



Chapter 2.0 – Site Characteristics

Construction Permit Application for Radioisotope Production Facility

**NWMI-2013-021, Rev. 0
January 2015**

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TERMS

Acronyms and Abbreviations

⁸² Rb	rubidium-82
ACI	American Concrete Institute
ALOHA	Areal Locations of Hazardous Atmospheres
BLEVE	boiling liquid expanding vapor explosion
CATSO	Columbia Area Transportation Study Organization
CFR	Code of Federal Regulations
CHM	Children's House Montessori Early Learning Center
CONUS	Continental United States
CUSEC	Central United States Earthquake Consortium State Geologists
DHSS	Department of Health & Senior Services
Discovery Ridge	Discovery Ridge Research Park
DOA	Department of Administration
EF scale	enhanced Fujita tornado intensity scale
ESRI	Environmental Systems Research Institute
F scale	(original) Fujita tornado intensity scale
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing Standards
GIS	Geographical Information System
IBC	International Building Code
IDLH	immediately dangerous to life and health
ISCM	Islamic School of Columbia Missouri
LEL	lower explosion limit
MDE	Missouri Department of Education
MDNR	Missouri Department of Natural Resources
MMI	Modified Mercalli Intensity
MMRPC	Mid-Missouri Regional Planning Commission
MU	University of Missouri
NAD	National Geodetic Survey
NCES	National Center for Education Statistics
NMSZ	New Madrid Seismic Zone
NOAA	National Oceanic and Atmospheric Administration
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NWMI	Northwest Medical Isotopes, LLC
OGP	International Association of Oil and Gas Producers
RAWS	Remote Automatic Weather Station
RSAC	Radiological Safety Analysis Computer
REDI	Regional Economic Development, Inc.
RPF	radioisotope production facility
SARA	Superfund Amendments and Reauthorization Act
Terracon	Terracon Consultants, Inc.
TNT	trinitrotoluene
U.S.	United States
U.S.C.	United States Code
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey

Units

°C	degrees Celsius
°F	degrees Fahrenheit
BTU	British thermal unit
cm	centimeter
ft	feet
ft ²	square feet
ft ³	cubic feet
g	g-force
gal	gallon
ha	hectare
hr	hour
in.	inch
in. ²	square inch
kg	kilogram
kgal	thousand gallons
kip	kilopound
km	kilometer
km ²	square kilometers
kPa	kilopascal
kW	kilowatt
L	liter
lb	pound
m	meter
m ²	square meter
m ³	cubic meter
MeV	million electron volt
Mgal	million gallons
mi	mile
mi ²	square mile
rem	roentgen equivalent in man
sec	second
yd ²	square yard

2.0 SITE CHARACTERISTICS

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 Site Location and Description

This subsection describes the location and important features of the Northwest Medical Isotopes, LLC (NWMI) proposed Radioisotope Production Facility (RPF) site.

2.1.1.1 Specification and Location

The proposed 3.0 hectares (ha) (7.4-acre) site is situated in Boone County, Missouri, within the University of Missouri (MU) Discovery Ridge Research Park (Discovery Ridge) in Columbia, Missouri, north of Discovery Ridge Drive. The site is situated in central Missouri approximately 201 kilometers (km) (125 miles [mi]) east of Kansas City and 201 km (125 mi) west of St. Louis. The site is 7.2 km (4.5 mi) south of United States (U.S.) Interstate Highway 70 just to the north of U.S. Highway 63. The Missouri River lies 15.3 km (9.5 mi) to the west of the site. The site is located 5.6 km (3.5 mi) to the southeast of the main MU campus and is shown on the map on Figure 2-1. Figure 2-2 provides the 8 km (5-mi) radius from the center of the facility and shows highways, rivers, and other local bodies of water.

The approximate center of the proposed RPF (NAD 83, 1983) is:

Latitude and Longitude

Longitude: 92° 16' 34.63"

Latitude: 38° 54' 3.31"

Universal Transverse Mercator Coordinates (meters [m])

Northing: 4306031 m

Easting: 562755 m

Zone: 15S

Missouri State Plane Coordinates (U.S. Survey feet [ft])

North: 1116979.02 ft US

East: 1704082.07 ft US

FIPS Zone: Missouri Central 2402



Figure 2-1. 200 km (124 mi) Radius with Cities and Roads

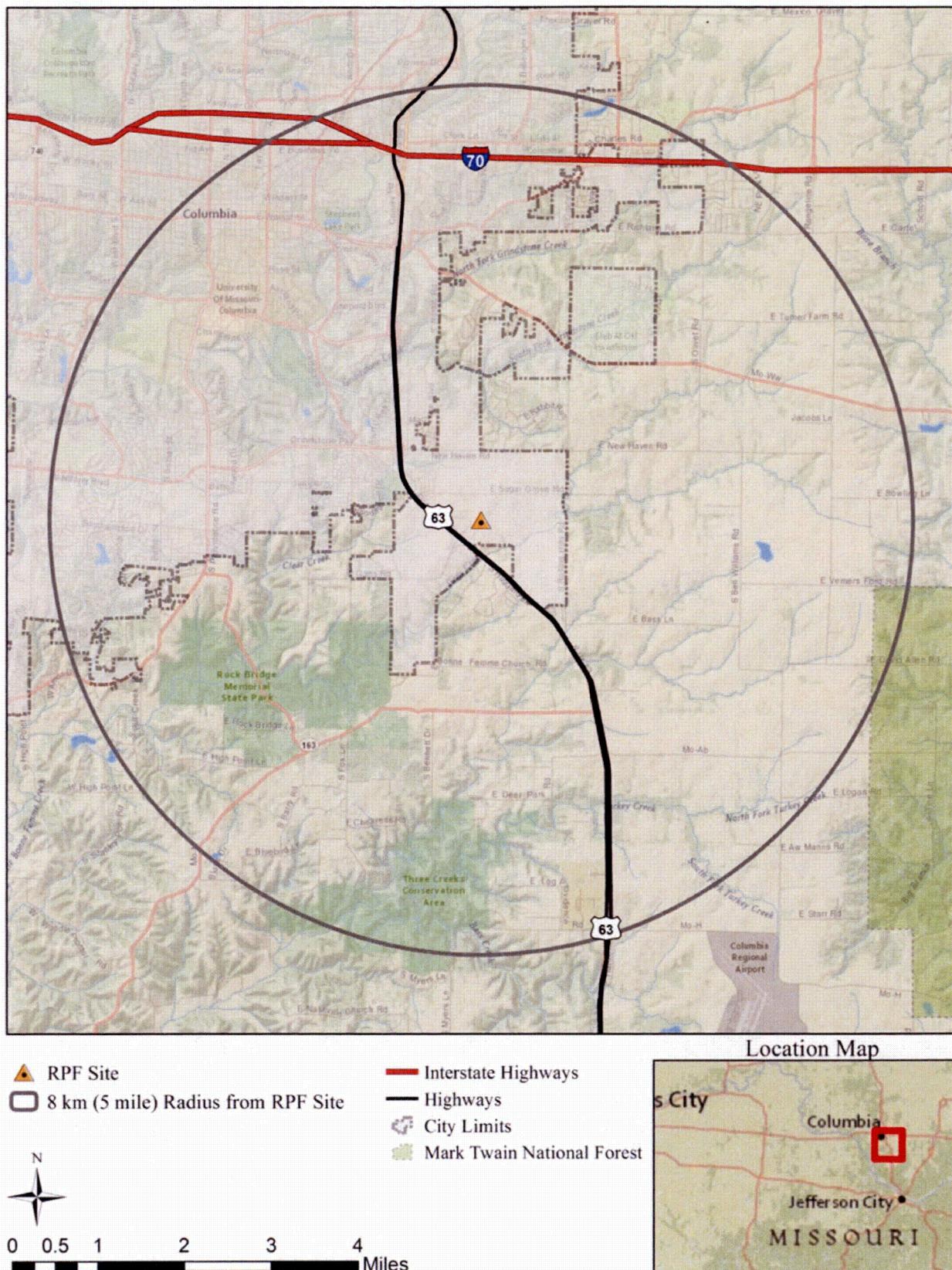


Figure 2-2. Illustration of 8 km (5-mi) Radius from the Center of the Facility

2.1.1.2 Boundary and Zone Area Maps

Figure 2-3 shows the boundaries and zones applicable to the proposed RPF site. The square area near the center of the site within which all safety-related structures are located gives the rough location and size of the operations boundary in accordance with ANSI/ANS-15.7, *Research Reactor Site Evaluation*, and ANSI/ANS-15.16, *Emergency Planning for Research Reactors*. The Emergency Planning Zone is encompassed by the site boundary using the guidance in:

- ANSI/ANS-15.16, *Emergency Planning for Research Reactors*
- Regulatory Guide 2.6, *Emergency Planning for Research and Test Reactors* (NRC, 1983)
- Title 10, *Code of Federal Regulation*, Part 50.54 (10 CFR 50.54), “Conditions of Licenses”
- 10 CFR 50, “Domestic Licensing of Production and Utilization Facilities,” Appendix E, “Emergency Planning and Preparedness for Production and Utilization Facilities.”

The site boundary is the property line around the perimeter of the RPF site in accordance with ANSI/ANS-15.7 and ANSI/ANS-15.16. The controlled area is the area within the site boundary in accordance with 10 CFR 20, “Standards for Protection Against Radiation,” Subpart 20.1003, “Definitions,” and 10 CFR 70.61(f), “Performance Requirements.” The area directly under the facility operating license will also be delineated by the site boundary.

Figure 2-4 shows the highways, railways, and waterways within the 8 km (5-mi) radius of the RPF site. The approximately 3.0 ha (7.4-acre) RPF site is located entirely on property owned by MU. The site presently consists of grass fields. Access to the site is provided from Discovery Drive and Discovery Parkway. The RPF site is primarily relatively flat surfaces at an elevation of 231 m (758 ft). Figure 2-5 shows the topography within the vicinity of the RPF site.

Estimates of population density around the proposed project site included data from the most recent census year (USCB, 2010). Block groups and associated populations were identified within the 8 km (5-mi) radius of the RPF site using ArcGIS 10.1 (ESRI, 2011). The associated population was divided by the calculated area (square mile [mi^2]) of each block group. The resulting population density was used to determine if the block group could be classified as either rural or urban. Block groups with a population density of more than 500 people/ mi^2 were identified as urban. Block groups with a population density of lesser than 500 people/ mi^2 were identified as rural. Urban or rural zones are identified in Figure 2-6.

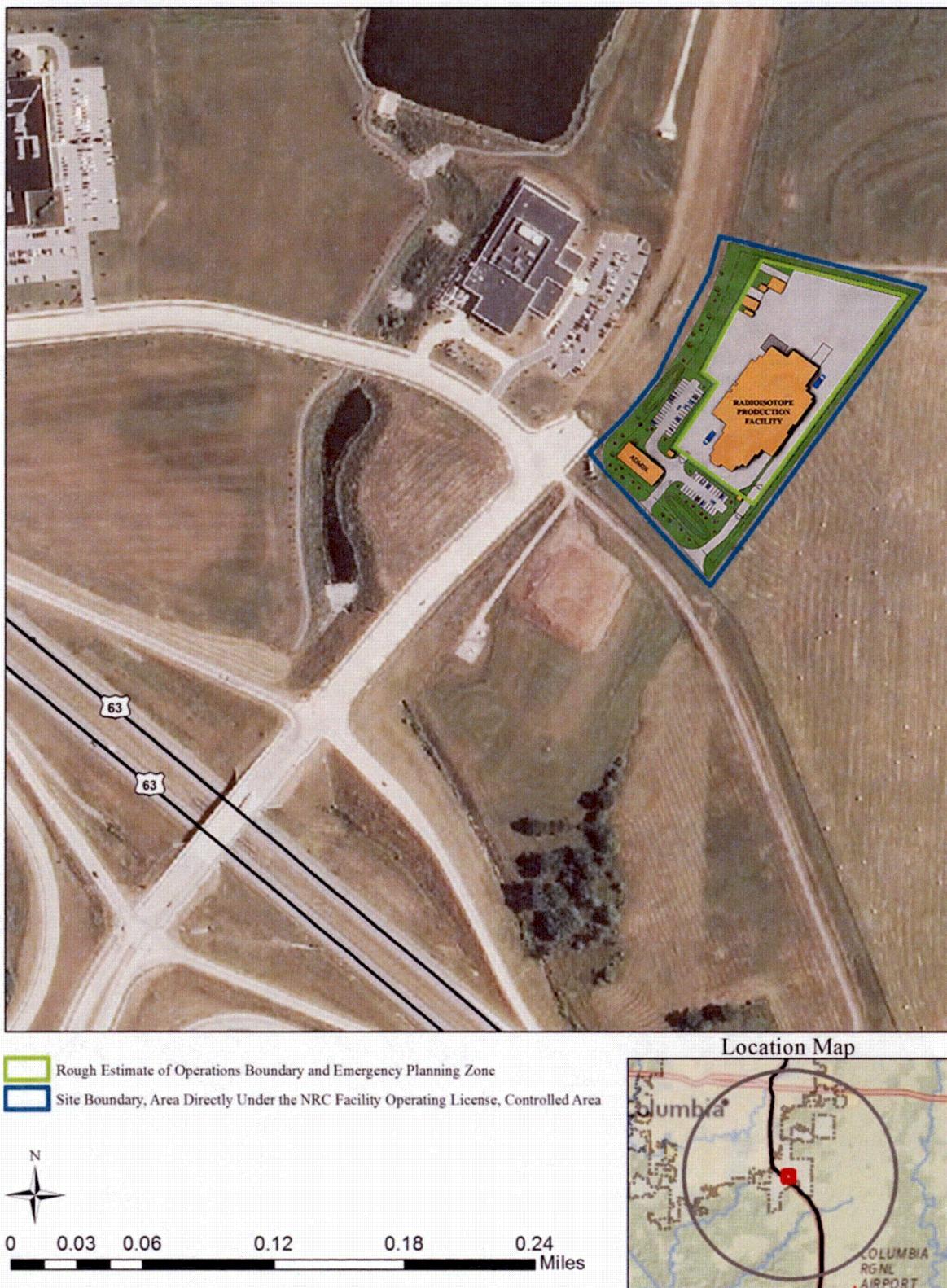
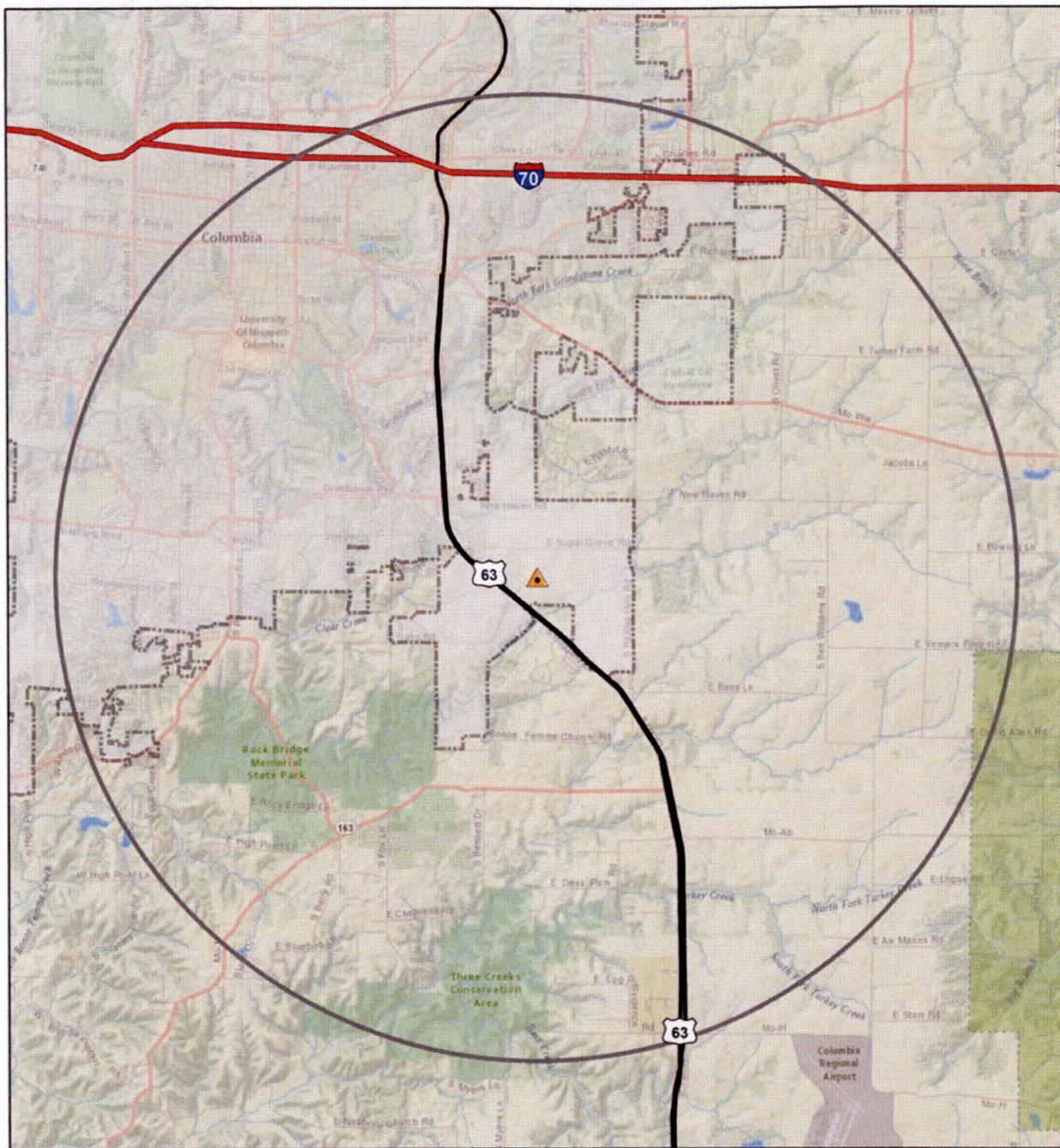


Figure 2-3. Boundaries and Zones Associated with the Facility



Location Map

▲ RPF Site

□ 8 km (5 mile) Radius from RPF Site

— Interstate Highways

— Highways

• City Limits

■ Mark Twain National Forest



0 0.5 1 2 3 4 Miles

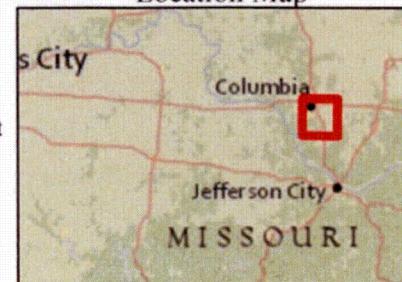


Figure 2-4. Prominent Features in Site Area

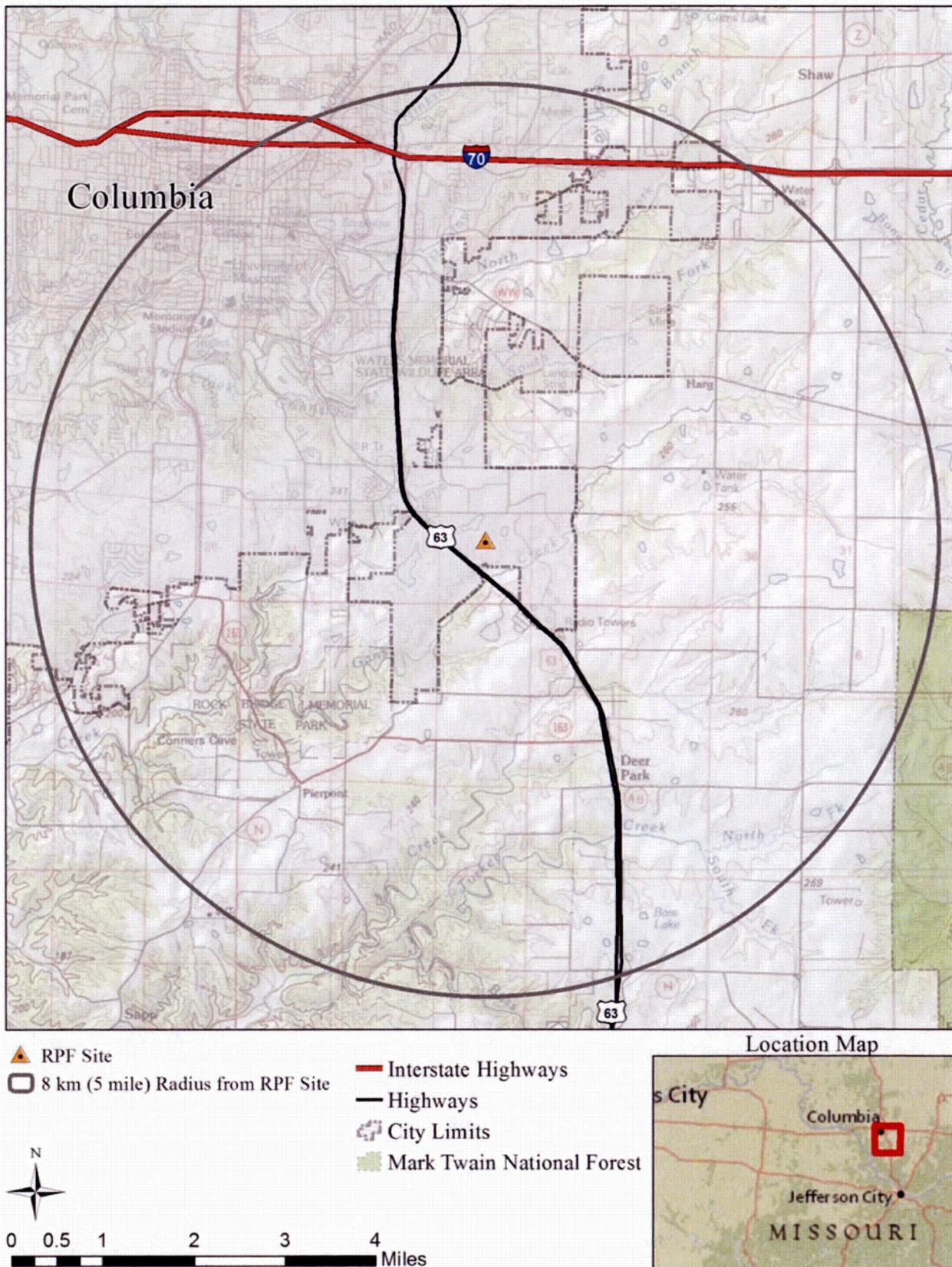


Figure 2-5. Topography in Site Area

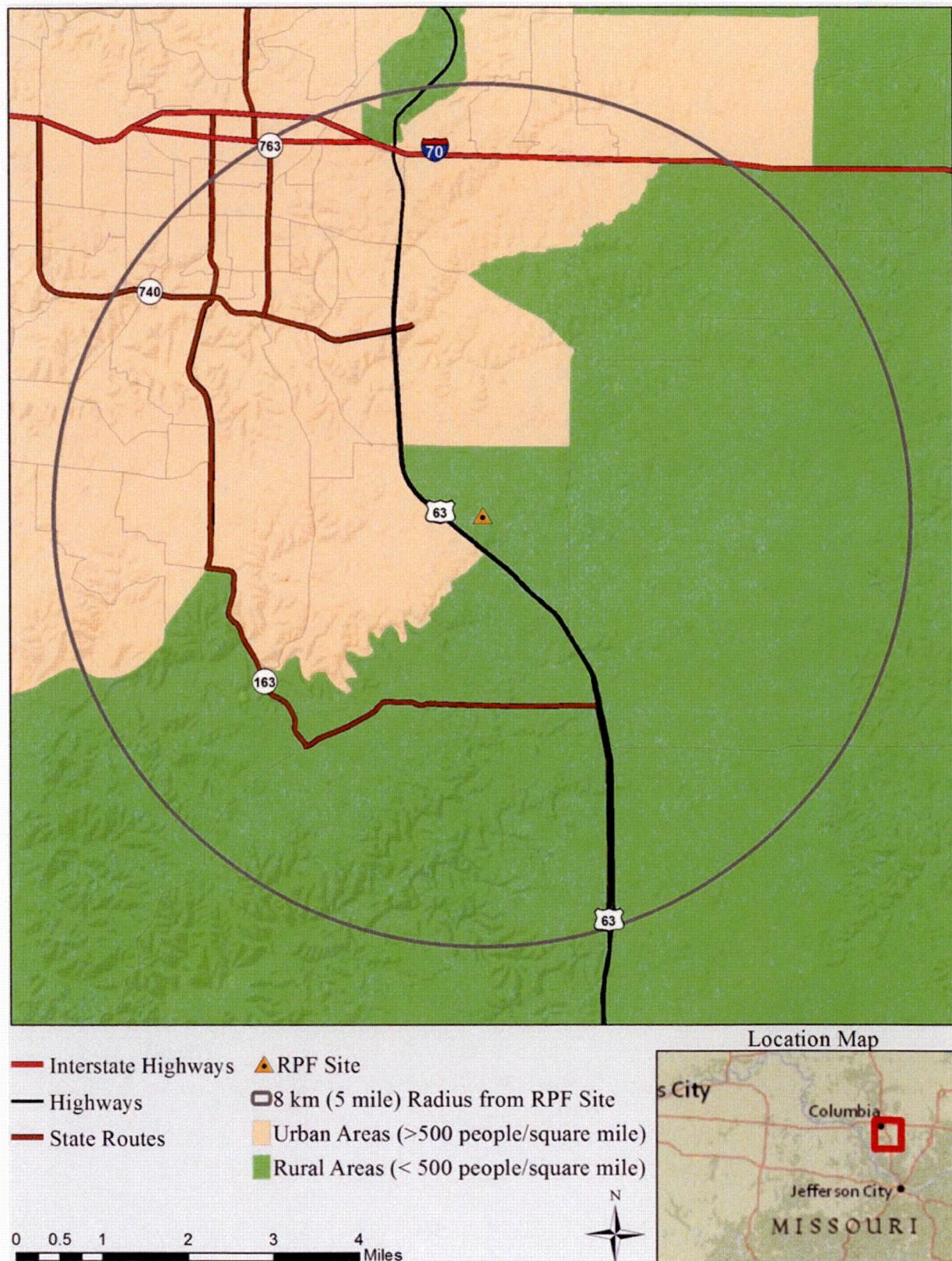


Figure 2-6. The Rural and Urban Zones Surrounding the Radioisotope Production Facility

2.1.2 Population Distribution

This subsection describes the population distribution within 8 km (5.0 mi) of the center point of the safety-related area at the proposed site. The information includes estimates of the resident and transient populations for the most recent census year (2010) and projects of the resident and transient populations for the following future years:

- Year submitting Construction Permit application (2015)
- Year of submitting Operating License application (2016)
- Five years after submitting Construction Permit application (2020)
- Five years after submitting Operating License application (2021)
- Approximate expected end of Operating License period (2047)
- Five years after approximate expected end of Operating License period (2052)

Estimates and projections of resident and transient populations around the proposed project site are divided into five distance bands—concentric circles at 0-1 km (0-0.6 mi), 1-2 km (0.6-1.2 mi), 2-4 km (1.2-2.5 mi), 4-6 km (2.5-3.7 mi), and 6-8 km (3.7-5.0 mi) from the center point of the RPF—and 16 directional sectors (with each direction sector centered on one of the 16 compass points). For each segment formed by the distance bands and directional sectors, the resident population was estimated using U.S. Census Bureau 2010 census data, and the transient population was estimated using the best available data for major employers, schools, medical facilities, and lodging facilities. Collected transient population data is intended to represent 2010 population levels.

The future resident and transient population growth in each distance/direction segment was projected using specific growth rates that depend on whether the segment is located in the city of Columbia or in Boone County. The specific growth rates used in these areas are explained in the following paragraphs.

The City of Columbia comprehensive land use plan (City of Columbia, 2013), presents projections on the city's future population calculated using several possible population growth rates. The plan states that the Columbia Area Transportation Study Organization (CATSO) model projects a greater rate of population growth and is considered the most reasonable and conservative basis for estimating the city's future population. According to the plan, the CATSO model growth rate was calculated by using historic population data and land use trends, which are then projected forward to estimate future growth. Based on these projections, the CATSO model estimated that the rate of population growth (growth rate) is 1.5 percent annually. This growth rate was used to project future populations for areas within the analysis area that are within the Columbia city limits. The 2010 estimated resident and transient population in each distance/direction segment that is located partially or entirely within the city boundaries was increased by 1.5 percent each year from 2011 to 2050.

The Missouri Department of Administration (DOA) provides state and county population projections that were developed using the cohort-component method (DOA, 2008). The cohort-component method reviews recent historical patterns to determine age- and sex-specific rates of fertility, mortality, and migration. The DOA used the 2000 Census as a base for population counts. The base count is then advanced at five-year intervals to the year 2030 by using projected survival rates and net migration rates by age and sex. The DOA projections show that the population of Boone County is expected to increase by 7.9 percent for the five-year period from 2010 to 2015, by 7.2 percent from 2015 to 2020, by 6.2 percent from 2020 to 2025, and by 5.0 percent for the period from 2025 to 2030. For each five-year period, the percent growth was divided by five to give the estimated annual growth rate within that period. The annual growth rates were used to project future populations for the areas around the project site that are entirely outside the boundaries of the city of Columbia. The estimated 2010 resident and transient population in each distance/direction segment that is located entirely outside of the city boundaries was increased by 1.58 percent each year from 2011 to 2015, by 1.44 percent from 2016 to

2020, by 1.24 percent from 2021 to 2025, and by 1.0 percent from 2026 to 2030. The growth rate of 1.0 percent was used for the period from 2031 to 2050.

The following subsections described the resident and transient population distribution surrounding the proposed RPF site.

2.1.2.1 Resident Population

The permanent residences nearest to the proposed RPF site were identified through an examination of aerial photographs and geographic information system (GIS) data files using ArcGIS 10.1 (ESRI, 2011). There are two permanent residences located approximately 0.48 km (0.3 mi) from the center point, one to the south and the other to the northeast. These two houses are the closest residences to the center point of the safety-related area.

Figure 2-7 shows places of significant population groupings (incorporated cities and unincorporated villages) within 8 km (5.0 mi) of the center point of the safety-related area. The map includes concentric circles drawn at distances of 1 km (0.6 mi), 2 km (1.2 mi), 4 km (2.5 mi), 6 km (3.7 mi), and 8 km (5 mi) from the center point, and is divided into 16 directional sectors, with each directional sector consisting of 22.5 degrees centered on one of the 16 compass points. Table 2-1 shows the closest permanent resident within each of the 16 sectors.

The 2010 resident population within the 1 km (0.6 mi) and 2 km (1.2 mi) concentric circles was estimated based on the number of occupied houses (as identified through an examination of aerial photographs) and the average number of people per household (as reported by the U.S. Census Bureau). U.S. Census Bureau data indicates that Boone County has an average of 2.36 people per household (USCB, 2013).

Table 2-1. Closest Permanent Residents Within Each Compass Section Around the Proposed Site

Quadrant	Nearest resident	
	km	mi
North to North-Northeast	1.4	0.86
North-Northeast to Northeast	0.6	0.36
Northeast to East-Northeast	2.0	1.22
East-Northeast to East	1.1	0.7
East to East-Southeast	1.8	1.1
East-Southeast to Southeast	2.0	1.24
Southeast to South-Southeast	0.9	0.55
South-Southeast to South	0.8	0.48
South to South-Southwest	0.4	0.27
South-Southwest to Southwest	1.4	0.89
Southwest to West-Southwest	1.4	0.87
West-Southwest to West	2.0	1.23
West to West-Northwest	0.9	0.58
West-Northwest to Northwest	1.0	0.65
Northwest to North-Northwest	1.7	1.04
North-Northwest to North	1.4	0.86

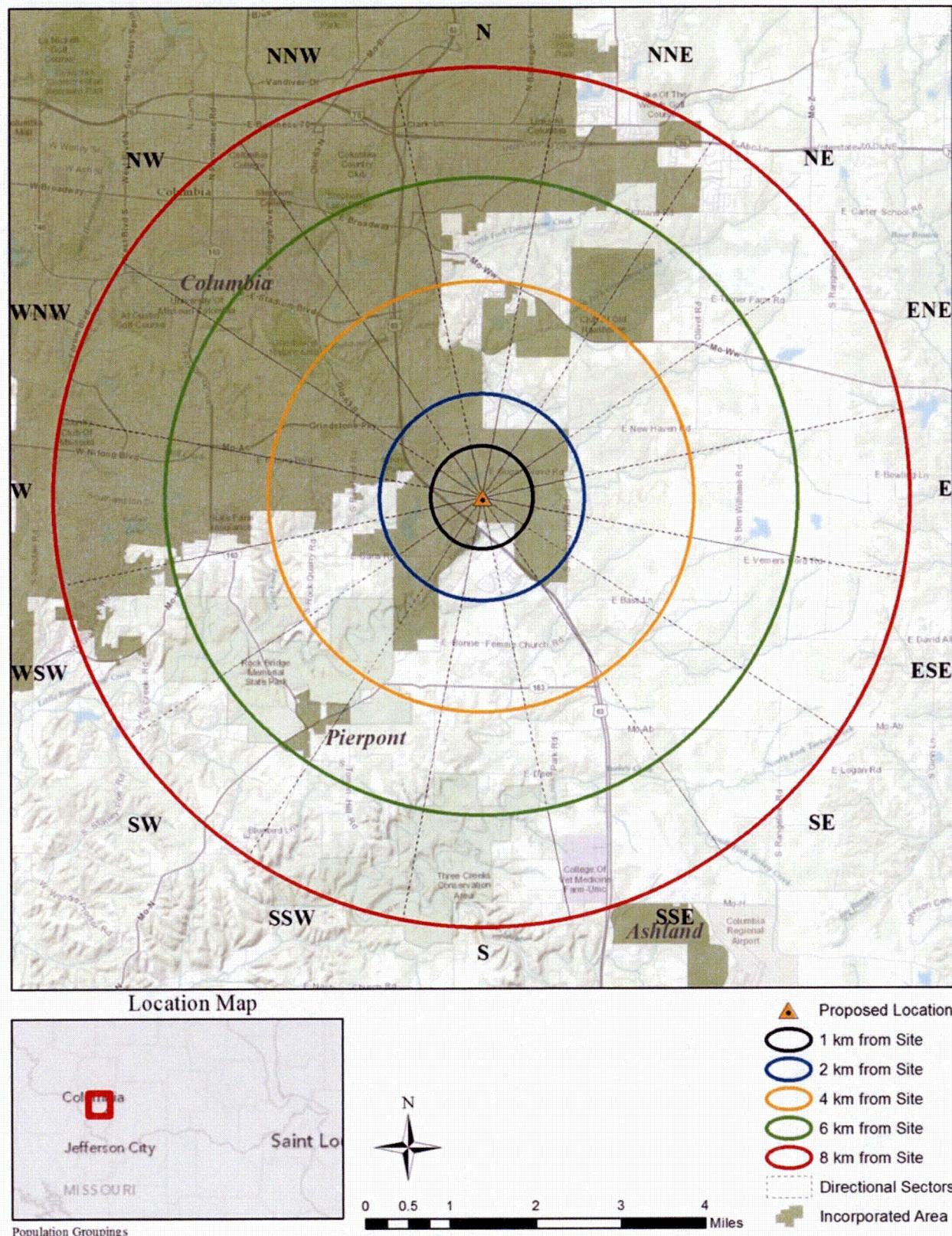


Figure 2-7. Population Groupings

The 2010 resident population estimate was derived by multiplying the number of occupied houses by 2.36 people per house and rounding to the nearest whole number. The total resident population estimated in this manner for 2010 is 205 people at a distance of 0-1 km (0-0.6 mi) from the proposed site, and 1,862 people at a distance of 1-2 km (0.6-1.2 mi). These population estimates are shown in Table 2-2, along with estimates for other distances. Figure 2-8 shows the population estimates divided into the distance/direction sections.

Table 2-2. Resident Population Distribution within 8 km (5 mi) of the Proposed Site

Year	Distance band (km)						Total 0 – 8
	0 – 1	1 – 2	2 – 4	4 – 6	6 – 8		
2010	205	1,862	7,070	16,919	21,508		47,564
2014	218	1,974	7,495	17,936	22,801		50,423
2015	221	2,004	7,608	18,205	23,143		51,181
2019	234	2,124	8,063	19,296	24,530		54,247
2020	238	2,156	8,184	19,585	24,897		55,060
2045	291	2,628	9,991	23,948	30,428		67,287
2050	313	2,820	10,727	25,728	32,683		72,271

The U.S. Census Bureau 2010 census block and tract data (USCB, 2012) was used to estimate the resident population within the 4 km (2.5 mi), 6 km (3.7 mi), and 8 km (5.0 mi) distance bands. For each segment formed by the distance bands and directional sectors, the percentage of each census tract's land area that falls, either partially or entirely, within that segment was calculated using ArcMap 10 GIS software (ESRI, 2011). The equivalent proportion of each census tract's population was then assigned to that segment. If portions of two or more census tracts fall within the same segment, the proportional population estimates for the census tracts were summed to obtain the population estimate for that segment. Table 2-2 shows total 2010 population estimates within the 4 km (2.5 mi), 6 km (3.7 mi), and 8 km (5.0 mi) distance bands, and Figure 2-8 shows the population estimates divided into the distance/direction sections.

Using the methodologies described above, the 2010 resident population estimates within the distance bands and directional sectors were extrapolated to the years 2014, 2015, 2019, 2020, 2045, and 2050. Table 2-2 shows that total projected resident population for these years within the distance bands, and Figure 2-9 to Figure 2-14 show the projections for these years divided into the distance/direction sections.

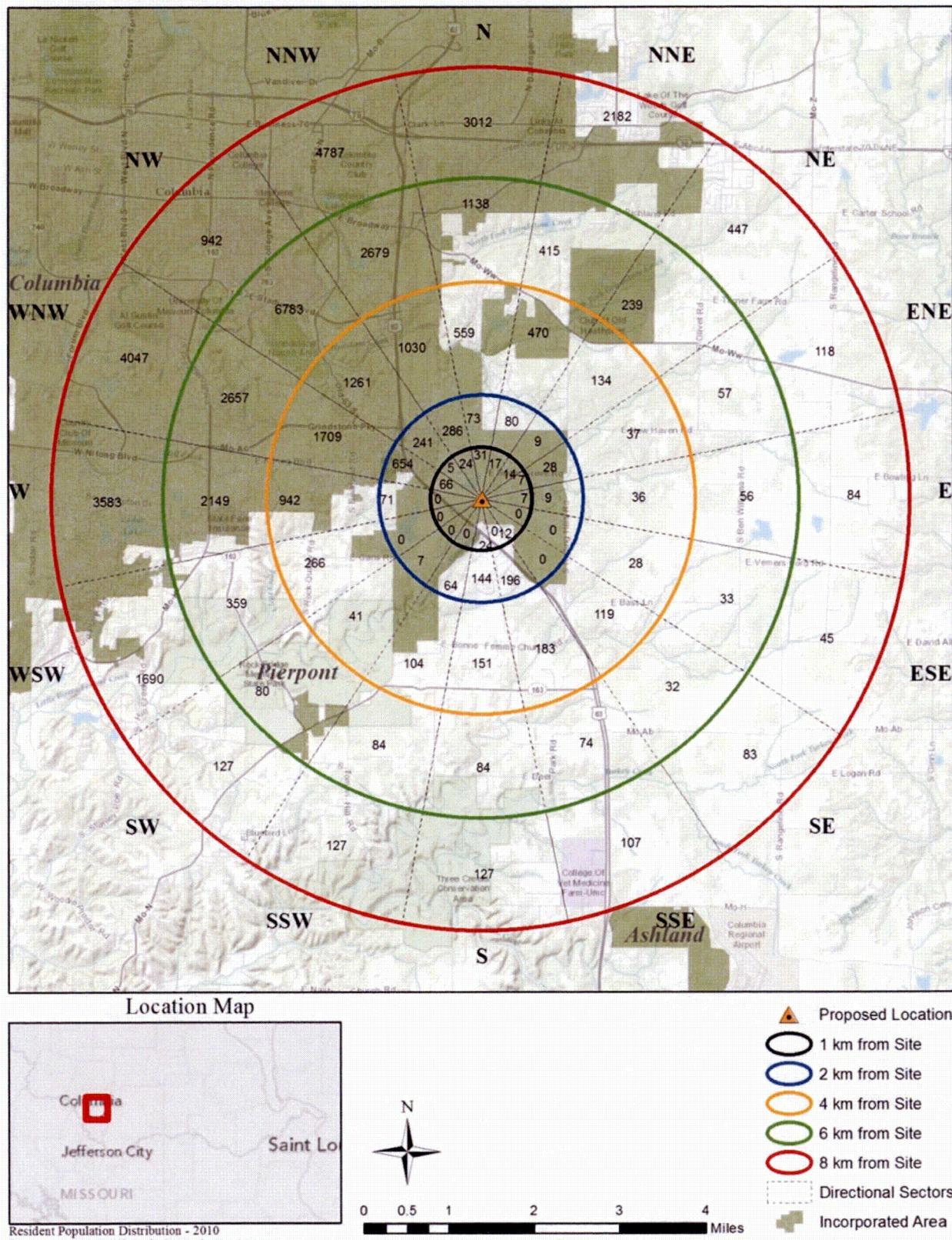


Figure 2-8. Resident Population Distribution – 2010

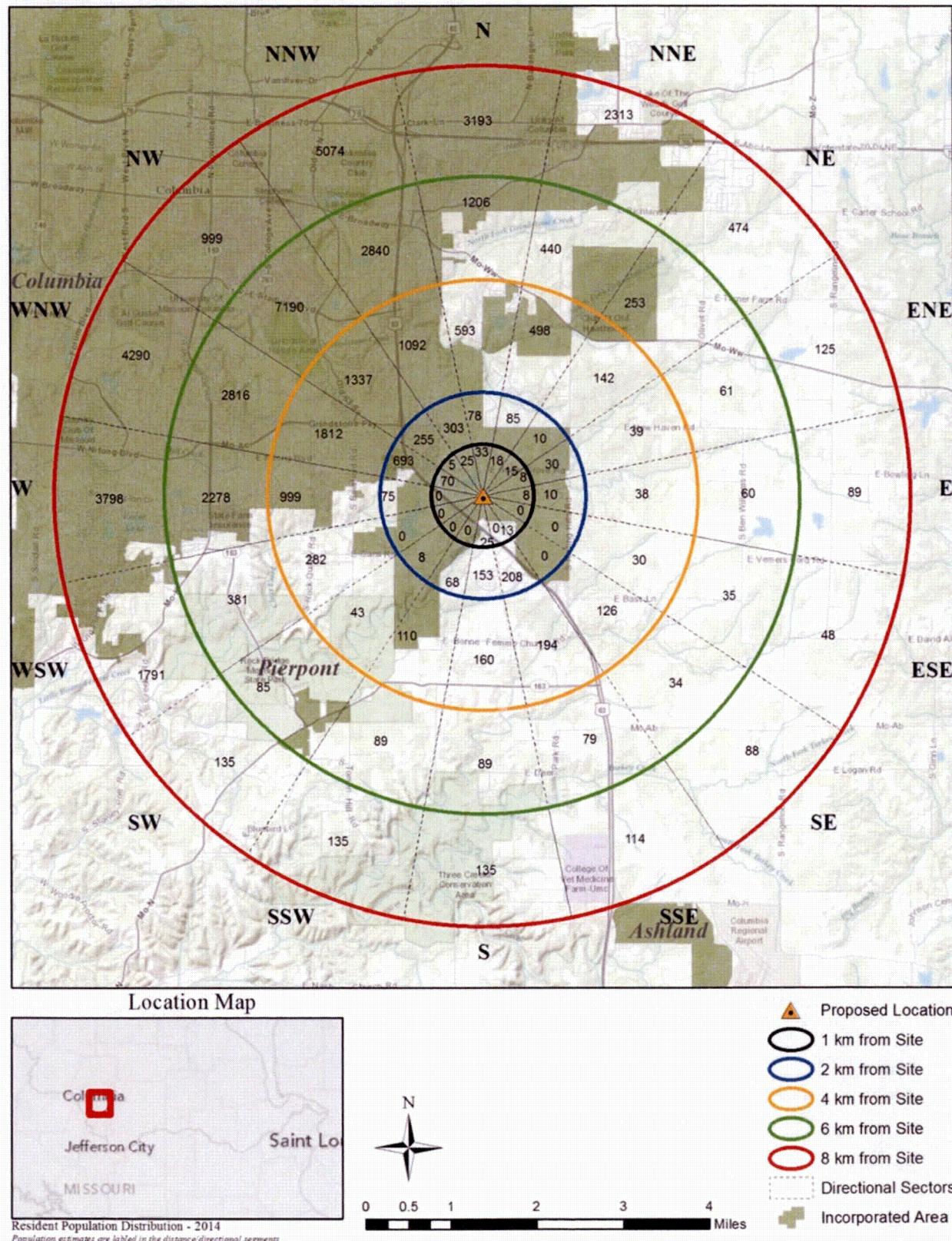


Figure 2-9. Resident Population Distribution – 2014

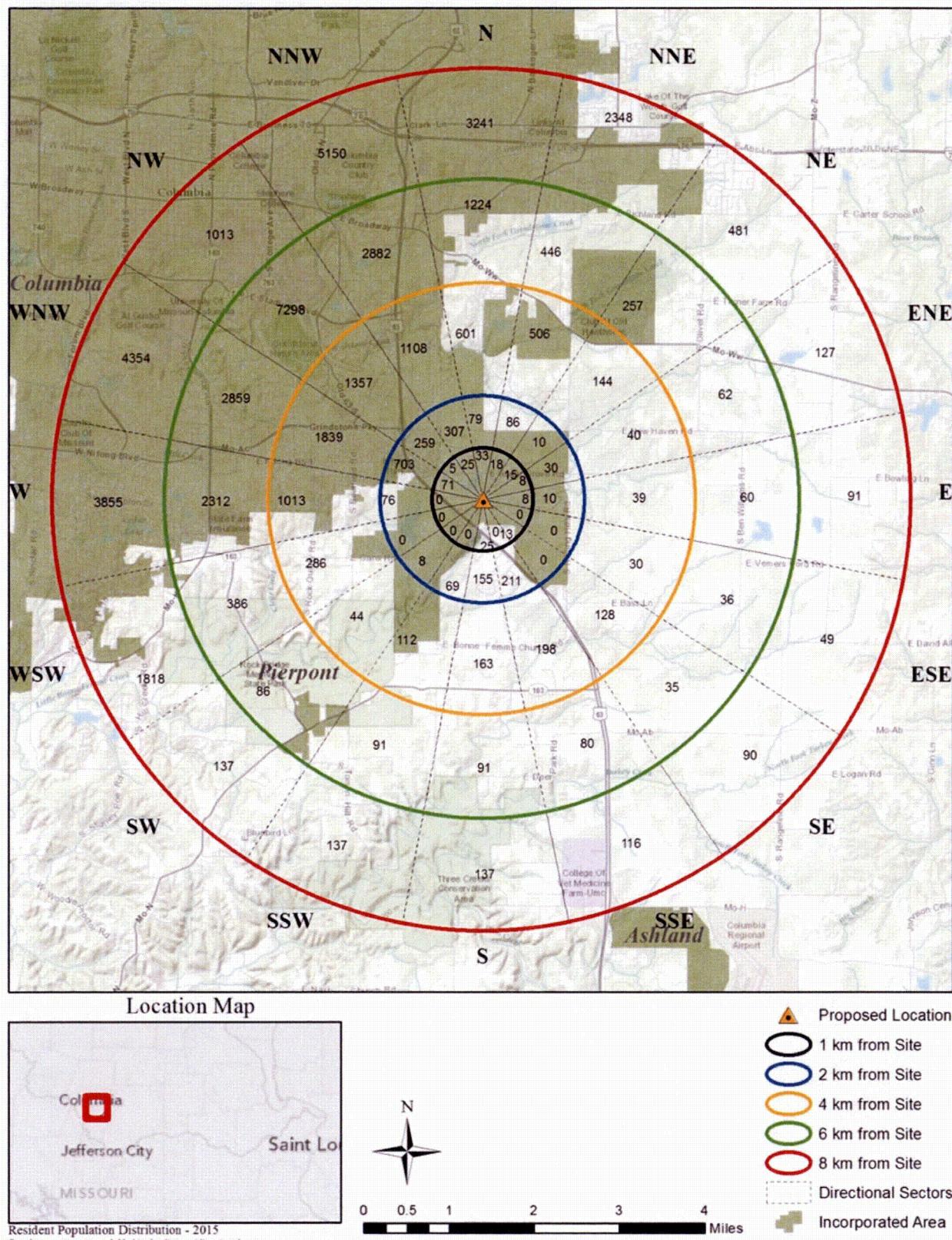


Figure 2-10. Resident Population Distribution – 2015

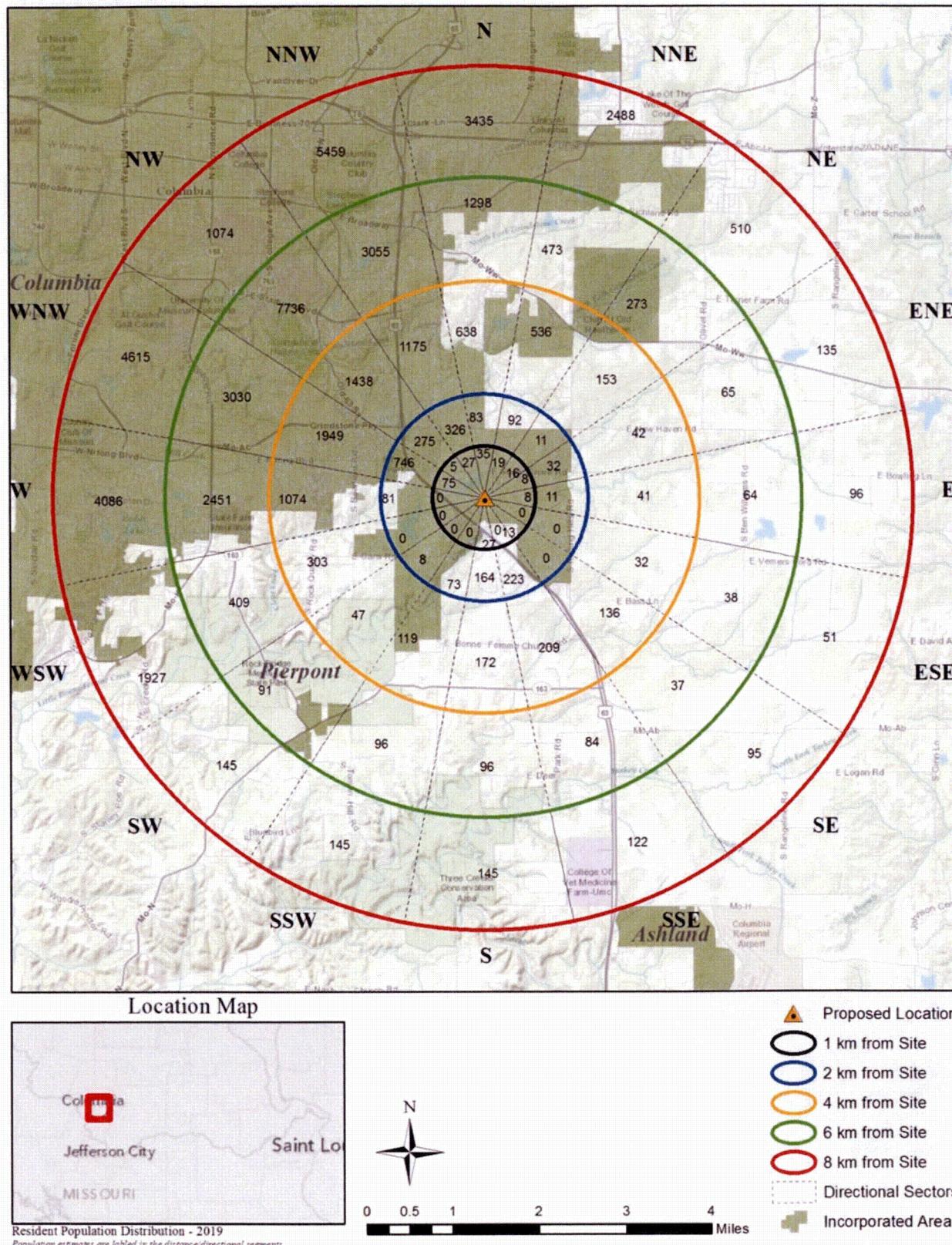


Figure 2-11. Resident Population Distribution – 2019

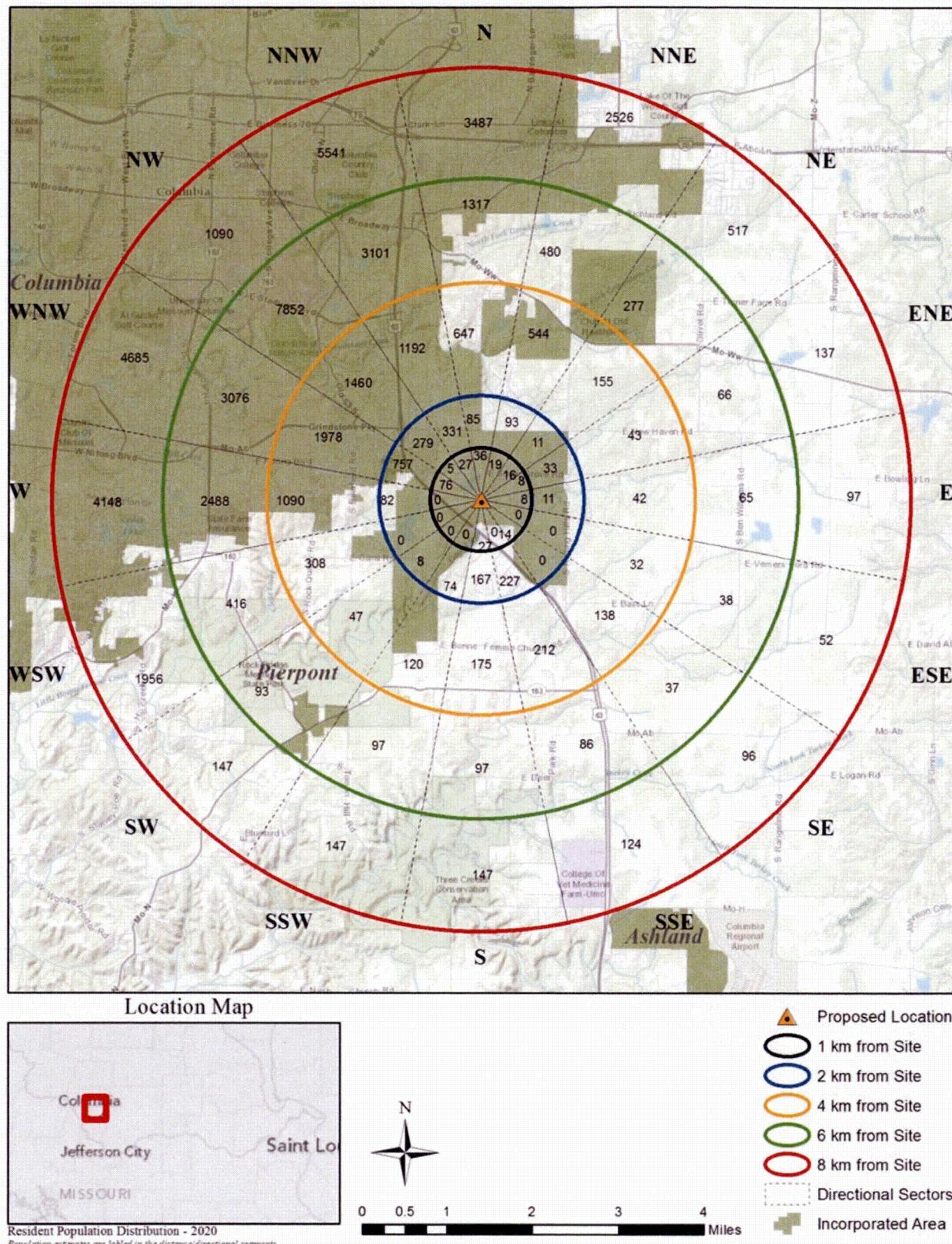


Figure 2-12. Resident Population Distribution – 2020

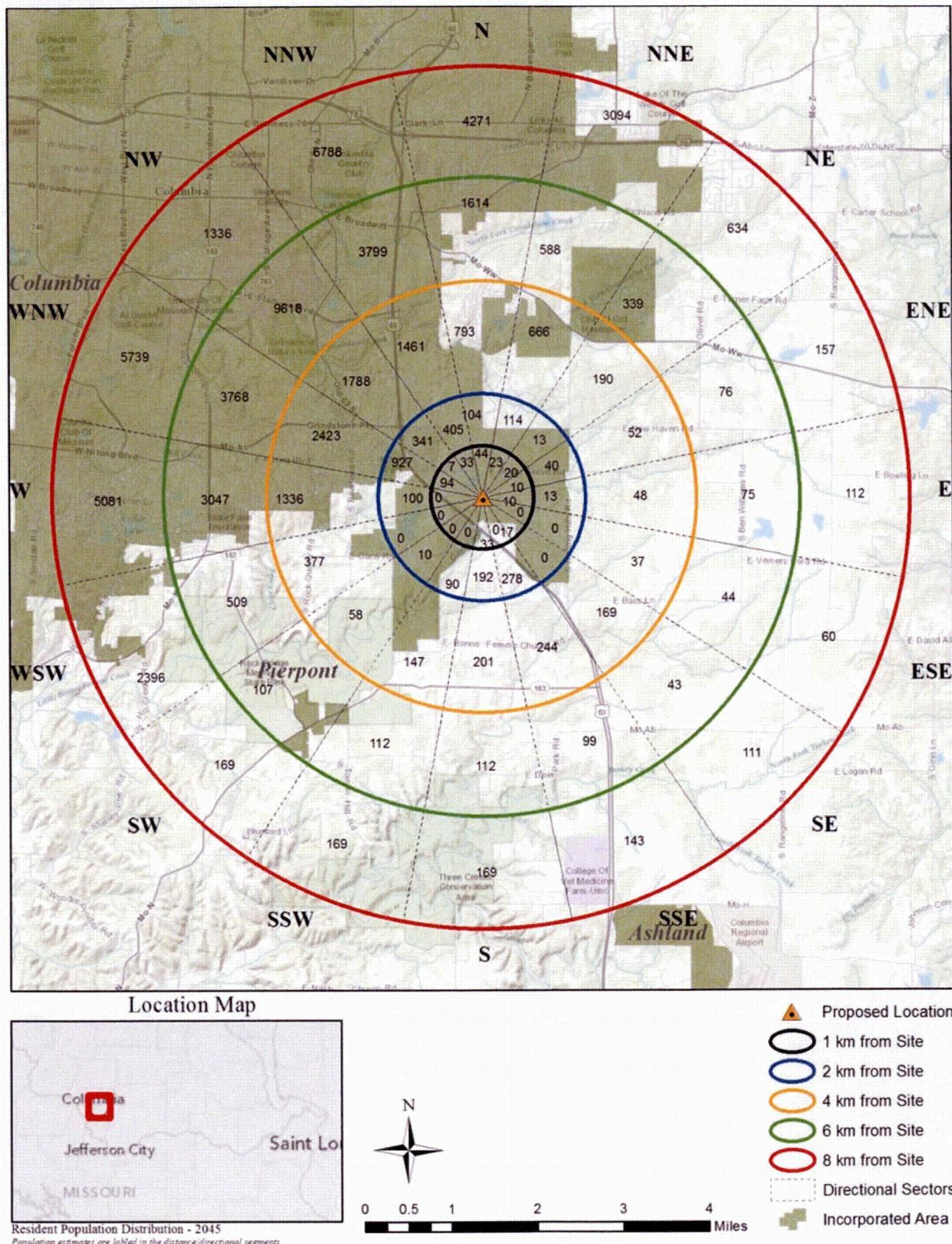


Figure 2-13. Resident Population Distribution – 2045

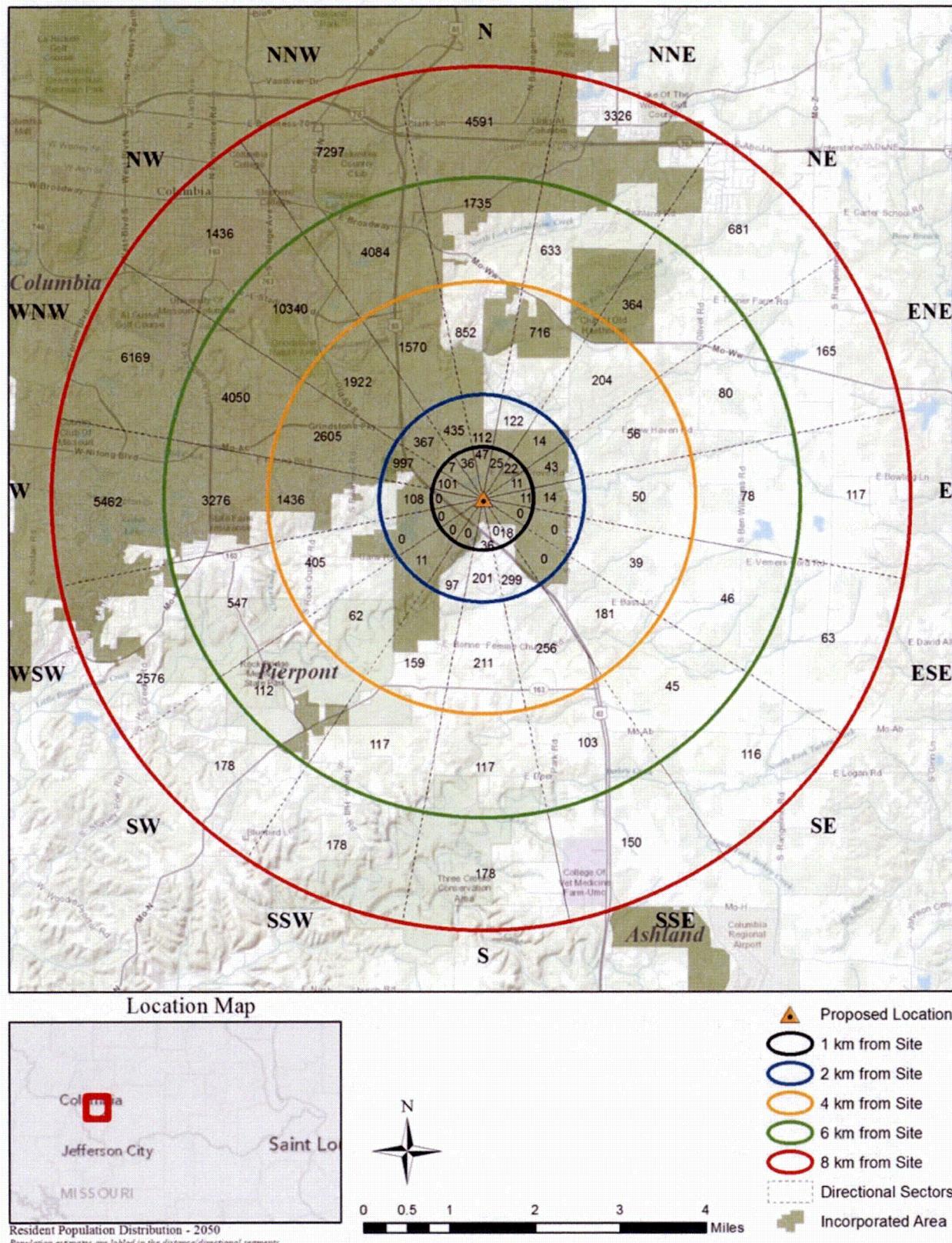


Figure 2-14. Resident Population Distribution – 2050

2.1.2.2 Transient Population

In the addition to permanent residents around the proposed RPF site, there are people who enter this area temporarily for activities such as employment, education, medical care, and lodging. Although, some residents may not leave the safety-related area for any of these above activities, it is assumed that the estimated transient population estimates represent the population that is using the area temporarily. These transient populations were estimated based on data obtained from local officials, tourist boards, and government agency websites for major employers, schools, medical facilities (hospitals and nursing homes), and lodging facilities (hotels and motels) within 8 km (5.0 mi) of the center point. Transient populations using recreation sites were not used as part of the estimate because data could not be obtained for facility daily use.

Table 2-3 lists the major employers identified within 8 km (5.0 mi) of the proposed site, the directional sector and distance band within which each employer is located, and the best available estimate of the total number of people employed at that location. Data from Regional Economic Development, Inc. was used to estimate the number of employee per major employers within the safety-related area (REDI, 2011).

Table 2-3. Employers (2 pages)

Facility	Directional sector	Distance band (km)	Employment
ABC Laboratories, Inc.	W	0 to 1	348
^a Columbia School District - New Haven	NW	1 to 2	23
Boone County Public Works	SSE	1 to 2	74
^a Columbia School District – Cedar Ridge	N	2 to 4	15
MBS Textbook Exchange	NW	2 to 4	1,084
State Farm Insurance Companies	WNW	2 to 4	1,043
^b U.S. Postal Service 341	NW	2 to 4	43
Woodhaven	WNW	2 to 4	220
MFA, Inc.	NW	2 to 4	250
^c University of Missouri	NW	4 to 6	3,162
^c University of Missouri	WNW	4 to 6	611
^c University of Missouri	NNW	4 to 6	2
^a Columbia School District – Gentry Middle School	W	4 to 6	64
^a Columbia School District – Rock Bridge	WSW	4 to 6	40
^a Columbia School District – Rock Bridge High School	W	4 to 6	107
^a Columbia School District – Sheppard Boulevard	NNW	4 to 6	30
Boyce and Bynum Pathology Laboratories, P.C.	N	4 to 6	369
^b U.S. Postal Service	W	4 to 6	43
^d Boone County National Bank	WNW	4 to 6	16
^d Boone County National Bank	NNW	4 to 6	16
Missouri Employers Mutual Insurance	NNW	4 to 6	201
^c University of Missouri	NW	6 to 8	3,273
^c University of Missouri	WNW	6 to 8	1,581
^e University Hospital and Clinics – Women's and Children's Hospital	N	6 to 8	1,412

Table 2-3. Employers (2 pages)

Facility	Directional sector	Distance band (km)	Employment
^e University Hospital and Clinics	NW	6 to 8	2,867
^a Columbia School District – Benton	NNW	6 to 8	23
^a Columbia School District – Douglass High School	NW	6 to 8	15
^a Columbia School District – Grant	NW	6 to 8	23
^a Columbia School District – Jefferson Junior High	NW	6 to 8	65
^a Columbia School District – Lee	NW	6 to 8	21
Boone Hospital Center	NW	6 to 8	1,647
City of Columbia	NW	6 to 8	1,286
U.S. Department of Veterans Affairs	NW	6 to 8	1,250
Columbia College	NW	6 to 8	490
Boone County Government	NW	6 to 8	291
^b U.S. Postal Service	NW	6 to 8	43
CenturyLink	NW	6 to 8	230
U.S. Department of Agriculture	NW	6 to 8	258
^d Boone County National Bank	W	6 to 8	16
^d Boone County National Bank	NW	6 to 8	16
^d Boone County National Bank	NW	6 to 8	16
^d Boone County National Bank	NNW	6 to 8	16
^d Boone County National Bank	NNE	6 to 8	16
Total:			22,615

Sources:

DHSS, 2013, “DHSS Community Data Profiles – Hospital Revenues from 2010-2012,” <http://health.mo.gov/data/CommunityDataProfiles/index.html>, Missouri Department of Health & Senior Services, Jefferson City, Missouri, accessed September 5, 2013.

MDE, 2013, “District Student Staff Ratios – Columbia 93,” Missouri Department of Education, Jefferson City, Missouri.

REDI, 2011, “2011 Fact Book Columbia/Boone County Missouri,” <http://www.columbiaredi.com/wp-content/uploads/2011/04/REDI-Fact-Book-11.pdf>, Regional Economic Development, Inc., Columbia, Missouri.

^a Employee estimates are based on school-to-student and administrator-to-student ratios. These are the estimated personnel who are most likely to be onsite 9 hours (hr)/day, 5 days/week.

^b The total number of post office employees (341) were divided by the total number of branches (8) located within the Columbia metropolitan area and distributed accordingly.

^c The total number of University of Missouri employees (8,630) is proportional to the area of the University of Missouri that lies within the distance/direction sector based on the area.

^d The total number of Boone County National Bank employees (275) were divided by the total number of branches (17) and distributed accordingly.

^e The total number of University Hospital and Clinics employees (4,279) is proportional to the number of licensed beds at the University Hospital and Clinics and the Women’s and Children’s Hospital.

MU is located in several of the distance/direction sections. For the employee estimate, the percentage of the university's area that falls, either partially or entirely, within that segment was calculated using ArcMap 10 GIS software (ESRI, 2011). The equivalent proportion of university's employment was then assigned to that segment. To estimate the percentage of employees for the Columbia School District within the safety-related area, the distance/direction section for each school was noted, and the number of employees at each school was estimated using teacher-to-student and administrator-to-student ratios provided by the Missouri Department of Education (MDE, 2013). The University Hospital and Clinics operates several facilities within the safety-related area. The majority of facilities are located near MU in one distance/direction section; however, the Women's and Children's Hospital is separate from these facilities. The number of licensed rooms that are managed by the University Hospital and Clinics was used to estimate the proportion of employees at the Women's and Children's Hospital (DHSS, 2013). For the population estimate for the U.S. Postal Service and Boone County National Bank, the total number of employees was divided by the total number of branches in Boone County and then assigned to the appropriate branches within the safety-related area.

Table 2-4 lists the schools identified within 8.0 km (5 mi) of the proposed site, the directional sector and distance band within which each school is located, and the best available estimate of the total number of students at that location. MU is located in several of the distance/direction sections. For the enrollment estimate, the percentage of the university's area that falls, either partially or entirely, within that segment was calculated using ArcMap 10 GIS software (ESRI, 2011). The equivalent proportion of university's enrollment was then assigned to that segment.

Table 2-4. Schools (2 pages)

Facility	Directional sector	Distance band (km)	Enrollment
New Haven	NW	1 to 2	329
Bryan University	NW	2 to 4	331
Cedar Ridge	N	2 to 4	196
William Woods University	NW	2 to 4	1,036
Christian Chapel Academy	NNW	4 to 6	153
Columbia Career Center	W	4 to 6	43
Gentry Middle School	W	4 to 6	787
Rock Bridge	WSW	4 to 6	524
Rock Bridge High School	W	4 to 6	1,820
Sheppard Boulevard	NNW	4 to 6	504
^a University of Missouri	NW	4 to 6	12,731
^a University of Missouri	NNW	4 to 6	2,458
^a University of Missouri	NNW	4 to 6	8
Benton	NNW	6 to 8	244
Children's House of Columbia	NW	6 to 8	80
Columbia College	NW	6 to 8	2,614
Columbia Independent	NW	6 to 8	230
Columbia Independent School	NW	6 to 8	117
Douglass High School	NW	6 to 8	144
Field	NNW	6 to 8	257
Grant	NW	6 to 8	304
Islamic School of Columbia	NW	6 to 8	54
Jefferson Junior High	NW	6 to 8	812

Table 2-4. Schools (2 pages)

Facility	Directional sector	Distance band (km)	Enrollment
Lee	NW	6 to 8	305
Stephens College	NNW	6 to 8	1,029
Stephens College Children's School	NNW	6 to 8	93
^a University of Missouri	NW	6 to 8	13,180
^a University of Missouri	WNW	6 to 8	6,368
Total			46,751

Sources: CHM, 2013; Columbia College, 2013; ISCM, 2013; MDE, 2013; Movoto, 2013; MU, 2013; NCES, 2013; New America Foundation, 2013; School Digger, 2013; and US News, 2013.

^a The total University of Missouri enrollment (34,748) is proportional to the area of the University of Missouri that lies within the distance/direction sector based on the area.

Table 2-5 lists the medical facilities (hospitals and nursing homes) identified within 8 km (5.0 mi) of the proposed RPF site, the directional sector and distance band within which each facility is located, and the best available estimate of the total in-patient capacity (number of licensed beds) at that location. Medical facilities that do not have licensed beds (out-patient facilities) for patients to reside for more than one day were not included in the transient population estimate because visitations for these facilities are temporary (less than 8 hr/day).

Table 2-5. Medical Facility

Facility	Directional sector	Distance band (km)	Licensed beds
Lenoir Manor	WNW	1 to 2	84
Tiger Place	NW	2 to 4	112
Lenoir Health Care Center	NW	2 to 4	122
The Bluffs	NW	2 to 4	132
Columbia Manor Care	WNW	2 to 4	52
Bluff Creek Terrace	NW	2 to 4	52
Neighborhoods Rehabilitation and Skilled Nursing	NW	2 to 4	120
Boone Hospital Center	NNW	6 to 8	400
Landmark Hospital	NNW	6 to 8	42
University Hospital and Clinics	NW	6 to 8	383
^a Women's and Children's Hospital	N	6 to 8	190
Daybreak Residential Treatment Center	NW	6 to 8	14
Harambee House, Inc.	NW	6 to 8	15
Columbia Healthcare Center	NNW	6 to 8	97
Harry S Truman Memorial Veterans	NW	6 to 8	126

Source: DHSS, 2013, "DHSS Community Data Profiles – Hospital Revenues from 2010-2012," <http://health.mo.gov/data/CommunityDataProfiles/index.html>, Missouri Department of Health & Senior Services, Jefferson City, Missouri, accessed September 5, 2013.

^a In 2010, Columbia Regional Hospital became Women's and Children's Hospital.

Table 2-6 lists lodging facilities (hotels and motels) identified within 8 km (5.0 mi) of the proposed site, the directional sector and distance band within which each facility is located, and the best available estimate of the lodging capacity (number of rooms) at that location.

Table 2-6. Lodging Facilities

Facility	Directional sector	Distance band (km)	Room
Courtyard by Marriott	NW	2 to 4	125
Hampton Inn & Suites	NW	4 to 6	134
Stoney Creek Inn & Conference Center	WNW	4 to 6	181
Candlewood Suites	N	6 to 8	81
Baymont Inn & Suites	N	6 to 8	65
Country Inn & Suites	N	6 to 8	85
Fairfield Inn & Suites	N	6 to 8	91
Hampton Inn	N	6 to 8	120
Holiday Inn East	NNE	6 to 8	126
Ramada Inn & Suites	NNW	6 to 8	89
Residence Inn	N	6 to 8	80
Staybridge	N	6 to 8	82
Super 8	N	6 to 8	75
Super 8 East	NNE	6 to 8	56
The Gathering Place	NW	6 to 8	5
The Tiger Hotel	NW	6 to 8	62
University Ave Bed & Breakfast	NW	6 to 8	4
Wingate	N	6 to 8	81

Sources:

Columbia Convention and Visitors Bureau, 2013, “Where to stay- Hotels, Inns, and Motels,” <http://www.visitcolumbiamo.com/section/stay/>, Columbia, Missouri, accessed September 9, 2013.

Cvent, 2013, “Hotels near Columbia MO,” <http://www.cvent.com/RFP/Venues.aspx?ist=6&ma=97&csn=1&vtt=1#page-6&so-1>, Cvent Supplier Network, Tysons Corner, Virginia, accessed September 9, 2013.

The estimates provided in Table 2-7 represent the total number of people expected to be at each facility for any part of the day, with no consideration of the length of time they are likely to be there. To more accurately represent the transient population around the proposed site, the values in Table 2-7 were weighted according to the length of time people could be expected to stay at each facility, assuming typical use patterns for that type of facility. The estimates for employers and schools were multiplied by a weighting factor of 0.27, which assumes that each employee or student is present at the facility 9 hr/day and 5 days/week. The estimates for medical facilities were multiplied by a weighting factor that was determined by the specific use. For hospitals and clinics, the known occupation rate for each facility was multiplied by the number of licensed beds, which assumes at any one time only a percentage of the beds are in use (DHSS, 2013). Nursing homes were not multiplied by any weighting factor, effectively assuming that each available room is occupied 24 hr/day and 7 days/week. The estimates for lodging facilities in the city of Columbia were multiplied by the average occupancy rate (60 percent) (Reed, 2010).

Table 2-7. Weighted Transient Population Estimates by Source

Distance band (km)	Major employers	Schools	Medical facilities (hospitals and assisted living)	Lodging (hotels and motels)	Totals
0 - 1	94	0	0	0	94
1 - 2	26	89	84	0	199
2 - 4	717	423	590	75	1,805
4 - 6	1,258	5,143	0	189	6,590
6 - 8	4,011	6,982	804	661	12,458
0 - 8 (Total)	6,106	12,637	1,478	925	21,146

The weighted 2010 transient population estimates calculated for each type of facility in each distance band area summarized in Table 2-7. Figure 2-15 shows the weighted 2010 transient population estimates divided into the distance/direction segments.

Using the same population projection methodologies used for resident populations, the 2010 transient population estimates within the distance bands and directional sectors were extrapolated to the years 2014, 2015, 2019, 2020, 2045, and 2050. Table 2-8 shows the total projected transient population for these years within the distance bands, and Figure 2-15 through Figure 2-21 show the population projections for these years divided into the distance/direction segments.

Table 2-8. Total Project Transient Population

Year	Distance Band (km)						Total 0 – 8
	0 – 1	1 – 2	2 – 4	4 – 6	6 – 8		
2010	94	199	1,805	6,590	12,458		21,146
2014	100	211	1,913	6,985	13,205		22,414
2015	101	214	1,942	7,092	13,404		22,753
2019	107	227	2,058	7,515	14,208		24,115
2020	109	230	2,089	7,629	14,422		24,479
2045	133	282	2,559	9,345	17,666		29,985
2050	143	303	2,752	10,045	18,992		32,235

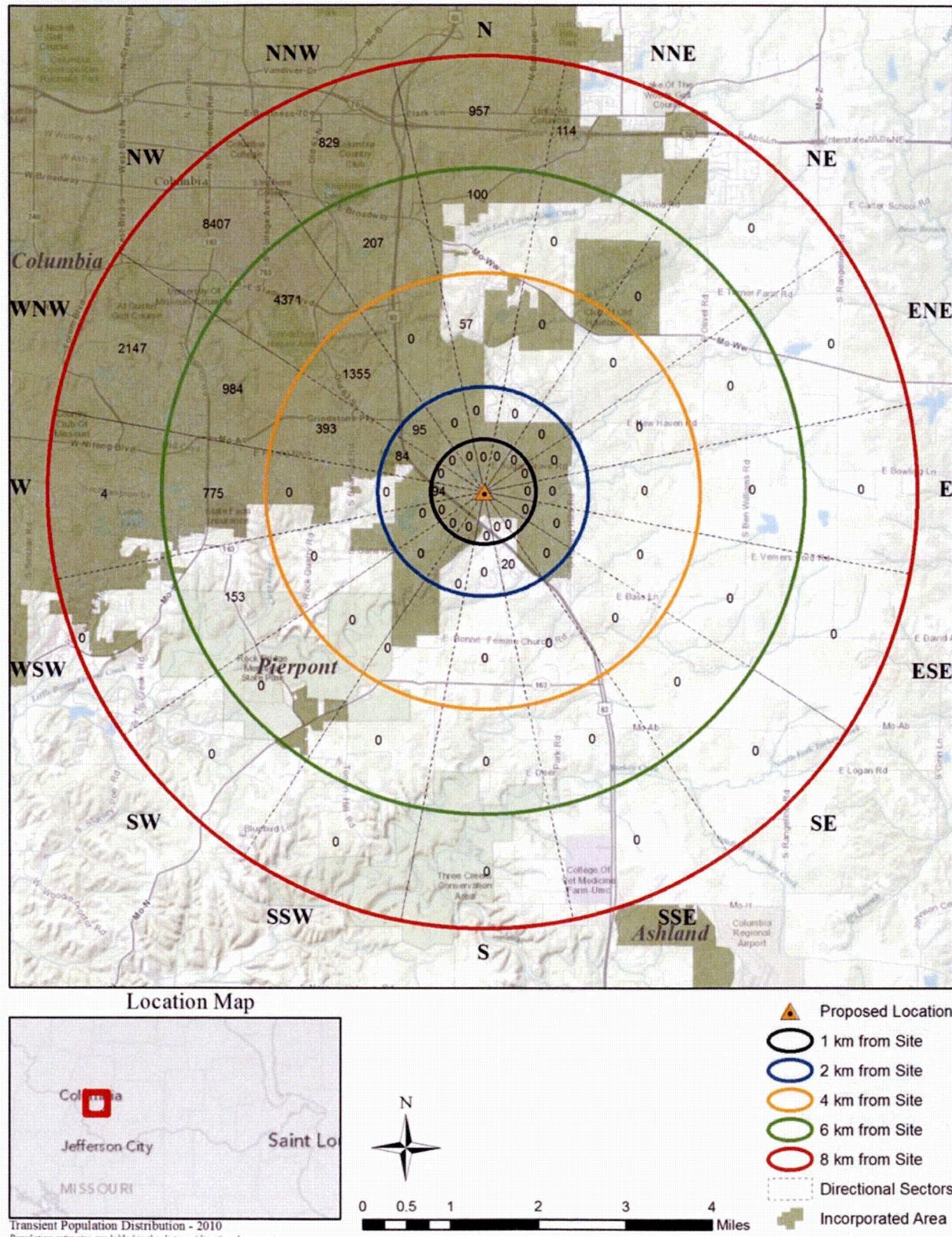


Figure 2-15. Transient Population Distribution – 2010

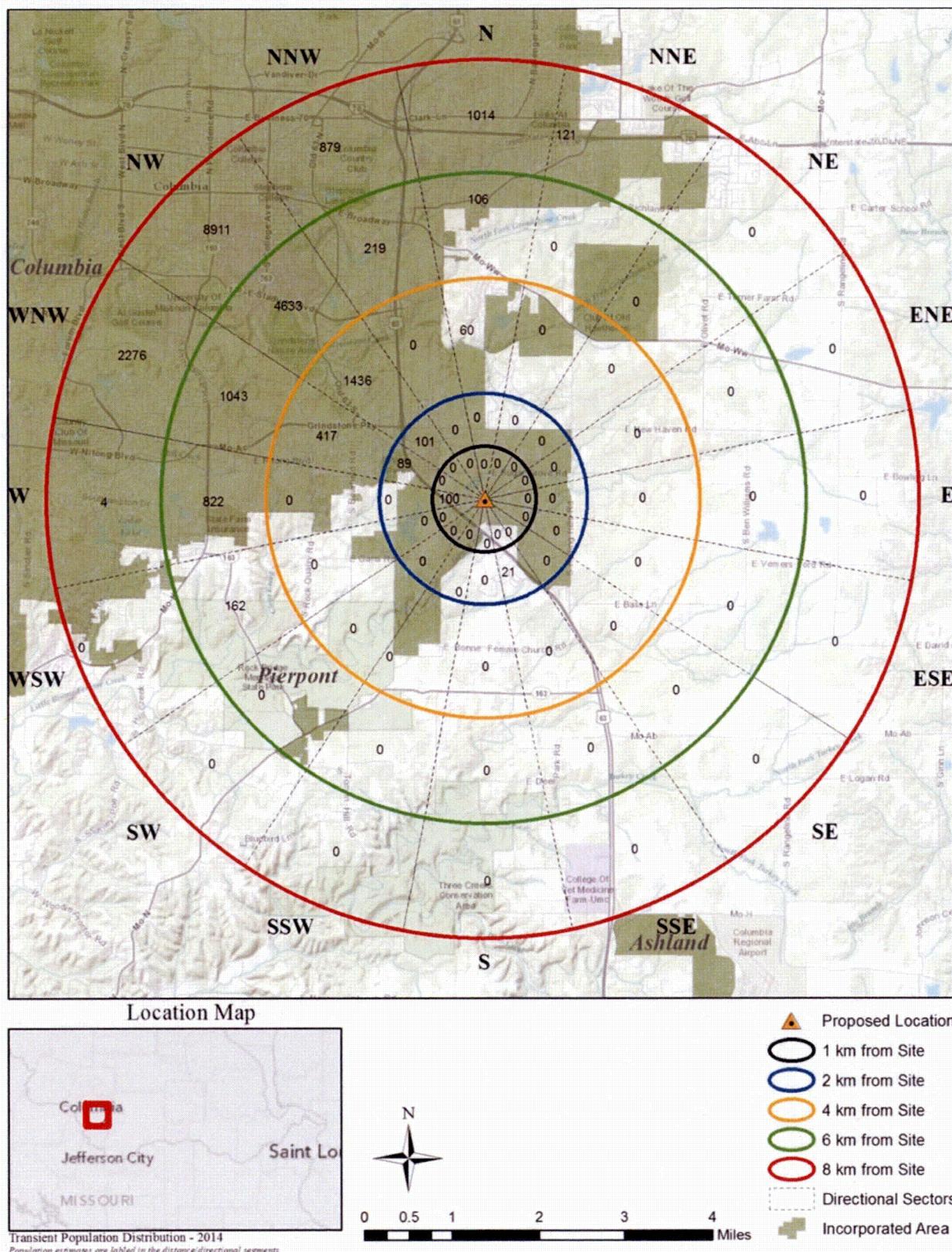


Figure 2-16. Transient Population Distribution – 2014

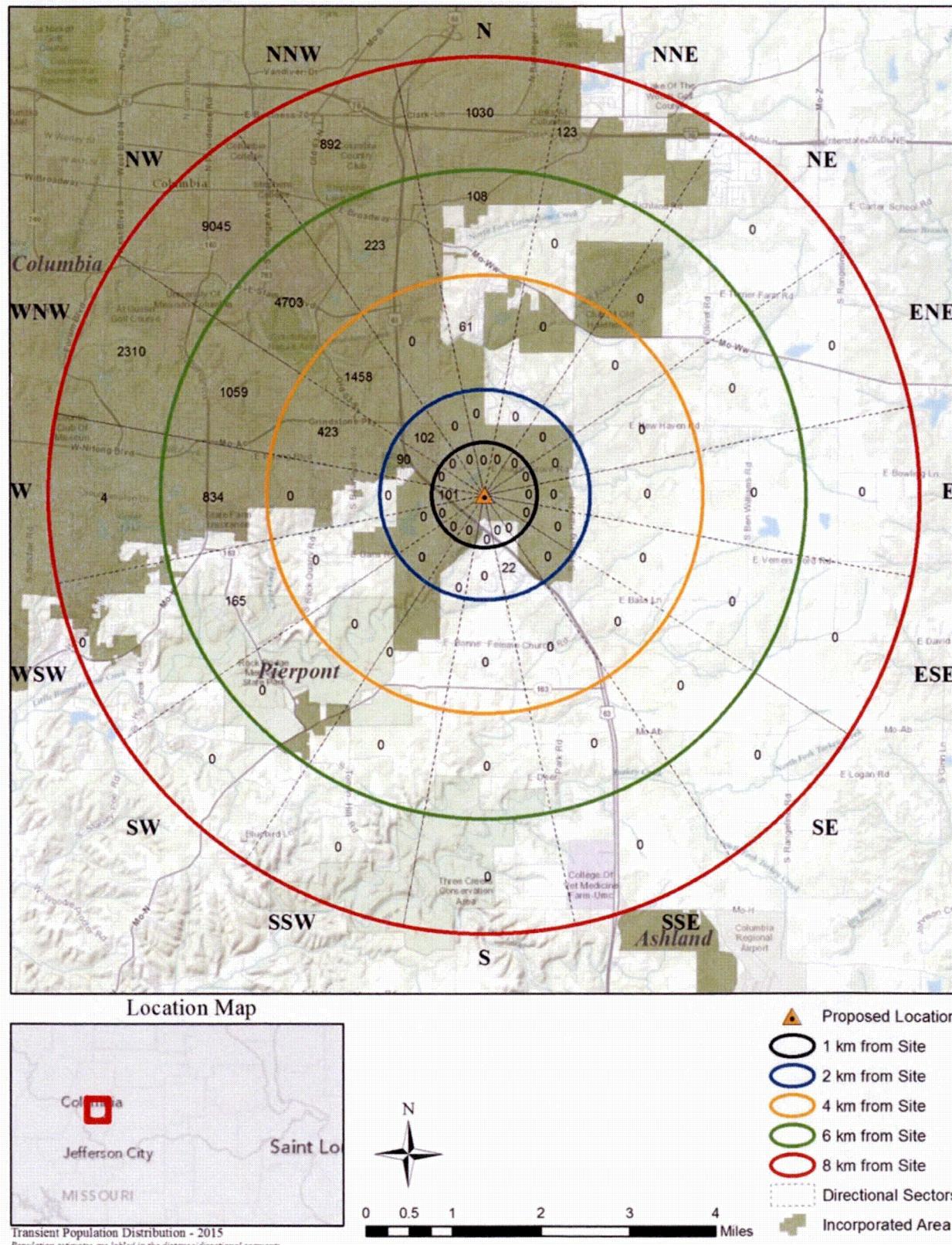


Figure 2-17. Transient Population Distribution – 2015

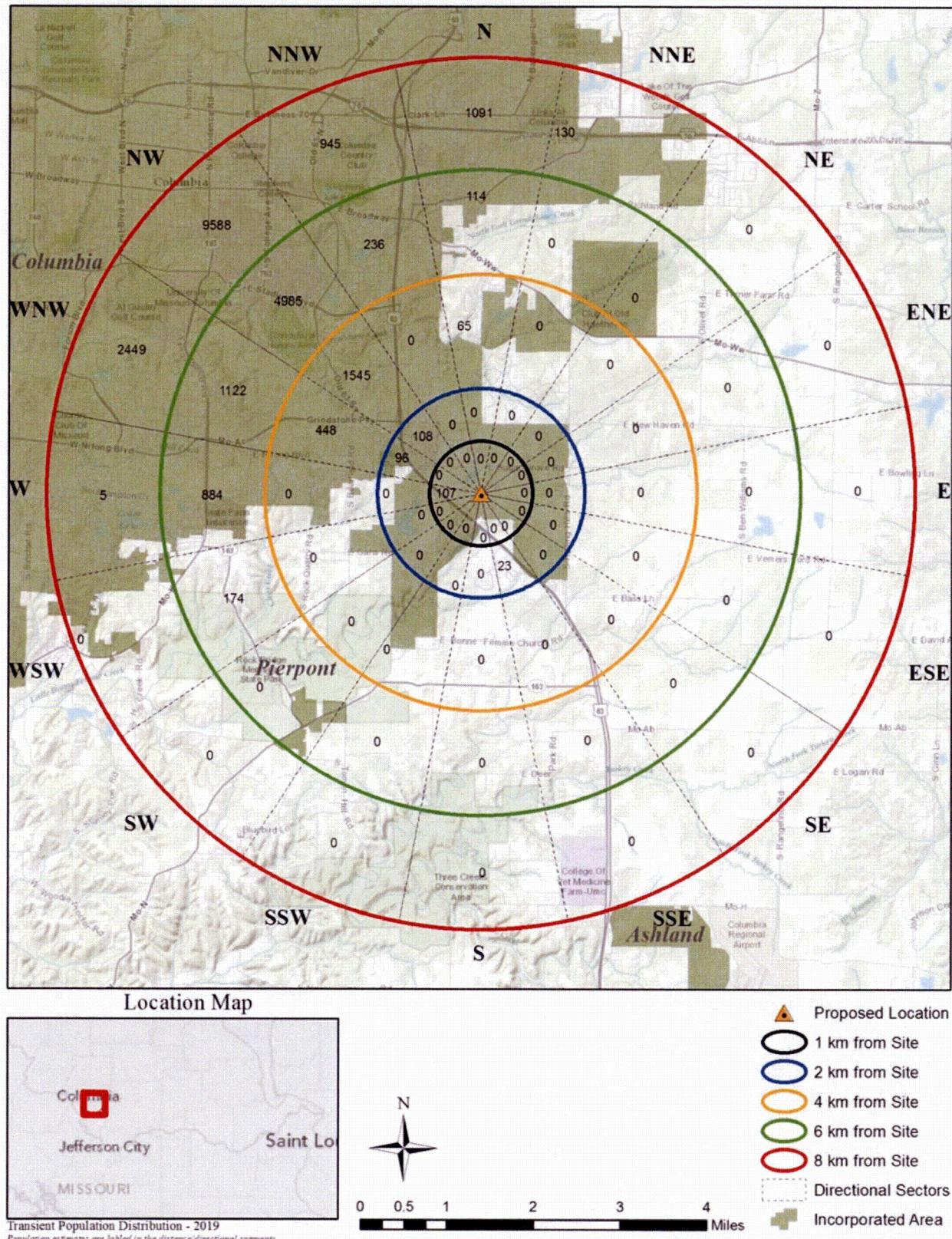


Figure 2-18. Transient Population Distribution – 2019

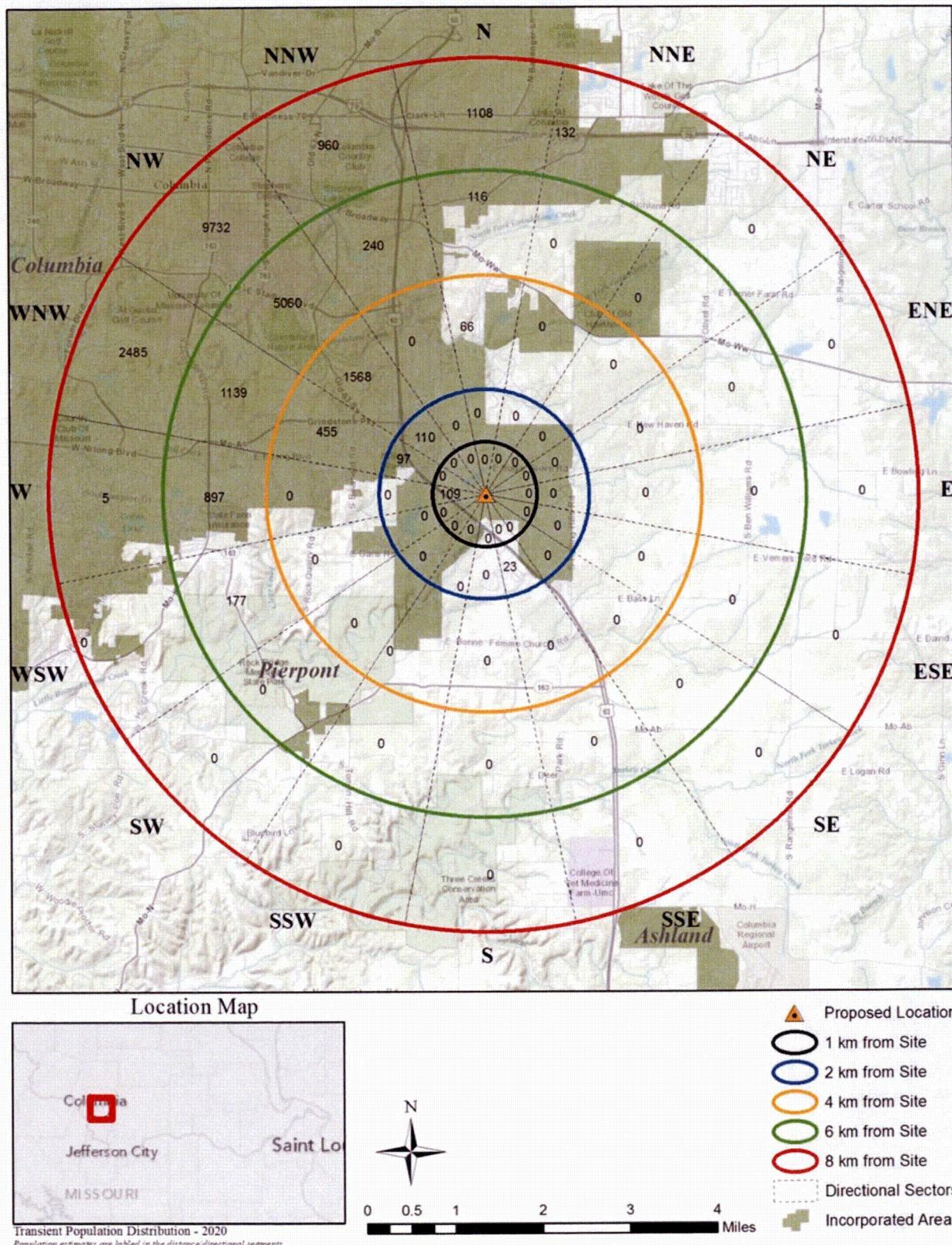


Figure 2-19. Transient Population Distribution – 2020

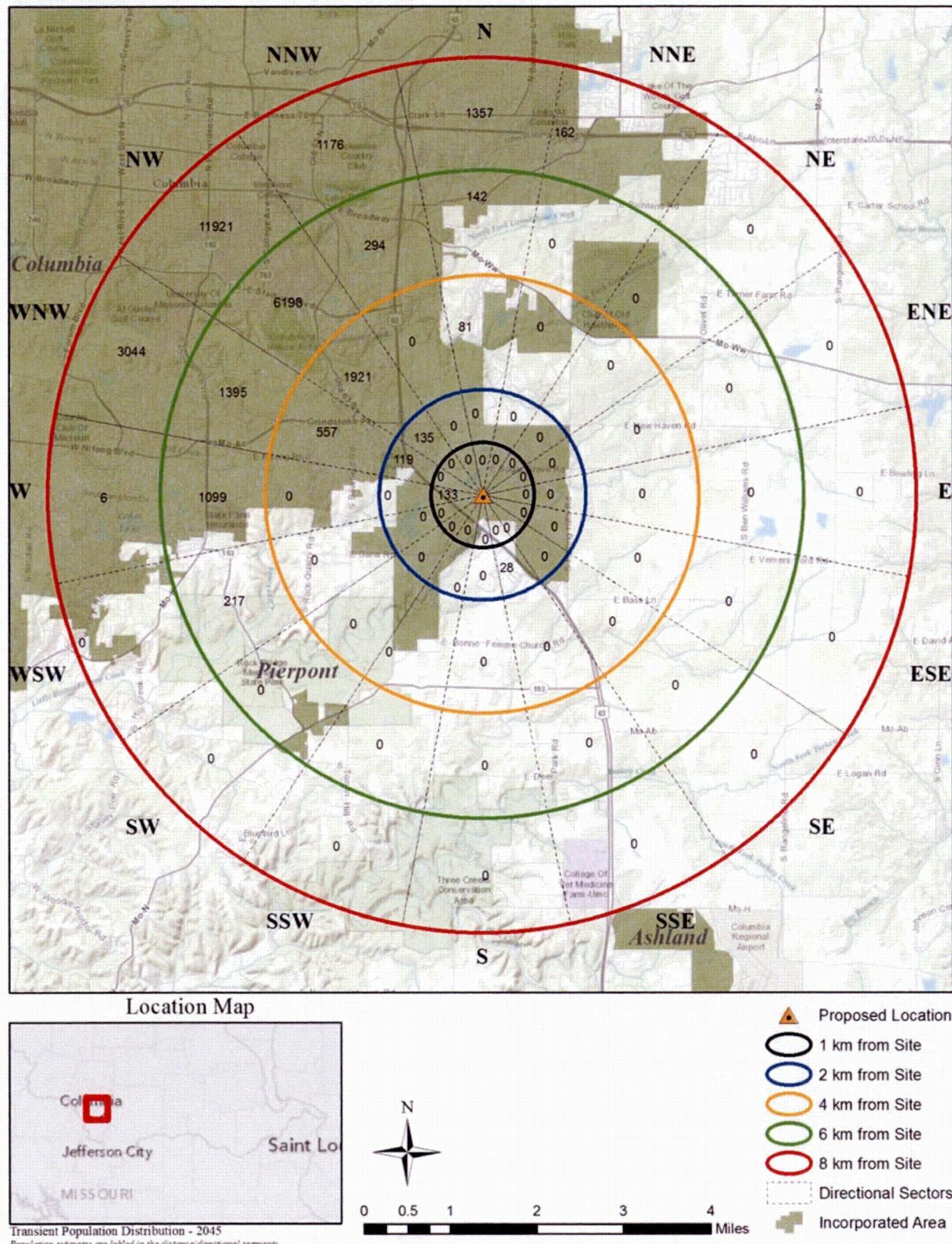


Figure 2-20. Transient Population Distribution – 2045

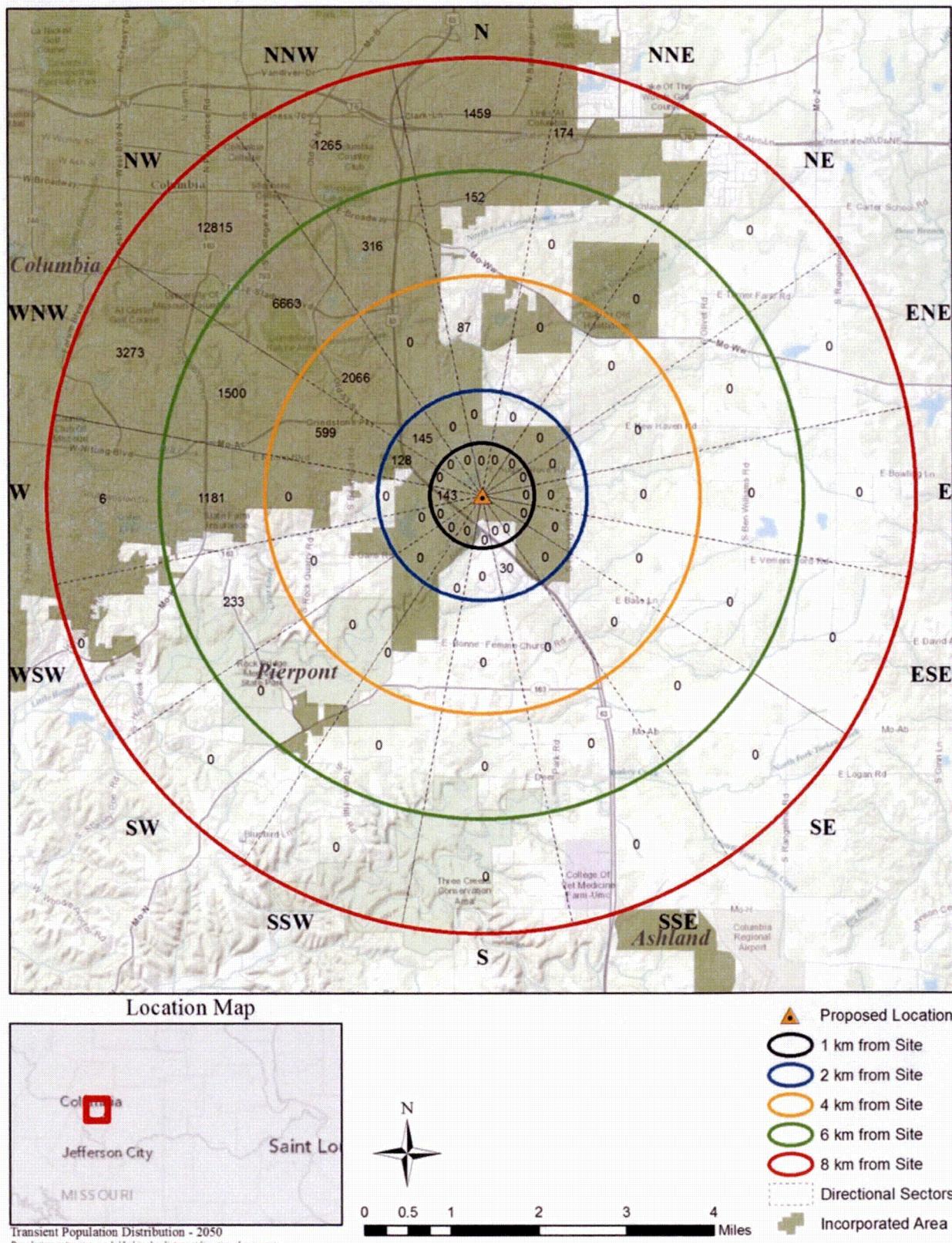


Figure 2-21. Transient Population Distribution – 2050

2.1.3 Combined Resident and Transient Population

The estimated 2010 and projected future resident and transient population values were summed to obtain an indication of the effective total population around the project site. Table 2-9 summarizes the combined resident and transient population values for all the years within the distance bands, and Figure 2-22 through Figure 2-28 show that combined populations for all years divided into the distance/directional segments.

Table 2-9. Combined Resident and Transient Population

Year	Distance band (km)					
	0 – 1	1 – 2	2 – 4	4 – 6	6 – 8	Total 0 – 8
2010	299	2,061	8,875	23,509	33,966	68,710
2014	318	2,185	9,408	24,921	36,006	72,837
2015	322	2,218	9,550	25,297	36,547	73,934
2019	341	2,351	10,121	26,811	38,738	78,362
2020	347	2,386	10,273	27,214	39,319	79,539
2045	424	2,910	12,550	33,293	48,094	97,272
2050	456	3,123	13,479	35,773	51,675	104,506

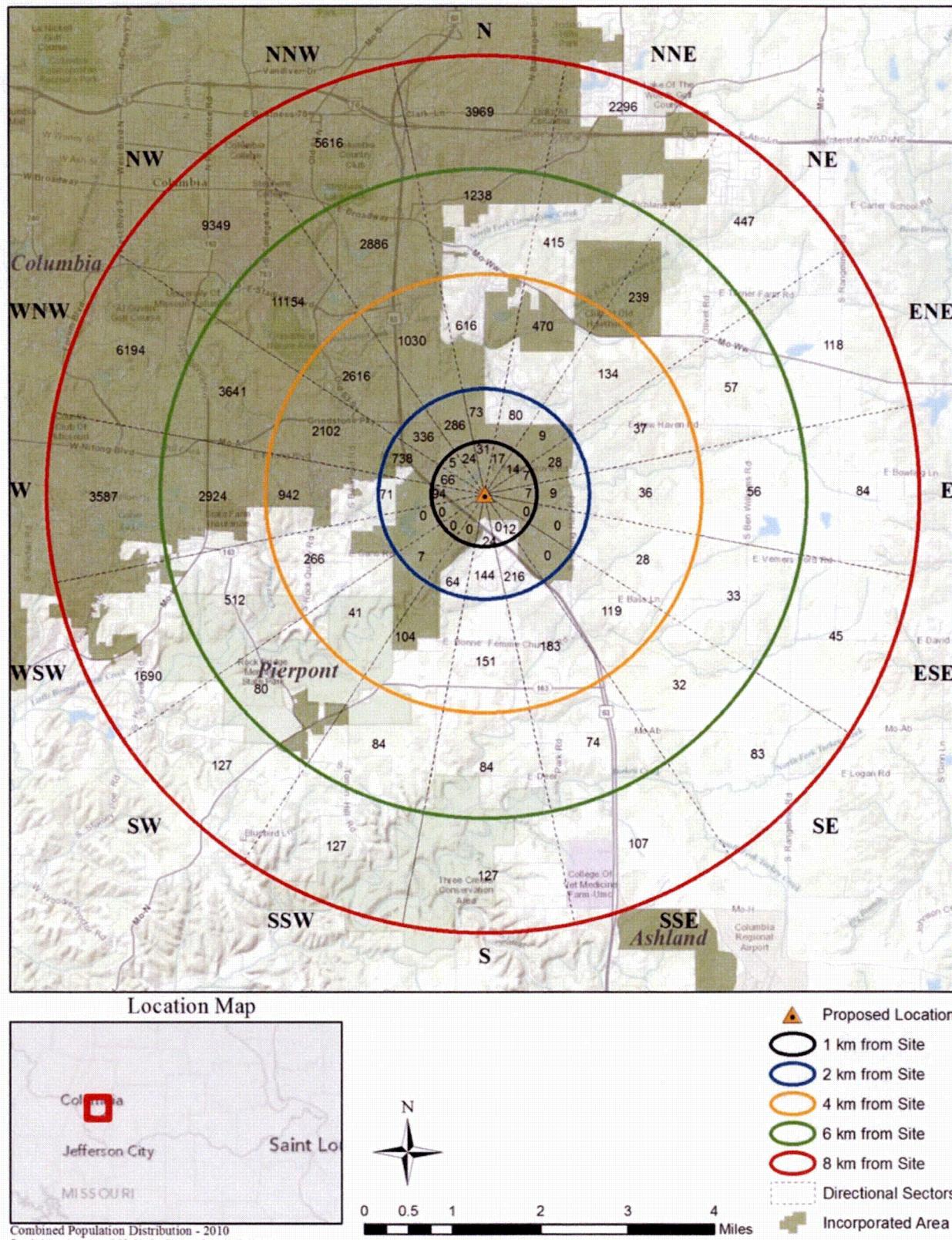


Figure 2-22. Combined Population Distribution – 2010

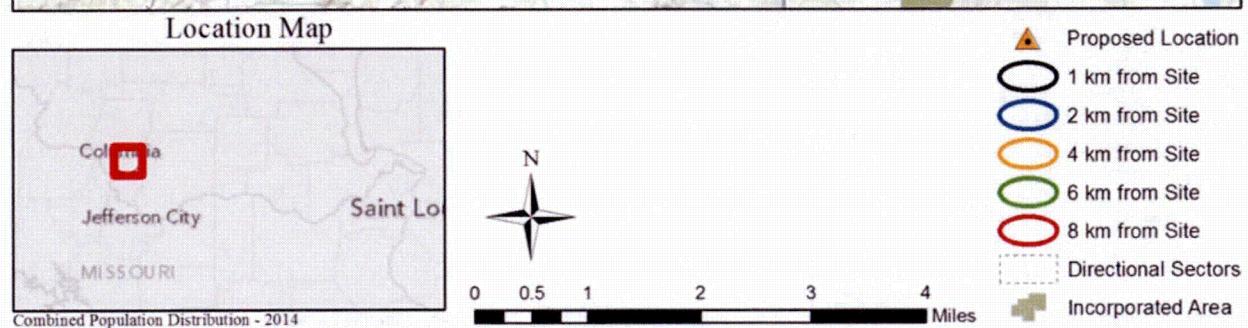
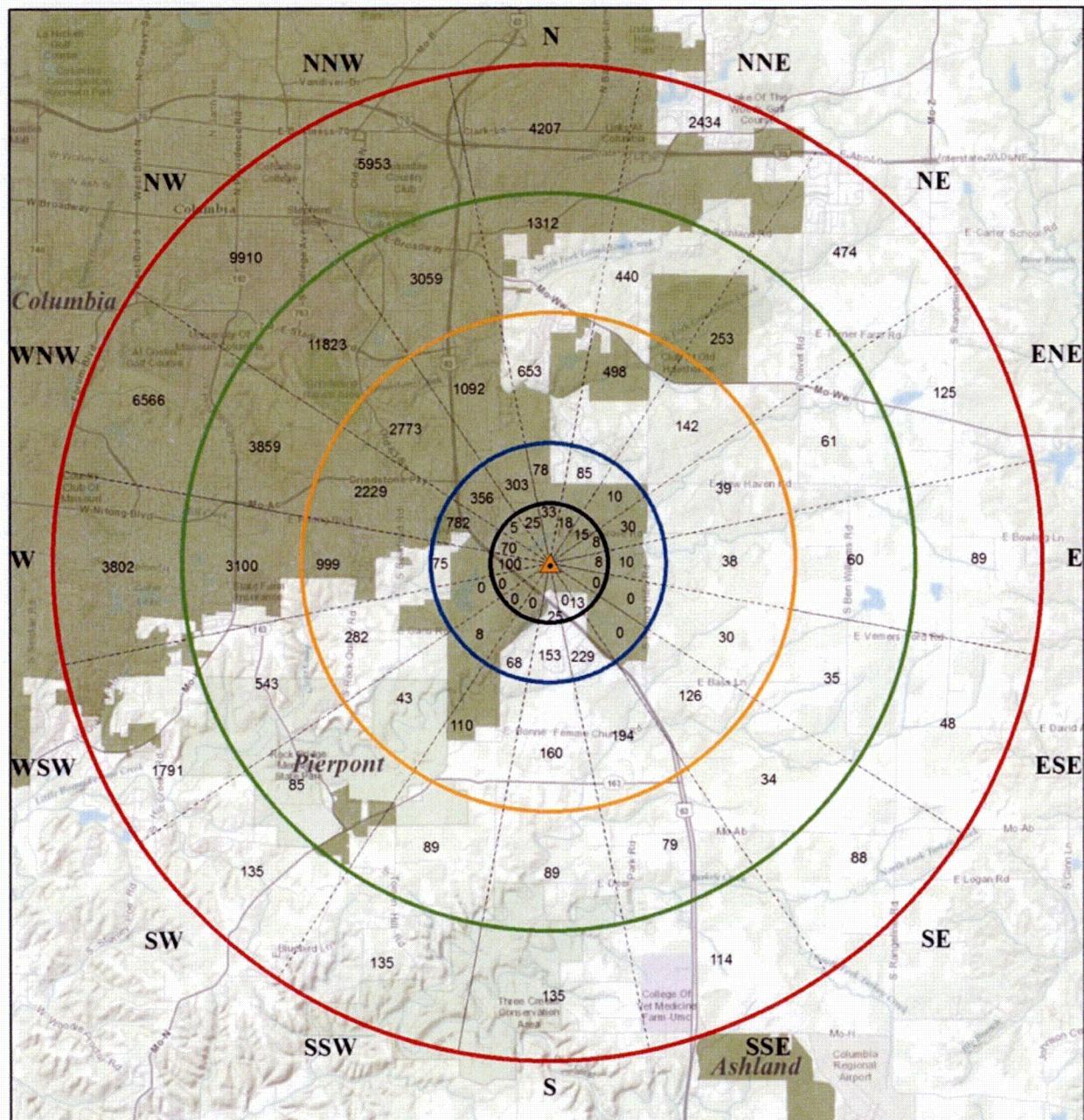
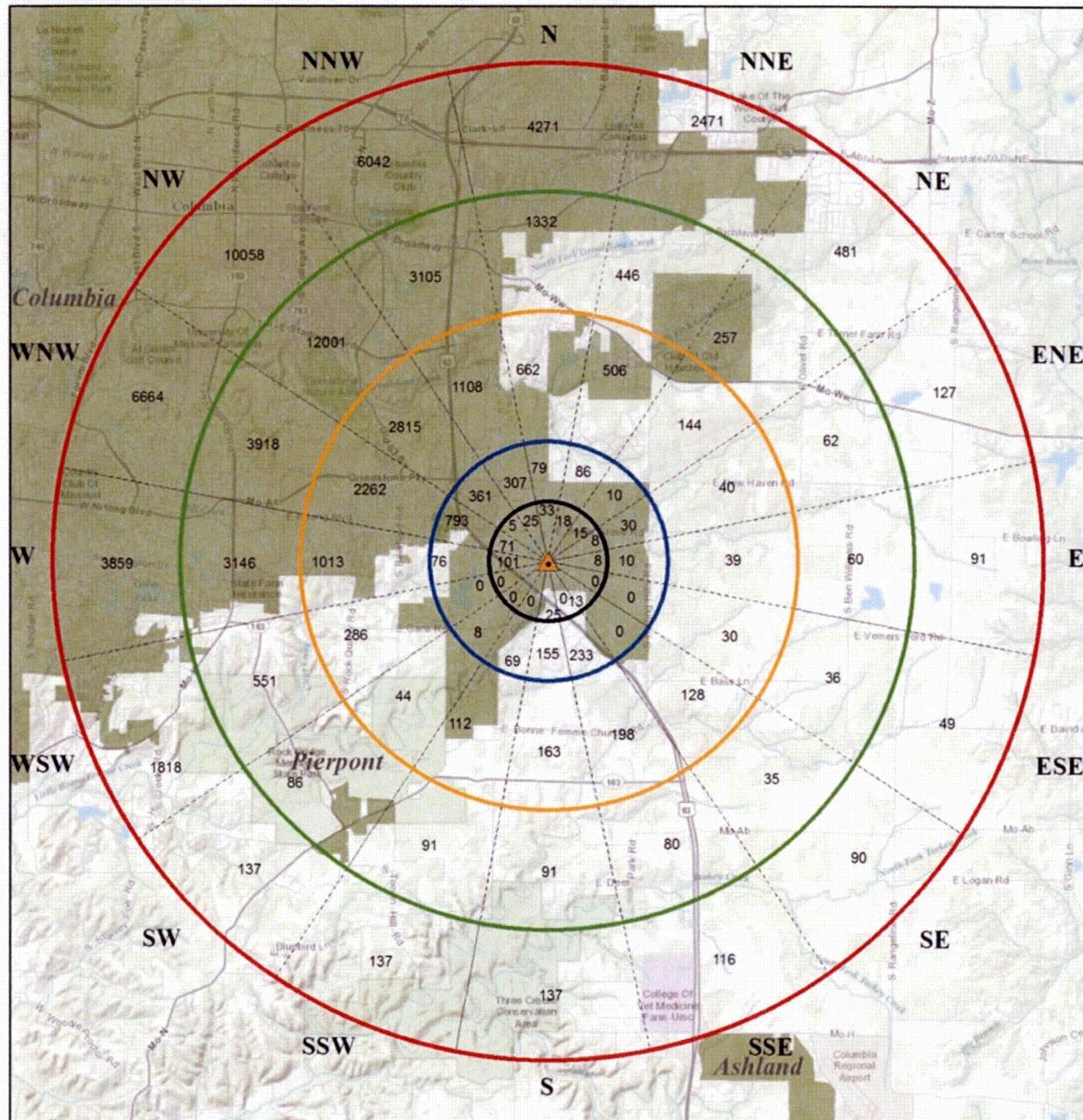
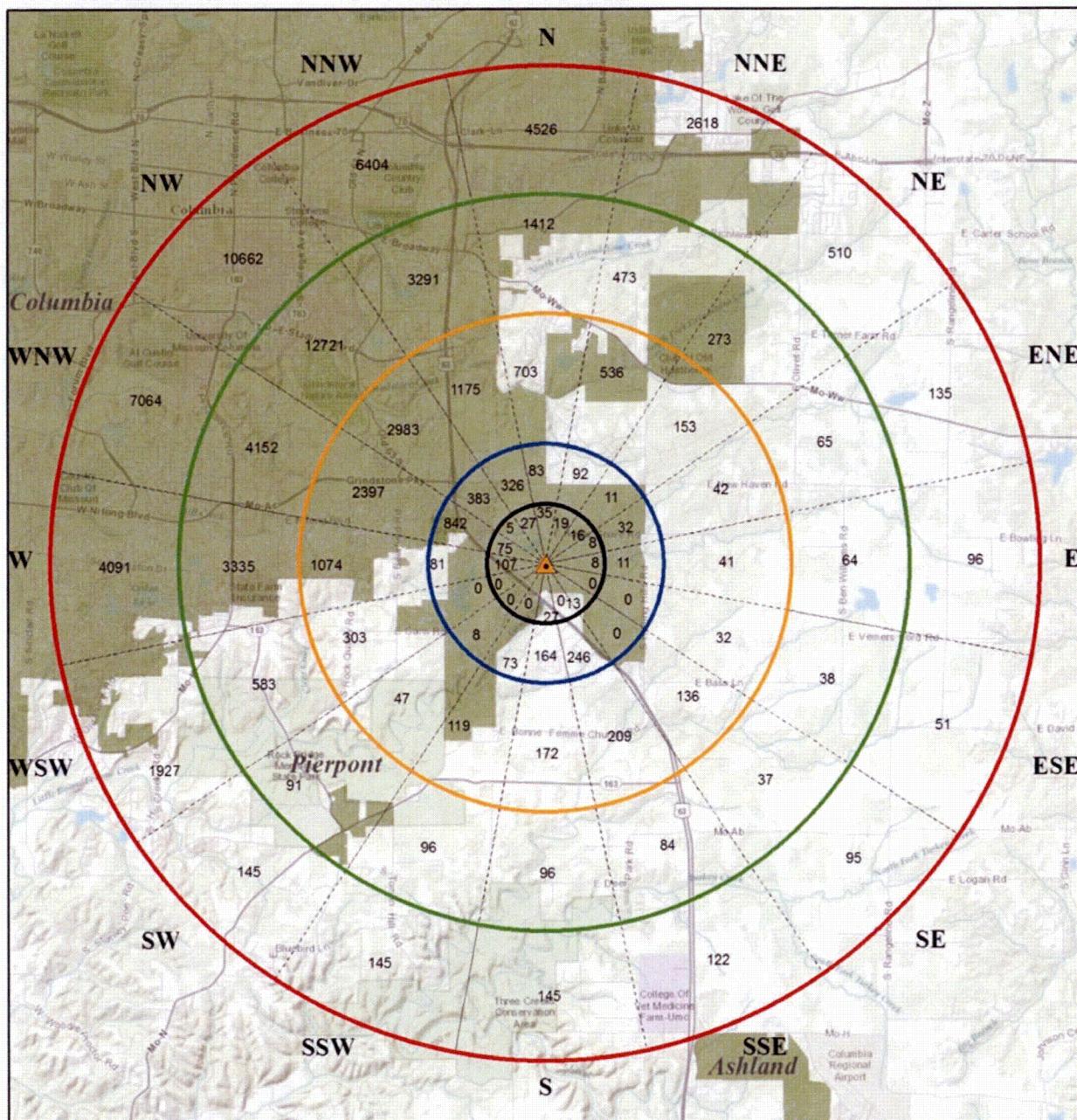


Figure 2-23 Combined Population Distribution – 2014





Location Map

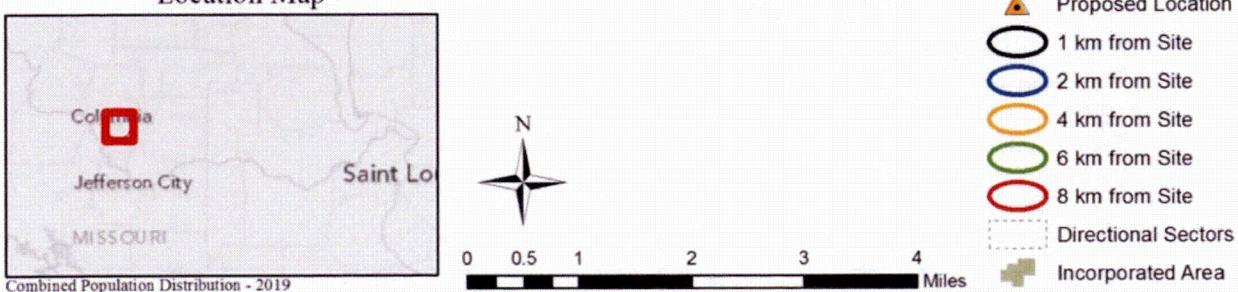


Figure 2-25. Combined Population Distribution – 2019

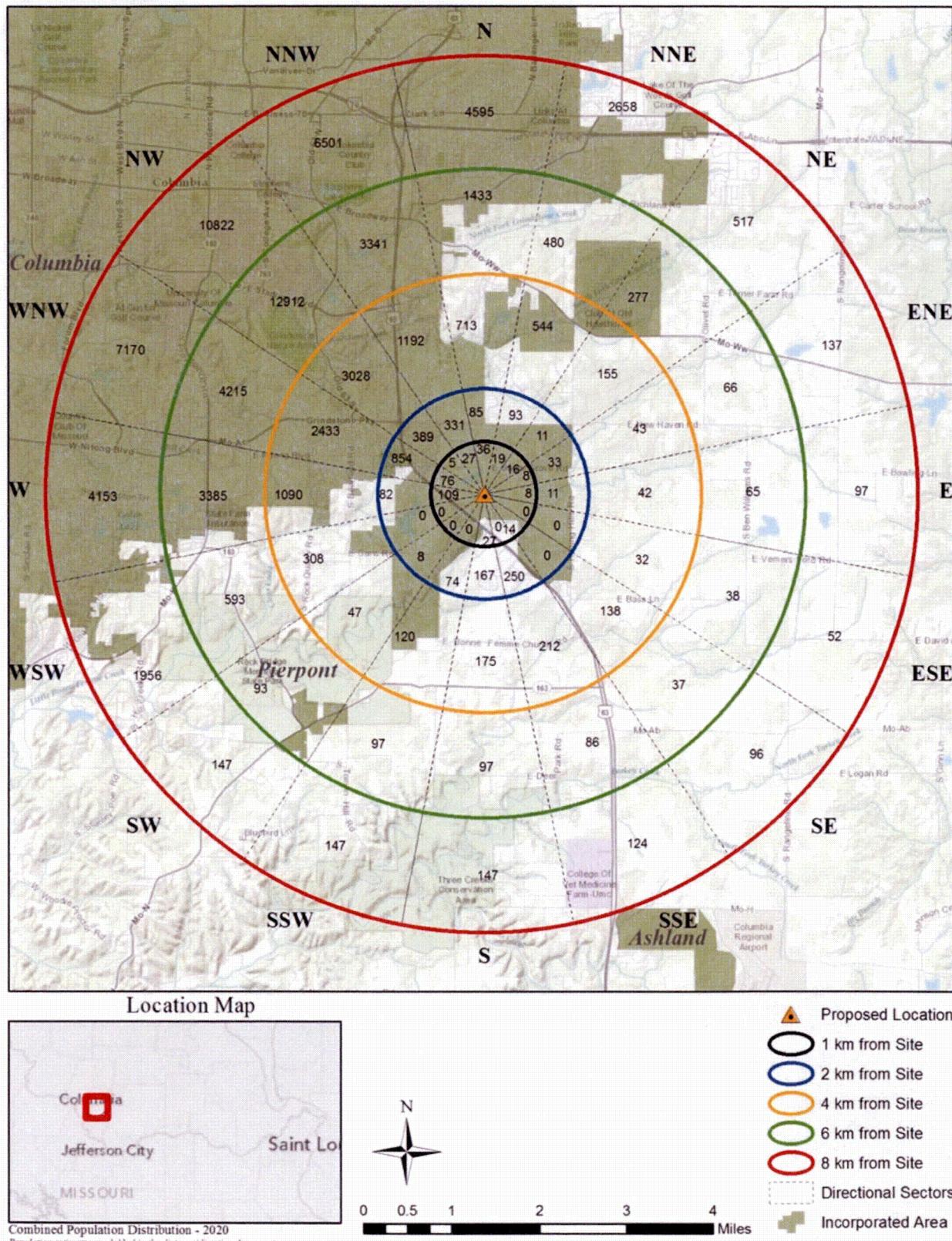


Figure 2-26. Combined Population Distribution – 2020

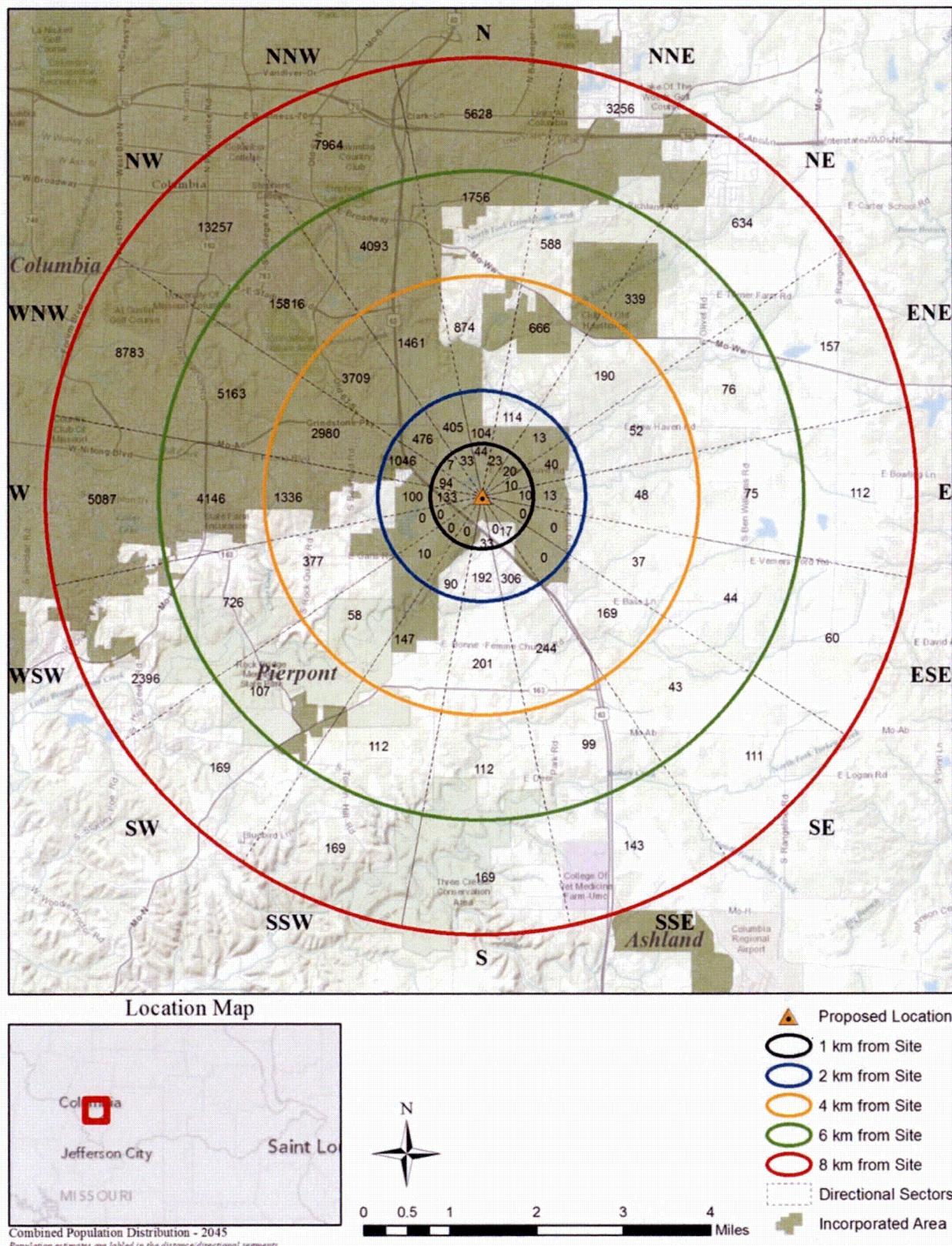


Figure 2-27. Combined Population Distribution – 2045

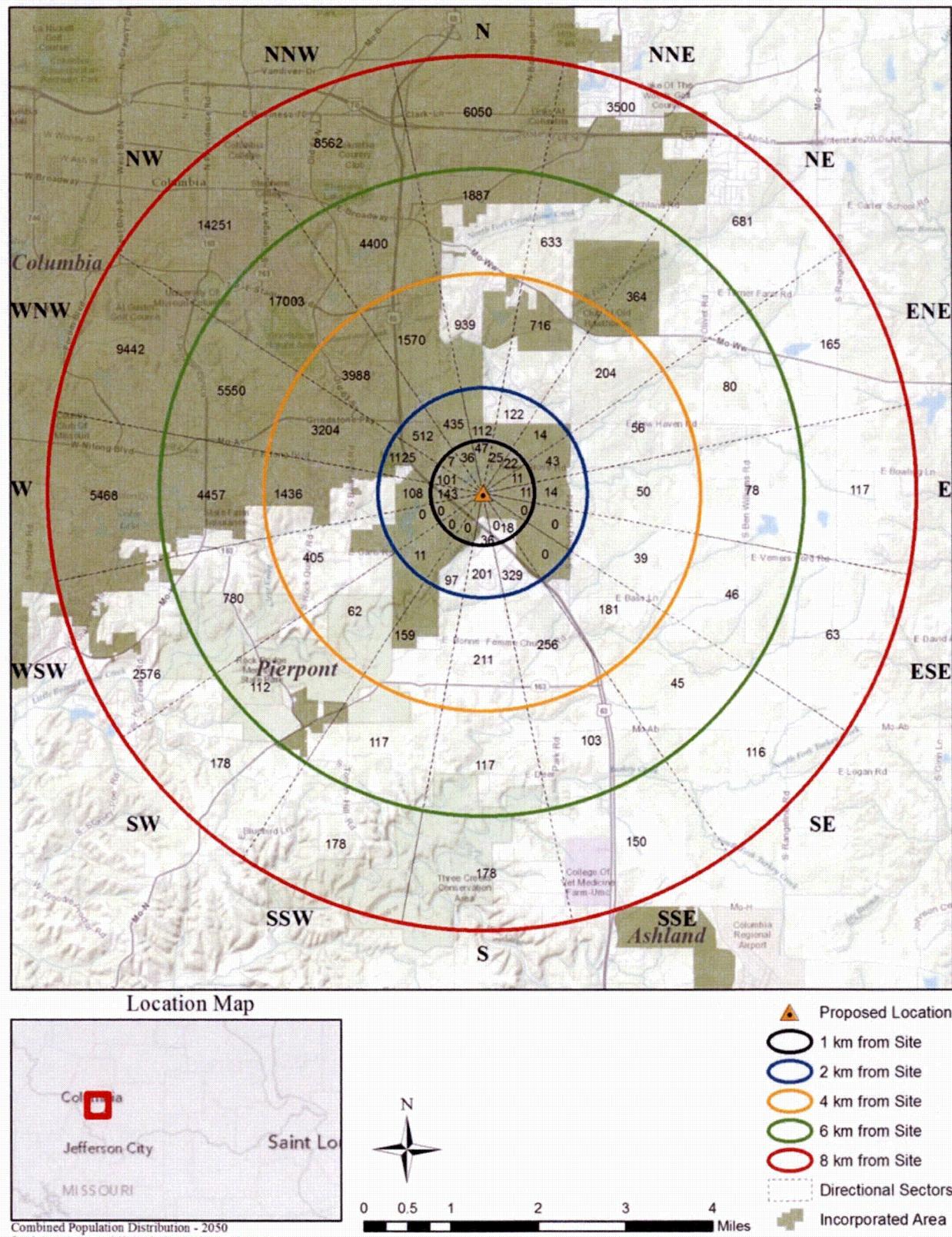


Figure 2-28. Combined Population Distribution – 2050

2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

This section identifies and evaluates present and projected future industrial, transportation, and military installations and operations in the area within 8 km (5 mi) of the RPF site. In addition, facilities and activities at a greater distance than 8 km (5 mi) are also considered as appropriate to their significance.

2.2.1 Location and Routes

Access to the proposed RPF site is from Discovery Ridge Drive. The site is situated in central Missouri, approximately 201 km (125 mi) east of Kansas City and 201 km (125 mi) west of St. Louis. The site is 7.2 km (4.5 mi) south of U.S. Interstate 70, just north of U.S. Highway 63. The Missouri River lies 15.3 km (9.5 mi) west of the site. The site is located 5.6 km (3.5 mi) southeast of the main MU campus.

An investigation of industrial, transportation and military facilities within 5 mi (8 km) of the proposed site was performed. The U.S. Environmental Protection Agency's Envirofacts Database was initially used to identify potential facilities within 8 km (5 mi). The Missouri Emergency Management Agency supplied Tier II chemical inventory reports for all of the facilities in Boone County. The following facilities were identified for further evaluation.

Industrial Facilities

- Analytical Bio Chemistry Laboratories, Inc.
- Radil Discovery Ridge
- Gates Power Transmissions Materials Center
- MU South Farm
- MU Woman's and Children's Hospital
- Ryder Transportation
- Truegreen
- Schwan's Home Service
- Petro Mart #44

Pipelines

- South Star Central Gas Pipeline
- Magellan Pipeline Company Non-HLV product Hazardous Pipeline
- Ameren Natural Gas Transmission Pipeline

Fuel Storage Facilities

- Magellan Pipeline Company Breakout Tank

Mining and Quarrying Operations

None

Figure 2-29 shows the location of the transportation and industrial facilities identified within 8 km (5 mi) of the proposed RPF site.

An investigation of industrial, military, and transportation facilities from 8 km to 16 km was also conducted and identified the following transportation facilities for further evaluation. Figure 2-30 shows the airports, jet routes, and airway routes within 16 km (10 mi) of the proposed RPF site.

Transportation Routes/Facilities

- Air
 - State University Hospitals and Clinics Heliport
 - University of Missouri Heliport
 - Boone Hospital Center Heliport
- Land
 - U.S. Highway 63
 - U.S. Interstate 70
 - State Route 163
 - State Route 740
 - State Route 763
- Waterways – None
- Railroads – COLT Transload

Military Bases

- None

Industrial Facilities

- 3M Company – Columbia
- AT&T, Inc.
- Columbia Municipal Power
- MPC #93

Major Waterways

- Missouri River

Pipelines

- Panhandle Eastern Pipeline Company

Airports

- Sugar Branch Airport
- Cedar Creek Airport
- Columbia Regional Airport

Fuel Storage Facilities

- Midway Auto Truck plaza
- Ballenger Propane, Inc.
- Ferrellgas

2.2.1.1 Future Facilities

A review was conducted to identify potential future facilities and transportation routes (e.g., industrial growth) that if established or constructed, could have an adverse effect on the RPF. These future facilities/routes were identified through several sources. The initial lists of local projects were identified using the City of Columbia comprehensive land use plan (City of Columbia, 2013). State and county planning documents were also reviewed, and potential projects were discussed with Regional Economic Development, Inc., to identify potential private facilities. The majority of projects identified in the City of Columbia comprehensive land use plan are infrastructure-type projects of a nature that would exclude potential accidents that could affect the RPF.

Two new projects were identified that may be constructed near the Discovery Ridge, including:

- **Global PET Imaging Facility** – The proposed facility is being designed and constructed to process rubidium-82 (^{82}Rb) using a 70-million electron volt (MeV) cyclotron. This facility, along with any other potential facilities that might be constructed within the Discovery Ridge, are assumed to be similar in nature to the existing facilities and RFP with similar potential hazards. As such, accidents associated with future facilities are assumed to be similar to those currently at Discovery Ridge and are bounded within the current accident analysis.
- **Odles' Discovery Park (residential/commercial development)** – Proposed development would be located approximately 0.8 km (0.5 mi) west of Discovery Ridge. The development is currently planned as a housing development intermixed with commercial shops and businesses. These commercial facilities are not anticipated to store large quantities of hazardous or flammable materials and would not likely pose a hazard to the RPF.

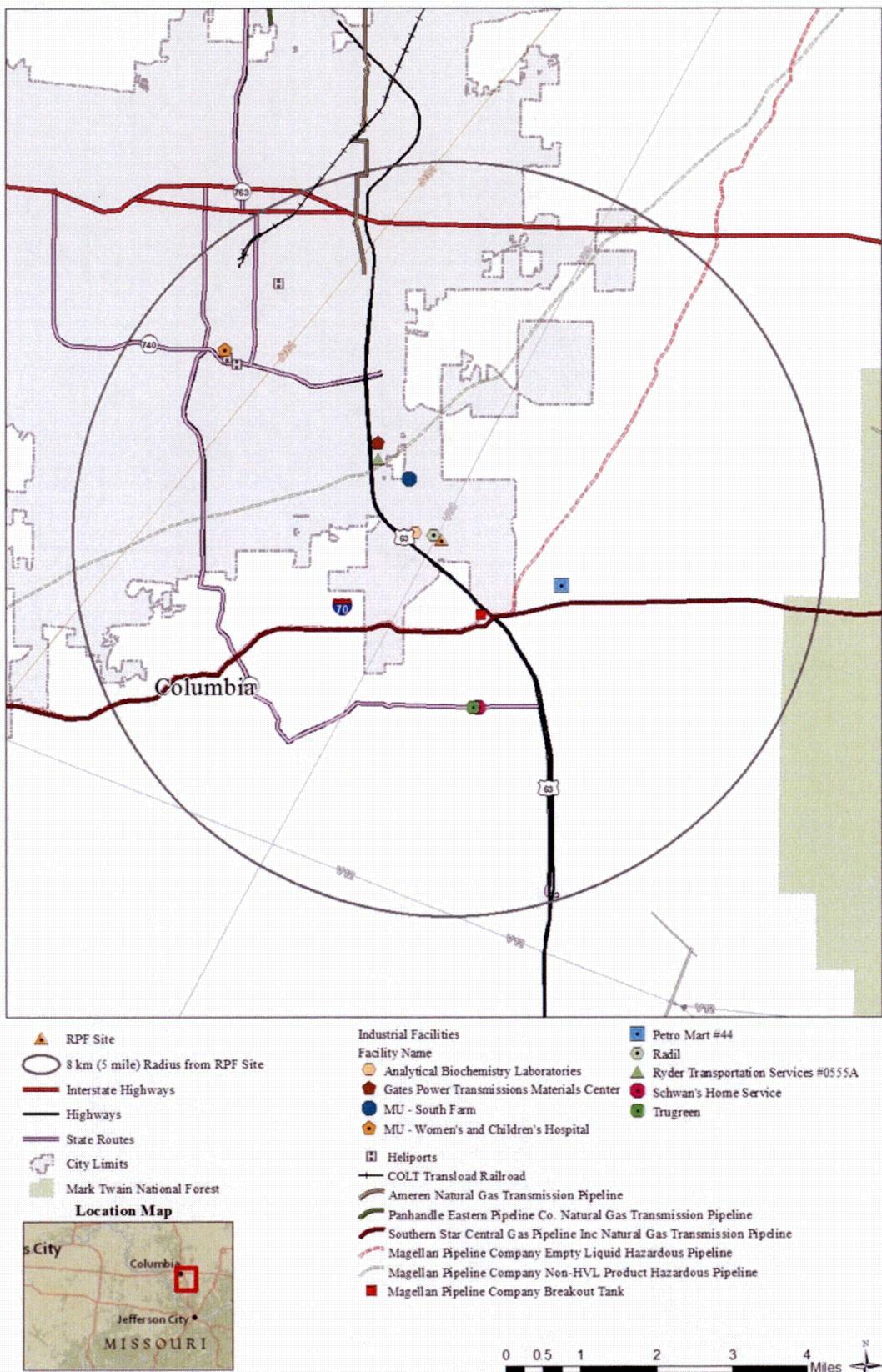


Figure 2-29. Industrial and Transportation within 8 km (5 mi) of the Radioisotope Production Facility Site

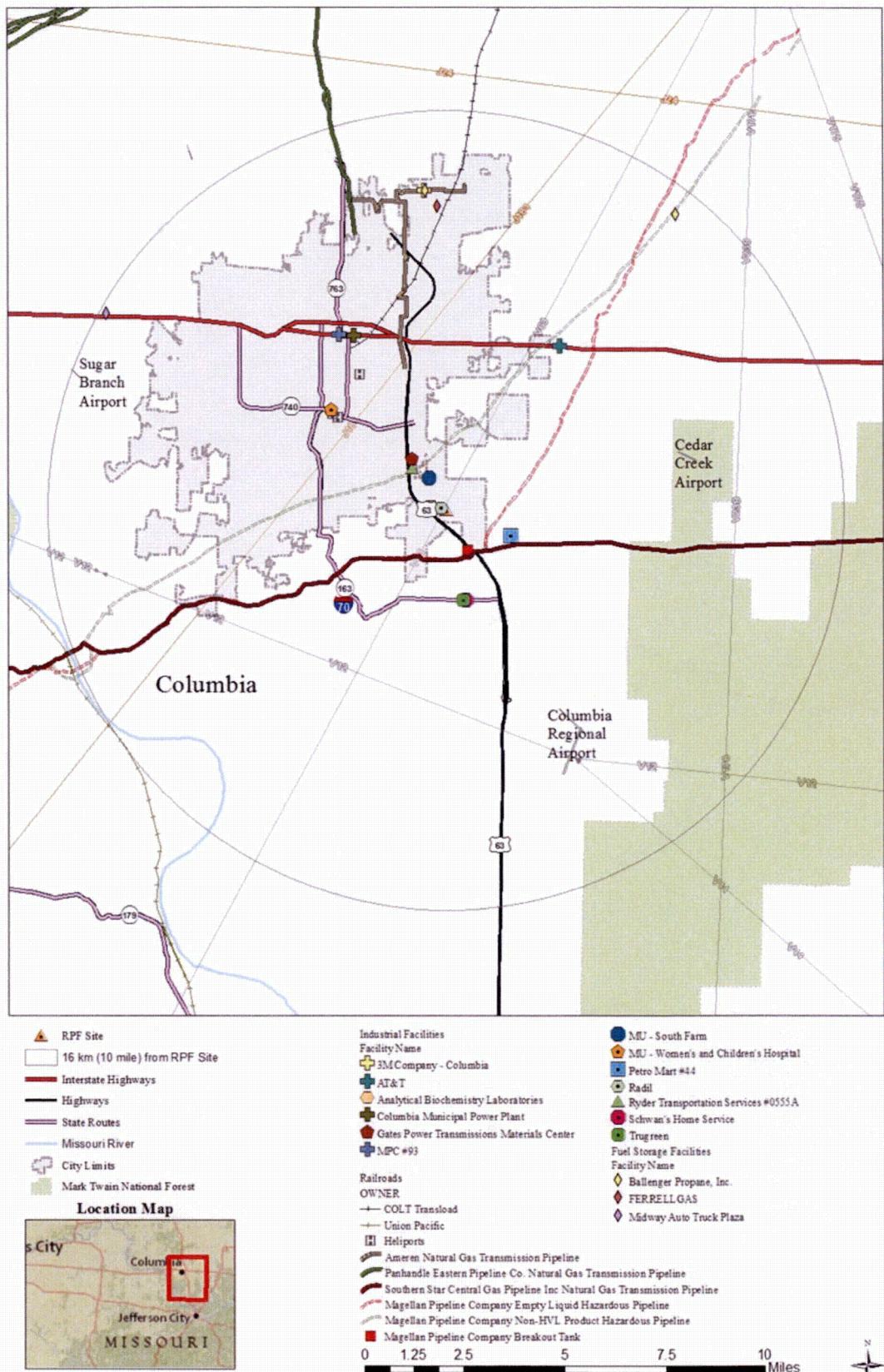


Figure 2-30. Industrial and Transportation within 16 km (10 mi) of the Radioisotope Production Facility Site Descriptions

2.2.1.2 Industrial Facilities

Descriptions of the industrial and transportation facilities identified within the 8 km (5-mi) radius of the RPF are provided below. For those facilities identified for future investigation, the Tier II reports were evaluated to determine if the facility used or stored large amounts of hazardous materials that could have a potential impact on the RPF. Of the facilities identified in Figure 2-29, Table 2-10 provides a description of those facilities that were identified as having potentially hazardous materials onsite that could potentially affect the RPF. Table 2-10 provides a listing of these facilities, including their primary functions and major products, and the hazardous materials onsite. A detailed analysis was conducted of the potential accidents at these facilities and potential hazards and impacts to the proposed RPF.

Table 2-10. Significant Industrial Facilities within 16 km (10 mi) of the Radioisotope Production Facility Site

Facility	Product	Distance from RPF		Direction	Hazardous material
		km	mi		
Gates Power Transmissions Materials Center	Vehicle and machinery drive belts	2.4	1.5	Northwest	[Proprietary Information] [Proprietary Information]
MU South Farm	Agriculture	1.6	1	Northwest	[Proprietary Information] [Proprietary Information] [Proprietary Information] [Proprietary Information]
Ryder Transportation	Rental trucks	2.4	1.5	South	[Proprietary Information]
3M Company	Electronic components	12.9	8	North	[Proprietary Information]
Schwan's Home Service	Food service	6.8	2.4	South	[Proprietary Information]

MU = University of Missouri.

RPF = Radioisotope Production Facility

2.2.1.3 Transportation Routes

U.S. Highway 63 runs approximately 0.4 km (0.25 mi) south of the RPF site. U.S. Highway 63 proceeds north and intersects U.S. Interstate 70 approximately 7.64 km (4.75 mi) to the north. U.S. Highway 63 continues to Jefferson City, Missouri, approximately 50 km (31 mi) to the south.

Other highways within the 8 km (5-mi) radius of the proposed RPF site include State Highway 63 that intersects U.S. Highway 63 3.2 km (2 mi) south of the RPF and routes north approximately 4.8 km (3 mi) west of the RPF. State Highway 740 intersects U.S. Highway 63 approximately 3.7 km (2.3 mi) north of the RPF, and routes west. State Highway 763 intersects State Highway 740 5.3 km (3.3 mi) north of the RPF and routes north to U.S. Interstate 70.

Information is not available about the materials transported on the roads in the vicinity of RPF site. To better understand the materials that could be transported over these roads, Superfund Amendments and Reauthorization Act (SARA) Title III, Tier II reports for industrial facilities within 8 km (5 mi.) of the RPF site were consulted.

The Missouri's Commercial Vehicle Regulations (MoDOT, 2013) provided the maximum gross vehicle weight of 36,290 kilogram (kg) (80,000 pounds [lb]). Using the assumption that an average truck and trailer combination weighs 13,600 kg (30,000 lb), the allowable weight that a truck could carry on the highways would be 22,690 kg (50,000 lb).

For analysis, all materials were assumed to travel on State Highway 63, 0.4 km (.25 mi) south of the RPF. Table 2-11 summarizes the chemicals and anticipated amounts that are present at the industrial facilities that could pose a hazard when transported.

2.2.1.4 Pipelines

Several natural gas distribution pipelines are located within 8 km (5 mi) of the proposed RPF site, as depicted in Figure 2-29. Available information about these pipelines is included in Table 2-12.

Ameren Missouri operates a natural gas transmission line approximately 6.4 km (4 mi) north of the proposed RPF site. Southern Star Central Gas Pipeline, Inc. operates a natural gas transmission pipeline located approximately 1.6 km (1 mi) south of the proposed site.

Magellan Midstream Partners, LP operates two pipelines within 8 km (5 mi) of the site, including a pipeline 2.4 km (1.5 mi) to the north, which carries refined petroleum products. The company also maintains an empty line approximately 1.6 km (1 mi) south of the proposed RPF site.

Table 2-11. Hazardous Chemical Potentially Transported on Highways within a 8 km (5-mi) Radius of the Radioisotope Production Facility

Hazardous material	Quantity	
	kg	lb
Ammonia	22,680	50,000
Ammonium nitrate	22,680	50,000
Chlorine	408	900
Diesel	22,680	50,000
Gasoline	22,680	50,000
Glycol ether PM	22,680	50,000
Hydrofluorosilicic acid	22,680	50,000
Hydrogen	1,497	3,300
JP-4 aviation fuel	22,680	50,000
Methyl ethyl ketone	22,680	50,000
Oil	22,680	50,000
Pentaerythritol distearate	22,680	50,000
Petroleum naphtha	22,680	50,000
Propane	22,680	50,000
Sulfur dioxide	22,680	50,000
Toluene (32-8413)	22,680	50,000
Zetpol (all types)	22,680	50,000

Table 2-12. Major Pipelines Located within 8 km (5 mi) of the Radioisotope Production Facility Site

Pipeline company	Product	Diameter		Pressure (max)		Distance from RPF		Direction
		cm	in.	kPa	lb/in. ²	km	mi	
Ameren Missouri	Natural gas			[Proprietary Information]				North
Southern Star Central Gas Pipeline, Inc.	Natural gas			[Proprietary Information]				South
Magellan Midstream Partners, LP	Refined petroleum			[Proprietary Information]				North
Magellan Midstream Partners, LP	Empty			[Proprietary Information]				South/east

N/A = Not available.

RPF = Radioisotope Production Facility.

2.2.1.5 Fuel Storage

Two major fuel storage facilities are located within the 8 km (5-mi) radius of the proposed RPF site, and include the Magellan Pipeline Company Breakout Tank and the Ferrellgas facility. Information of each of these facilities is provided in Table 2-13.