APPENDIX D: ECOSYSTEM CLASSIFICATION AND VEGETATION

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ACRONYMS

AFB	Air Force Base
GAP	Gap Analysis Project
HCCVI	Habitat Climate Change Vulnerability Index
MC2	Dynamic Global Vegetation Model
RCP	Representative Concentration Pathway
USGS	United States Geological Survey

D.1. ECOSYSTEM CLASSIFICATION

Four primary natural ecosystems at Tinker Air Force Base (AFB) were identified for analysis: turf and managed grassland, mixed native prairie, mixed forest and open water. This analysis used data from the United States Geological Survey (USGS) National Gap Analysis Project (GAP) Land Cover 2011 classification. Although open space and developed areas have limited value as habitat for priority species, there are significant areas of these lands at the installation. Therefore, they have also been included in the classification map presented in Figure D-1.

D.1.1. Turf and Managed Grassland

Vulnerable turf and managed grassland ecosystems comprise 20.1% of the total vulnerable ecosystem area at Tinker AFB. These areas are covered by a mixture of native grasses and other turf species. Vegetation cover is composed of native species and shrubs include commonly used landscaping species for the region. At Tinker AFB, turf and managed grassland ecosystems cover 20.1% of the installation area.

D.1.2. Mixed Native Prairie

Grasslands and other grass- and graminoid-dominated ecosystems occupy about 30–40 % of Earth's land surface. They cover more terrestrial area than any other single biome (Blair, Nippert, & Briggs, 2014). At Tinker AFB, grasslands and prairie ecosystems cover 16.2% of the installation area.

D.1.3. Mixed Forest

The upland forests of Oklahoma are a westward extension of the oak-hickory association of the deciduous forest formation (Braun, 1947). At Tinker AFB, mixed forest ecosystems contain a mixture of oak-hickory, oak-pine, post oak-blackjack oak, loblolly pine and cypress bottoms. At Tinker AFB, mixed forest ecosystems cover 3.5% of the installation area.

D.1.4. Open Water

The open water classification includes a diverse set of inland freshwater ecosystems that provide essential resources and ecosystems for both terrestrial and aquatic organisms. Open water ecosystem accounts for 0.4% of the total vulnerable ecosystem area in the installation.

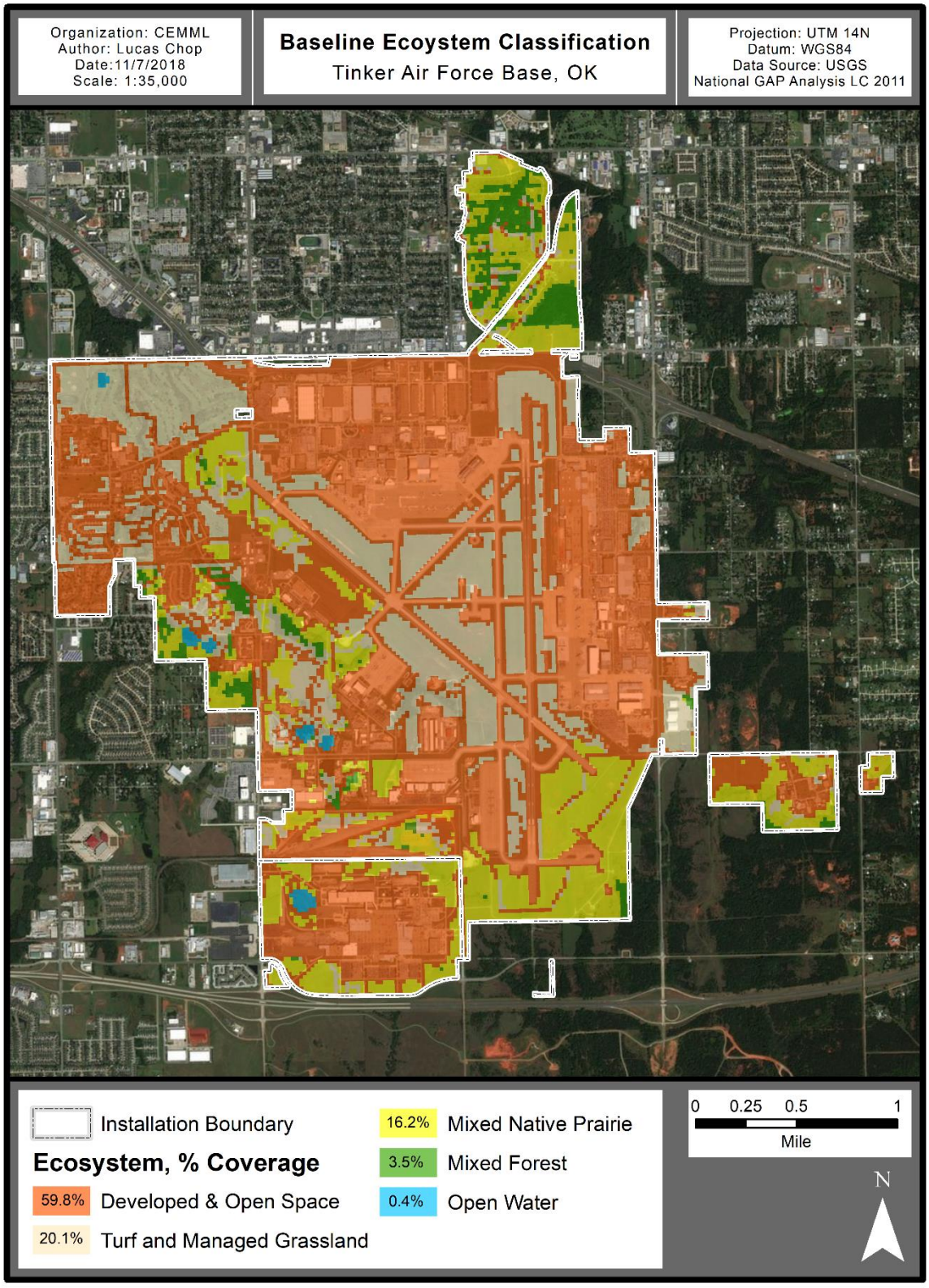

Figure D-1. Ecosystem classification.

D.2. VULNERABILITY ASSESSMENT

Ecosystem vulnerability to climate change were assessed using the Habitat Climate Change Vulnerability Index (HCCVI) framework developed by Comer et.al. (2012). This index uses a two-dimensional analysis of climate change sensitivity and ecological resilience for each ecosystem type within a given ecoregion. HCCVI results are summarized in Table D-1 and Table D-2.

The analysis revealed that mixed native prairie, mixed forest, and open water are all highly vulnerable ecosystems (with medium to high confidence) under the 2050 timeframe. Under the 2030 timeframe, mixed forest is moderately to highly vulnerable. Turf and managed grassland ecosystems are moderately to highly vulnerable (with low to medium confidence) under both climate change scenarios, and both timeframes.

Table D-1. Ecosystem vulnerability and level of confidence[1] for the 2030 timeframe.

Ecosystem	Low Vulnerability		Moderately Vulnerability		Highly Vulnerability	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Turf and Managed Grassland				1	1	
Mixed Native Prairie					2	2
Mixed Forest				1	2	
Open Water					3	3

[1] 3 = high level of confidence, 2 = moderate level of confidence, 1 = low level of confidence.

Table D-2. Ecosystem vulnerability and level of confidence[1] for the 2050 timeframe.

Ecosystem	Low Vulnerability		Moderately Vulnerability		Highly Vulnerability	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Turf and Managed Grassland				2	2	
Mixed Native Prairie					3	3
Mixed Forest					2	2
Open Water					3	3

[1] 3 = high level of confidence, 2 = moderate level of confidence, 1 = low level of confidence.

D.2.1. HCCVI Results Summary

The impacts of changes in climatic regimes to prairie bioregions include increased seasonal, annual, minimum, and maximum temperature and changing precipitation patterns. Because these ecosystems are relatively dry with a strong seasonal climate, they are sensitive to climatic changes and vulnerable to shifts in climatic regime. Slight changes in temperature and precipitation can substantially alter the composition, distribution, and abundance of species, and the products and services they provide. The

extent of these changes will also depend on changes in precipitation and fire. Increased drought frequency could also cause major changes in vegetation cover.

Losses of vegetative cover coupled with increases in precipitation intensity and climate-induced reductions in soil aggregate stability will dramatically increase potential erosion rates. Rising temperatures under various climate change scenarios will likely enhance soil decomposition. Together with reductions in rainfall, this may also reduce plant productivity over large areas.

Slight changes in temperature and precipitation can substantially alter the composition, distribution, and abundance of species, and the products and services they provide. Climate projections for Tinker AFB indicate that minimum and maximum temperatures will increase over time under both emissions scenarios by a range of 2.6 °F (1.4°C) to 3.9 °F (2.2°C) by 2030. By 2050, projections estimate increases in temperature of approximately 3.6 °F (2.0 °C) to 5.1 °F (2.8 °C). As warmer temperatures increase evaporation and water use by plants, soils are likely to continue to become drier. Average rainfall is likely to decrease during winter, spring, and summer. Increased evaporation and decreased rainfall are both likely to reduce the average flow of rivers and streams.

Mixed forests have low summertime evaporative fraction (defined as the ratio of latent heat flux to available energy) compared with deciduous broadleaf forests, producing high rates of sensible heat exchange and deep atmospheric boundary layers. Flux tower measurements illustrate the potential for changes in species composition, arising from change in the fire regime, to affect climate (Bonan, 2008).

A qualitative analysis of vegetation cover type maps in the MC2 Dynamic Global Vegetation Model (MC2) was done to assess potential changes to land cover and uses under the projected climate change scenarios. Historically, vegetation type at Tinker AFB has been temperate cool mixed woodland in the west section of the installation, and subtropical shrubland C4 in the east part of the installation. Under the current projected scenarios, vegetation cover at Tinker AFB will convert to temperate warm mixed forest/woodland in its entire area, which means a projected loss of diversity and ecosystem services in the mixed forest and mixed native prairie areas at the installation.

D.3. ECOSYSTEM INUNDATION

Projected inundation from stream channel overflow along Crutcho Creek from flood modeling associated with climate change scenarios (Appendix C) is shown over current ecosystem coverage in Figure D-2.

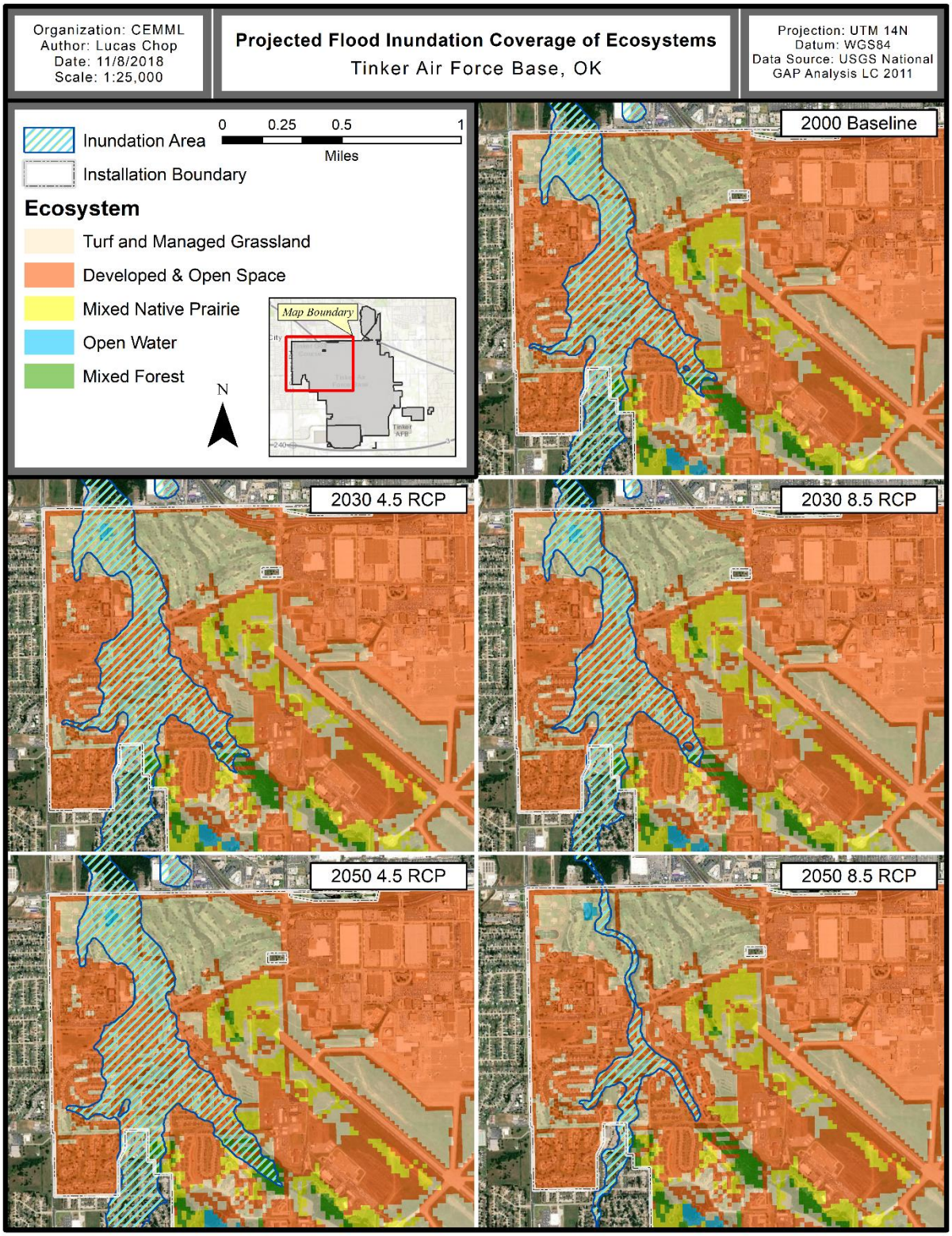

Figure D-2. Projected flood inundation over current ecosystem coverage.

D.4. LITERATURE

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