Growth Modeling and Utility Impact Analysis

Jake Petrosky, AICP
LandDesign
UC 2015
Outline

• Background
• Goals of the Process
• Modeling
• Highlights & Takeaways
BACKGROUND

- WSACC
  - Water and Sewer Authority of Cabarrus County
  - “Wholesale” service to the four major municipal utility providers in Cabarrus County (Concord, Harrisburg, Kannapolis and Mount Pleasant) and Charlotte Water
  - Operates Don T. Howell reservoir
  - Manages wastewater transportation and three treatment plants
  - 2001 Master Plan needed an update
Relentless N. Carolina drought could be devastating in '08

Posted 12/26/2007 5:41 PM | Comment 0 | Recommend 0

Concord, Kannapolis settle Catawba water dispute

Jan 20, 2010, 7:42am EST  Updated Jan 20, 2010, 8:21am EST
Susan Stabiley
Staff Writer

Concord and Kannapolis say they will limit how much water can be transferred from the Catawba River during droughts. And that deal settles a nearly three-year battle among communities that depend on the waterway for their drinking supply.

The Catawba Riverkeeper Foundation and the Protect the Catawba Coalition — an 18-member group that included municipalities from both Carolinas — had appealed a state water permit that allowed the controversial inter-basin transfer in 2007.
OLD PROJECTIONS

Note the Discrepancy…
200,000 people = 19 MGD in Demand
GOALS

• Tap local knowledge ➔ Buy-in on final plan
• Realistic growth assumptions ➔ Avoid 50’ pipes to nowhere
• Water Supply Analysis ➔ Do we have enough water?
• Dynamic plan ➔ Easy to update/respond to changing conditions
STAKEHOLDER INVOLVEMENT

- Kick-Off Meeting
- Data Provided to WSACC Stakeholders for Review
- Draft Findings Presented to WSACC Board
- Master Plan Highlights and Maintenance Strategies Presented to Stakeholders

2012
- Jurisdictional Meetings

2013
- Edits to Future Land Use Per Stakeholder Comments
- Updated Materials Sent to WSACC Stakeholders

2014
- Edits to Model Assumptions Per Stakeholder Comments and Project Team QC
- Draft Master Plan Presented to WSACC Board

2024
- WSACC Board Approved Master Plan
MODELING INPUTS

• Analysis of existing water usage records
  - To get usage estimates by land use

• Market based demographic and employment projections
  - By Municipal Utility Service Area

• Probability based growth model
  - Available land
  - Pending developments
  - Suitability of land
  - Generalized Future Land Use
WATER USAGE ANALYSIS

- Developed Existing Land Use Inventory
- Collected and Processed Water Usage Records
  - 51,000 Meters
  - 415 MGM Median Usage
  - 95% of records geocoded to parcel
  - 75% of usage geocoded to parcel
- Draft Generalized Usage Rates by Land Use Developed
  - “Back Cast” validation step within 9% of actual usage
WATER USAGE ANALYSIS

Water Sales vs Wastewater Flow

[Chart showing monthly water usage from January 2010 to January 2011, with bars for metered water sales and WSACC meters, and a line graph for the ratio, % over (under).]
MARKET BASED PROJECTIONS
### PROJECTIONS (2012-2040)

#### EMPLOYMENT BASE YEAR TOTALS (2012)

<table>
<thead>
<tr>
<th>Service Area</th>
<th>Kannapolis</th>
<th>Concord</th>
<th>Harrisburg</th>
<th>Midland</th>
<th>Locust</th>
<th>Mt. Pleasant</th>
<th>Northeast</th>
<th>Total Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total EMP, 2012</td>
<td>11,542</td>
<td>44,923</td>
<td>4,362</td>
<td>1,028</td>
<td>11</td>
<td>934</td>
<td>307</td>
<td>63,107</td>
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</table>

#### EMPLOYMENT GROWTH 2012-2040

<table>
<thead>
<tr>
<th>Service Area</th>
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<th>Mt. Pleasant</th>
<th>Northeast</th>
<th>Total Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>1,200</td>
<td>3,848</td>
<td>505</td>
<td>1,010</td>
<td>72</td>
<td>184</td>
<td>111</td>
<td>6,929</td>
</tr>
<tr>
<td>Commercial</td>
<td>914</td>
<td>3,446</td>
<td>433</td>
<td>593</td>
<td>125</td>
<td>331</td>
<td>5</td>
<td>5,846</td>
</tr>
<tr>
<td>OIGOV</td>
<td>4,541</td>
<td>12,605</td>
<td>2,613</td>
<td>1,220</td>
<td>0</td>
<td>1,149</td>
<td>117</td>
<td>22,245</td>
</tr>
<tr>
<td>Lodge</td>
<td>98</td>
<td>555</td>
<td>62</td>
<td>31</td>
<td>19</td>
<td>27</td>
<td>0</td>
<td>793</td>
</tr>
<tr>
<td>Service</td>
<td>504</td>
<td>3,426</td>
<td>449</td>
<td>181</td>
<td>100</td>
<td>146</td>
<td>0</td>
<td>4,806</td>
</tr>
<tr>
<td>Total Added</td>
<td>7,256</td>
<td>23,880</td>
<td>4,061</td>
<td>3,035</td>
<td>316</td>
<td>1,838</td>
<td>234</td>
<td>40,620</td>
</tr>
<tr>
<td>Total EMP, 2040</td>
<td>18,798</td>
<td>68,803</td>
<td>8,423</td>
<td>4,063</td>
<td>327</td>
<td>2,773</td>
<td>540</td>
<td>103,727</td>
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</table>

#### HOUSING BASE YEAR TOTALS (2012)

<table>
<thead>
<tr>
<th>Service Area</th>
<th>Kannapolis</th>
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<th>Harrisburg</th>
<th>Midland</th>
<th>Locust</th>
<th>Mt. Pleasant</th>
<th>Northeast</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total RES, 2012</td>
<td>21,158</td>
<td>41,002</td>
<td>9,987</td>
<td>3,099</td>
<td>78</td>
<td>2,807</td>
<td>1,698</td>
<td>79,829</td>
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</table>

#### HOUSING GROWTH 2012-2040

<table>
<thead>
<tr>
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<th>Midland</th>
<th>Locust</th>
<th>Mt. Pleasant</th>
<th>Northeast</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF</td>
<td>9,212</td>
<td>19,325</td>
<td>6,123</td>
<td>4,279</td>
<td>808</td>
<td>1,291</td>
<td>646</td>
<td>41,682</td>
</tr>
<tr>
<td>Townhouse</td>
<td>232</td>
<td>1,057</td>
<td>504</td>
<td>160</td>
<td>1</td>
<td>32</td>
<td>22</td>
<td>2,008</td>
</tr>
<tr>
<td>MF</td>
<td>1,843</td>
<td>5,290</td>
<td>685</td>
<td>700</td>
<td>-3</td>
<td>-69</td>
<td>0</td>
<td>8,446</td>
</tr>
<tr>
<td>Total Added</td>
<td>11,286</td>
<td>25,672</td>
<td>7,312</td>
<td>5,139</td>
<td>805</td>
<td>1,254</td>
<td>668</td>
<td>52,136</td>
</tr>
<tr>
<td>Total RES, 2040</td>
<td>32,444</td>
<td>66,674</td>
<td>17,299</td>
<td>8,238</td>
<td>883</td>
<td>4,061</td>
<td>2,366</td>
<td>131,965</td>
</tr>
</tbody>
</table>
SUITABILITY BASED GROWTH MODEL (COMMUNITYVIZ)

Land Supply
- Vacant Lands
- Underutilized Parcels (Redevelopment)

Future Land Use
- Allowable Densities (Per Adopted Land Use Plans)
- Recent Development Approvals

Suitability
- Economic Factors
- Environmental Constraints
- Local Policies & Infrastructure
- Investments
- Land Use Assumptions

Growth Forecasts
- Parcel Based Forecasts
- Dwelling Units
- Employment

Control Totals
MODELING APPROACH PRECEDENTS

• Transportation Precedent
  - Small Scale → Traffic Impact Analysis (TIA)
  - Large Scale → Regional transportation planning projects have utilized CommunityViz to create probability-based growth models

• Land Use Planning Precedent
  - Scenario planning used to determine impacts of land use policy alternatives

• Application to utility demand planning was a logical step toward transparent and *defensible* forecasts
MODELING PRECEDENT
MODELING PRECEDENT
Wetlands
Lakes
Floodplains
50ft Buffer of Hydrology Features
25,000 Acres
WHERE CAN GROWTH GO?
Pending Developments cover 7,771 acres
(3.4% of Study Area)
35% of total residential growth
SUITABILITY ANALYSIS

• Suitability is the likelihood (or probability) of development based on economic and environmental factors

• Suitability surfaces created for different land use categories
  - SF - Single Family Residential
  - MF - Multi-family Residential
  - COM/SVC - Commercial/Service
  - IND - Industrial
  - OIGOV - Office, Institutional, Government
  - LODGING - Lodging
SUITABILITY ANALYSIS

My Land Use Modeling & Suitability Bible
SUITABILITY ANALYSIS

Tobler’s First Law of Geography

“Everything is related to everything else, but near things are more related to each other”

Waldo Tobler with awesome hat
SINGLE FAMILY RESIDENTIAL SUITABILITY FACTORS

- Lands near existing single family development
- Lands near existing commercial and services
- Lands near schools
- Lands near parks
- Lands not proximal to industrial uses
- Lands near Charlotte
- Lands with buildable slope
- Lands not environmentally constrained
- Lands not adjacent to major roads
- Lands proximal to water supply lines
- Lands proximal to sewer collection line
- Lands on large parcels
ADOPTED LAND USE POLICY

Problem:
- 7 Jurisdictions
- 14 Policy Documents
- 1 regional plan: CONNECT
- 122 Zoning & FLU Classes

Solution:
- 18 Development Types
- Methodology Addressed Conflicts

Map of Source Policy Documents
# Generalized Future Land Use

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th>Specific Land Use</th>
<th>Description</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Single Family Density (DU/Acre)</th>
<th>Multi-Family Density (DU/Acre)</th>
<th>Floor to Area Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OS</strong> Open Space</td>
<td>Protected lands, including local parks, federal lands, and conservation easements</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>VLRES</strong> Very Low Density Residential</td>
<td>Large lot residential uses: One home on multiple acres. Conservation Subdivisions</td>
<td>100 %</td>
<td>0 %</td>
<td>0 %</td>
<td>.25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>WSW</strong> Water Supply Watershed</td>
<td>Areas subject to WSV(IL, II, III) / Outstanding Resource Water regulations</td>
<td>90 %</td>
<td>10 %</td>
<td>0 %</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>LRES</strong> Low Density Residential</td>
<td>Detached single family homes at low densities. Isolated commercial and home based businesses</td>
<td>95 %</td>
<td>5 %</td>
<td>0 %</td>
<td>.5</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>MLRES</strong> Medium Low Density Residential</td>
<td>Detached single family homes at low densities. Isolated commercial and home based businesses</td>
<td>95 %</td>
<td>5 %</td>
<td>0 %</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>MRES</strong> Medium Density Residential</td>
<td>Detached single family homes and duplexes at medium densities. Isolated commercial and home based businesses</td>
<td>95 %</td>
<td>5 %</td>
<td>0 %</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>MHRES</strong> Medium High Density Residential</td>
<td>Small lot single family, townhomes and some attached housing. Isolated commercial and home based businesses</td>
<td>95 %</td>
<td>5 %</td>
<td>0 %</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>HRES</strong> High Density Residential</td>
<td>Townhomes, apartments and condos. Isolated commercial and home based businesses</td>
<td>95 %</td>
<td>5 %</td>
<td>0 %</td>
<td>6</td>
<td>10</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>CMU</strong> Commercial Mixed Use</td>
<td>Shopping, retail, with some office, flex space and light industrial uses</td>
<td>0 %</td>
<td>75 %</td>
<td>25 %</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>IND</strong> Industrial</td>
<td>Industrial areas with some flex space</td>
<td>0 %</td>
<td>10 %</td>
<td>90 %</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>CMU</strong> Commercial Mixed Use</td>
<td>Commercial areas with some residential uses</td>
<td>25 %</td>
<td>50 %</td>
<td>25 %</td>
<td>8</td>
<td>12</td>
<td>0</td>
<td>.5</td>
</tr>
<tr>
<td><strong>HDMU</strong> High Density Mixed Use</td>
<td>Very high density residential with commercial and office</td>
<td>50 %</td>
<td>50 %</td>
<td>0 %</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>.20</td>
</tr>
<tr>
<td><strong>INDMU</strong> Industrial Mixed Use</td>
<td>Industrial areas with some flex and residential uses</td>
<td>20 %</td>
<td>20 %</td>
<td>60 %</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>.5</td>
</tr>
<tr>
<td><strong>VMU</strong> Village Mixed Use</td>
<td>Town scale mixed use. A mix of medium density residential and commercial uses</td>
<td>50 %</td>
<td>50 %</td>
<td>0 %</td>
<td>4</td>
<td>10</td>
<td>0</td>
<td>.5</td>
</tr>
<tr>
<td><strong>DTMU</strong> Downtown Mixed Use</td>
<td>High density mixed use for downtown areas</td>
<td>50 %</td>
<td>50 %</td>
<td>0 %</td>
<td>8</td>
<td>15</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>OU</strong> Open Use</td>
<td>Areas with limited land use regulation. Average densities and uses estimated</td>
<td>80 %</td>
<td>15 %</td>
<td>5 %</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>.2</td>
</tr>
</tbody>
</table>
INPUTS SUMMARY

• Where can growth go?
  - Land Supply - Environmental Constraints

• Where do we know it will go?
  - Pending Development

• Where it is likely to go?
  - Suitability

• What scale and intensity can we expect?
  - Generalized Future Land Use
DRAFT DISTRIBUTION
New Growth 2010-2040

- 1 Dot = 1 Employee
- 1 Dot = 1 SF Dwelling Unit
- 1 Dot = 1 MF Dwelling Unit

Utilized Land (From Land Supply)
COUNTIES
Municipal Limits

PARCEL LEVEL FORECASTS
TOTAL WATER DEMAND IN 2040 BY BASIN
SEWER MODEL

- Calibrated model using actual flow data
- Monitor and predict flows at the sub-basin level
- Basis for determining capital improvement needs to support future growth
REGIONAL SEWER INFRASTRUCTURE NEEDS

**Legend**
- Metering Station
- Future WSACC Pipelines
- Future Rehab Projects
- Existing WSACC Pipelines
- Service Area Boundary
- Future Pumping Station

**Additional Capacity Improvements**
- Lower Coddle Creek Parallel Interceptor
- Lower Cold Water Creek Parallel Interceptor
- Lower Muddy Creek Parallel Interceptor
- Threemile Branch Parallel Interceptor

**Expanded Service Area Improvements**
- Royal Oaks-Copperfield Interceptor Replacement
- International Business Park Interceptor
- Upper Rocky River Interceptor
- Little Cold Water Creek Interceptor
- Crestridge Interceptor
- Muddy Creek Interceptor
- Back Creek Interceptor
- Caldwell Creek Interceptor
- Mt. Pleasant Pumping Station
- Adams Creek & Dutch Buffalo Interceptor, Pumping Station & Force Main
WATER DEMAND PROJECTIONS

Graph showing projected water demand from 2000 to 2045. The graph includes lines for peak demand, peak demand with restrictions, and average demand. The y-axis represents water supply in MGD (megagallons per day), while the x-axis represents years from 2000 to 2045.
UTILITY IMPACT ANALYSIS / SCENARIO TESTING
UTILITY IMPACT ANALYSIS

Existing LU Policy

New Lakeside Village
UTILITY IMPACT ANALYSIS

Existing LU Policy

New Lakeside Village
UTILITY IMPACT ANALYSIS

Allocation
Existing LU Policy

Allocation
New Scenario
Upper Coddle Creek (CC8) basin increases from 300,000 GPD to 600,000 GPD in 2040
UTILITY IMPACT ANALYSIS

- Afton Run Branch Outfall would exceed capacity in the plan horizon year
- LOS changes from 72% to 117%
- Upgrades to downstream transmission lines also justifiable
BENEFITS TO CLIENT / JURISDICTIONS

• **Efficient use of resources**
  - Saved $150 million in CIP projects

• **Stakeholder buy-in**

• **Nimble, living process**
  - Dynamic model to assess land use changes and utility demand in real time (i.e. utility impact analysis)

• **Usable outputs and tools**
  - Water usage rate data (lower than state standards)
  - Future demand by parcel (regional and local utility planning)
  - Models: local applications (schools, transportation, local utilities)
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