POPULATION CHANGE ANALYSIS REPORT

COHYST MODEL AREA, 1997 TO 2017

NEBRASKA

DEPT. OF NATURAL RESOURCES

Introduction

This study was conducted to update population estimates for the COHYST model area and the overappropriated (OA) area of the Upper Platte River Surface Water Basin. The results generated in this report used 2017 U.S. Census Bureau population estimates. This report adds to prior research conducted by Nebraska Department of Natural Resources (NeDNR) that used population estimates from 1997 and 2005. Figure 1 shows the geographic areas used in this study.

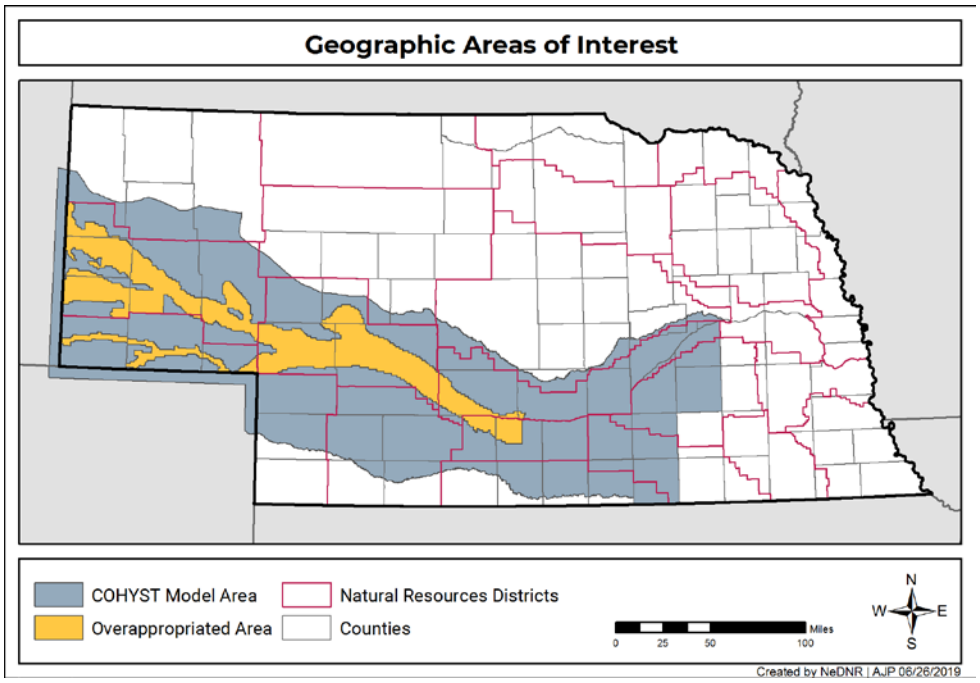

Figure 1. Geographical boundaries of the COHYTST model area, overappropriated area and Natural Resources Districts.

Each year, the U.S. Census Bureau releases midyear population estimates at national, state and county levels, along with minor civil divisions (census tracts, block groups, townships, etc.) and places (cities, villages, towns, etc.). These estimates are recalculated yearly and are based on a combination of the most recent decennial census counts and the demographic balancing equation, which takes into account births, deaths, and migration (Figure 2).

Figure 2. The basic deomgraphic balancing equation.

Unfortunately, the boundaries of the COHYST study area, the OA area, and Nebraska's Natural Resources Districts (NRDs) are not coincident with the boundaries of any geographic area for

which population data are tabulated. These boundaries split counties, townships, census tracts, and even cities and villages. Therefore, population estimates must be interpolated from known geographies like counties or places.

Technical Methods

The method used to interpolate population counts for the irregular geographies in this study is known as areal interpolation. Areal interpolation uses spatial analysis tools in ArcGIS along with population estimates from known geographic areas to create population estimates for irregular geographic areas. This methodology is based on the assumption that population is distributed evenly throughout each known geographic area. For example, if a place is split across a boundary (county line, NRD boundary or COHYST model boundary), it is assumed that the estimated population for each component piece of that place is directly proportionate to the area of the component. Therefore, in order to estimate the total population of an irregular geographic area, the estimated proportionate population of all places within the unknown area is added to the estimated proportionate population of all non-places (the county balance or rural balance) within the unknown area. Figure 3 shows the basic steps in the areal interpolation process.

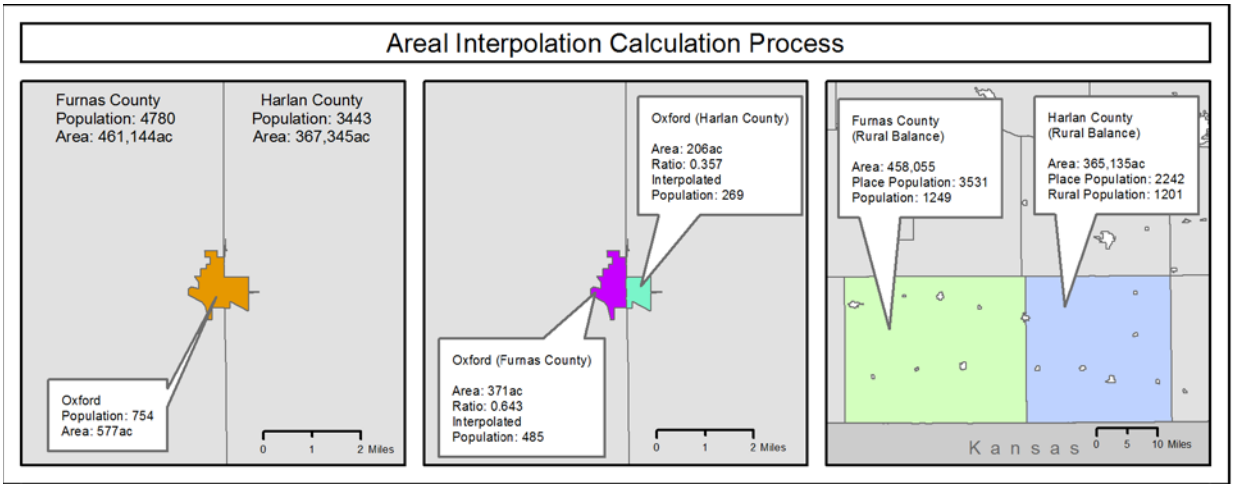

Figure 3a. The village of Oxford NE spans the border between Furnas and Harlan Counties. The identity tool is used to separate the village of Oxford into component pieces for each county.

Figure 3b. The area of each component piece is calculated and divided by the total place area to generate a raito that represents the proportion of the whole for each component piece. This ratio is then multiplied by the place population to generate an interpolated population for each component.

Figure 3c. Estimate place populations are then subtracted from their respective counties to generate an estimated county rural population. The itentity tool also generates a county balance area that represents the total non-place or rural area within a county.

Population analysis for this study was completed using Microsoft Excel and spatial analysis was done using ESRI's ArcMap and ArcToolbox. Population data were obtained from American Fact Finder, the U.S. Census Bureau's online database and joined to spatial data that were also

obtained from American Fact Finder. Population estimates used in this study represent the total estimated place and county populations as of July 1, 2017, (vintage 2018) and were based on 2010 decennial census counts.

For each level of analysis, similar methods were employed. The first step for each analysis was to identify the place and non-place balance (county balance) in each county that intersects unknown boundary (COHYST, NRD, OA area). Using the assumption of even population distribution, the identity tool was used to generate component pieces of each place and county within the COHYST area. The resulting data were then separated into layers based on area type (places or county balance). In order to estimate the population per of each component piece, the area of each component divided by the total area of that components respective geography (ie. place components were divided by the total area of their repsective place). This generated a ratio that was then multiplied by the total population of the respective geography in order to generate an estimate of component population. These component population estimates were then aggregated by location inside or outside of the desired irregular geography.

Results

Estimated Population within the COHYST Model Boundary

As shown in Table 1 below, the final population estimate totals consisted of the sum of place and rural population estimates. Between 2005 and 2017, the place popluation within the COHYST model area saw an increase of 10,812 persons (3.8%) while the rural population within the model area decreased by 7,354 (7.9%). The total population within the COHYST model are increased by 3,458 (0.9%).

Table 1. *Estimated population within the COHYST model area 1997, 2005, and 2017.*

Estimated Population within the COHYST Model Area 2017				
	1997	**2005**	**2017**	**Change 2005 to 2017 (%)**
Place Population	257,071	281,481	292,293	10,812 (3.8%)
Rural Population	91,660	92,887	85,533	-7,354 (-7.9%)
Total	**366,731**	**374,368**	**377,826**	**3,458 (0.9%)**

Estimated Population within the COHYST Boundary by NRD

Using the areal interpolation methodology, population estimates for the area within the COHYST model area were generated by NRD as well. Between 2005 and 2017, Central Platte, Lower Loup, Upper Big Blue, and Upper Loup NRDs saw an increase in population within their respective portions of the COHYST model area. Central Platte saw the largest increase with an addition of 10,739 persons. Little Blue, Lower Republican, Middle Republican, North Platte, South Platte, Tri-Basin, Twin Platte, Upper Niobrara-White, and Upper Republican all saw decreases in population within their portions of the COHYST model area between 2005 and 2017. These figures can be seen in Table 2.

***Table 2**. Estimated population within the COHYST model area by NRD 1997, 2005, 2017.*

Estimated Population within the COHYST Model Area by NRD				
NRD Name	**1997**	**2005**	**2017**	**Change 2005 to 2017 (%)**
Central Platte	121,977	129,586	140,325	10,739 (8.3%)
Little Blue	34,818	37,470	32,349	-5,121 (-13.9%)
Lower Loup	5,007	5,661	6,205	544 (9.6%)
Lower Platte North	3	3	3	0 (0.0%)
Lower Republican	15,227	13,860	12,896	-964 (-7.0%)
Middle Republican	16,512	16,078	15,448	-630 (-3.9%)
North Platte	45,088	44,928	44,073	-855 (-1.9%)
South Platte	15,597	15,779	15,177	-602 (-3.8%)
Tri-Basin	18,934	18,243	17,618	-625 (-3.4%)
Twin Platte	40,351	41,835	41,298	-537 (-1.3%)
Upper Big Blue	34,173	34,018	35,912	1,894 (5.6%)
Upper Loup	669	567	596	29 (5.1%)
Upper Niobrara-White	11,849	10,271	9,905	-366 (-3.6%)
Upper Republican	6,526	6,069	6,009	-60 (-1.0%)
Total	**366,731**	**374,368**	**377,814**	**3,446 (0.9%)**

Table 3 shows the breakdown of rural and place populations by NRD within the COHYST model area. Minor differences can be seen between these totals and those calculations generated for the model area as a whole. These variations are the result of aggragating rounded figures for each NRD and amount to a margin of error of 0.003%

Table 3. *Estimated place and rural population within the COHYST model area by NRD 2017.*

Estimated Population within the COHYST Model Area by NRD 2017			
NRD Name	**Place Population**	**Rural Population**	**Total Population**
Central Platte	116,661	23,664	140,325
Little Blue	26,521	5,828	32,349
Lower Loup	1,473	4,732	6,205
Lower Platte North	0	3	3
Lower Republican	9,914	2,982	12,896
Middle Republican	10,635	4,813	15,448
North Platte	32,200	11,873	44,073
South Platte	11,751	3,426	15,177
Tri-Basin	11,769	5,849	17,618
Twin Platte	32,074	9,224	41,298
Upper Big Blue	26,959	8,953	35,912
Upper Loup	338	258	596
Upper Niobrara-White	8,164	1,741	9,905
Upper Republican	3,834	2,175	6,009
Total	**292,293**	**85,521**	**377,814**

Estimated Population within the Overappropriated (OA) Area by NRD

As shown in Table 4, population estimates were generated for the overappropriated surface water area (OA) within the COHYST model area. In total, the population within the OA area of the COHYST model area decreased by 1,217 persons (-1.2%) from 2005-2017. When broken down by NRD, it can be seen that the North Platte, South Platte, Tri-Basin and Twin Platte NRDs all experienced decreases in population between 2005 and 2017. The Central Platte NRD experienced a slight increase in population during the same time period.

Table 4. *Estimated total population within the COHYST OA area by NRD 1997, 2005, 2017.*

Estimated Total Population within the COHYST Overappropriated Area by NRD				
	1997	**2005**	**2017**	**Change 2005 to 2017 (%)**
Central Platte	8,155	8,577	8,642	65 (0.8%)
North Platte	37,680	37,600	37,349	-251 (-0.7%)
South Platte	10,762	10,806	10,537	-269 (-2.5%)
Tri-Basin	2,918	2,838	2,612	-226 (-8.0%)
Twin Platte	36,627	37,796	37,260	-536 (-1.4%)
Total	**96,142**	**97,617**	**96,400**	**-1,217 (-1.2%)**

Table 5 shows changes in population estimates for only places within the COHYST OA area. Between 2005 and 2017, there was a slight increase in the overall place population within the OA area. Central Platte and North Platte NRDs experienced some growth in place population while South Platte, Tri-Basin and Twin Platte experienced decreases in place population within the OA area.

Table 5. *Estimated place population within the COHYST OA area by NRD 1997, 2005, 2017.*

Estimated Place Population within the COHYST Overappropriated Area by NRD				
	1997	**2005**	**2017**	**Change 2005 to 2017 (%)**
Central Platte	6,301	6,676	6,840	164 (2.5%)
North Platte	29,445	29,333	30,139	806 (2.7%)
South Platte	10,064	10,095	9,920	-175 (-1.7%)
Tri-Basin	1,626	1,618	1,515	-103 (-6.4%)
Twin Platte	31,712	32,395	31,958	-437 (-1.3%)
Total	**79,148**	**80,117**	**80,372**	**255 (0.3%)**

Table 6 shows the changes in rural population within the OA area. In total, the rural population within the OA area decreased by 1,472 persons (-8.4%) from 2005-2017. Each of the NRDs within the OA area saw decreases in rural population with North Platte NRD experiencing the largest decrease in rural population (1,057 persons).

***Table 6**. Estimated rural population within the COHYST OA area by NRD 1997, 2005, 2017.*

Estimated Rural Population within the COHYST Overappropriated Area by NRD				
	1997	**2005**	**2017**	**Change 2005 to 2017 (%)**
Central Platte	1,854	1,901	1,802	-99 (-5.2%)
North Platte	8,235	8,267	7,210	-1,057 (-12.8%)
South Platte	698	711	617	-94 (-13.2%)
Tri-Basin	1,292	1,220	1,097	-123 (-10.1%)
Twin Platte	4,915	5,401	5,302	-99 (-1.8%)
Total	**16,994**	**17,500**	**16,028**	**-1,472 (-8.4%)**