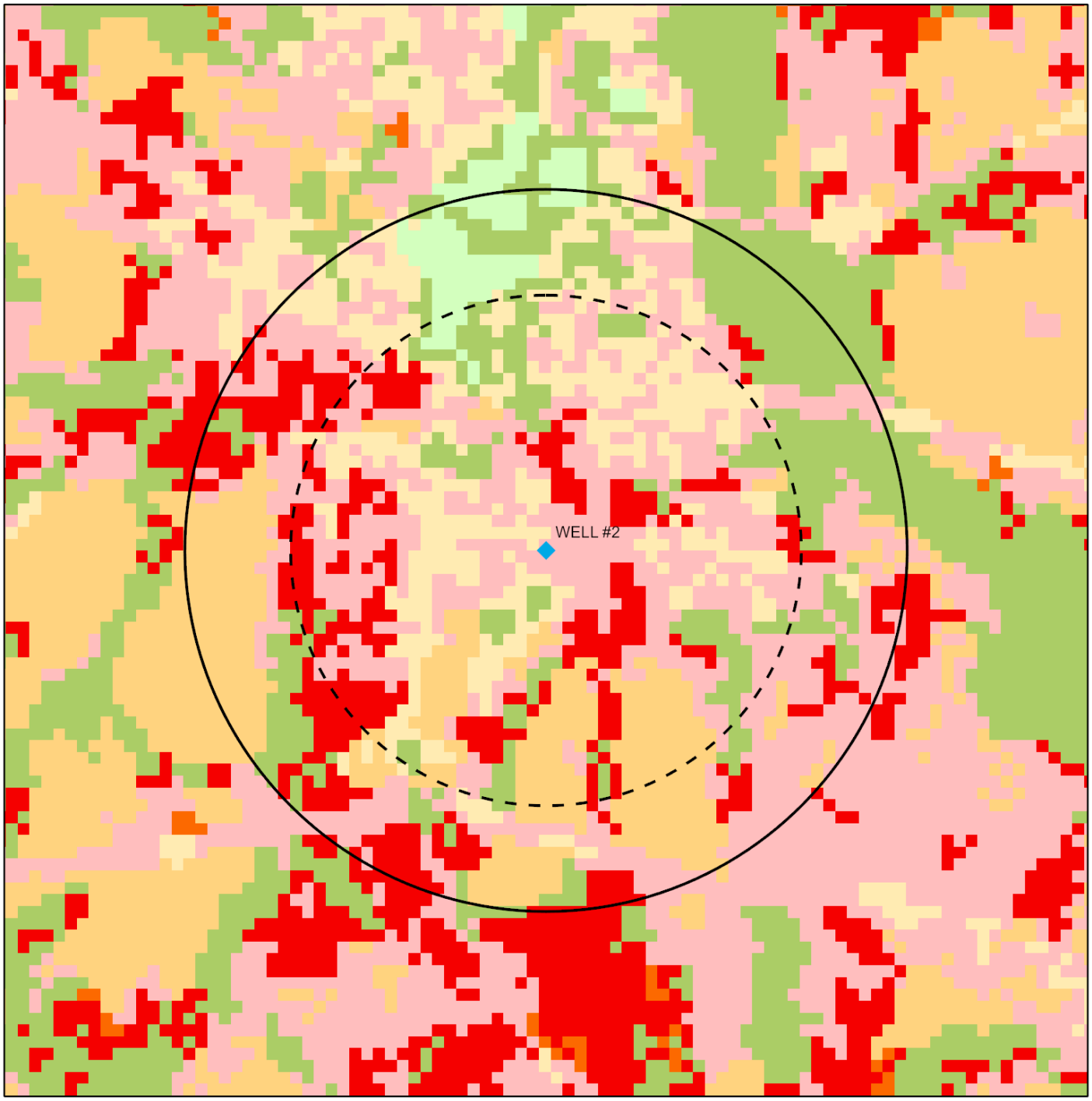

FIGURE 6. LAND COVER RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #2

N
W
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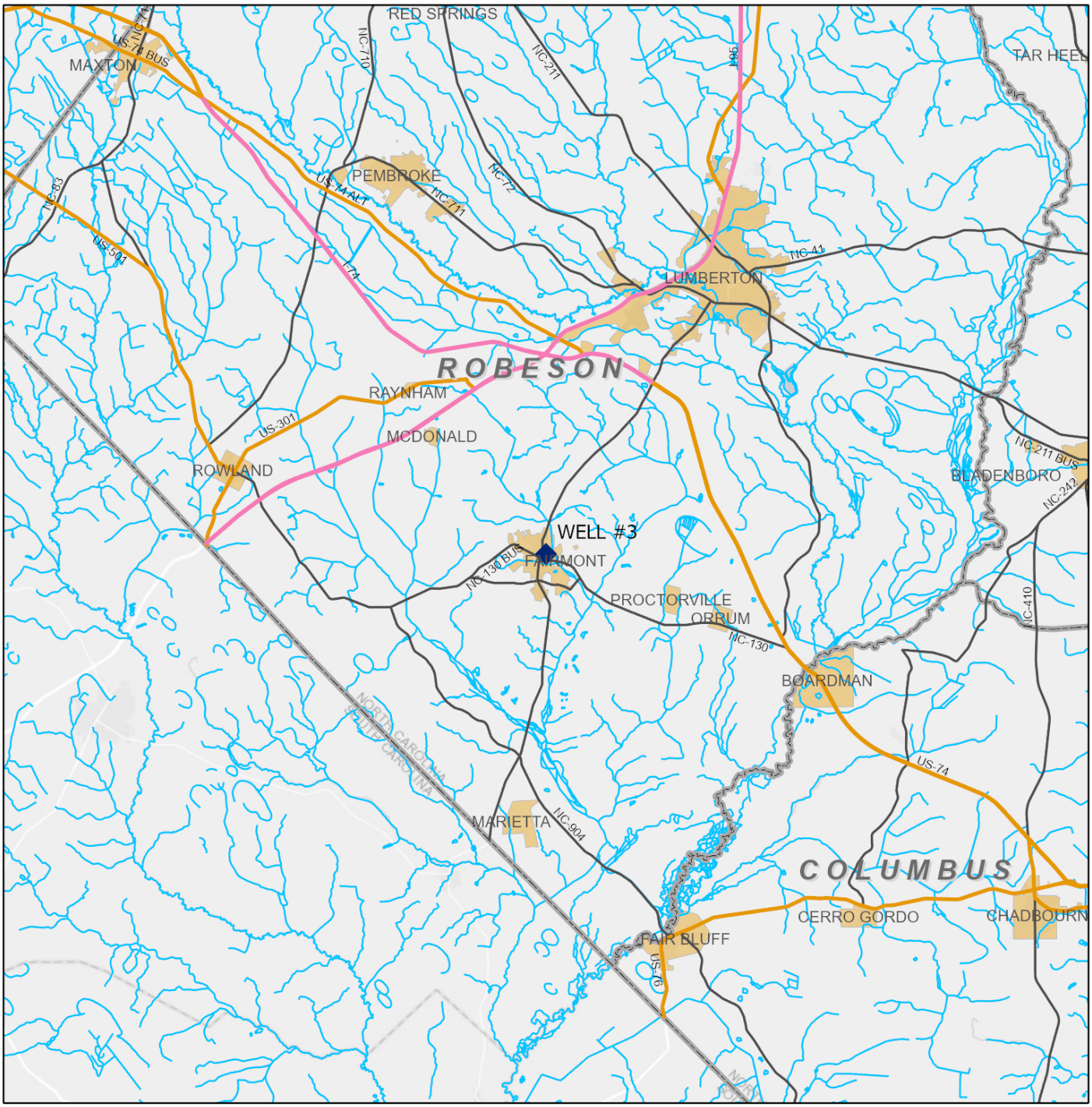
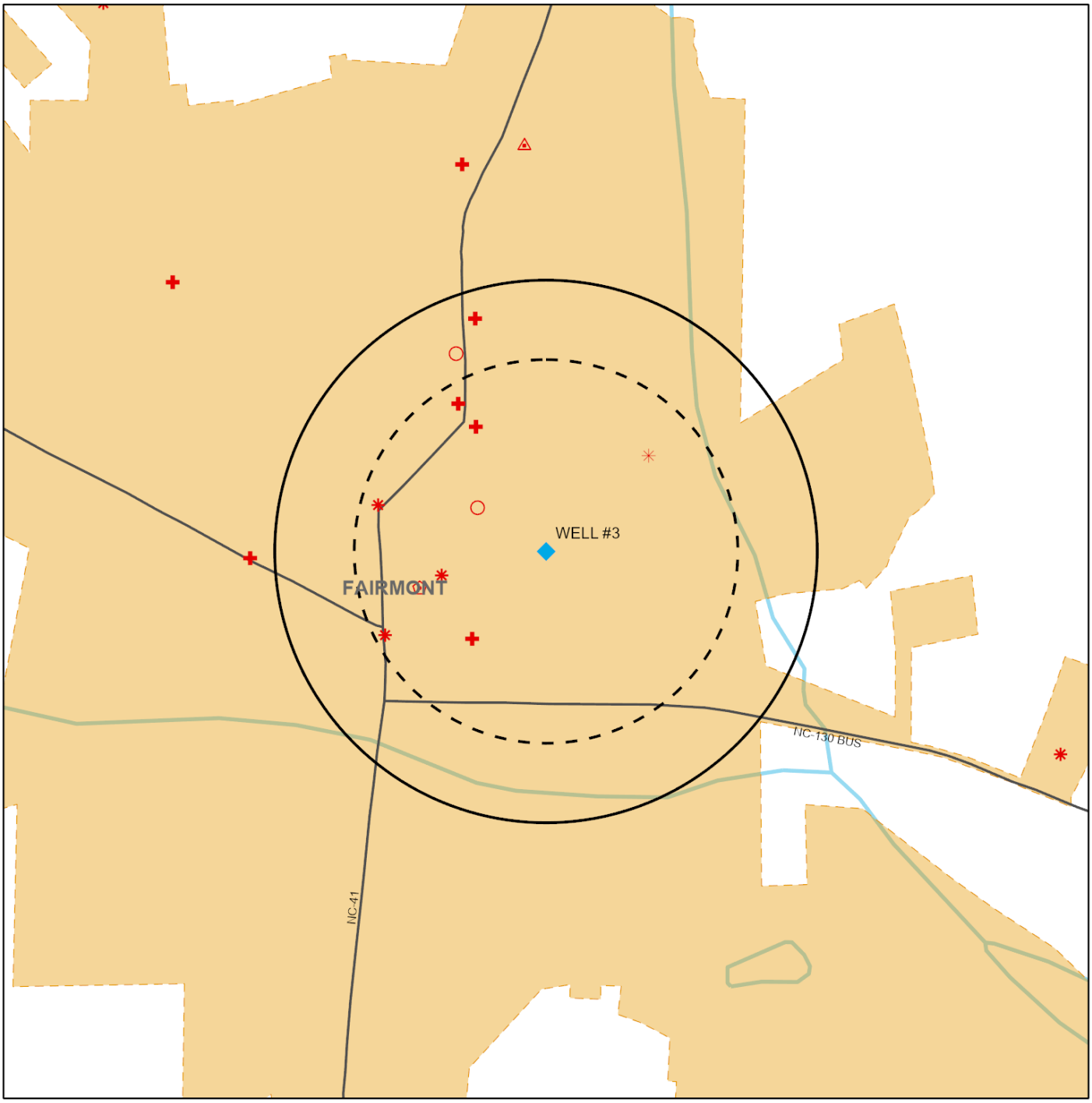
0 500 1,000 2,000 3,000 Feet



MAP 1. LOCATION MAP

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3



MAP 2. DELINEATED AREA AND PCS MAP

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

PCS Types
- Animal Operations
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- US Route
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- Municipal Boundaries
- Ground Water Assessment Area - Delineated Area
- Ground Water Assessment Area - Zone A

N W E S

0 500 1,000 2,000 3,000 Feet

Table 4. Potential Contaminant Source Attributes
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #3

PCS Name	PCS ID	PCS Type	PCS Risk Rating	Street Address	City	Zip	County
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BellSouth - 21807	6373584	Tier II Sites	Higher	104 N Main St	Fairmont	28340	Robeson
Fairmont, Town of	78B-DEMO-1980	Solid Waste Facilities	Moderate	Mcdaniel Street	Fairmont	28340	Robeson
ED F. HODGES, INC. STATION 3	00-0-0000023557	UST Permits	Higher	130 South Walnut Street	Fairmont	28340	Robeson
FOUR POINT CONVENIENCE MART	00-0-0000032479	UST Permits	Higher	203 N Walnut Street	Fairmont	28340	Robeson
PREVATTE FUNERAL HOME, INC.	7791	Pollution Incidents	Higher	301 N Walnut St	Fairmont	28340	Robes
TIGER MART	00-0-0000019936	UST Permits	Higher	310 N Walnut Street	Fairmont	28340	Robeson

Table 5. Inherent Vulnerability Rating
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #3

Ground Water Source Characteristics	Vulnerability
Aquifer Rating	Lower
Unsaturated Zone Rating	Moderate
Well Integrity/Construction Rating	Higher

Inherent Vulnerability Rating: Lower

Table 6. Unsaturated Zone Rating Calculation
FAIRMONT, TOWN OF
PWS ID: NC0378025, WELL #3

Unsaturated Zone Score	61.2

Notes:

1. Unsaturated Zone Score for each cell (CS):

CS = [3 x (vertical hydraulic conductance score)] + [2 x (land surface slope score)] + [3 x (land use score)] + [2 x (land cover score)]

2. Unsaturated Zone Score (S) for the entire assessment area is the mean of the cell scores (CS) calculated as:

The sum of all cell unsaturated zone scores (CS) divided by the number of cells (N) within the assessment area: $S = (\Sigma CS) / N$

3. The USGS publication "Methods of ranking unsaturated zone and watershed characteristics of public water supplies in North Carolina", by J. L. Eimers, J. C. Weaver, S. Terziotti, and R. W. Midgette, 1999, provides a detailed discussion of the methods used to determine unsaturated zone ratings.

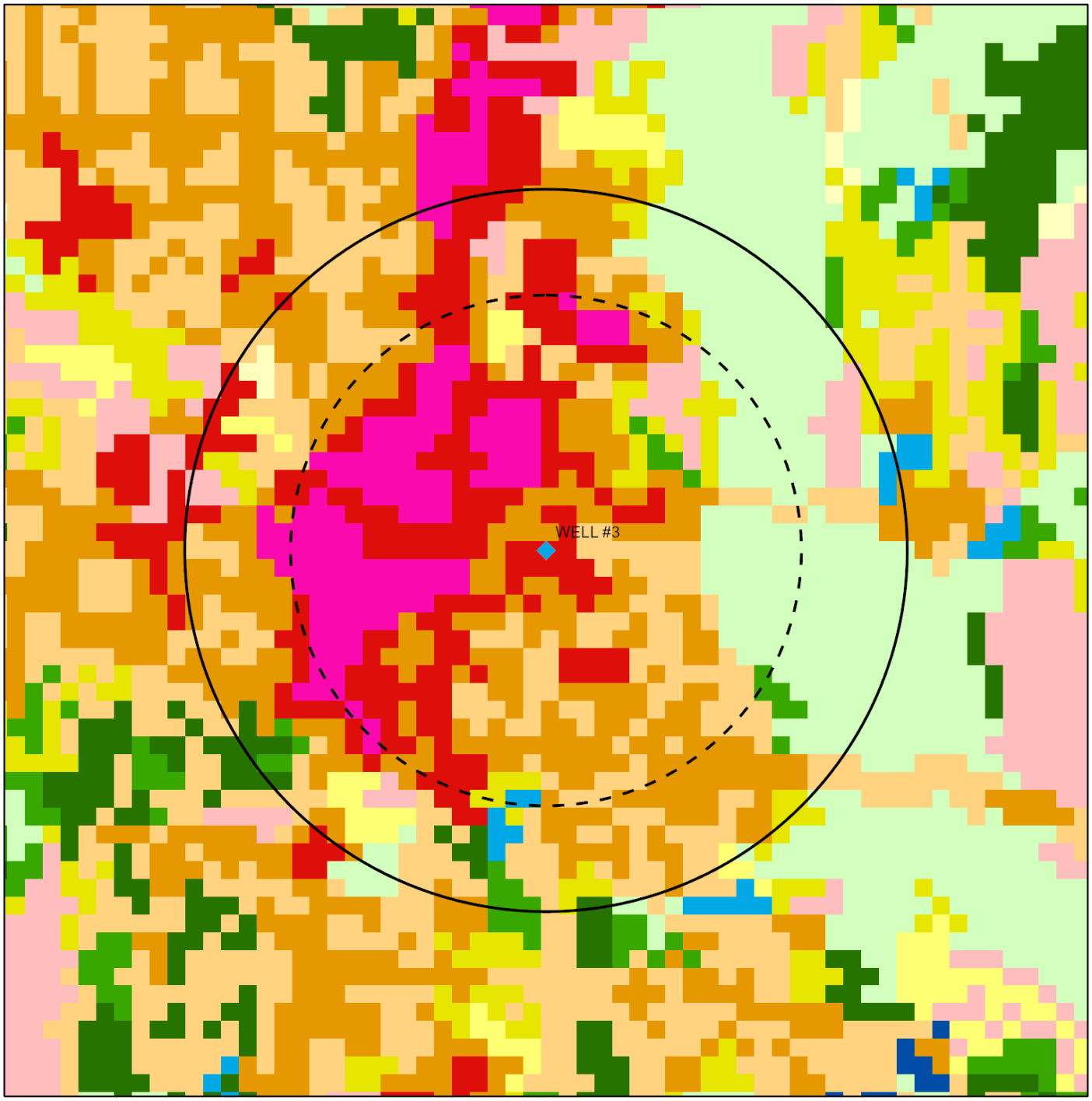

FIGURE 1. LAND USE/LAND COVER CATEGORIES

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

N
W
E
S

Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land (Rock, Sand, Clay)
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Grassland, Herbaceous
Pasture, Hay
Cultivated Crops
Woody Wetlands
Emergent Herbaceous Wetlands
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

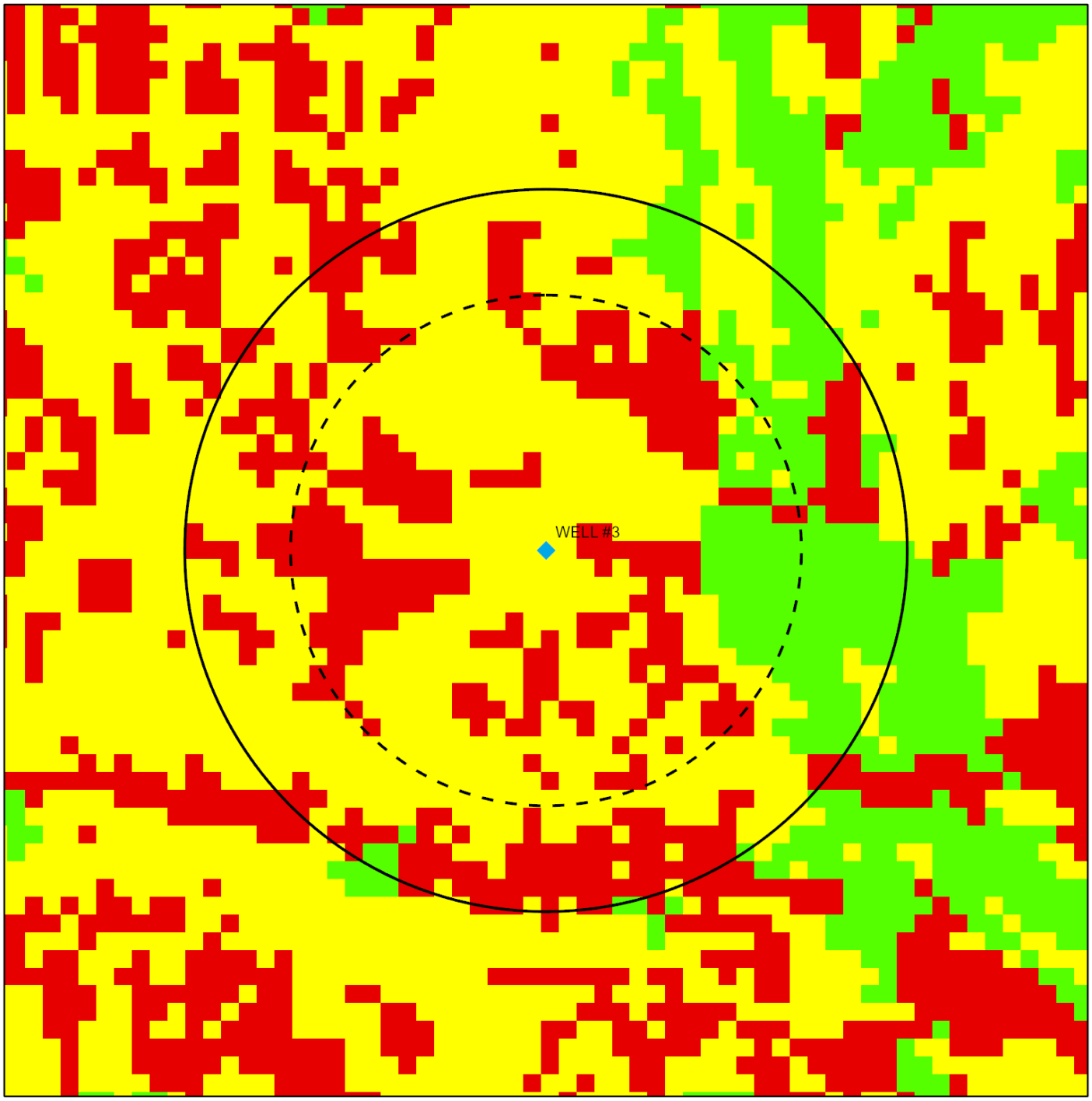

FIGURE 2. UNSATURATED ZONE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

Lower <= 50

Moderate > 50 to 65

Higher > 65

Ground Water Assessment Area - Delineated Area

Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000

Feet

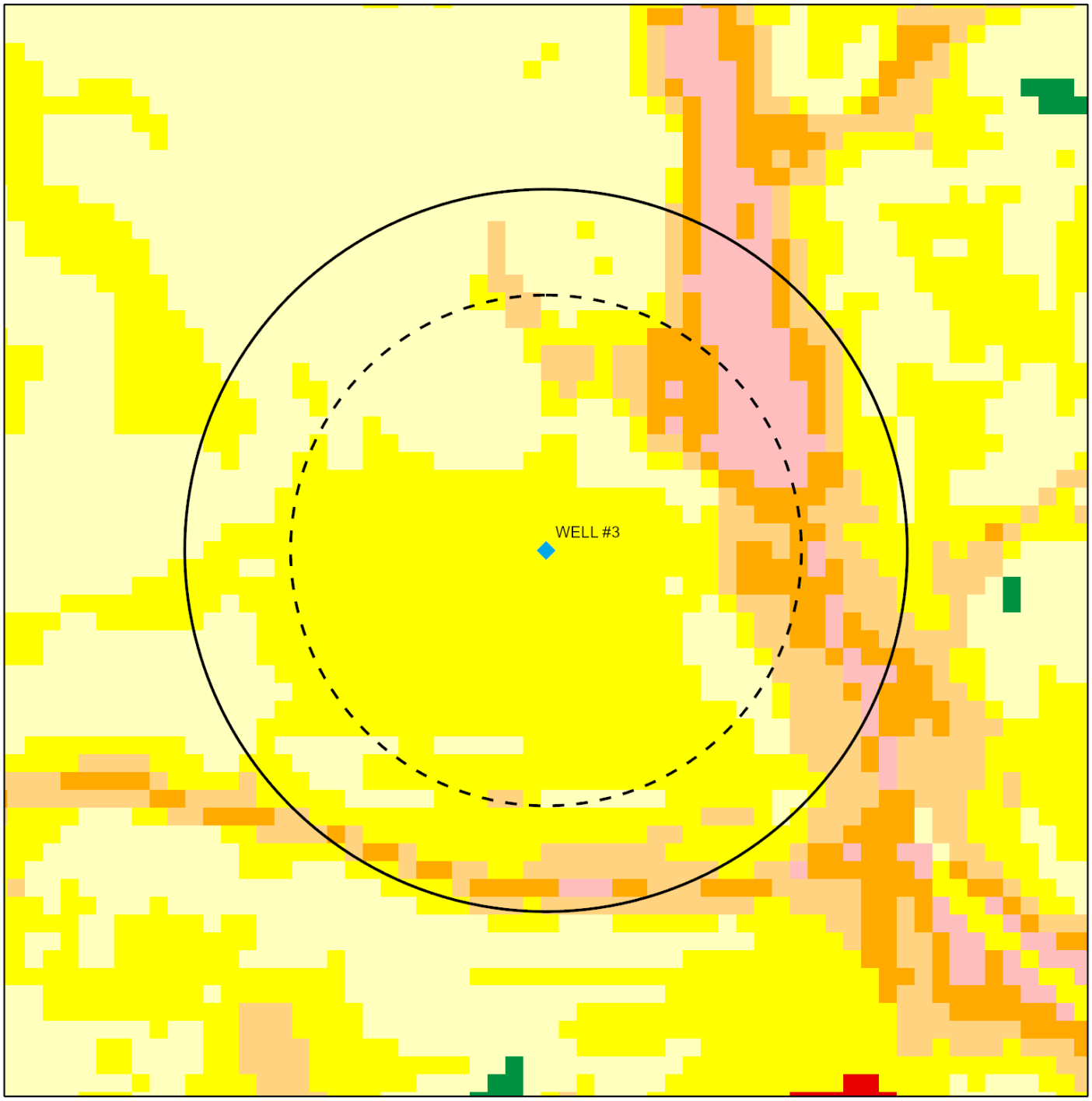

FIGURE 3. VERTICAL HYDRAULIC CONDUCTANCE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

N
W
E
S

1 (<= 5 sq. ft./day)
2 (>5 to 10 sq. ft./day)
3 (>10 to 20 sq. ft./day)
4 (> 20 to 40 sq. ft./day)
5 (> 40 to 80 sq. ft./day)
6 (> 80 to 160 sq. ft./day)
7 (> 160 to 320 sq. ft./day)
8 (> 320 to 640 sq. ft./day)
9 (> 640 to 1,280 sq. ft./day)
10 (> 1,280 sq. ft./day)
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

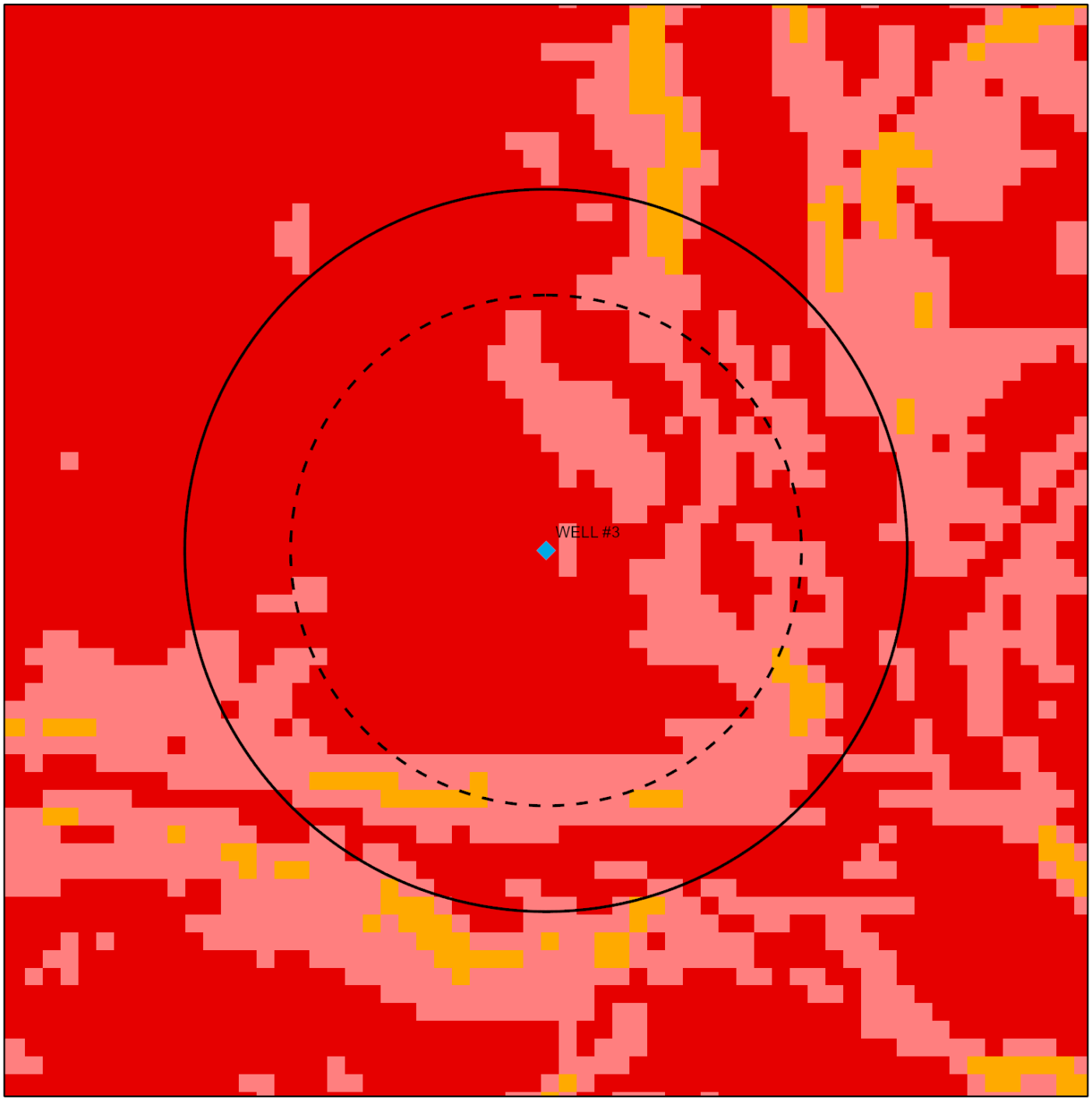

FIGURE 4. LAND SURFACE SLOPE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

1 (> 50 percent)
3 (> 20 to 50 percent)
5 (> 10 to 20 percent)
7 (> 5 to 10 percent)
9 (> 2 to 5 percent)
10 (<= 2 percent)
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

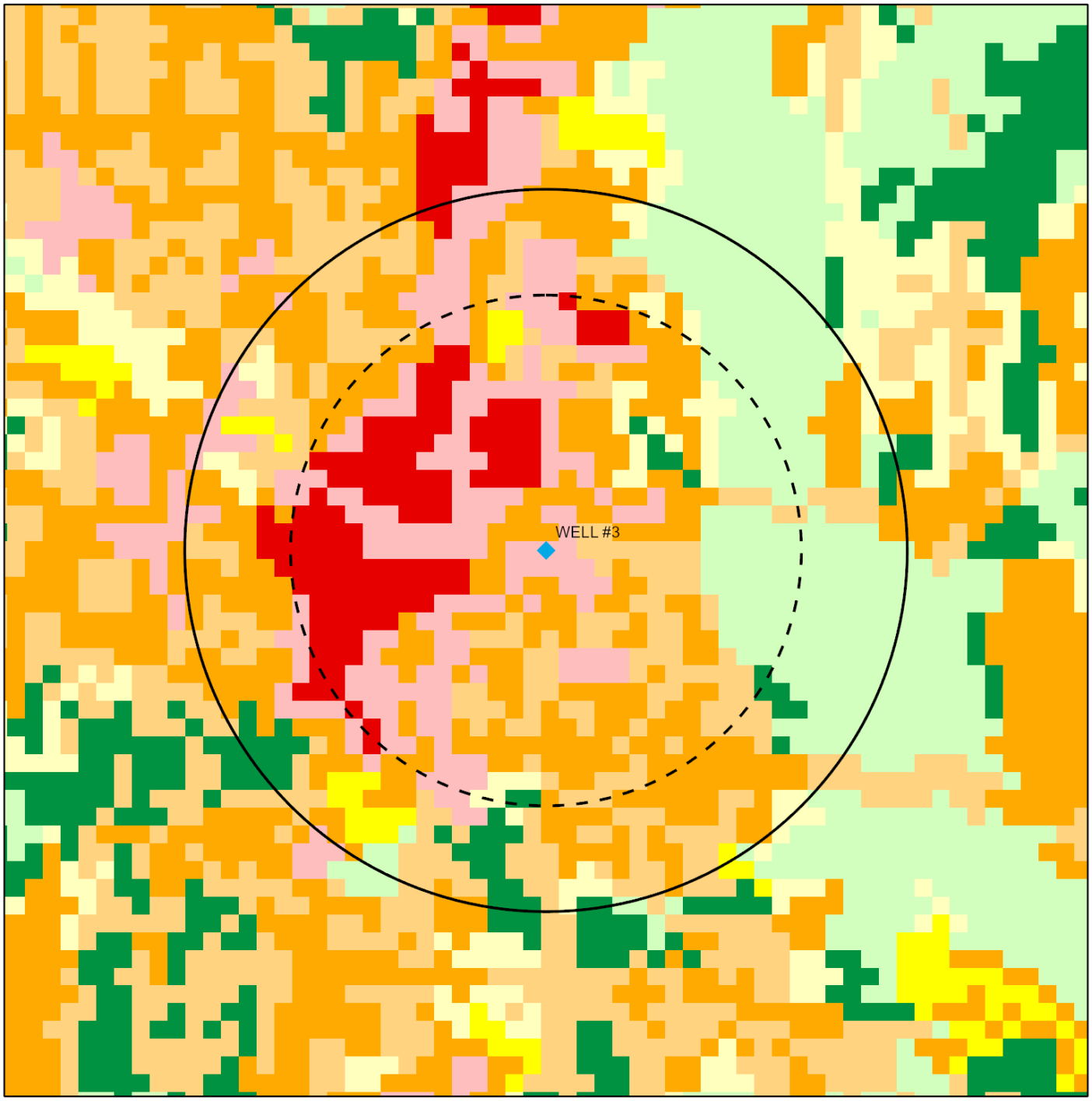

FIGURE 5. LAND USE RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

N
W
E
S

1 Water, Wetlands (Woody and Herbaceous)
2 Barren Land (Rock/Sand/Clay)
3 Forest (Deciduous, Evergreen, Mixed)
4 Grassland/Herbaceous; Shrub/Scrub
5 Pasture/Hay
6 Developed, Open Space
7 Developed, Low Intensity; Cultivated Crops
8 Developed, Medium Intensity
10 Developed, High Intensity
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

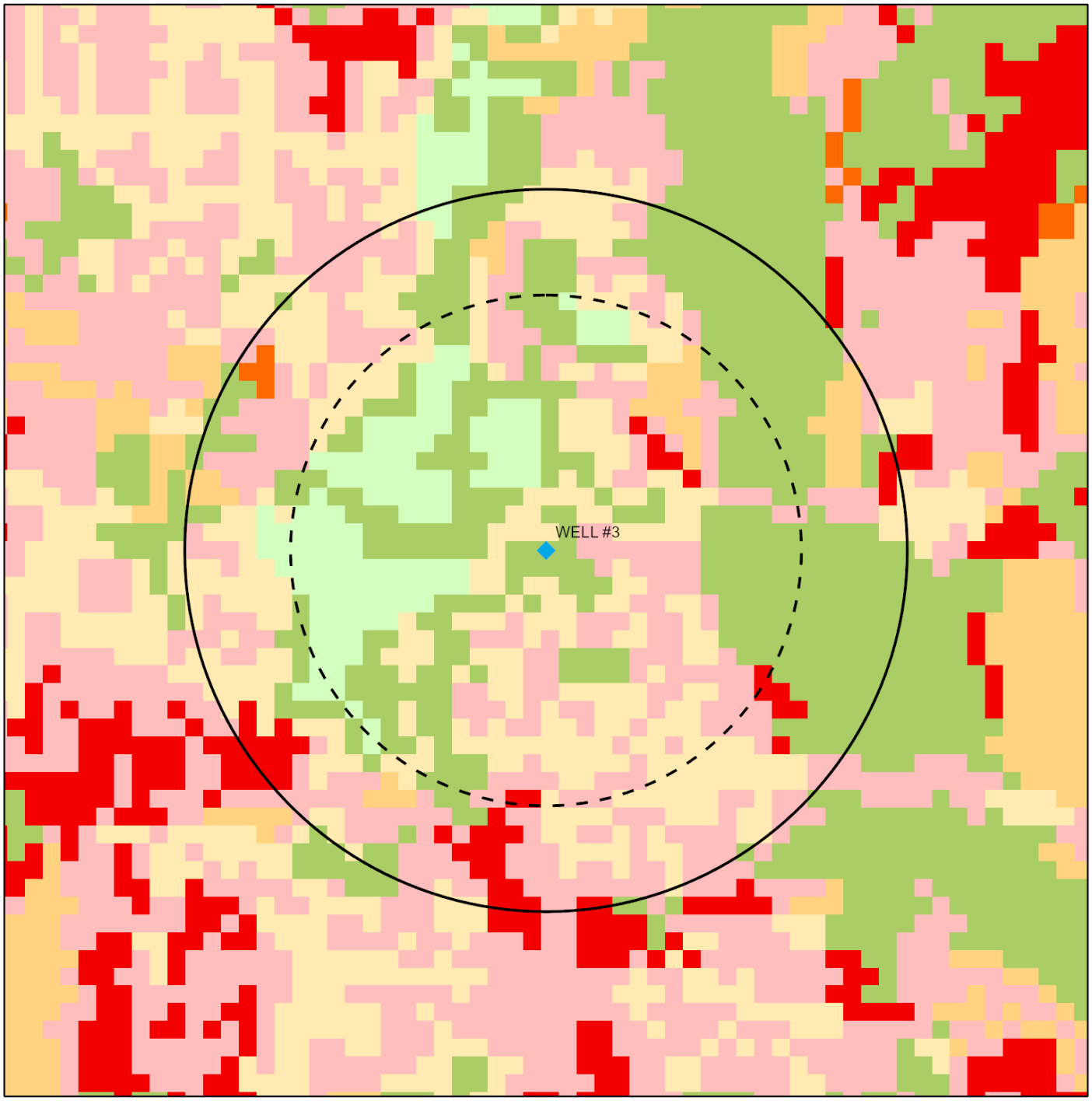

FIGURE 6. LAND COVER RATING

FAIRMONT, TOWN OF, PWS ID: 0378025, WELL #3

N
W
E
S

1 Developed, High Intensity
2 Water; Wetlands; Developed, Medium Intensity
4 Developed, Low Intensity
6 Barren Land (Rock, Sand, Clay); Cultivated Crops
8 Grassland/Herbaceous; Pasture/Hay; Developed, Open Space
9 Shrub/Scrub
10 Deciduous, Evergreen and Mixed Forest
Ground Water Assessment Area - Delineated Area
Ground Water Assessment Area - Zone A

0 500 1,000 2,000 3,000
Feet

Section 6: North Carolina's SWAP Approach

This section of the report is a more detailed description of North Carolina's SWAP approach. This is a summary of Chapter 2 of North Carolina's Source Water Assessment Program Plan.

Description of North Carolina's SWAP Approach

To meet the requirements of the 1996 SDWA Amendments, a Source Water Assessment was completed for approximately 8,000 drinking water sources in North Carolina. A delineated area for assessment was established for each drinking water source. An inventory of potential contaminant sources was conducted in each assessment area and finally, a susceptibility rating was assigned to each drinking water source. Because of the scope of this task and the limited time and resources available for completing the work, North Carolina's SWAP program efforts relies on Geographic Information Systems (GIS) to effectively use information. GIS allows databases to be linked to points on a map (e.g., public water supply sources, streams, geology, land use, roads, permitted waste disposal sites, Superfund sites, etc.) and overlaid on top of one another.

Delineation of Assessment Areas for Surface Water Sources

For the purpose of performing source water assessments, "delineation" means defining what land area constitutes the area contributing water to a public water supply source. The delineation of the source water assessment areas for surface water sources was done in consideration and collaboration with the Water Supply Watershed Protection (WSWP) Program. During the development of the WSWP program (final state rules adopted in 1992), the state worked with local governments to determine the location of all surface water sources and existing land uses within the water supply watersheds. This information, in conjunction with information on the types and location of wastewater discharges, was used to determine the appropriate Water Supply Watershed Classification for more than 200 surface water sources in the state. The watershed classifications, WS-I, WS-II, WS-III, WS-IV, and WS-V are based on the size of the watershed, development activities, and allowable waste treatment and disposal practices.

All surface water sources were located on US Geological Survey 1:24,000 scale topographic maps. The water supply watershed boundaries were delineated (except WS-V waters, which were delineated for the SWAP assessments by the PWS Section), and the boundaries of the Critical Area, and in the case of most WS-IV water supply watersheds Protected Areas (described below) were delineated.

For protection of the surface water sources in North Carolina, a segmentation of the water supply watersheds was implemented through the WSWP rules. The entire drainage areas of WS-I water supply watersheds were delineated. These watersheds are all publicly owned and no new development is allowed in these watersheds. These watersheds are very small. Some are located within National Forests. Others are owned by a local government.

All WS-II, WS-III and WS-IV water supplies require delineation of a Critical Area which is defined as the area within 1/2 mile and draining to the normal pool elevation of a water supply reservoir, or 1/2 mile and draining to a water supply intake in a river. For WS-II and WS-III water supplies, the remainder of the drainage area is subject to the development standards of the WSWP rules and are implemented through local land use ordinances. WS-IV water supplies, which are typically portions of major river systems, are segmented in a Critical Area (previously defined) and a Protected Area. The Protected Area is defined as the area within 5 miles and draining to the normal pool elevation of a reservoir or 10 miles upstream and draining to a river intake. In very few instances the WS-IV Protected Area encompasses the entire drainage area due to the size of the watershed. In 1995, the state allowed local governments to request that the 10 mile Protected Area boundary of a WS-IV water supply be measured "run of river" rather than using a 10-mile arc linear measurement. Surface waters that are used by industry to supply their employees with drinking water or waters formerly used as water supply are generally classified as WS-V. The WS-V waters are protected as

water supplies and are typically located upstream of and draining to Class WS-IV waters. Land use restrictions do not apply to WS-V waters under the WSWP rules.

Please note that for the purpose of the PWS Section's Source Water Assessments, delineation of WS-IV boundaries may be different from the WSWP Program's delineation. The PWS Section watershed assessment areas include all land draining to a drinking water source. However, the watersheds defined in accordance with the WSWP rules often exclude land area draining to a source based on municipal or county jurisdictional boundaries. Please refer to the WSWP program website for information on the regulations associated with their program and the land area affected by their regulations.

Delineation of Assessment Areas for Public Water Supply Wells

The delineation of source water assessment areas for wells was in accordance with North Carolina's EPA approved Wellhead Protection Program. The calculated fixed radius method was used to delineate assessment areas around each well in the following areas: piedmont and mountains; the unconfined surficial aquifer of the coastal plain; and in the semi-confined portions of the Castle Hayne aquifer with an estimated recharge rate of 250,000 gallons per day per square mile. The aquifer-source-volume method was used for confined aquifers of the coastal plain. These methods are described below. Well depth is the determining factor for a well to be considered confined. Well depths greater than 70 feet are considered confined.

Other assessment area delineation methods may be of interest to a PWS system in an effort to more accurately define the area contributing water to the well. The state will review delineations provided by any PWS system that employs acceptable alternative delineation methods. Resulting alternative delineation areas will be incorporated into the SWAP if the state concludes that the use of the more sophisticated method is appropriate.

Calculation of the Contributing Area

The first step in delineating the assessment areas is to determine the size of the contributing area to the well. When a well is pumped, it causes groundwater that is flowing through the subsurface to flow toward the well. The surface area surrounding a well that delineates the area in which water entering the groundwater system at the water table eventually flows to the well and discharges is known as the contributing area for the well. In this area, any contaminants released to the environment that reach the water table, can reasonably be expected to move toward and possibly reach the well. The calculated fixed radius method requires the pumping rate (Q) and the recharge rate (W) for the pumping well in order to calculate the size of the contributing area. The contributing area is calculated as follows:

$$Ac = \frac{Q}{W}$$

where:

Ac = contributing area in square miles,
Q = maximum daily pumping rate in gallons per day, and
W = average recharge rate in gallons per day per square mile.

The maximum daily pumping rate in gallons per day was determined from information on wells obtained from PWS Section sanitary survey inspection forms, Division of Water Resources Local Water Supply plans, and information supplied by system owners/operators. Where no information was available, an estimate of maximum daily pumping rate was assigned based on hydrogeologic characteristics of the aquifer supplying water to the well.

Size of the Assessment Area for Wells Using Calculated Fixed Radius Method

Estimates of the size of the contributing area can be obtained using the equation given above. However, because of the complex nature of groundwater flow and contaminant transport, it is not possible to define exact contributing area boundaries around each well. Two factors that affect the shape of the contributing area and its position and orientation with respect to a pumping well are the hydraulic gradient and aquifer transmissivity. The variation in aquifer transmissivity is important in determining the shape of the contributing area for a supply well. In areas where the hydraulic gradient and the aquifer transmissivity are essentially the same in all directions, the shape of the contributing area depends primarily on the hydraulic gradient. Where the water table is nearly flat, as near the water-table divide in broad interstream areas of low relief, the contributing area is approximately circular. Where the hydraulic gradient is moderate to steep, the contributing area is approximately elliptical, being oriented in the direction of groundwater movement.

Due to limited availability of information on both hydraulic gradient and aquifer transmissivity, the assessment area for each well was doubled. Therefore, the assessment area for each well is twice the size of the calculated contributing area or:

$$Aswap = 2Ac = \frac{2Q}{W}$$

Delineation of Assessment Areas for Wells in Confined Aquifers

Recharge to confined aquifers is much less than that to the surficial unconfined aquifer where the calculated fixed radius method was used. If the calculated fixed radius method were applied to wells withdrawing water from confined aquifers, the resulting assessment areas would be very large. With the exception of a portion of the Castle Hayne aquifer, the aquifer-source-volume method was used for delineating assessment areas for wells determined to be withdrawing water from highly confined and semi-confined aquifers. "Aquifer source volume" refers to the volume of the source aquifer that supplies the withdrawals from a well for a specified period of time. This factor has been adopted in many states for defining assessment areas for confined aquifers.

For the purpose of these assessments, the volume of aquifer that supplies ten years of withdrawals (i.e. the area surrounding a well in which the time of travel to the well is ten years) was used. A ten-year period should be sufficient to provide time to assess the potential impact of any groundwater contamination discovered within an assessment area and for developing appropriate remediation and source water protection strategies for the water supply. For any well in the coastal plain determined to be withdrawing water from a confined aquifer, the table below will be used to determine the size of the assessment area.

Table 1. Radii of Assessment Areas for Wells Withdrawing from Confined Aquifers in the Coastal Plain

Pumping Rate of Well (Gal. / min.)	Radius of Assessment Area (Feet Rounded)
50	1000
100	1000
200	1500
500	2000
1000	3000
2000	3500

Delineation of Assessment Areas for Water Supply Sources Classified as GWUDIs

Drinking water supplied by a well may include a surface water component. This is defined as Ground Water Under the Direct Influence of Surface Water (GWUDIs). This term is used to indicate that water withdrawn from a well contains a specific indicator or indicators (e.g., giardia) of the presence of a surface water component. The delineated area for a PWS well classified as a GWUDI well will be the combined area of a circle based on the calculated fixed radius method and the resulting upgradient watershed of the intersected surface water. Segmentation of the resulting watersheds was in accordance with the most appropriate water supply watershed classification scheme.

Delineation for Water Supply Sources Classified as Springs

Springs can be defined as areas where the water table intersects the ground surface. Ground water may have flowed many miles before appearing on the surface to form a particular spring. The delineated area for a drinking water source classified as a spring was defined as the entire watershed area upgradient of the spring. Segmentation of the resulting watersheds was in accordance with the most appropriate water supply watershed classification scheme.

Susceptibility Rating Methodology

The state determined that the overall susceptibility rating for each drinking water source should be based on two key components, a contaminant rating and an inherent vulnerability rating. Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. A contaminant rating refers to an evaluation of the number and location of potential sources of contamination. The contaminant rating and inherent vulnerability methodologies are explained below.

Contaminant Rating Methodology

The contaminant rating for each water supply source was determined based on the number and location of potential contaminant sources (PCSs) within the delineated area. The delineated area for the drinking water source encompasses the area where PCSs, if released to the environment, could reasonably be expected to be a risk or a potential for contamination of the drinking water supply. A PCS in this assessment report is a facility or site regulated under a state or federal regulatory program. These facilities are identified in electronic databases that contain location information for each facility. Only databases that include information statewide were used for this source water assessment. Each PCS identified within the delineated area was assigned a risk rating of higher, moderate or lower. The number of PCSs that occur within the delineated area was determined and a Contaminant Rating of higher, moderate or lower was assigned to each drinking water source.

Contaminant Rating for Ground Water Sources

For each ground water source, define an inner Zone A with an area equal to half the area of the delineated assessment area. Using Table 2, determine the number of PCSs that occur within each risk category according to their location, either in Zone A or in the remaining delineated area. Determine the Contaminant Rating of higher, moderate or lower for each well by adding the totals for each risk category.

Table 2. Determination of Contaminant Rating for Ground Water Sources

Potential Contaminant Sources in:	Number of Higher Risk PCSs	Cumulative Number of Higher and Moderate Risk PCSs	Cumulative Number of Higher, Moderate and Lower Risk PCSs
Zone A (the inner 1/2 of the delineated area)	(Number of sources) > 1 Score: (1 or 0)	(Number of sources) > 2 Score: (1 or 0)	(Number of sources) > 4 Score: (1 or 0)
Delineated Area (Zone A plus the remaining delineated area)	(Number of sources) > 2 Score: (1 or 0)	(Number of sources) > 4 Score: (1 or 0)	(Number of sources) > 8 Score: (1 or 0)

For each category, score "1" if the number of contaminants exceeds the indicated threshold, or score "0" if the number of contaminants is less than the threshold. Total all the scores (1 or 0) for each category. Therefore, the highest possible score is 6.

Determine the **Contaminant Rating** for each well as follows:

Higher (6 - 4)
Moderate (3 - 2)
Lower (< 1)

Contaminant Rating for Surface Water Sources

Because the WSWP rules prohibit development in these watersheds, the existence of one PCS in the delineated area of a drinking water source located in a WS-I watershed will result in a contaminant rating of higher.

Using Table 3 for WS-II and WS-III watersheds, or Table 4 for WS-IV and V watersheds, determine the number of PCSs that occur within each risk category (i.e., lower, moderate or higher risk) and within each delineated assessment area (e.g., critical area, protected area, etc). Determine the Contaminant Rating for each surface water PWS source by summing the totals for each risk category.

Table 3. Determination of Contaminant Rating for Surface Water Sources in WS - II or III Watersheds

Potential Contaminant Sources in:	Number of Higher Risk PCSs	Cumulative Number of Higher and Moderate Risk PCSs	Cumulative Number of Higher, Moderate and Lower Risk PCSs
Critical Area	(Number of sources) > 1 Score: (1 or 0)	(Number of sources) > 5 Score: (1 or 0)	(Number of sources) > 10 Score: (1 or 0)
Watershed Area Within 1000 Foot Stream Zone	(Number of sources) > 5 Score: (1 or 0)	(Number of sources) > 10 Score: (1 or 0)	(Number of sources) > 20 Score: (1 or 0)
Watershed Area Outside Stream Zone	(Number of sources) > 20 Score: (1 or 0)	(Number of sources) > 40 Score: (1 or 0)	(Number of sources) > 80 Score: (1 or 0)

For each category, score "1" if the number of contaminants exceeds the indicated threshold, or score "0" if the number of contaminants is less than the threshold. Total the scores (1 or 0 for each category). Therefore, the highest possible score is a 9.

Determine the **Contaminant Rating** for each surface water source in a Water Supply Watershed II or III as follows:

Higher (9 - 6)
Moderate (5 - 3)
Lower (<= 2)

Table 4. Determination of Contaminant Rating for Surface Water Sources in WS - IV and V Watersheds

Potential Contaminant Sources in:	Number of Higher Risk PCSs	Cumulative Number of Higher and Moderate Risk PCSs	Cumulative Number of Higher, Moderate and Lower Risk PCSs
Critical Area	(Number of sources) > 1 Score: (1 or 0)	(Number of sources) > 5 Score: (1 or 0)	(Number of sources) > 10 Score: (1 or 0)
Protected Area Within 1000 Foot Stream Zone	(Number of sources) > 5 Score: (1 or 0)	(Number of sources) > 10 Score: (1 or 0)	(Number of sources) > 20 Score: (1 or 0)
Protected Area Outside Stream Zone	(Number of sources) > 20 Score: (1 or 0)	(Number of sources) > 40 Score: (1 or 0)	(Number of sources) > 80 Score: (1 or 0)
Stream Zone from Protected Area to 25 Mile or Watershed Boundary	(Number of sources) > 20 Score: (1 or 0)	(Number of sources) > 40 Score: (1 or 0)	(Number of sources) > 80 Score: (1 or 0)

For each category, score "1" if the number of contaminants exceeds the indicated threshold, or score "0" if the number of contaminants is less than the threshold. Total the scores (1 or 0 for each category). Therefore, the highest possible score is a 12.

Determine the **Contaminant Rating** for each surface water source in a Water Supply Watershed IV or V as follows:

Higher (12 - 9)
Moderate (8 - 4)
Lower (<= 3)

Inherent Vulnerability Rating Methodology

The inherent vulnerability of a well or surface water source refers to the characteristics or existing conditions of the well or surface water source and its delineated assessment area. Several factors were evaluated for both groundwater and surface water sources and included in the inherent vulnerability rating of each public water supply source. Each drinking water source was assigned an inherent vulnerability rating of higher, moderate or lower.

Inherent Vulnerability Rating for Wells

The characteristics included for assigning an inherent vulnerability rating for wells are aquifer rating, unsaturated zone rating and well integrity/well construction rating. The aquifer rating is an assessment of the water transmitting characteristics of the aquifer. The unsaturated zone rating is an assessment of the likelihood that contaminants from surface and shallow sources will follow the path of aquifer recharge and reach the water table. The well integrity/construction rating is an assessment of the quality of the construction of the well. A brief description of each factor follows:

Aquifer Rating

The aquifer rating is a qualitative assessment of the water transmitting characteristics of the aquifer. Relative differences in aquifer vulnerability were based on a review of relevant literature, expert opinions, and confirmed with historical data. Factors considered in rating aquifer vulnerability include hydraulic conductivity, degree of confinement, dilution, and sorption potential. The attenuative capacity of the unsaturated zone is not considered in the determination of aquifer ratings. Table 5 summarizes the aquifer-rating scheme used for these assessments.

Well depths determined whether a well was considered unconfined, deep confined or shallow confined for these assessments. Wells less than or equal to 70 feet deep were considered to be withdrawing water from an unconfined or surficial aquifer. Wells greater than 70 feet but less than 180 feet deep were considered to be withdrawing water from a shallow confined aquifer. Wells greater than 180 feet deep were considered to be withdrawing water from a deep confined aquifer.

Table 5. Aquifer Rating Based on Water Transmitting Characteristics

Aquifer/Ground Water Source	Rating
Coastal Plain Aquifers:	
Deep Confined (e.g., Kinston area)	Lower
Shallow Confined (e.g., Pamlico Co.)	Moderate
Unconfined (e.g., Castle Hayne Outcrop area)	Higher
Piedmont and Mountain Aquifers:	
Triassic Basins (e.g., Sanford-Durham)	Moderate
Fractured Rock Aquifers	Higher
Other:	
Metamudstones and Meta-argillites of the Carolina Slate Belt	Higher
Areas with Wells Cased to Less Than 20 Feet	Higher
Groundwater under the Direct Influence of Surface Water	Higher
Sand Hills Area	Higher

Unsaturated Zone Rating

The state, in cooperation with the United States Geological Survey (USGS), developed the unsaturated zone rating methodology. The USGS Water-Resources Investigations Report 99-4283, "Methods of Rating Unsaturated Zone and Watershed Characteristics of Public Water Supplies in North Carolina" describes the methodology. The unsaturated zone rating is the combination of selected factors that contribute to the likelihood that contaminants from surface and shallow sources will follow the path of aquifer recharge and reach the water table. Contributing factors, in the form of GIS spatial data layers, include land use/land cover, vertical hydraulic conductance of the unsaturated zone, and land-surface slope. Vertical hydraulic conductance measures the capacity of the unsaturated zone to transmit water from land surface to water table. Land-surface slope and land cover influences the amount of precipitation that infiltrates into the subsurface. Land use describes the activities that take place on the surface or in the shallow subsurface and the type of contaminants that may be present as a result of those activities (i.e., "non-point source" potential contaminant sources).

Well Integrity/Construction Rating

The integrity of well construction can vary widely, depending on details such as casing depth, grouting depth, well materials and driller knowledge. However, these details are not always available for assigning SWAP assessment ratings. In 1994 and 1999 there were important rule changes that greatly improve the quality of the well construction

standards. Therefore, the SWAP assessments use well construction and approval dates as a surrogate to construction details to assign a well construction / integrity rating. For wells that construction and approval date is not available, the well construction/integrity rating defaults to Higher.

Table 6 summarizes the characteristics evaluated and rated for the inherent vulnerability for each PWS well. Each well was assigned an inherent vulnerability rating of higher, moderate or lower:

Table 6. Inherent Vulnerability Rating of Wells

Inherent Vulnerability Factors	Higher Vulnerability	Moderate Vulnerability	Lower Vulnerability
Aquifer Rating	10	5	-1
Unsaturated Zone Rating	10	5	1
Well Integrity/Construction Rating	5	3	1
Totals	25-18	17-15	14-1

Inherent Vulnerability Rating for Surface Water Sources

The inherent vulnerability of a surface water source refers to the characteristics and existing conditions of the source and the delineated assessment area (watershed). The characteristics included for assigning an inherent vulnerability rating are water supply watershed classification, surface water source location, raw water quality, and the watershed characteristics rating. The watershed classification is based on the size of the watershed, development activities, and allowable waste treatment and disposal practices. The surface water sources were characterized based on whether they are located in streams, large multi-purpose reservoirs, or small water supply reservoirs. The raw water quality rating is based on recorded turbidity and total coliform values over a twelve month period. The watershed characteristics rating is an assessment of the likelihood that contaminants will follow the path of overland flow or shallow subsurface flow to a surface water source. A description of each factor follows:

Watershed Classification

In North Carolina, all surface water sources are located in water supply watersheds that are classified as either WS-I, II, III, IV, or V. The Water Supply Watershed Protection rules required that all local governments having land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps and a management plan. All of these ordinances are in place and have been deemed to be in compliance with the statutory requirements. The inherent vulnerability ratings for watershed classification are based on differences between watershed classes, including size of the watershed, development activities, and allowable waste treatment and disposal practices.

Surface Water Source Location

All surface water sources are located in streams, large multi-purpose reservoirs (Class 3), or small water supply reservoirs (Class 1 or 2). The inherent vulnerability ratings for surface water source location are based on differences between the reaction time for a water plant in the case of a contamination event or spill in a stream versus a reservoir and includes the allowable activities on surface water reservoirs (i.e., single use versus multiple uses allowed).

Raw Water Quality

The likelihood of the presence of Cryptosporidium and other water-borne microorganisms increases when turbidity is high. Therefore, turbidity and total coliform bacteria are good indicators of raw water quality. The Area Wide Optimization Program (AWOP) within the PWS Section has developed a ranking system for surface water treatment

plants based primarily on these two parameters. This ranking system, with some minor modifications, has been adopted by SWAP in order to assign a raw water quality rating to each surface water source.

The AWOP ranking system is based on the treatment plant's raw, settled and finished water turbidity and coliform levels along with violations of MCLs and treatment techniques. Raw, settled and finished water samples are collected daily and compiled in a monthly report, commonly referred to as a MOR (monthly operating report). The AWOP ranking system first totals the number of months in a year that specific levels of turbidity and coliform are exceeded and/or the number of months certain violations occur. The monthly totals are then multiplied by a weighting factor to balance the relative importance of these parameters. These numbers are then totaled for the year and are considered the water treatment plant's total score.

Because the purpose of SWAP is to assess sources of drinking water supply and not how well water plants treat their water, SWAP only uses the raw water scores for turbidity and coliform from the AWOP ranking system. The total raw water quality scores were divided into three categories of vulnerability: Higher, Moderate and Lower. The AWOP ranking system is for surface water treatment plants and not individual surface water sources. Therefore, in the case where more than one source is used by a treatment plant, the plant's raw water quality rating was initially assigned to all of the plant's sources. Upon review by the regional office staff some of the ratings were then adjusted based on their extensive knowledge of the surface water sources in their area.

Watershed Characteristics Rating

The state determined the watershed characteristics ratings of each surface water source in cooperation with the USGS. The USGS Water-Resources Investigations Report 99-4283, "Methods of Rating Unsaturated Zone and Watershed Characteristics of Public Water Supplies in North Carolina" describes this methodology. The watershed characteristics ratings were based on the combination of selected factors that may contribute to the likelihood that contaminants follow the path of overland flow and reach the surface water source. Contributing factors, in the form of GIS spatial data layers, include average annual precipitation, land cover, land use, land-surface slope and groundwater contribution. Precipitation is the source of water transported overland to a stream or lake. Land-surface slope and land cover influence the amount of precipitation that infiltrates into the subsurface. Land use describes the activities that take place on the surface or in the shallow subsurface and the type of contaminants that may be present as a result of those activities (i.e., non-point source potential contaminant sources). Ground-water contribution is the effect of ground water on surface-water quantity and quality. For these assessments the ground-water contribution is derived from the unsaturated zone rating described in the ground water inherent vulnerability section of this report. Table 7 includes the characteristics that were evaluated and rated for the inherent vulnerability for each surface water source:

Table 7. Inherent Vulnerability of Surface Water Sources

Surface Water Source Characteristics	Higher Vulnerability	Moderate Vulnerability	Lower Vulnerability
Watershed Classification	WS-IV, WS-V 10	WS-III, WS-II 5	WS-I 1
Intake Location	Direct Stream 8	Class 3 Reservoirs 4	Class 1 and 2 Reservoirs 2
Raw Water Quality (water plant data)	5	3	1
Watershed Characteristics Rating	10	5	1
Totals	33 - 21	20 - 13	12 - 5

Susceptibility Rating Methodology

The state assigned a susceptibility rating for each drinking water source that was based on two components, a contaminant rating and an inherent vulnerability rating. Using the results of the evaluations of contaminant rating and inherent vulnerability rating for each public drinking water source, a susceptibility rating of higher, moderate or lower was assigned to each source according to the table below:

Table 8. Susceptibility Rating for Public Water Supply Sources by Combining the Inherent Vulnerability and Contaminant Ratings

	Inherent Vulnerability Rating		
Contaminant Rating	**Higher**	**Moderate**	**Lower**
Higher	H	H	M
Moderate	H	M	M
Lower	M	M	L