

# ACR Slate Recommendations Analyses and Requests:

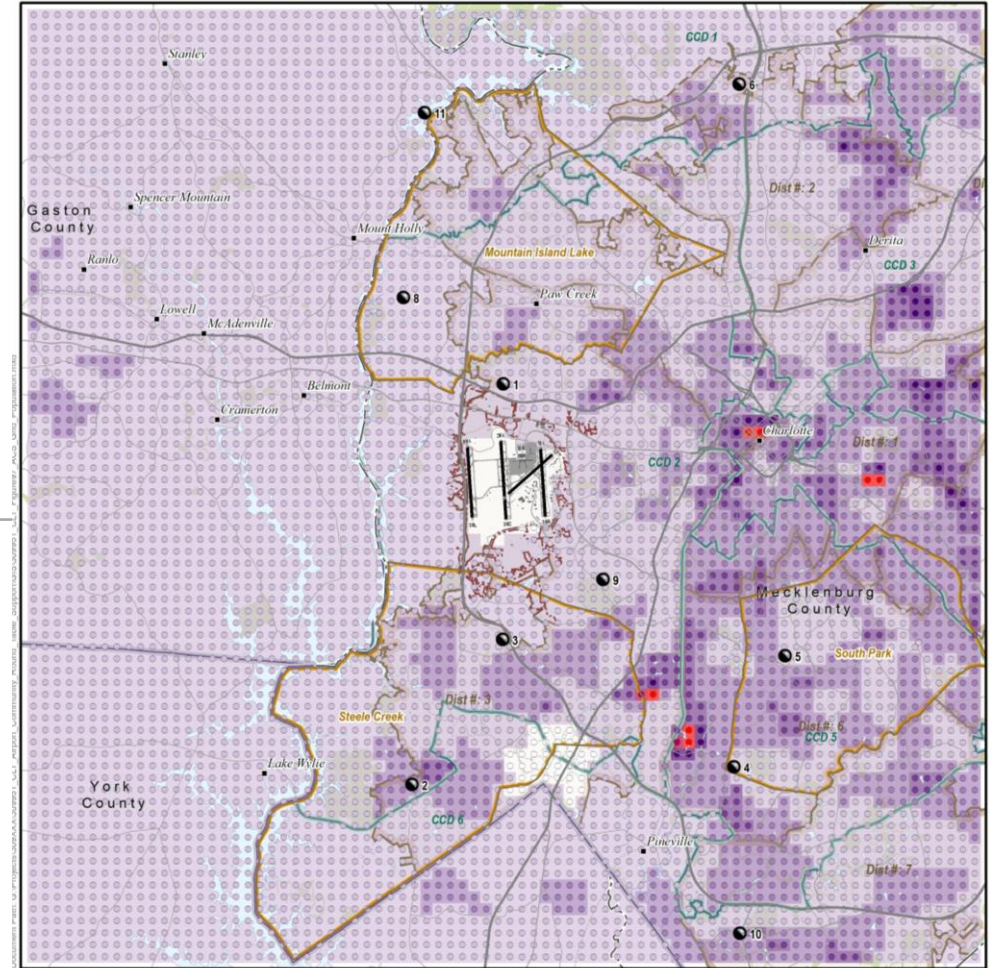
- Update Population Data*
- Change Initial Heading on South Flow Departures*
- Divergent Headings*
- Collective Analyses Options*

For ACR Review, Understanding, and Discussion

October 16, 2019

# ACR Request: Update Population Data

Request of the ACR at the  
August 2019 ACR meeting



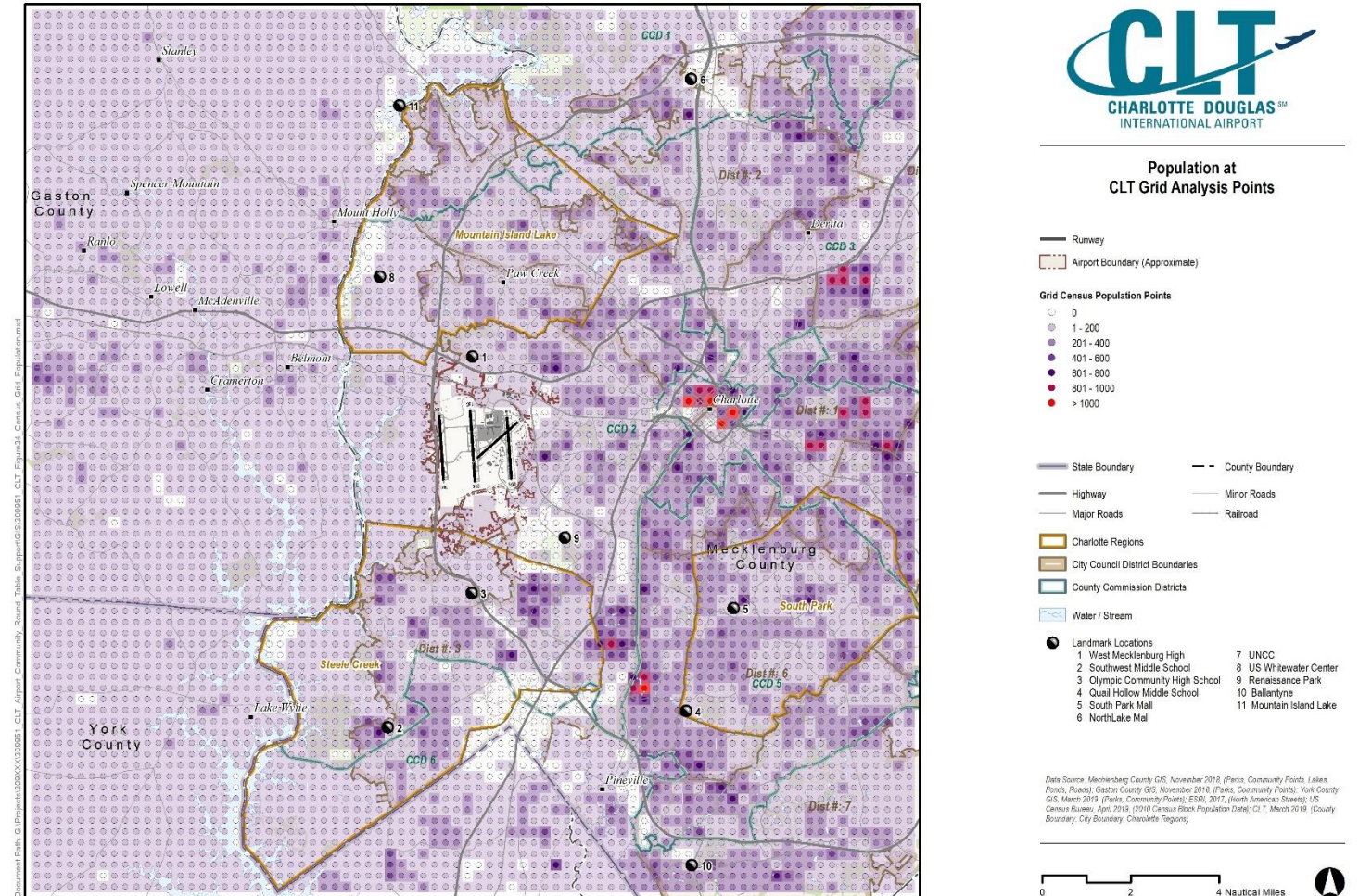
## ACR Request– Update Population Data

- Prior analysis of slate alternatives used population data from the 2010 US Census
- ACR requested incorporation of more recent population data sources if available
- CLT obtained the 2017 edition of the American Community Survey (ACS) from the City of Charlotte
- Population differences are shown in the following three slides
- Analyses going forward (after the results presented in this meeting) will use the 2017 ACS population data



# 2010 US Census Population Levels at Grid Analysis Points

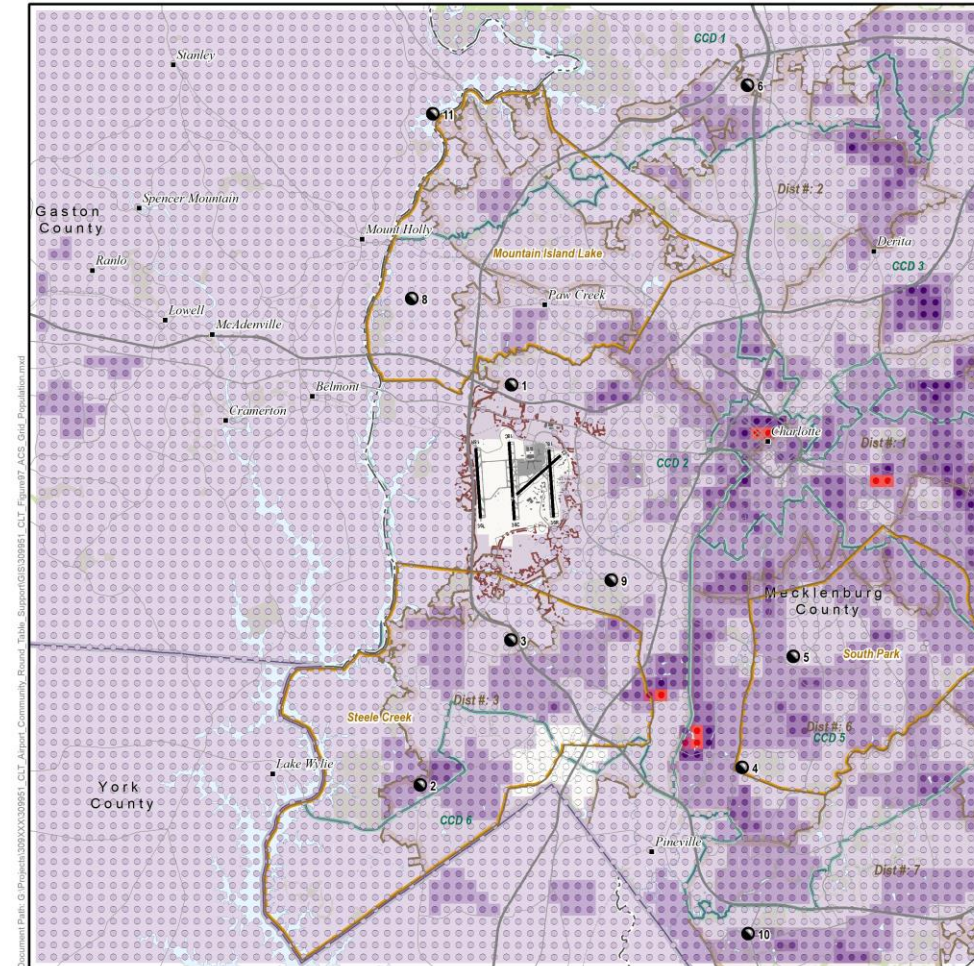
Population Interval	Count of Grid Points
0	323
1-200	4,578
201-400	1,154
401-600	186
601-800	39
801-1000	16
Greater than 1,000	5
Total	6,301
Total Grid Population	736,785



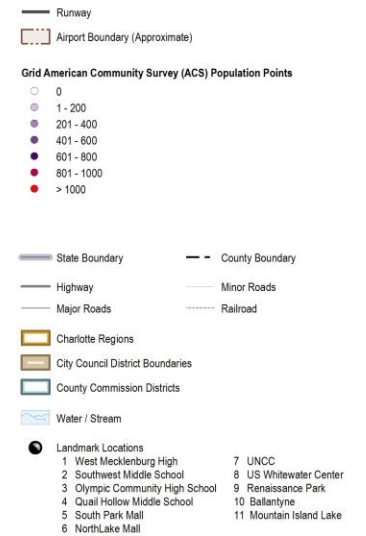


# 2017 ACS Population Levels at Grid Analysis Points

Population Interval	Count of Grid Points	
	2010 Census	2017 ACS
0	323	37
1-200	4,578	4,845
201-400	1,154	1,197
401-600	186	187
601-800	39	26
801-1000	16	2
Greater than 1,000	5	7
Total	6,301	6,301
Total Grid Population	736,785	825,350



## American Community Survey (ACS) Population at CLT Grid Analysis Points



Data Source: Mecklenburg County GIS, November 2016; (Parks, Community Points, Lakes, Points, Roads); Gaston County GIS, November 2016; (Parks, Community Points); York County GIS, March 2019; (Parks, Community Points); ESRRI, 2017; (North American Streets); US Census Bureau, April 2019; (2010 Census Block Population Data); CLT, March 2019; (County Boundary, City Boundary, Charlotte Regions)



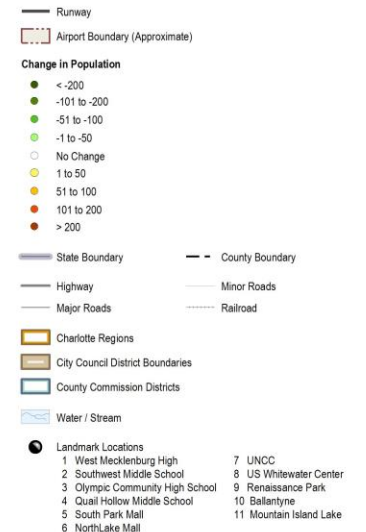


# Population Data Source Analysis: Difference – 2017 ACS Compared to 2010 US Census

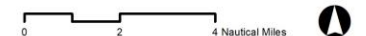
Population Interval	Count of Grid Points / % Change	Count of Population Change
Less than -30	133 / 2.1%	38,859
-30 to -20	315 / 5.0%	43,810
-20 to -10	419 / 6.6%	30,128
-10 to -1	1,109 / 17.6%	22,111
-1 to 1	120 / 1.9%	29
1 to 10	2,501 / 39.7%	52,702
10 to 20	1,078 / 17.1%	75,816
20 to 30	538 / 8.5%	72,079
Greater Than 30	88 / 1.4%	22,905
Total	6,301 / 100.0%	88,565



American Community Survey (ACS)  
Population Data compared to  
2010 US Census Population Data  
at CLT Grid Analysis Points



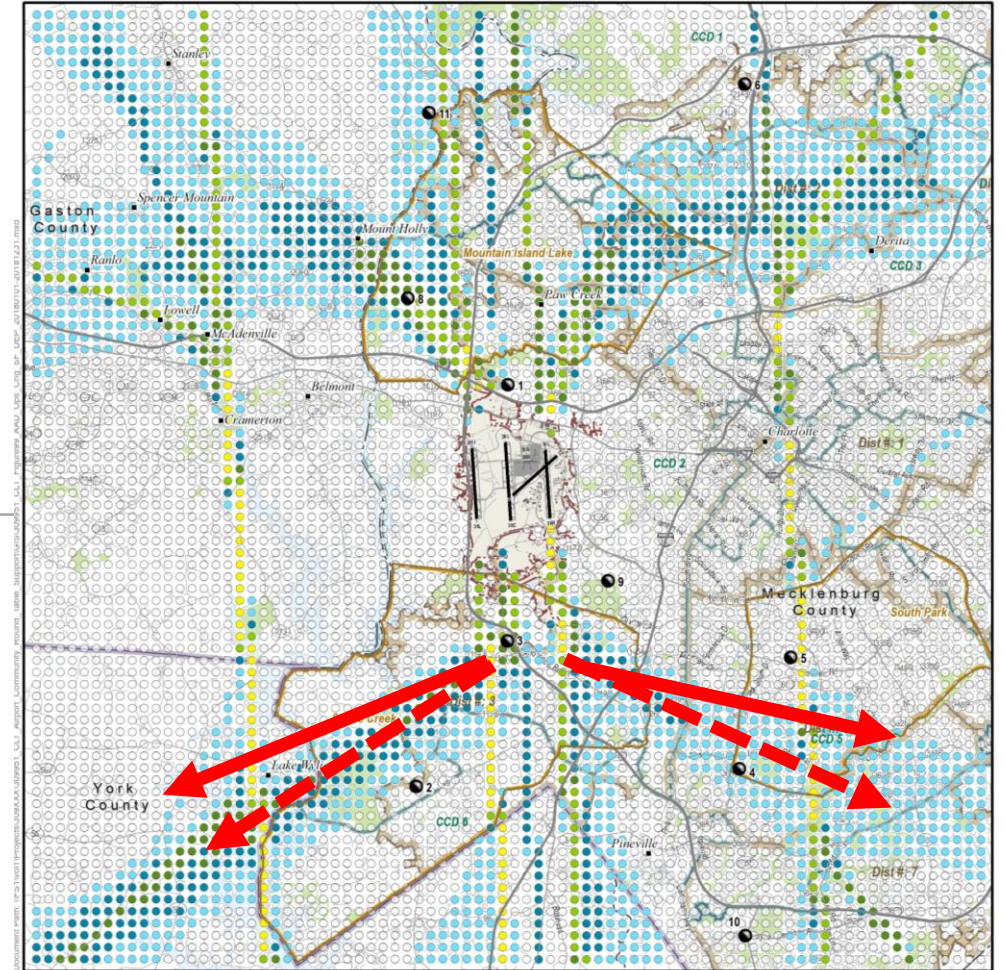
Data Source: Mecklenburg County GIS, November 2018; (Parks, Community Points, Lakes, Points, Roads); Gaston County GIS, November 2018; (Parks, Community Points); York County GIS, March 2019; (Parks, Community Points); ESRI, 2017; (North American Streets); US Census Bureau, April 2019; (2010 Census Block Population Data); CLT, March 2019; (County Boundary, City Boundary, Charlotte Regions)





# ACR Slate Recommendation Analysis: Change Initial Departure Heading

Slate recommendation adopted by ACR at  
March 2019 meeting





## ACR Slate Recommendation – Change Initial Heading on South Flow Departures

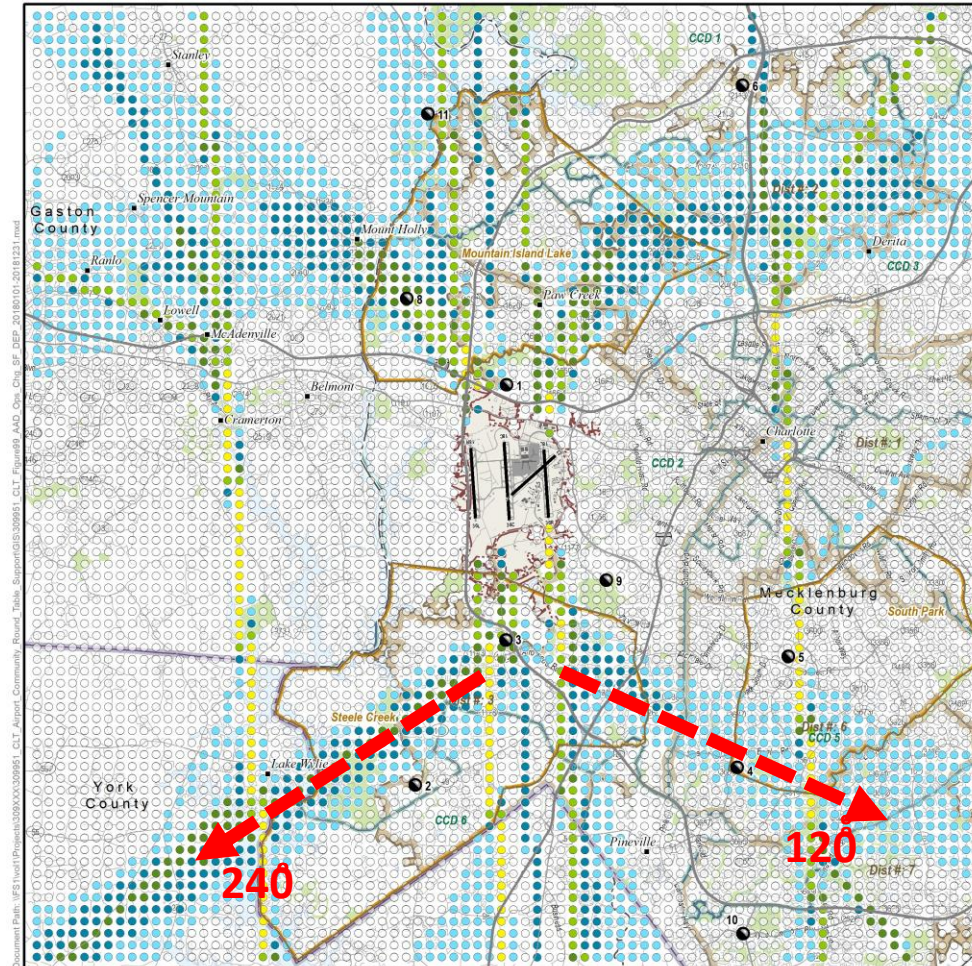
- Modified calendar year 2018 aircraft south flow departures so that aircraft would turn to a new initial heading at same locations where aircraft turn today:
  - 240 degree magnetic heading for departures to the west (current is 270 degrees)
  - 120 degree magnetic heading for departures to the east (current is 090 degrees)
    - *Note: CLT provided modified headings for our analyses*
- Compared the modified results with the 2018 baseline results at each of the grid points (including population estimates at each grid point) in terms of:
  - Number of annual-average overflights
  - Number of average daily noise events above 70 dB (N70)

*Note: 2018 baseline and modified scenarios modeled without terrain due to error in AEDT*

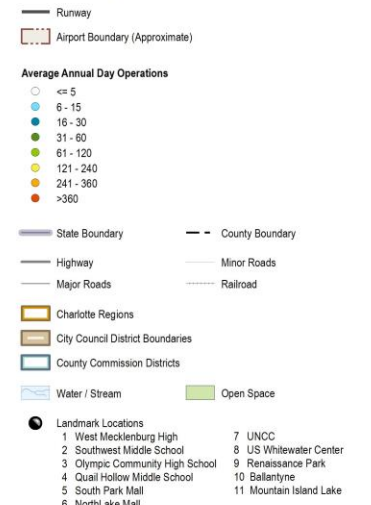


# Annual Average Day Aircraft Overflights Analysis: 2018 Operations with Change in Initial Heading on South Flow Departures

Overflight Interval (Operations)	Count of Grid Points	Count of Population
Less than 5	3,787	455,720
6-15	1,442	168,438
16-30	531	56,514
31-60	211	20,150
61-120	214	23,043
121-240	116	12,920
241-360	0	0
Greater than 360	0	0
Total	6,301	736,785



Average Annual Day Operations Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Change in Initial Heading  
for South Flow Departures

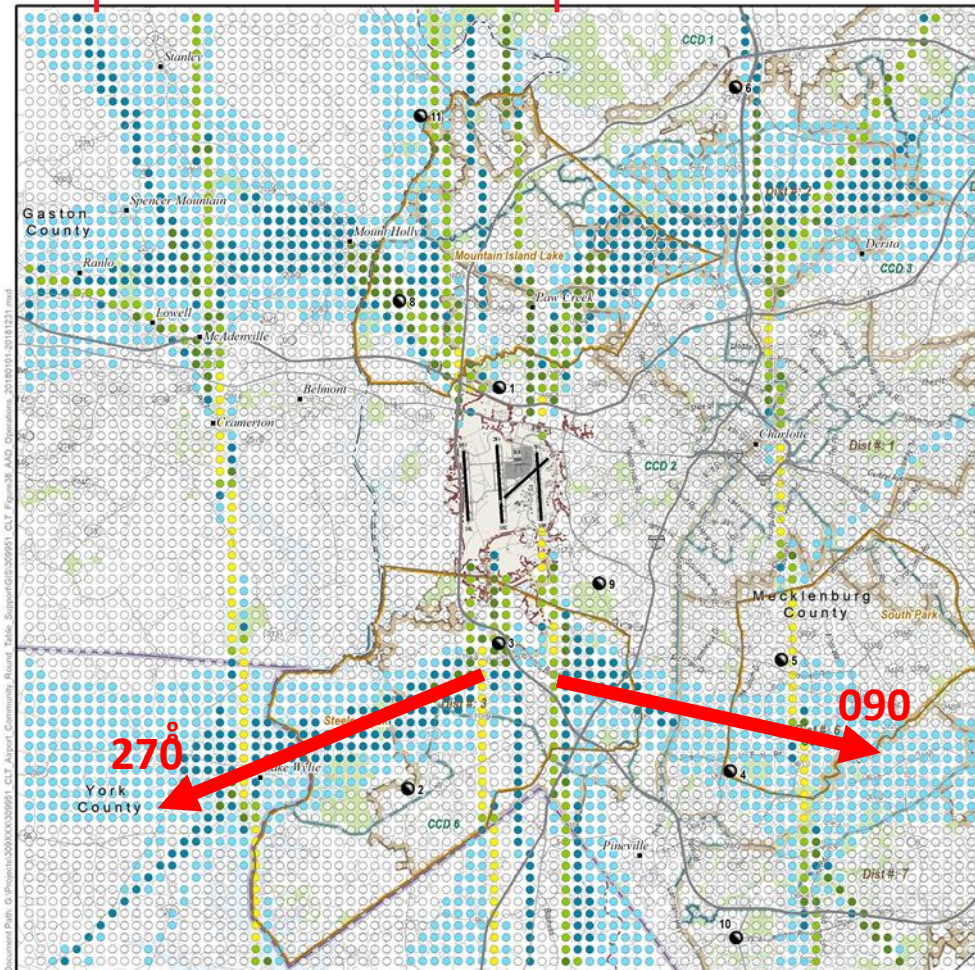


Data Source: Mecklenburg County GIS, November 2018; (Parks, Community Points, Lakes, Ponds, Rivers); Gaston County GIS, November 2018; (Parks, Community Points); York County GIS, March 2019; (Parks, Community Points); CLT, March 2019; (County Boundary, City Boundary, Charlotte Regions)

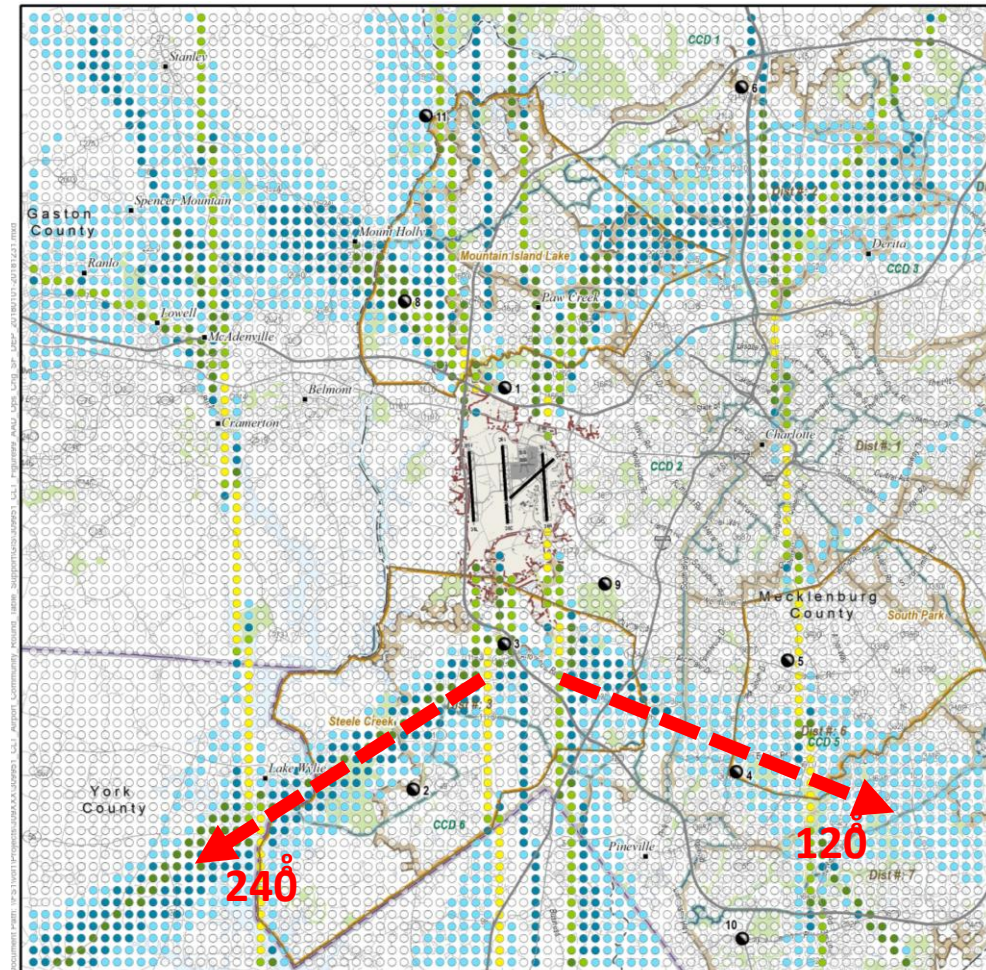




# Annual Average Day Aircraft Overflights Analysis: 2018 Operations with Change in Initial Heading on South Flow Departures Compared to Baseline



Baseline



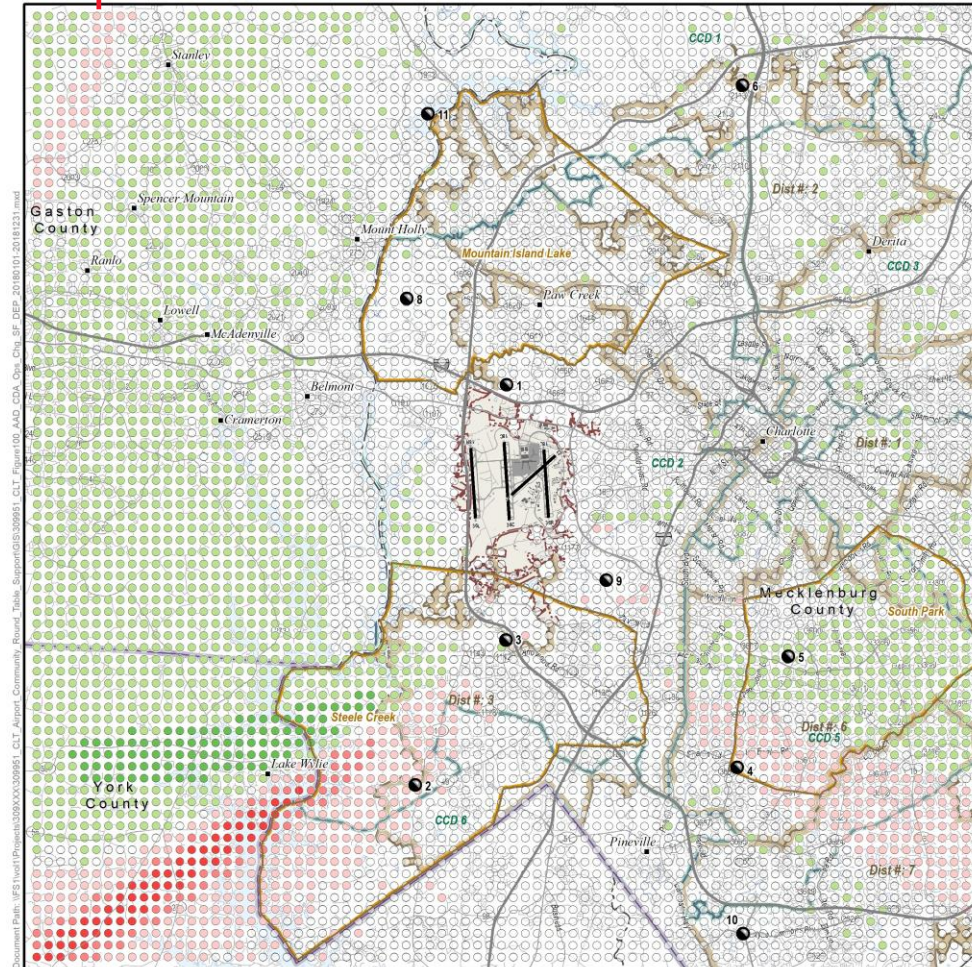
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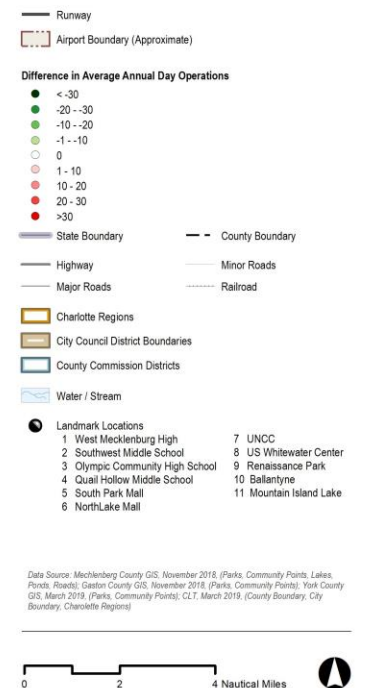


# Annual Average Day Aircraft Overflights Analysis: Difference – 2018 Operations with Change in Initial Heading on South Flow Departures Compared to Baseline

Overflight Interval (Operations)	Count of Grid Points / % Change	Count of Population / % Change
Less than -30	0 / 0.0%	0 / 0.0%
-30 to -20	0 / 0.0%	0 / 0.0%
-20 to -10	71 / 1.1%	3,424 / 0.5%
-10 to -1	531 / 8.4%	23,729 / 3.2%
-1 to 1	5,060 / 80.3%	650,564 / 88.3%
1 to 10	497 / 7.9%	54,540 / 7.4%
10 to 20	77 / 1.2%	2,496 / 0.3%
20 to 30	65 / 1.0%	2,032 / 0.3%
Greater Than 30	0 / 0.0%	0 / 0.0%
Total	6,301 / 100.0%	736,785 / 100.0%



Average Annual Day Operations Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Change in Initial Heading  
for South Flow Departures Compared to  
Baseline Operations

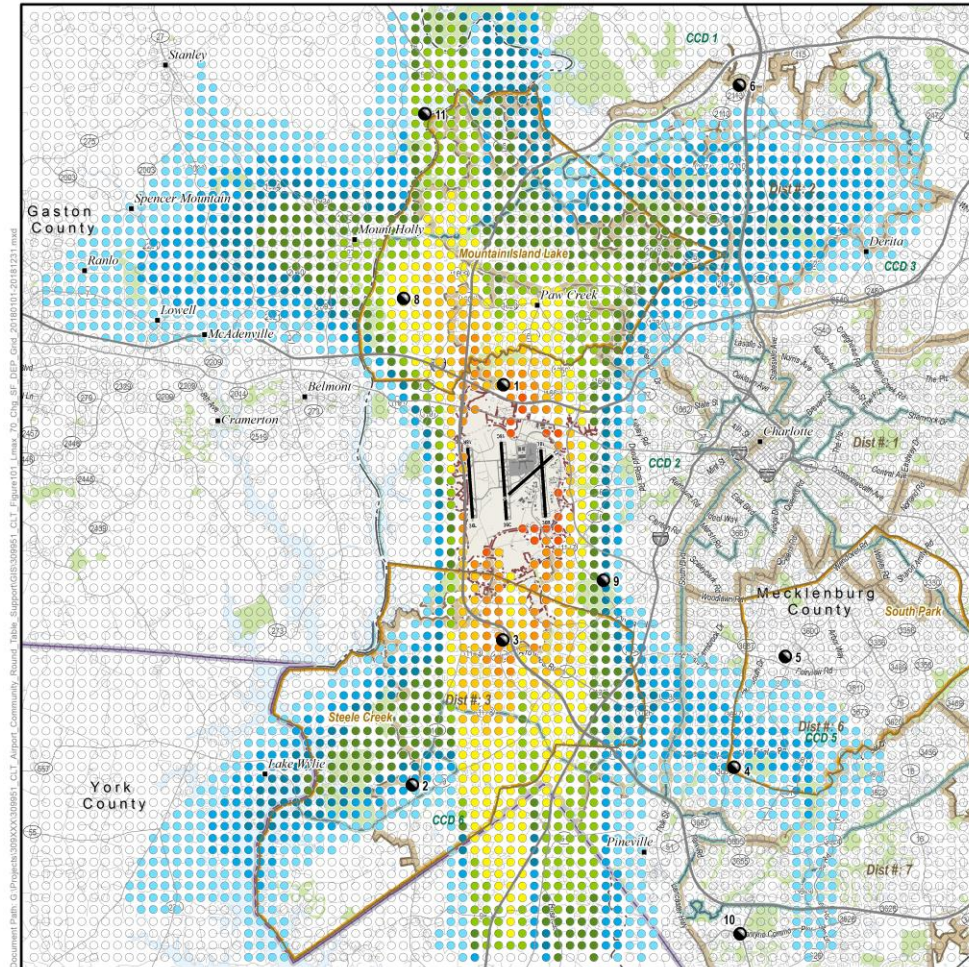


- 602 Grid points (9.6%) / 27,153 people (3.7%) would experience reduced numbers of overflights with change in initial heading
- 639 Grid points (10.1%) / 59,068 people (8.0%) would experience increased numbers of overflights with change in initial heading



# Number of Noise Events Above 70 dB (N70) Analysis: 2018 Operations with Change in Initial Heading on South Flow Departures

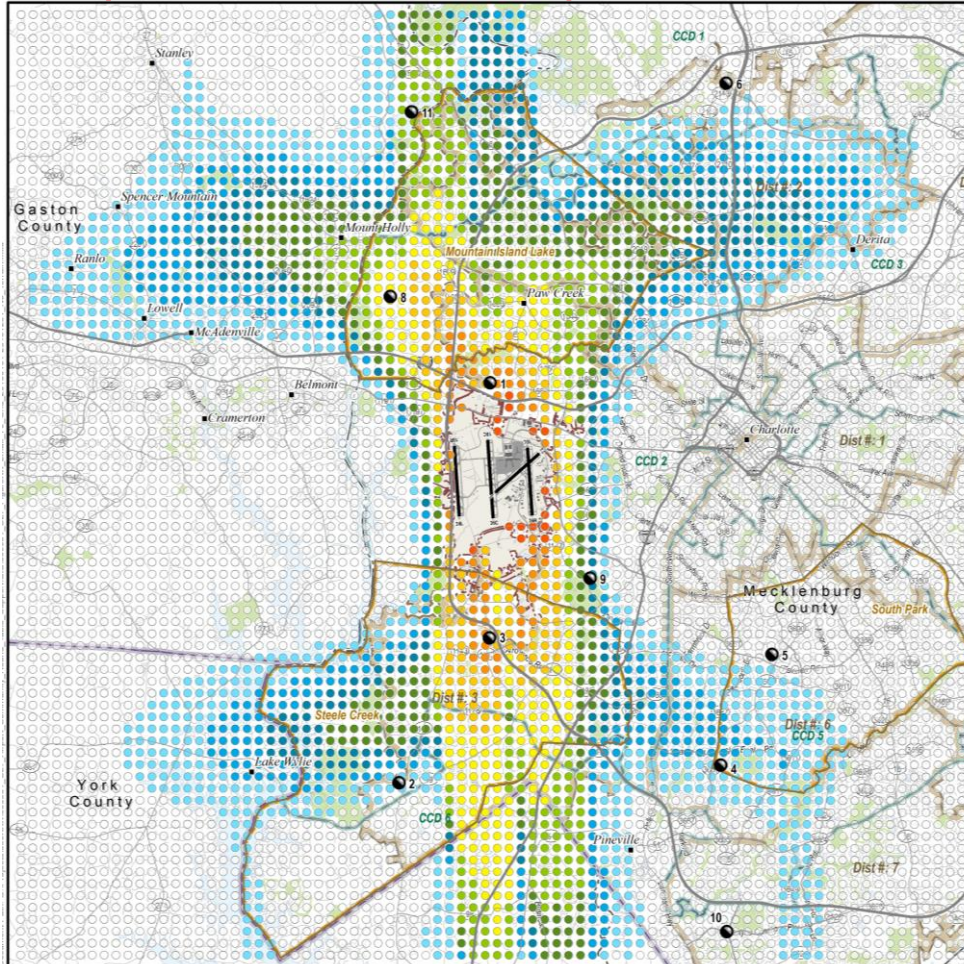
N70 Interval (Events)	Count of Grid Points	Count of Population
25 or Less	3,498	435,388
26-50	885	101,521
51-75	493	62,325
76-100	333	33,050
101-150	358	38,418
151-200	277	24,818
201-300	228	23,167
301-400	150	14,258
401-500	64	3,540
Greater than 500	15	300
<b>Total</b>	<b>6,301</b>	<b>736,785</b>



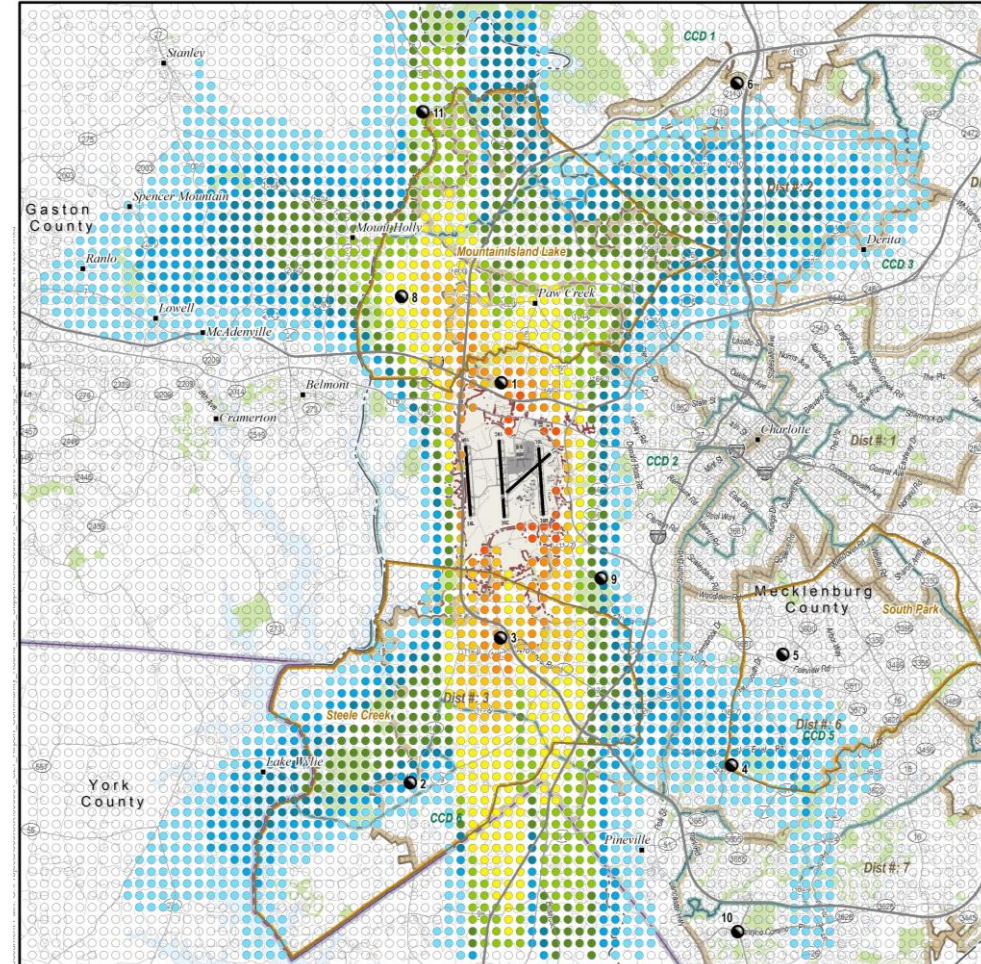
Number Above Lmax 70 Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Change in Initial Heading  
for South Flow Departures



# Number of Noise Events Above 70 dB (N70) Analysis: 2018 Operations with Change in Initial Heading on South Flow Departures Compared to Baseline



Baseline

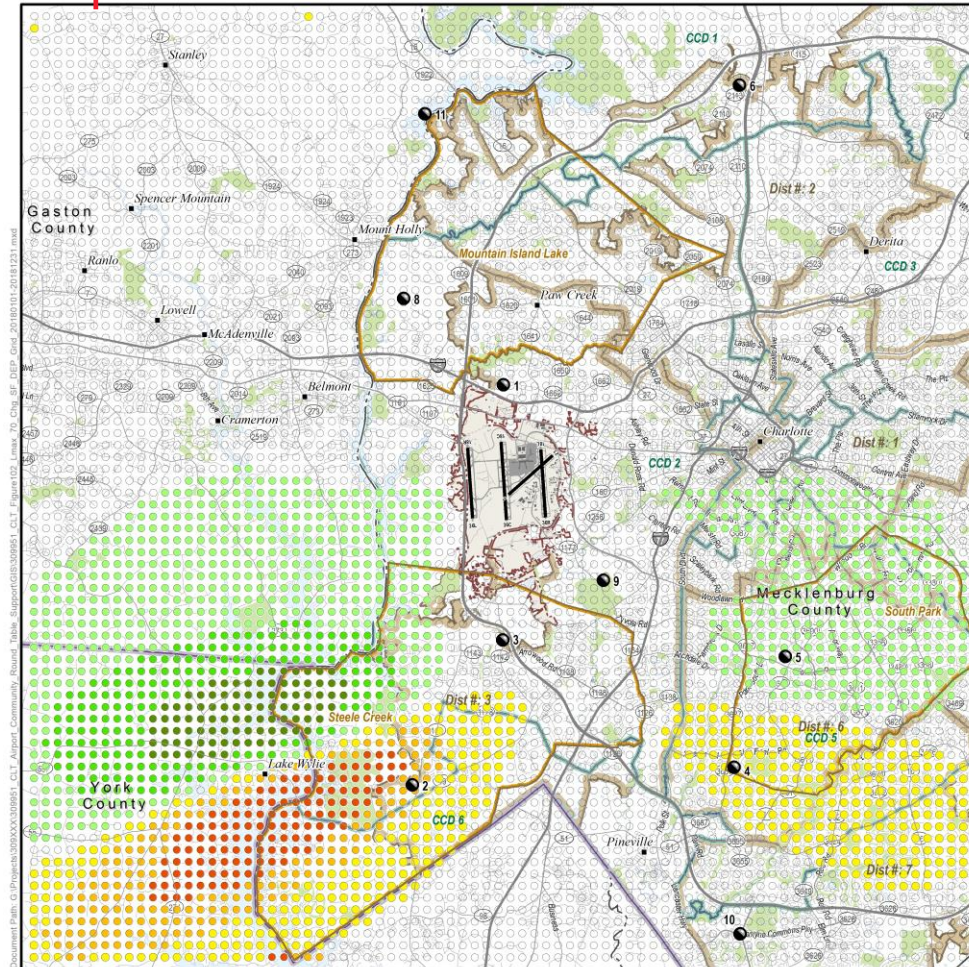


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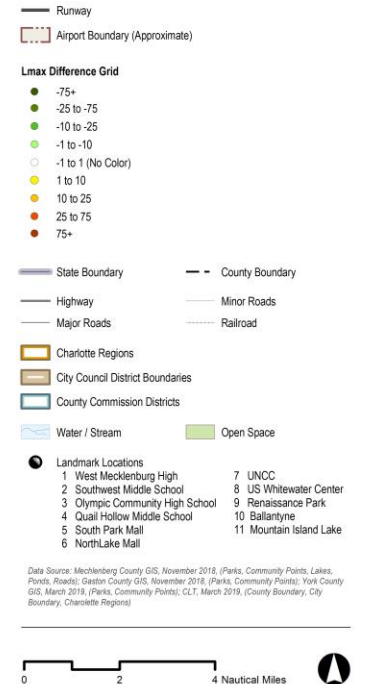


# Number of Noise Events Above 70 dB (N70) Analysis: Difference – 2018 Operations with Change in Initial Heading on South Flow Departures Compared to Baseline

N70 Difference Interval (Events)	Count of Grid Points / % Change	Count of Population / % Change
Less than -75	0 / 0.0%	0 / 0.0%
-75 to -25	95 / 1.5%	2,659 / 0.4%
-25 to -10	194 / 3.1%	5,238 / 0.7%
-10 to -1	890 / 14.1%	104,091 / 14.1%
-1 to 1	4,285 / 68.0%	528,917 / 71.8%
1 to 10	531 / 8.4%	80,386 / 10.9%
10 to 25	176 / 2.8%	9,835 / 1.3%
25 to 75	130 / 2.1%	5,659 / 0.8%
Greater than 75	0 / 0.0%	0 / 0.0%
Total	6,301 / 100.0%	736,785 / 100.0%



Number Above Lmax 70 Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Change in Initial Heading  
for South Flow Departures Compared to  
Baseline Operations



- 1,179 Grid points (18.7%) / 111,988 people (15.2%) would experience fewer events above 70 dB Lmax with change in initial heading
- 837 Grid points (13.3%) / 95,880 people (13.0%) would experience more events above 70 dB Lmax with change in initial heading

# ACR Slate Recommendation Analysis: 2018 Operations with Change in Initial Heading on South Flow Departures Observations

- Number of average daily overflight:
  - A greater number of grid points and more people experienced a increase than a decrease
- Number of noise events greater than 70 dB (N70)
  - A greater number of grid points and more people experienced a decrease than an increase
- Changing the initial heading for south flow departures provides the greatest benefits for areas close to the airport, and least benefit for areas further from the airport east and west of the south flow extended runway centerlines
- Potential noise reductions in the northern portions of the grid and noise increases in the southern portion of the grid for the community of South Park
- Potential noise reductions in the western central and northern portions of the grid and noise increases in the western southern portion of the grid for the community of Steele Creek
- Dispersion may decrease slightly compared to baseline operations since the turn angle is less
- May negatively effect operations throughput due to less separation of aircraft



## ACR Slate Recommendation Analysis: Change in Initial Heading on South Flow Departures Overall Analysis Considerations for the ACR

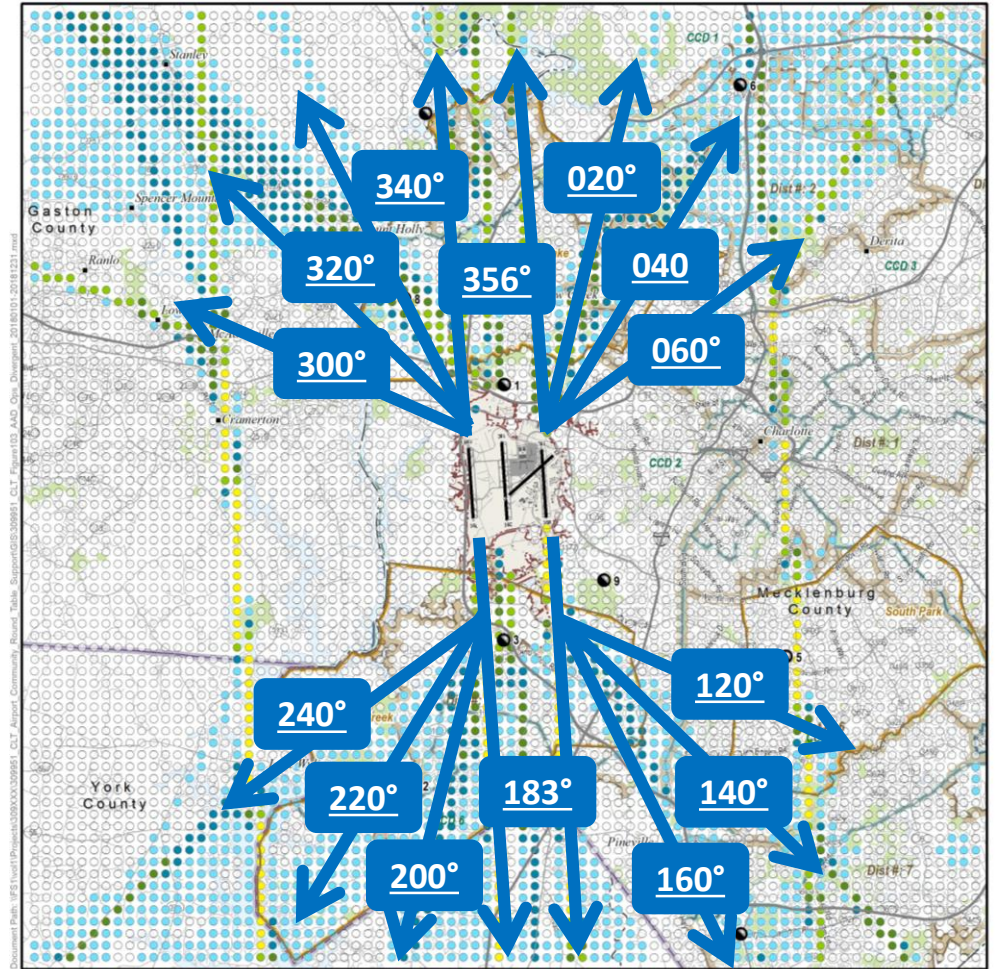
- Do the reported changes from the 2018 baseline to modifying the initial heading on south flow departures meet the goals of the ACR?
- How does the potential negative effect of changing the initial heading for south flow departures on airport throughput factor in to the ACR recommendations?
- Does the ACR want to recommend changing the initial heading on south flow departures for consideration of the final slate?
- Does the ACR prefer to recommend changing the initial heading on south flow departures along with another measure, such as altitude-based turns, rather than a stand-alone measure?





# ACR Slate Recommendation Analysis: Multiple Divergent Headings

Slate recommendation adopted by ACR at  
March 2019 meeting



## ACR Slate Recommendation – Multiple Divergent Headings

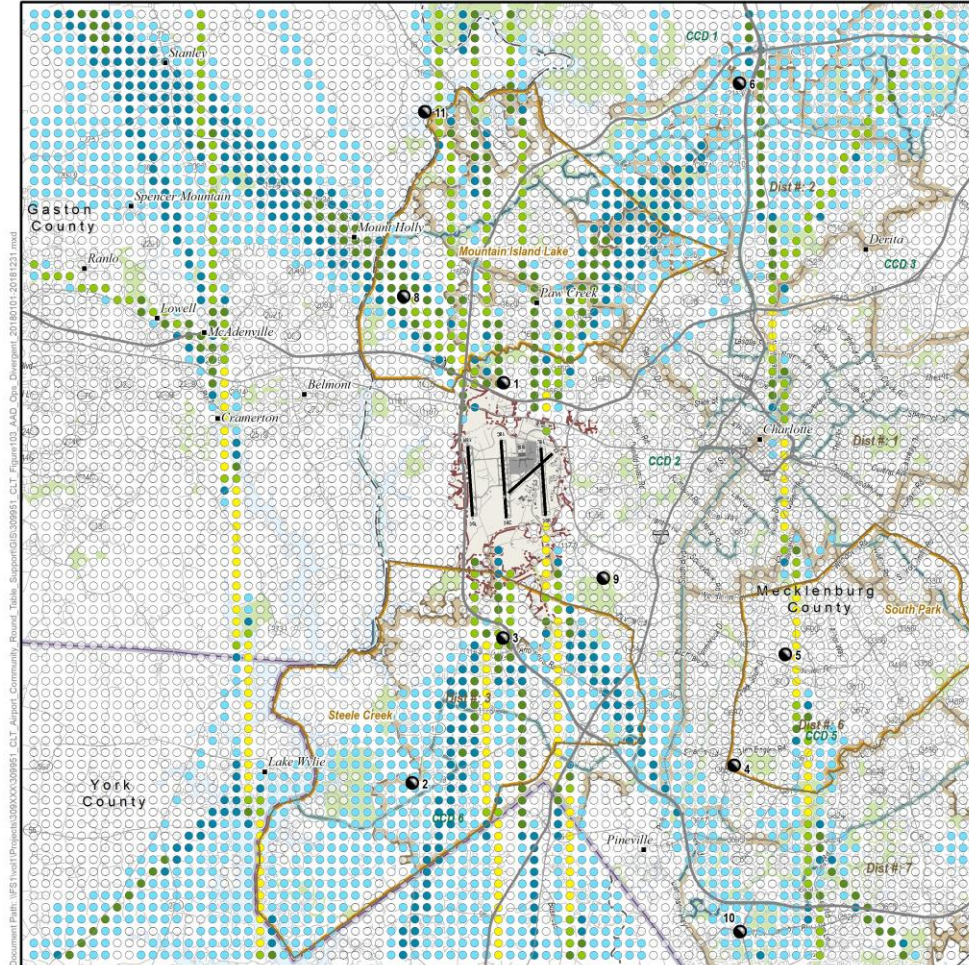
- Assigned flights to multiple divergent departure headings based on destination/exit point from CLT airspace
  - Multiple (seven) divergent headings for north and south flow departures, 14 total
  - Headings diverge at runway end for north flow departures and after two miles for south flow departures
- Compared the modeled results for multiple divergent headings with the 2018 baseline results at each of the grid points (including population estimates at each grid point) in terms of:
  - Number of annual-average overflights
  - Number of average daily noise events above 70 dB (N70)



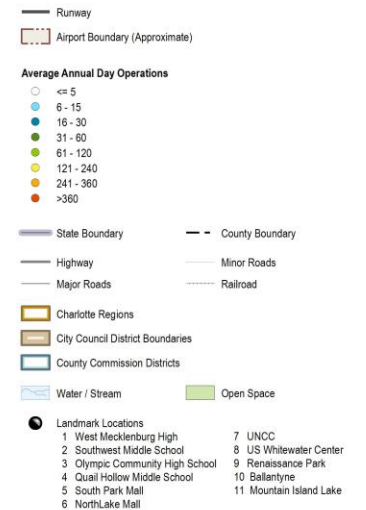


# Annual Average Day Aircraft Overflights Analysis: 2018 Operations with Multiple Divergent Headings

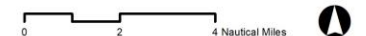
Overflight Interval (Operations)	Count of Grid Points	Count of Population
Less than 5	3,885	479,352
6-15	1,461	16,0359
16-30	399	40,337
31-60	210	19,958
61-120	212	22,111
121-240	134	14,668
241-360	0	0
Greater than 360	0	0
Total	6,301	736,785



Average Annual Day Operations Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Divergent Headings

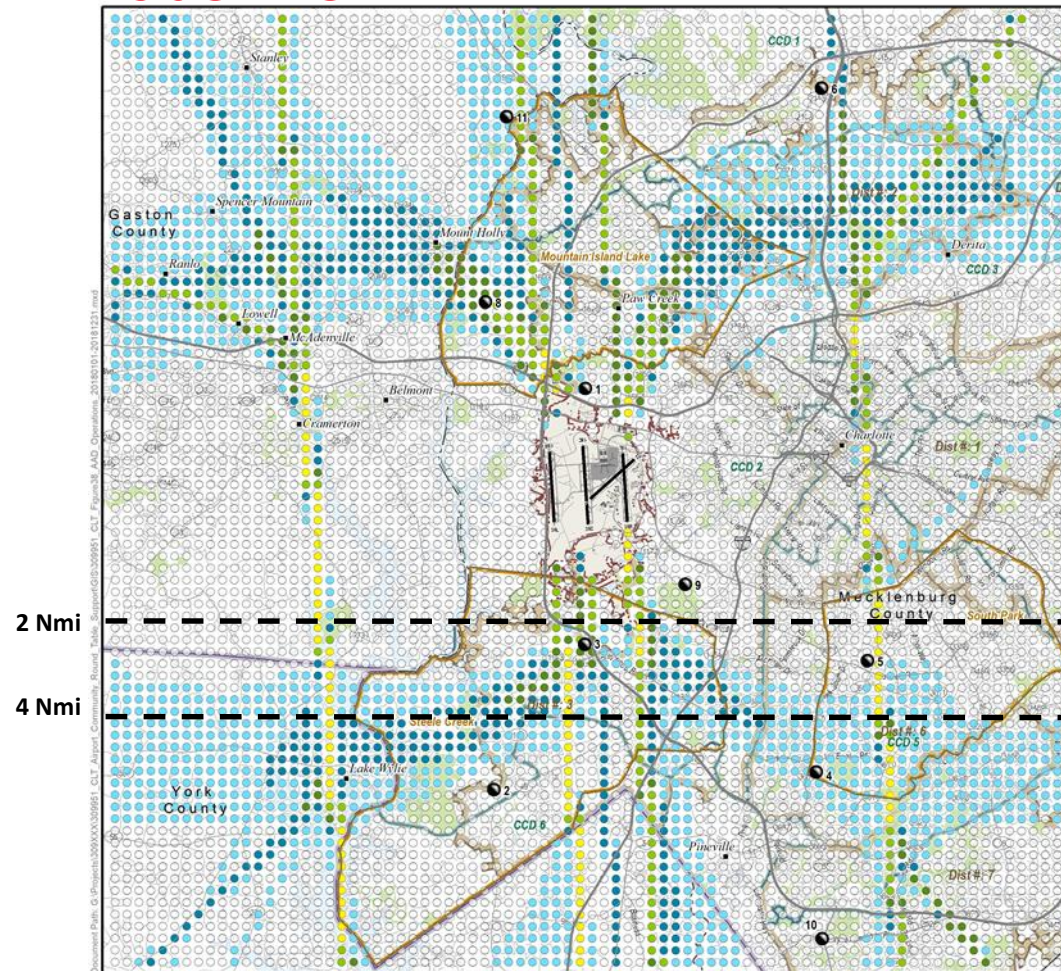


Data Source: Mecklenburg County GIS, November 2018; (Parks, Community Points, Lakes, Ponds, Rivers); Gaston County GIS, November 2018; (Parks, Community Points); York County GIS, March 2019; (Parks, Community Points); CLT, March 2019; (County Boundary, City Boundary, Charlotte Regions)

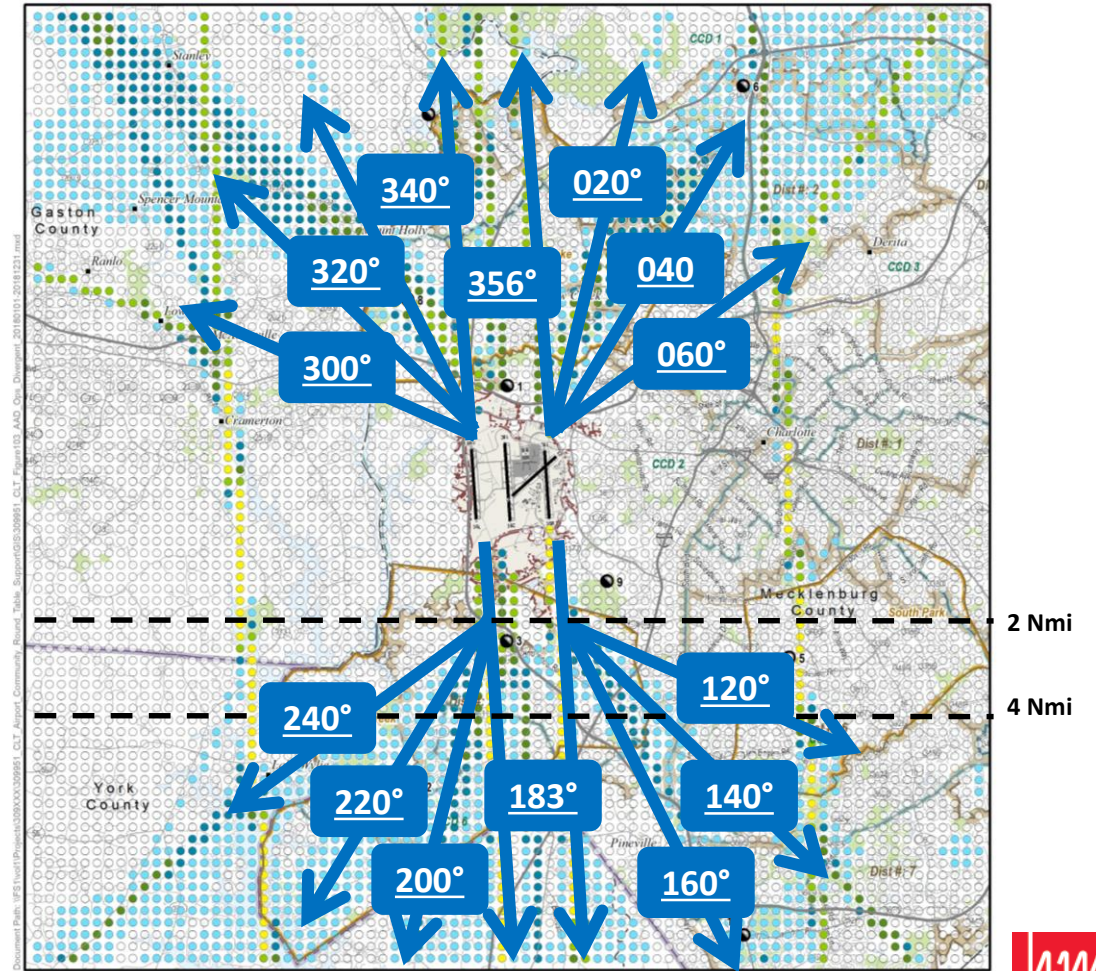




# Annual Average Day Aircraft Overflights Analysis: 2018 Operations with Multiple Divergent Headings Compared to Baseline



Baseline

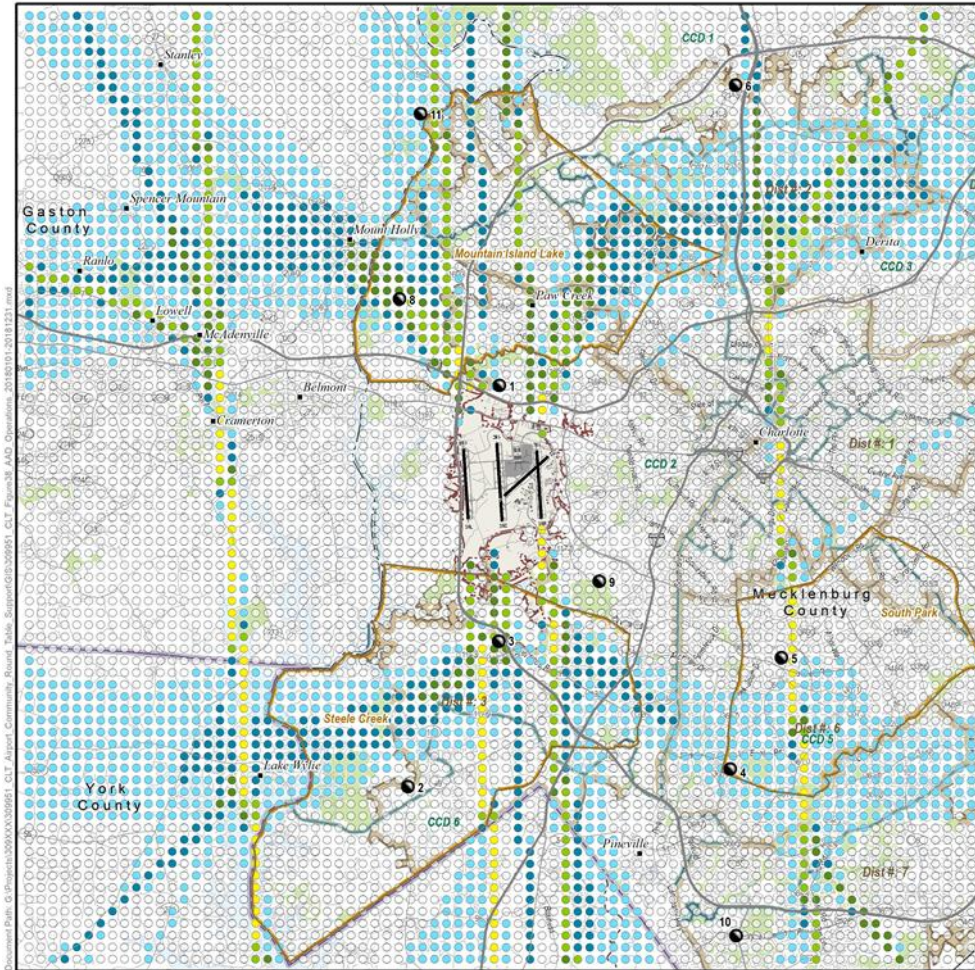


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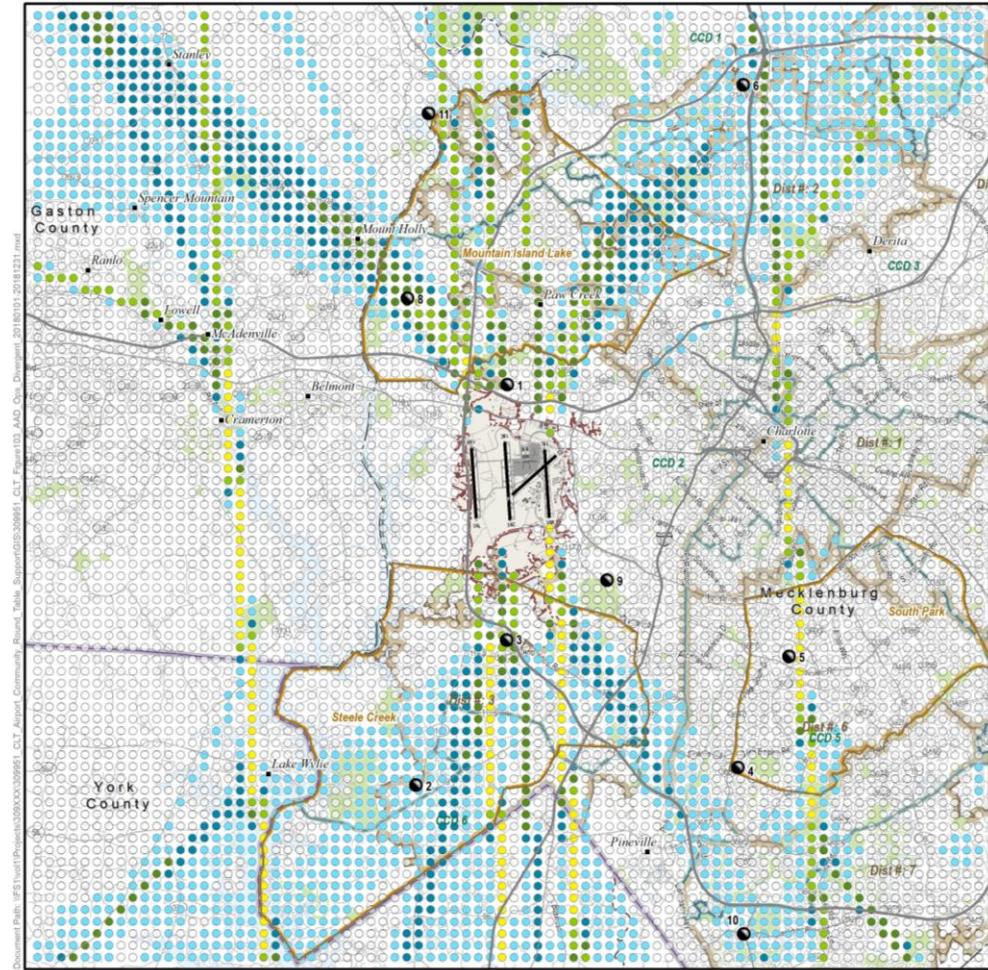




# Annual Average Day Aircraft Overflights Analysis: 2018 Operations with Multiple Divergent Headings Compared to Baseline



Baseline

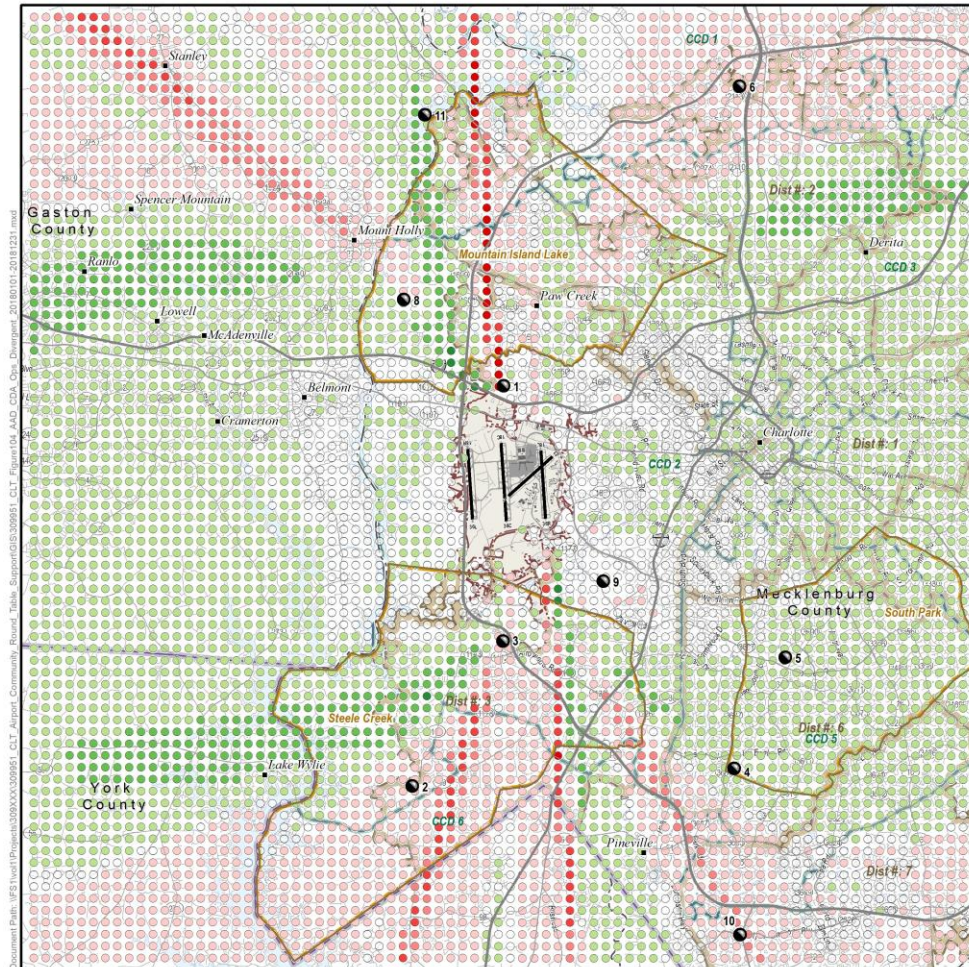


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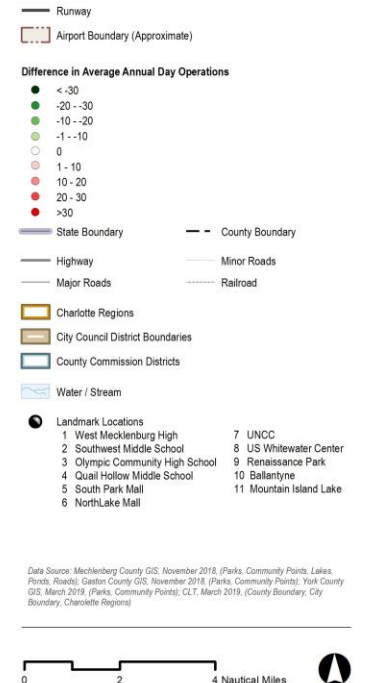


# Annual Average Day Aircraft Overflights Analysis: Difference – 2018 Operations with Multiple Divergent Headings Compared to Baseline

Overflight Interval (Operations)	Count of Grid Points / % Change	Count of Population / % Change
Less than -30	0 / 0.0%	0 / 0.0%
-30 to -20	630 / 10.0%	60,442 / 8.2%
-20 to -10	847 / 13.4%	92,521 / 12.6%
-10 to -1	2,221 / 35.2%	334,885 / 45.5%
-1 to 1	287 / 4.6%	31,085 / 4.2%
1 to 10	747 / 11.9%	74,010 / 10.0%
10 to 20	910 / 14.4%	73,634 / 10.0%
20 to 30	655 / 10.4%	70,166 / 9.5%
Greater Than 30	4 / 0.1%	42 / 0.0%
<b>Total</b>	<b>6,301 / 100.0%</b>	<b>736,785 / 100.0%</b>



Average Annual Day Operations Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Divergent Headings  
Compared to Baseline Operations

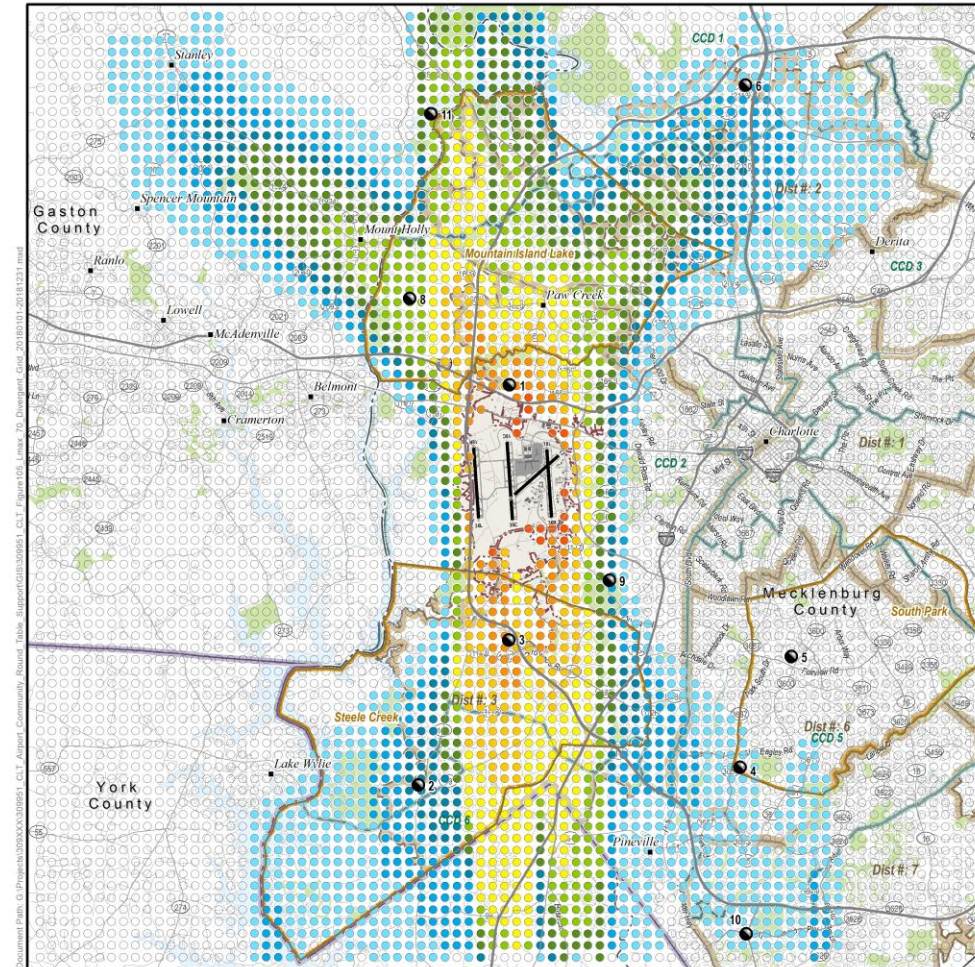


- 3,698 Grid points (58.7%) / 487,848 people (66.2%) would experience reduced numbers of overflights with multiple divergent headings
- 2,316 Grid points (36.8%) / 217,852 people (29.6%) would experience increased numbers of overflights with multiple divergent headings

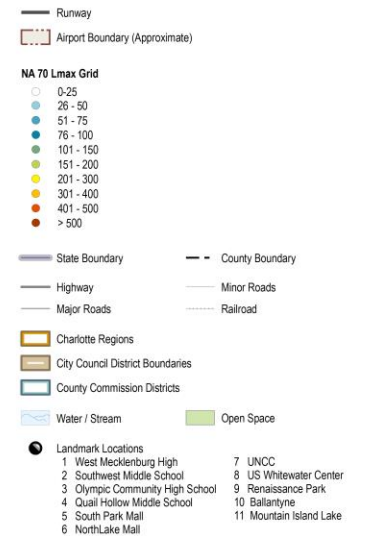


# Number of Noise Events Above 70 dB (N70) Analysis: 2018 Operations with Multiple Divergent Headings

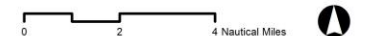
N70 Interval (Events)	Count of Grid Points	Count of Population
25 or Less	3,547	441,659
26-50	982	117,723
51-75	420	48,254
76-100	251	26,426
101-150	328	31,503
151-200	258	22,437
201-300	259	26,107
301-400	169	17,769
401-500	72	4,607
Greater than 500	15	300
<b>Total</b>	<b>6,301</b>	<b>736,785</b>



Number Above Lmax 70 Grid Analysis  
January 1, 2018 through December 31, 2018  
CLT Operations with Divergent Headings

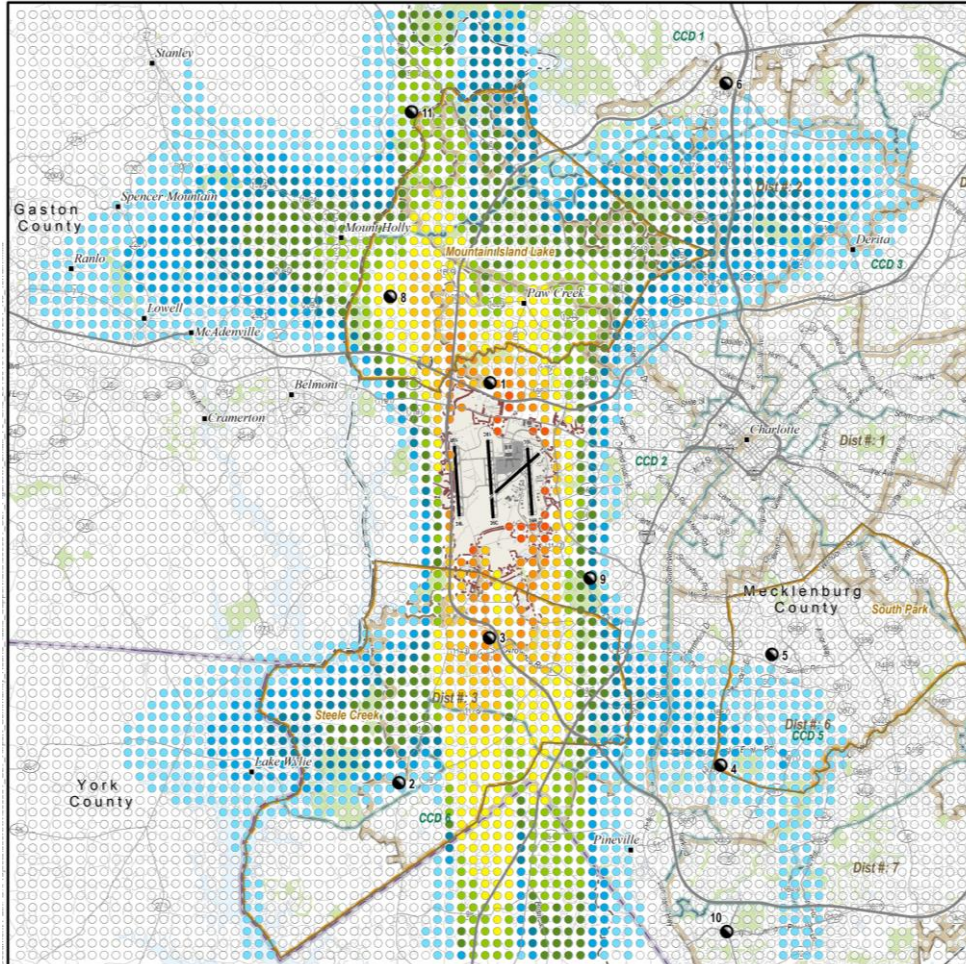


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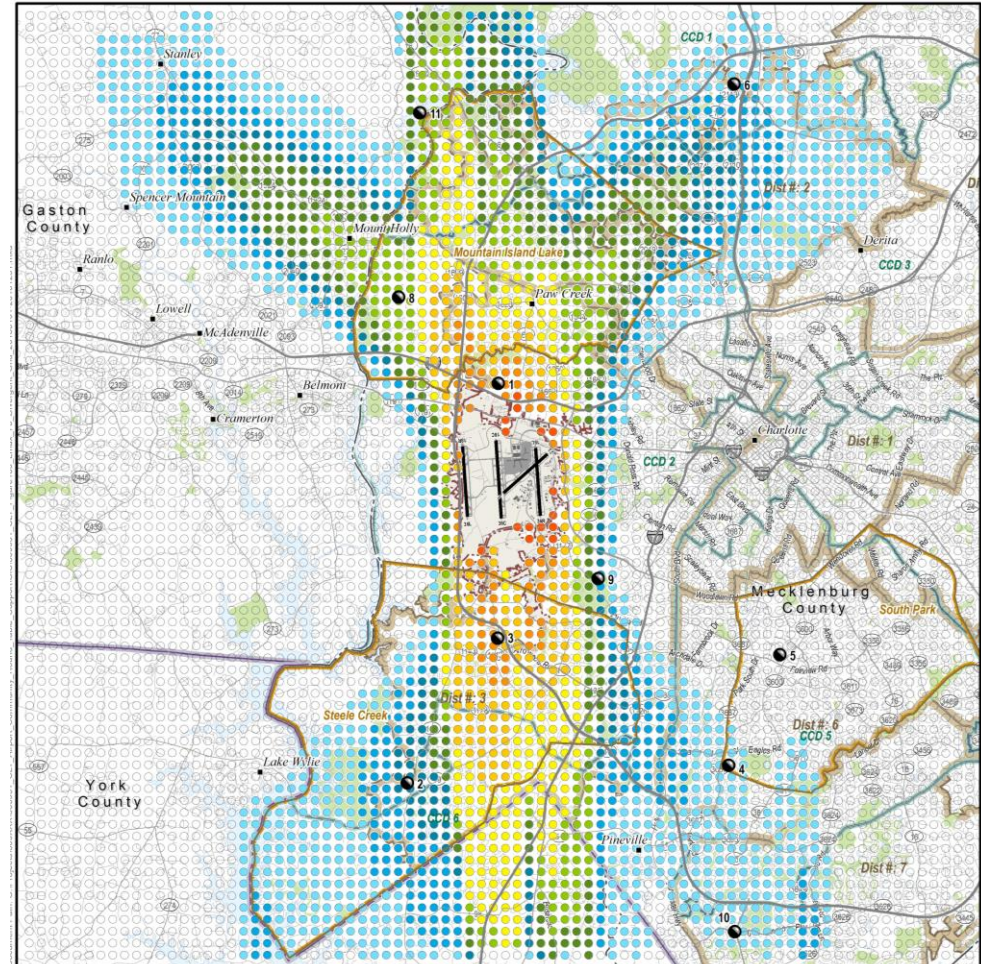




# Number of Noise Events Above 70 dB (N70) Analysis: 2018 Operations with Multiple Divergent Headings Compared to Baseline



Baseline

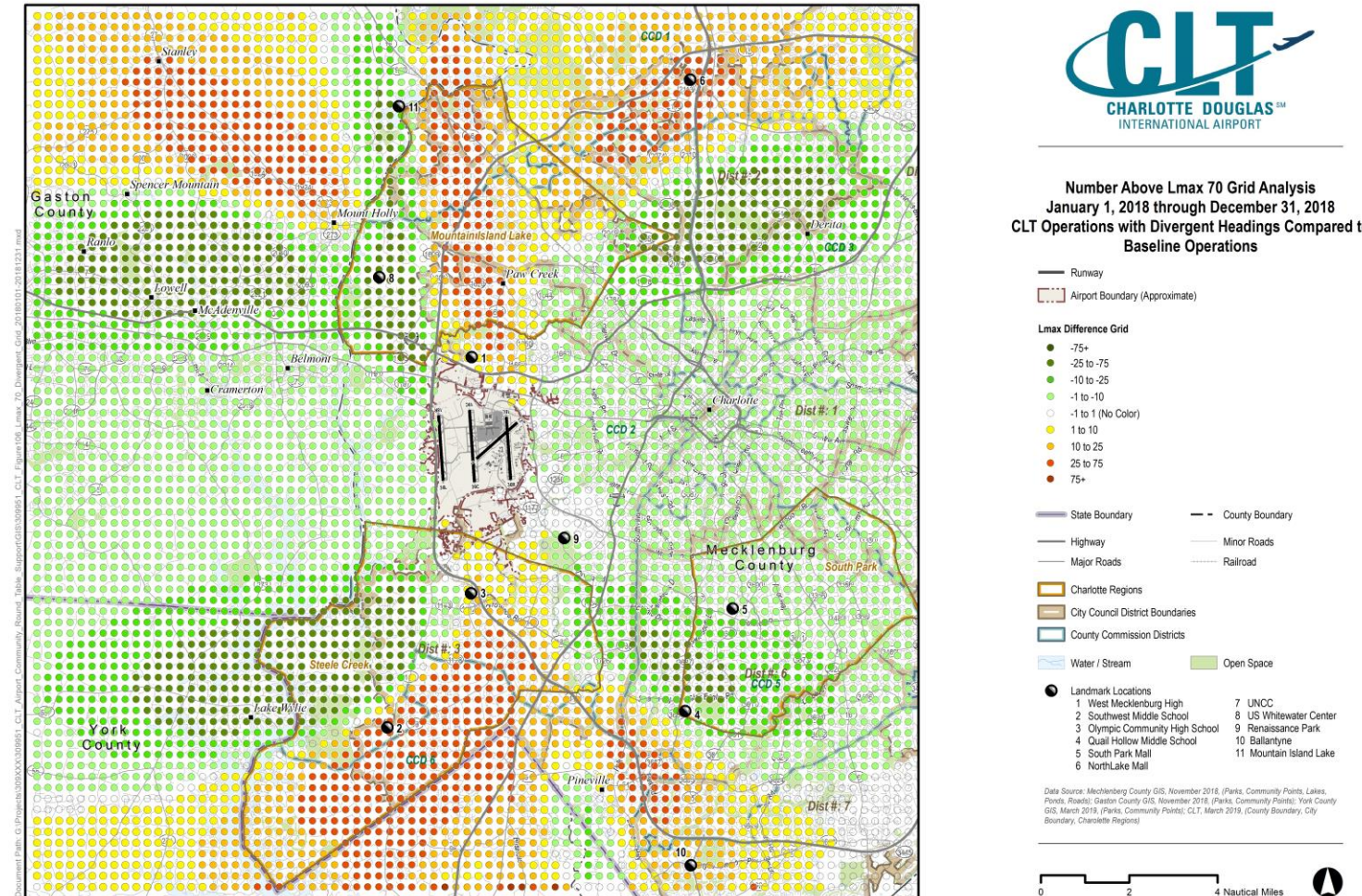


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# Number of Noise Events Above 70 dB (N70) Analysis: Difference – 2018 Operations with Multiple Divergent Headings Compared to Baseline

N70 Difference Interval (Events)	Count of Grid Points / % Change	Count of Population / % Change
Less than -75	0 / 0.0%	0 / 0.0%
-75 to -25	630 / 10.0%	60,442 / 8.2%
-25 to -10	847 / 13.4%	92,521 / 12.6%
-10 to -1	2,221 / 35.2%	334,885 / 45.5%
-1 to 1	287 / 4.6%	31,085 / 4.2%
1 to 10	747 / 11.9%	74,010 / 10.0%
10 to 25	910 / 14.4%	73,634 / 10.0%
25 to 75	655 / 10.4%	70,166 / 9.5%
Greater than 75	4 / 0.1%	42 / 0.0%
<b>Total</b>	<b>6,301 / 100.0%</b>	<b>736,785 / 100.0%</b>



- 3,698 Grid points (58.7%) / 487,848 people (66.21%) would experience fewer events above 70 dB Lmax with multiple divergent headings
- 2,316 Grid points (36.8%) / 217,852 people (29.6%) would experience more events above 70 dB Lmax with multiple divergent headings

# ACR Slate Recommendation Analysis: 2018 Operations with Multiple Divergent Headings Observations

- Number of average daily overflight:
  - A greater number of grid points and more people experienced a decrease than an increase
- Number of noise events greater than 70 dB (N70)
  - A greater number of grid points and more people experienced a decrease than an increase
- Multiple divergent departure headings provide the greatest benefits for areas close to the airport and increases the number of operations and number of events above 70 dB in the areas to the northern and southern edges of the analysis grid
- Potential noise decreases throughout the grid for the community of South Park
- Potential noise increases in the southern and eastern portions of the grid and noise decreases in the northwestern portion of the grid for the community of Steele Creek
- Potential noise increases in the central portion of the grid and decreases in the southeastern and western portions of the grid for the community of Mountain Island Lake
- Dispersion would remain roughly the same with each heading, but the multiple headings increase overall dispersion of the departures compared to baseline operations
- May negatively effect operations throughput due to less separation of aircraft, which is dependent on the initial departure turn heading





## ACR Slate Recommendation Analysis: Multiple Divergent Headings Overall Analysis Considerations for the ACR

- Do the reported changes from the 2018 baseline to the implementation of divergent headings meet the goals of the ACR?
- How does the potential negative effect of divergent headings on airport throughput, specifically for south flow departures, factor in to the ACR recommendations?
- Does the ACR want to recommend implementation of divergent headings for consideration of the final slate?



# ACR Slate Collective Analyses Options

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ACR recommended eight measures for the 2019 Slate



## ACR Slate Recommendations for Analysis – 2019

1. Noise abatement departure profile (NADP) procedures<sup>1</sup>
2. Continuous descent approach (CDA)<sup>2</sup>
3. Alternating downwind arrival rails
4. Altitude based turns for departures
5. Divergent departure headings
6. Delay initial aircraft turns for south departures
7. Change headings of initial aircraft turns for south departures
8. Remove the two-mile restriction for south departures



# Potential Collective Analysis Matrix

Combinations of Existing ACR Slate Measures previously evaluated

ACR Proposed Measure	1	2	3	4	5	6
Noise Abatement Departure Profiles						
Continuous Descent Approaches						
Alternating Downwind Rails	X	X	X	X	X	X
Altitude-based Turns	X	X		X		
Divergent departure headings			X			
Delay initial turns on departure				X		
Change initial departure turn heading						X
Remove 2-mile restriction		X			X	





# Potential Combined Measures for Additional Analysis Matrix

Potential Combinations of ACR Slate Measures that would require additional analysis

ACR Proposed Measure	1	2	3	4	5	6	7
Noise Abatement Departure Profiles	X	X	X	X	X	X	X
Continuous Descent Approaches	X	X	X	X	X	X	X
Alternating Downwind Rails	X	X	X	X	X	X	X
Altitude-based Turns	X	X	X	X			
Divergent departure headings			X	X	X	X	
Delay initial turns on departure					X		
Change initial departure turn heading	X	X					X
Remove 2-mile restriction		X		X		X	X



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# Discussion