Powell Bill Formula Adjustment Detailed Report
Preliminary Study on Seasonal Population Shifts in Powell Bill Allocation Funds Distribution

November 2017

Background

The Powell Bill Unit of the NCDOT annually distributes a fixed appropriation from the State Highway Fund to qualified North Carolina municipalities to maintain municipal streets within their corporate limits. Presently the funds are distributed by a formula allocating 75% of the money based on municipality population and 25% based on municipality street mileage. This formula does not presently take into account municipalities that are affected by seasonal population shifts or by the impacts of military installations located nearby. The objectives of this research are to develop a research plan to identify those municipalities that experience such shifts, quantify it, and develop a potential adjusted allocation formula.

Findings

Based on NCDOT Powell Bill application data, total NC permanent population of the participating municipalities increased 7.20% from 2010 to 2016 as shown in Table 1. The percent increase per year from each previous year ranged from 0.76% to 1.50%. The number of participating municipalities ranged from 502 to 508. Powell Bill funding increased 14.27% from 2010 to 2016 (in $ amount with no inflation or other factor considered).

Table 1. Total Permanent Population Increase 2010-2016 based on NCDOT Data

Year	Number of Municipalities	Permanent Population	Increase from 2010	Increase from 2010 (%)	Increase from Previous Year	Increase from Previous Year (%)
2010	508	5,143,073	--	--	--	--
2011	502	5,182,356	39,283	0.76	39,283	0.76
2012	508	5,241,767	98,694	1.92	59,411	1.15
2013	508	5,295,588	152,515	2.97	53,821	1.03
2014	507	5,374,873	231,800	4.51	79,285	1.50
2015	507	5,435,422	292,349	5.68	60,549	1.13
2016	508	5,513,373	370,300	7.20	77,951	1.43

2010 Census data is the most accessible and reliable source for seasonal population. It is especially reliable because it accounts for each and every household in the U.S. The difference in total permanent population between the 2010 Census data and the NCDOT 2010 data for Powell Bill municipalities is 0.14%. The formula to determine the seasonal population for each municipality is as follows.

$$Seasonal\ Population =$$
$$Number\ of\ Vacant\ Housing\ Units\ for\ Seasonal, Recreational, or\ Occational\ use *$$
$$Average\ Number\ of\ Persons\ per\ Household\ for\ all\ Housing\ Units\ in\ that\ Municipality \qquad Eq\ (1)$$

Based on 2010 Census data, overall seasonal population is actually a very small portion of total population (a preliminary estimate is about 3.10%). However, as would be expected, a small number of municipalities have larger ratios of seasonal to permanent (much like the 80/20 rule). A preliminary estimate is that about 6% of municipalities have 100% or more seasonal population increase vs. permanent population. This means that a small number of municipalities have a large population increase. 88% of the municipalities have less than a 10% seasonal population increase. This means that a very large majority are not significantly affected by seasonal population. In fact, over 50% of municipalities have less than a 1% seasonal population increase.

Adjusted Powell Bill Funding Allocation Formula Reflecting Seasonal Population Change

First, we calculate the Seasonal Population Ratio for each municipality.

$$Seasonal\ Population\ Ratio\ for\ each\ Municipality = \frac{Seasonal\ Population\ for\ a\ Municipality}{Permanent\ Population\ for\ a\ Municipality} \qquad Eq\ (2)$$

Where the Municipality's Seasonal Population is calculated using Eq (1). All population data for the municipality is obtained from the 2010 Census Database.

Next, we calculate the Total Seasonal Population Ratio (for all municipalities) using Eq (3).

$$Total\ Seasonal\ Population\ Ratio\ for\ all\ Municipalities = \frac{Total\ Seasonal\ Population\ for\ All\ municipalities}{Total\ Permanent\ Population\ for\ All\ municipalities}$$

$$Eq\ (3)$$

The Total Seasonal Population is the summation of the Seasonal Population of all participating municipalities. The Total Permanent population is obtained from the 2010 Census Database.

We choose the 2010 Census data to calculate the Total Seasonal Population Ratio because it is the most accessible and reliable data source for Seasonal Population. Although the permanent population increased 7.20% from 2010 to 2016, the difference in total permanent population in 2010 Census data and in NCDOT 2010 data is very small, at 0.14%. We made the assumption that the ratio between Seasonal Population and Permanent Population remains at the same level from 2010 Census data to the current year. More accurate and updated analysis to prove or adjust this assumption can be conducted in the proposed study.

$$Per\ Capita\ Allocation\ Rate = \frac{Total\ Allocation*75\%}{Total\ Permanent\ Population(1 + Total\ Seasonal\ Population\ Ratio*Duration\ Factor)} \qquad Eq\ (4)$$

Where Per Capita Allocation Rate is the amount of funding allocated per person for the current fiscal year. Total Allocation is the total available Powell Bill funding for the fiscal year. Total Permanent Population is a summation of the amount of permanent population submitted by the participating municipalities. Total Seasonal Population Ratio is calculated by using Eq (3). The Duration Factor is the ratio of expected duration of stay in month for Seasonal Population divided by 12 (months). The Seasonal funding allocation based on population for each municipality can be calculated using the Eq (5).

Seasonal Funding Allocation based on Population for each Municipality = (The Municipality's Permanent Population (1+ The Municipality's Seasonal Population Ratio* Duration Factor) * Per Capita Allocation Rate)

$$Eq\ (5)$$

For example, the Powell Bill funding allocation for 2015-2016 is $147.30M. The Total Permanent Population of all participating municipalities for 2015-2016 is 5,513,373. The Per Capita Allocation Rate (for the population portion of the funding formula) using the NCDOT formula [0.75*Population] is $20.06/person = $147.30M*0.75/5,513,373 persons.

Using the proposed formula, we obtained the Per Capita Allocation Rate of $19.83/person using Eq (4) as shown below, assuming the Duration Factor is 0.33 (a 4 month of residence per year). The true value for each Duration Factor is to be determined in the future study. A Total Seasonal Population of 3.10% was obtained following Eq (3).

$$Per\ Capita\ Allocation\ Rate = \frac{\$147.30*75\%}{5,513,373\ (1 + 3.1.\%*0.33)} = \$19.83/person$$

The new Per Capita Allocation Rate is slightly less than the NCDOT Per Capita Allocation Rate because the value of the denominator in Eq (4) is increased as a result of adding the Total Seasonal Population Ratio*

Duration Factor, while the total funding remains the same. The funding allocation for each municipality can be calculated using Eq (5). For example, the White Lake Town had a Permanent Population of 853 in 2016. Its permanent population was 802 and its seasonal population was 2,314 in 2010. The Municipality's Seasonal Population Ratio is, therefore, 2.89. Funding Allocation based on population using the NCDOT current formula will be $17,111.18 = 853 persons * $20.06/person. The Funding Allocation based on Eq (5) will be $33,046.82 = 853 * (1+2.89 * 0.33) persons * $19.83/person. The mileage for local street is $7,366.10 = 4.54*1622.49. The total funding allocation using current formula is $24,477.28 = $17,111.18 + $7,366.10. The total funding using the recommended formula is $40,413.92 = $33,046.82 + $7,366.10. The increase of $15,935.64 or 65% reflects the seasonal population change.

On the other hand, for municipalities with little seasonal population change, the funding allocation based on population will slightly decrease by a relatively small amount. For example, Youngsville had a permanent population of 1,300 in 2016. It had a seasonal population of 2 and Permanent Population of 1,157 in 2010. Its Seasonal Population Ratio is 0.0017, rounded to 0. The Funding Allocation using the NCDOT current formula is $26,078 = 1,300 persons * $20.06/person. The Funding Allocation using Eq (5) is $25,779 = 1,300 persons * (1+0) * $19.83/person. The mileage for local street is $11,552.13 = 7.12*1622.49. The total funding allocation using current formula is $37,630.13 = $26,078 + $11,552.13. The total funding using the recommended formula is $37,331.13 = $25,779 + $11,552.13The decrease of $299 is less than 1% of the funding received. The calculation and comparison results are shown in Table 2.

Table 2. Population Comparison between Current and Proposed Funding Allocation Formulas

Impact of Seasonal Change	Munici-pality	2016 Permanent Population	Seasonal to Permanent Population Ratio	Formula Types	Per Capita Allocation Rate ($/person)	Population Funding Allocation	Mileage Funding Allocation*	Total Funding Allocation*	Percent Change (%)
Large	White Lake Town	853	2.89	Current	20.06	$17,111	$7,366	$ 24,477	--
				Proposed	19.83	$33,047	$7,366	$40,414	+65.11
Small	Youngs ville	1,300	0	Current	20.06	$26,078	$11,552	$37,630	--
				Proposed	19.83	$25,779	$11,552	$37,331	-0.08

* Adjustment for Military Heavy Equipment Impact is not included in this calculation.

Adjusted Powell Bill Funding Allocation Formula Reflecting Military Heavy Equipment Impact

$$Per\ Mile\ Allocation\ Rate = \frac{Total\ Allocation*25\%}{Total\ Mileage+Total\ Military\ Mileage} \qquad \text{Eq (6)}$$

Military Funding Allocation based on Mileage for each Municipality = (Municipality Mileage + Municipality's Military Mileage based on Heavy Military Usage) * (Per Mile Rate)   Eq (7)

Where Per Mile Allocation Rate is the amount of funding allocated per mile. Total Allocation is the total available Powell Bill funding for the fiscal year. Total Mileage is the sum of all mileages from the participating municipalities. Since the calculation does not involve 2010 Census Data, we use current year data for all the variables in Eqs. (6) and (7). The Total Mileage for 2015- 2016 is 22,696.75. The Military Mileage based on heavy Equipment Usage will be identified in the proposed future study. For purposes of illustration, we have assumed a Military Mileage of 25% of the Municipality Mileage.

Using the NCDOT current formula, the Per Mile Allocation Rate is $1622.49/Mile = $147.30M * 25% / 22,696.75. The Per Mile Allocation Rate using the proposed formula will decrease because the denominator

is increased while the numerator is constant. But the decreased amount is expected to be small. For the a few municipalities with military installations and intense heavy military equipment usage, the funding allocation based on Mileage will increase. For the remaining municipalities, this part of the funding will be slightly decreased.

The total funding allocation will be a summation of the seasonal and military allocations for each municipality.

Impact and Discussion

The recommended formula addresses the funding allocation issue considering the impact from both the seasonal population change and military heavy equipment use. A small number of municipalities with significant impact will receive larger increases, while the majority of all municipalities experience very small decreases. The distribution of changes (if the recommended formula is adopted) are listed in Table 3 below.

$$Funding\ Allocation\ Change\ \% = \frac{(Funding\ allocation\ using\ recommended\ formula - NCDOT\ funding\ allocation)}{NCDOT\ funding\ allocation} \qquad \text{Eq (8)}$$

Table 3. Impact on Powell Bill Funding Distribution Using the New Formula

Funding Allocation % Change	-1.2%- 0%	0-5%	5-10%	10-30%	30-50%	50-100%	100-105%	Total
Number of Municipalities	402	63	7	18	7	7	1	505
% of Total Municipalities	79.59%	12.48%	1.39%	3.56%	1.39%	1.39%	0.20%	100%

Note that Table 3 shows very small decreases for nearly 80% of the municipalities. Nearly 12% of the municipalities would receive less than a 5% increase in funding. Less than 3% would receive greater than 30% of the funding and only one municipality would receive more than 100% increase (at 105%). Thus, it appears that municipalities in need would indeed receive the needed funds while other municipalities would not be significantly impacted with reductions.

Key work items are as follows.
- Determine duration factor, which is the number of months the seasonal population affects the municipality.
- Determine the Military Impact Factor which is the number of miles utilized by military equipment.

Advantages of the proposed formula include the following.
1. It allows the total funding allocation remains the same if needed. If NCDOT decides to increase the total funding, the formula will also be applicable.
2. The funding distribution is objective and consistent for all municipalities involved. There is no additional justification needed for criteria used.

One limitation of the recommended formula mainly lies in the assumption "the ratio between Seasonal Population and Permanent Population remains at the same level from 2010 Census Data to the current year." This may not be accurate or updated. But this is the most accessible and reliable data source. We expect that more analysis can be conducted in the proposed research and utilizing 2020 Census Data when it becomes available in the near future. We highly recommend an additional 2020 research project to align this work with that new census.

What is next?
A full research will be conducted under NCDOT Research Need Statement (RNS) # 9210 "How to Account for Seasonal Population Shifts in Distributing the Powell Bill Allocation Funds" for FY2019. The work proposed herein seeks to identify the municipalities that experience such shifts, quantify its impact, and assess the negative effect (allocation shortfall) of the shift relative to the allocation formula. The proposal will determine how to adjust the funding allocation formula. In addition, this research will suggest strategies to incrementally implement the new formula so as to minimize future allocation impacts on municipalities that may not receive a seasonal or military increase.