

**APPENDIX A**

**Tulsa Case Study #1 - January 4, 1998**

**DATA AND FIGURES**

Table A1. The first basin(s) in each county where ABR exceeded FFG during the January 4, 1998 event according to KINX data. The date and time (in UTC) indicate when ABR first exceeded FFG, and the ABR and FFG values over the specified time interval are included. Flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b> | <b>Basin ID(s)</b>                           | <b>Basin Type</b>                    | <b>Drainage Area (mi<sup>2</sup>)</b>        | <b>County</b>    | <b>ABR / FFG / Time Interval</b>   | <b>Flash Flood Reported</b> |
|--------------------|--|--------------------------------------|--|------------------|--|-----------------------------|
| 01/04<br>11:46     | 5786   | Subdivision                          | 14.5   | Pawnee<br>OK     | 2.58 / 2.50 / 6-hr   | No                          |
| 01/04<br>13:43     | 6260<br>6261<br>6304                         | Subdivision<br>“<br>“                | 11.0<br>18.9<br>35.8                         | Muskogee<br>OK   | 1.34 / 1.00 / 1-hr<br>1.23 / 1.00 / 1-hr<br>1.09 / 1.00 / 1-hr   | No                          |
| 01/04<br>13:43     | 6171   | Subdivision                          | 12.4   | Sequoyah<br>OK   | 1.21 / 1.20 / 1-hr   | No                          |
| 01/04<br>16:09     | 6166<br>6146<br>6082<br>6107<br>6166<br>6146 | Subdivision<br>“<br>“<br>“<br>“<br>“ | 26.5<br>17.4<br>72.9<br>64.0<br>26.5<br>17.4 | Adair<br>OK      | 2.26 / 1.80 / 3-hr<br>2.21 / 1.80 / 3-hr<br>1.88 / 1.80 / 3-hr<br>1.86 / 1.80 / 3-hr<br>2.86 / 2.20 / 6-hr<br>2.83 / 2.20 / 6-hr | Yes / 1530                  |
| 01/04<br>16:09     | 5969<br>5925<br>5959                         | Subdivision<br>“<br>“                | 42.5<br>18.4<br>13.7                         | Washington<br>AR | 2.53 / 2.20 / 6-hr<br>2.33 / 2.20 / 6-hr<br>2.28 / 2.20 / 6-hr   | Yes / 1600                  |
| 01/04<br>16:09     | 1243<br>1269<br>128                          | Primary<br>“<br>MAP                  | 27.9<br>108.9<br>406.1                       | Cherokee<br>OK   | 2.09 / 1.90 / 6-hr<br>2.04 / 1.90 / 6-hr<br>1.95 / 1.90 / 6-hr   | No                          |
| 01/04<br>16:09     | 6259<br>6339<br>1272<br>1297                 | Subdivision<br>“<br>Primary<br>“     | 34.1<br>10.5<br>47.1<br>207.2                | McIntosh<br>OK   | 1.97 / 1.80 / 6-hr<br>2.07 / 1.80 / 6-hr<br>2.27 / 1.80 / 6-hr<br>2.08 / 1.80 / 6-hr   | No                          |

Table A2. The first basin(s) in each county where ABR rate equaled or exceeded 1.5 inches/hour during the January 4, 1998 event according to KINX data. The ABR rate shown is the first rate to equal or exceed 1.5 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 1.5 inches/hour, and flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b> | <b>Basin ID(s)</b> | <b>Basin Type</b>          | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>                    | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|--------------------|----------------------------|---------------------------------------|----------------------------------|-------------------------------|------------------------------------|
| <b>01/04 1050</b>  | <b>5764</b>        | <b>Subdivision</b>         | <b>17.7</b>                           | <b>Washington &amp; Tulsa OK</b> | <b>1.7</b>                    | <b>No</b>                          |
| <b>01/04 1210</b>  | <b>6339</b>        | <b>Subdivision</b>         | <b>10.5</b>                           | <b>McIntosh OK</b>               | <b>1.7</b>                    | <b>No</b>                          |
| <b>01/04 1210</b>  | <b>6198</b>        | <b>Subdivision</b>         | <b>20.5</b>                           | <b>Muskogee OK</b>               | <b>2.1</b>                    | <b>No</b>                          |
| <b>01/04 1225</b>  | <b>5893 6138</b>   | <b>Subdivision “</b>       | <b>19.4 19.7</b>                      | <b>Cherokee OK</b>               | <b>1.5 2.0</b>                | <b>No</b>                          |
| <b>01/04 1255</b>  | <b>6171</b>        | <b>Subdivision</b>         | <b>12.4</b>                           | <b>Sequoyah OK</b>               | <b>2.8</b>                    | <b>No</b>                          |
| <b>01/04 1300</b>  | <b>5970 6092</b>   | <b>Subdivision “</b>       | <b>39.6 13.3</b>                      | <b>Adair OK</b>                  | <b>2.1 2.5</b>                | <b>Yes / 1530</b>                  |
| <b>01/04 1320</b>  | <b>5778</b>        | <b>Subdivision</b>         | <b>16.1</b>                           | <b>Benton AR</b>                 | <b>1.5</b>                    | <b>No</b>                          |
| <b>01/04 1330</b>  | <b>5939 1201</b>   | <b>Subdivision Primary</b> | <b>26.2 52.4</b>                      | <b>Washington AR</b>             | <b>1.6 1.5</b>                | <b>Yes / 1600</b>                  |

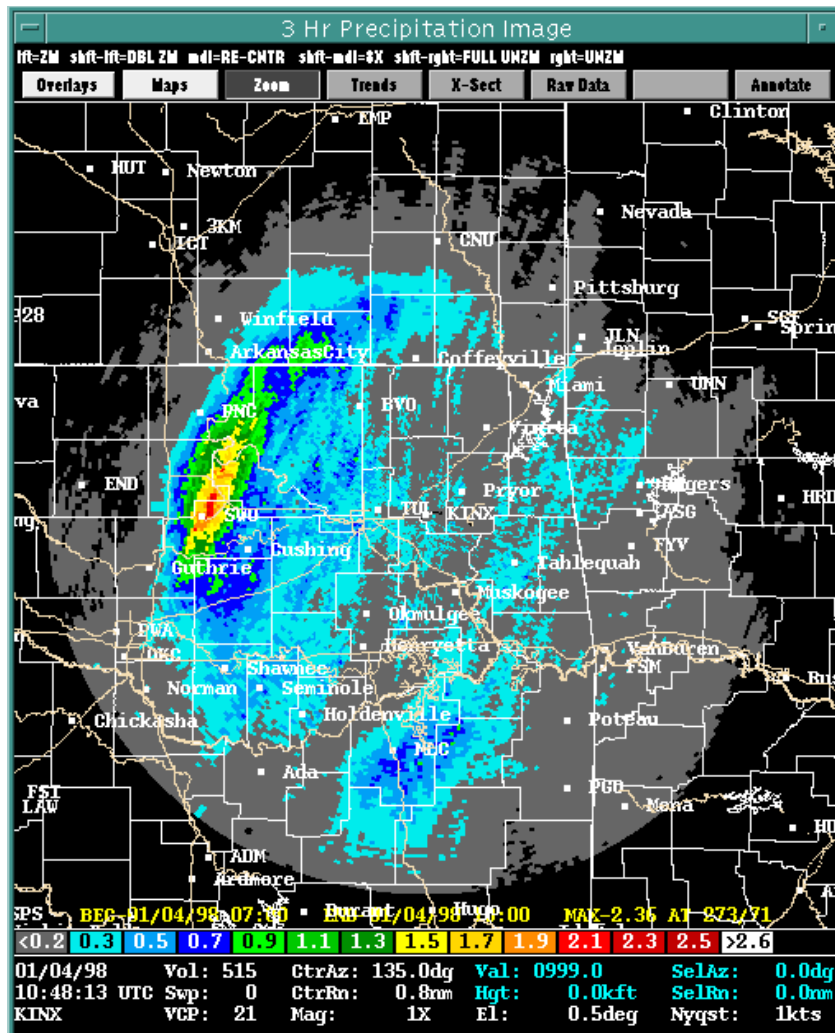


Figure A1. KINX 3-hour Precipitation Image: 01/04/98 0700-1000 UTC.

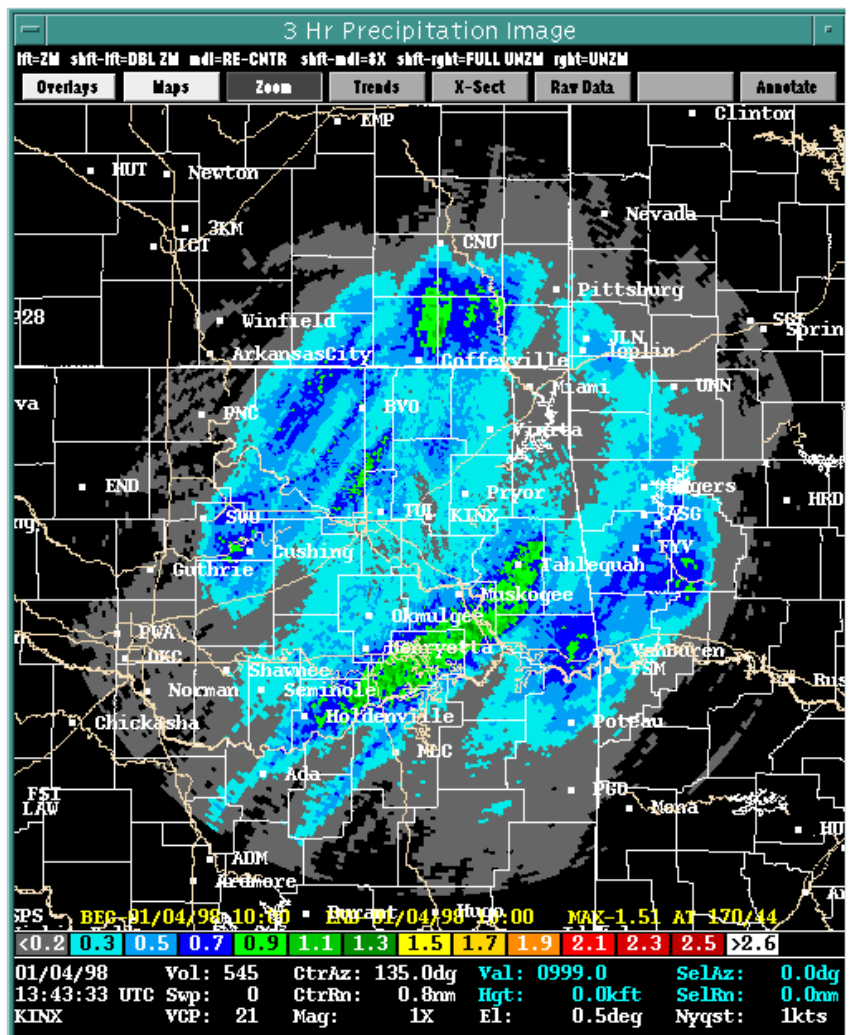


Figure A2. KINX 3-hour Precipitation Image: 01/04/98 1000-1300 UTC.

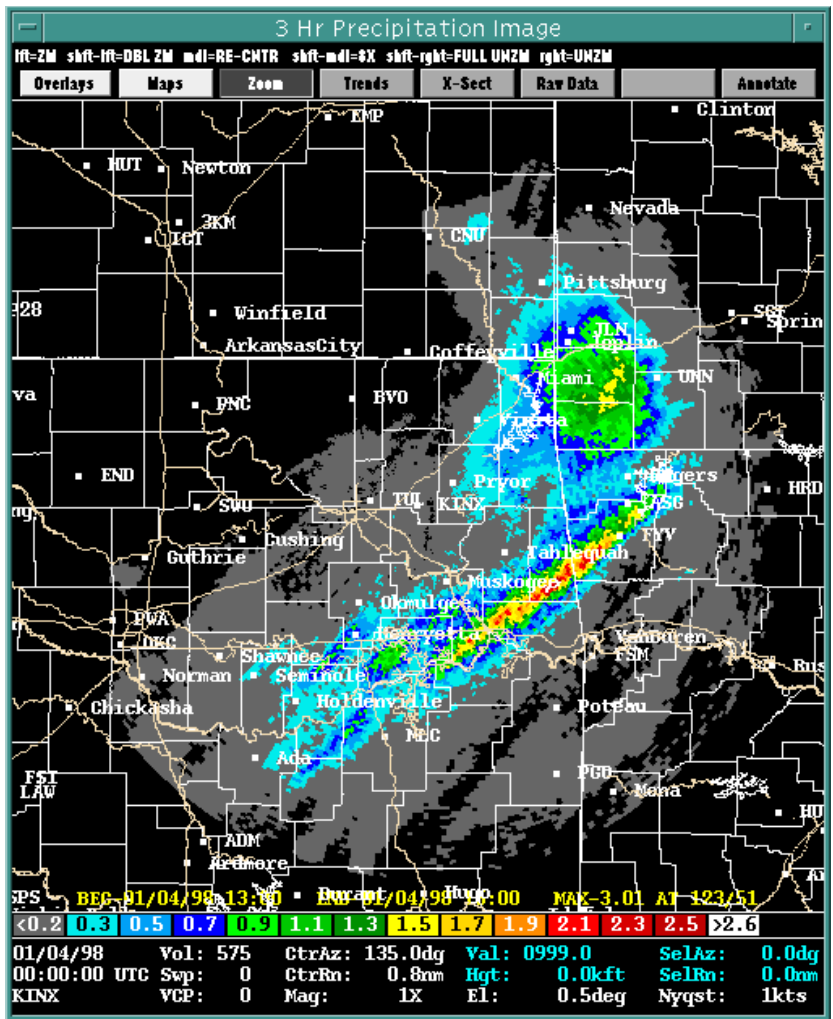


Figure A3. KINX 3-hour Precipitation Image: 01/04/98 1300-1600 UTC.

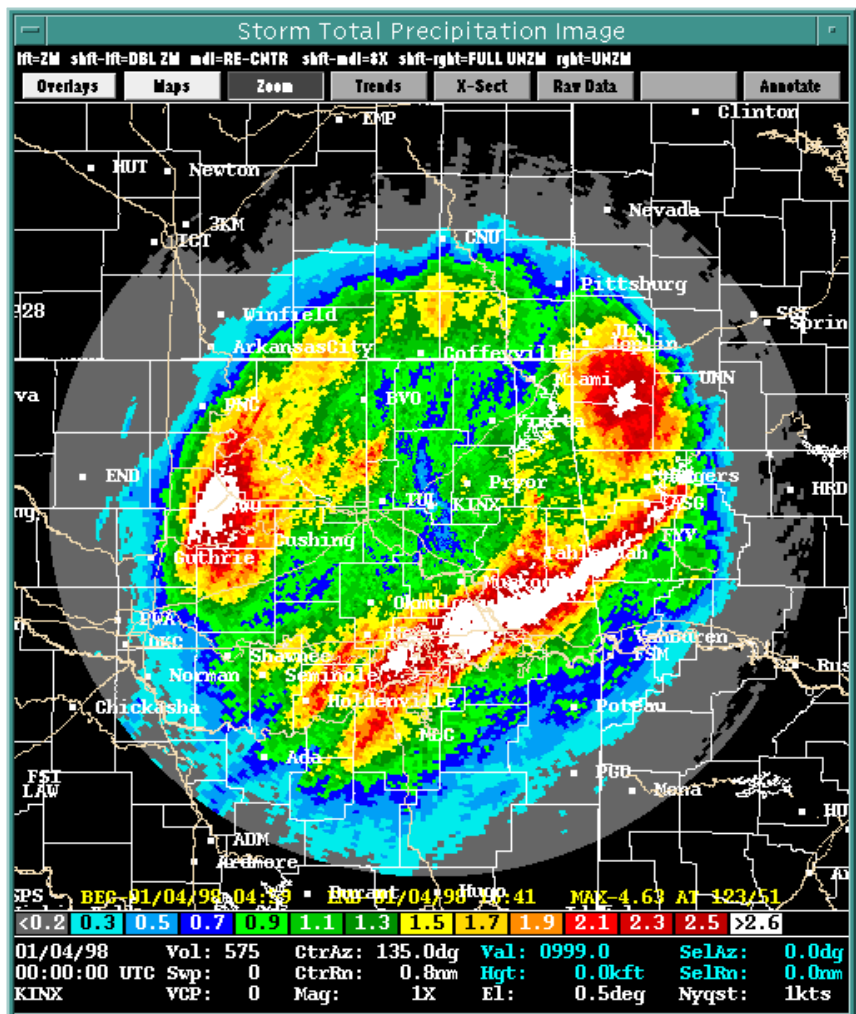


Figure A4. KINX Storm Total Precipitation Image: 01/04/98 0459-1641 UTC.

**Rain Gage Totals  
and  
AMBER ABR Values  
for the  
Subdivision Basins**

01/03/98 1200 UTC -  
01/05/98 1200 UTC

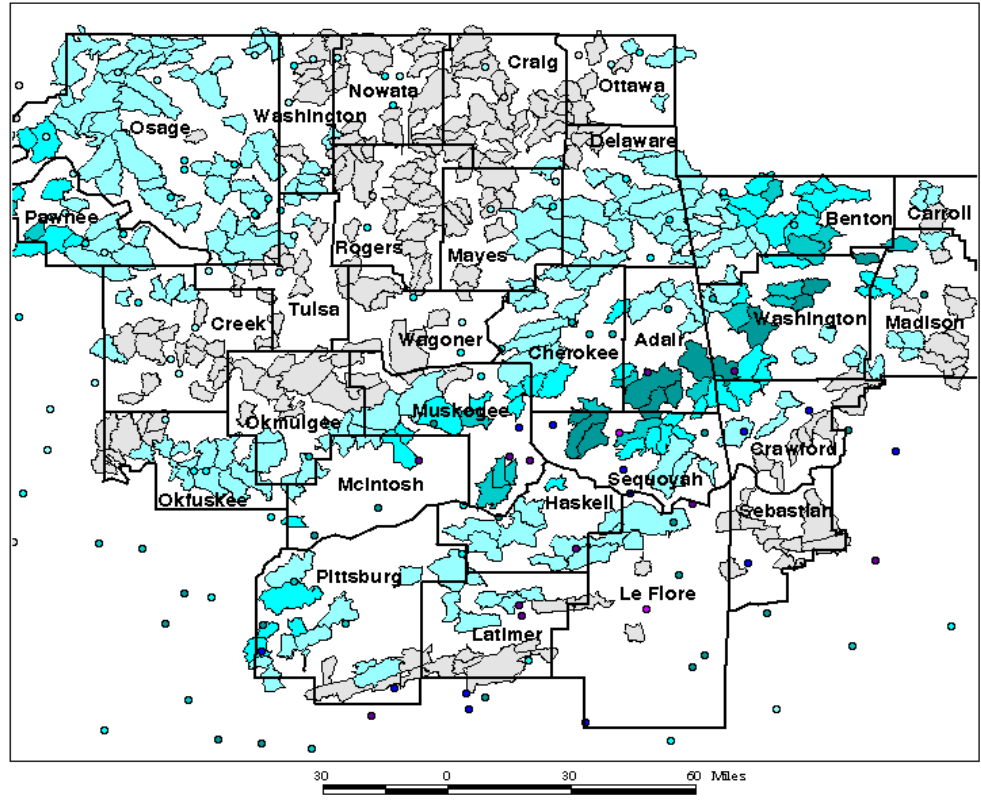
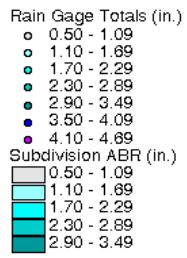


Figure A5.



Subdivision Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 01/04/98

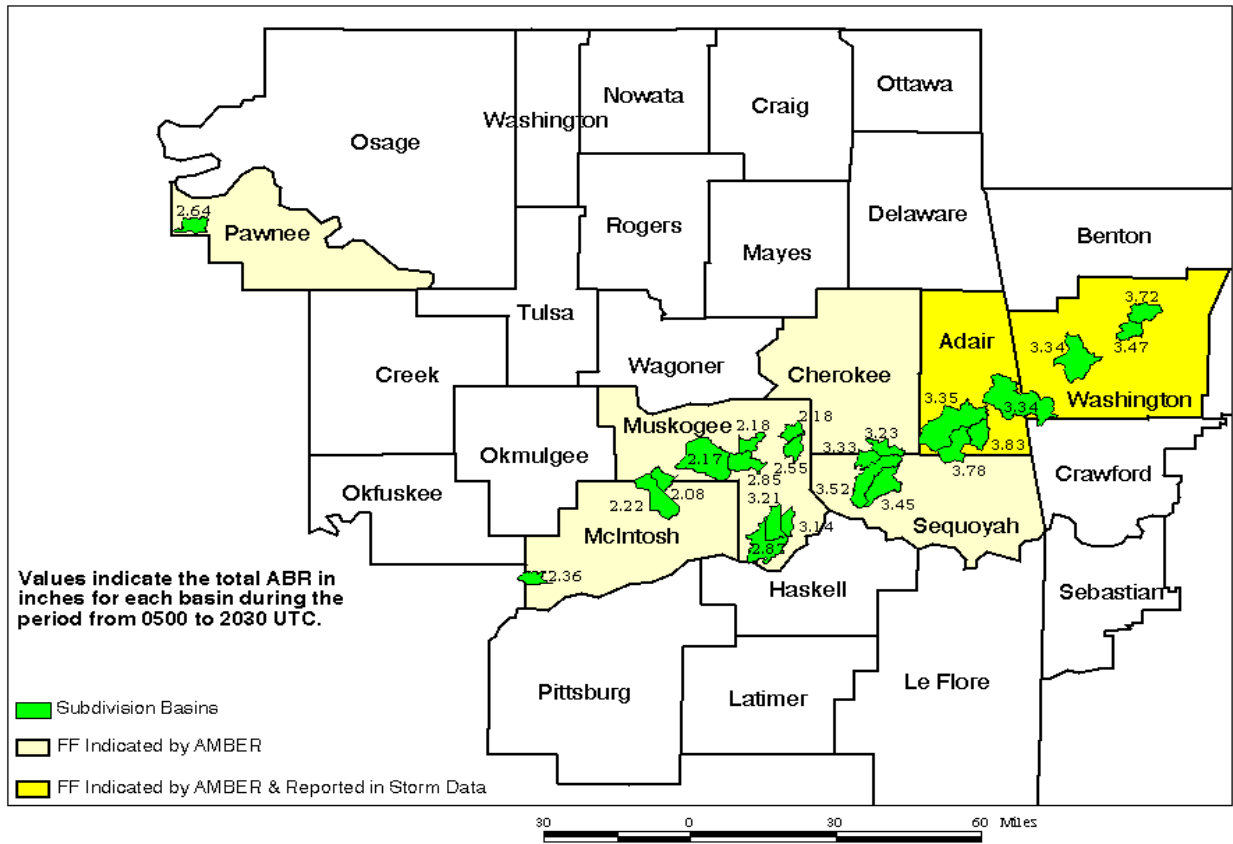


Figure A6.

Primary Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 01/04/98

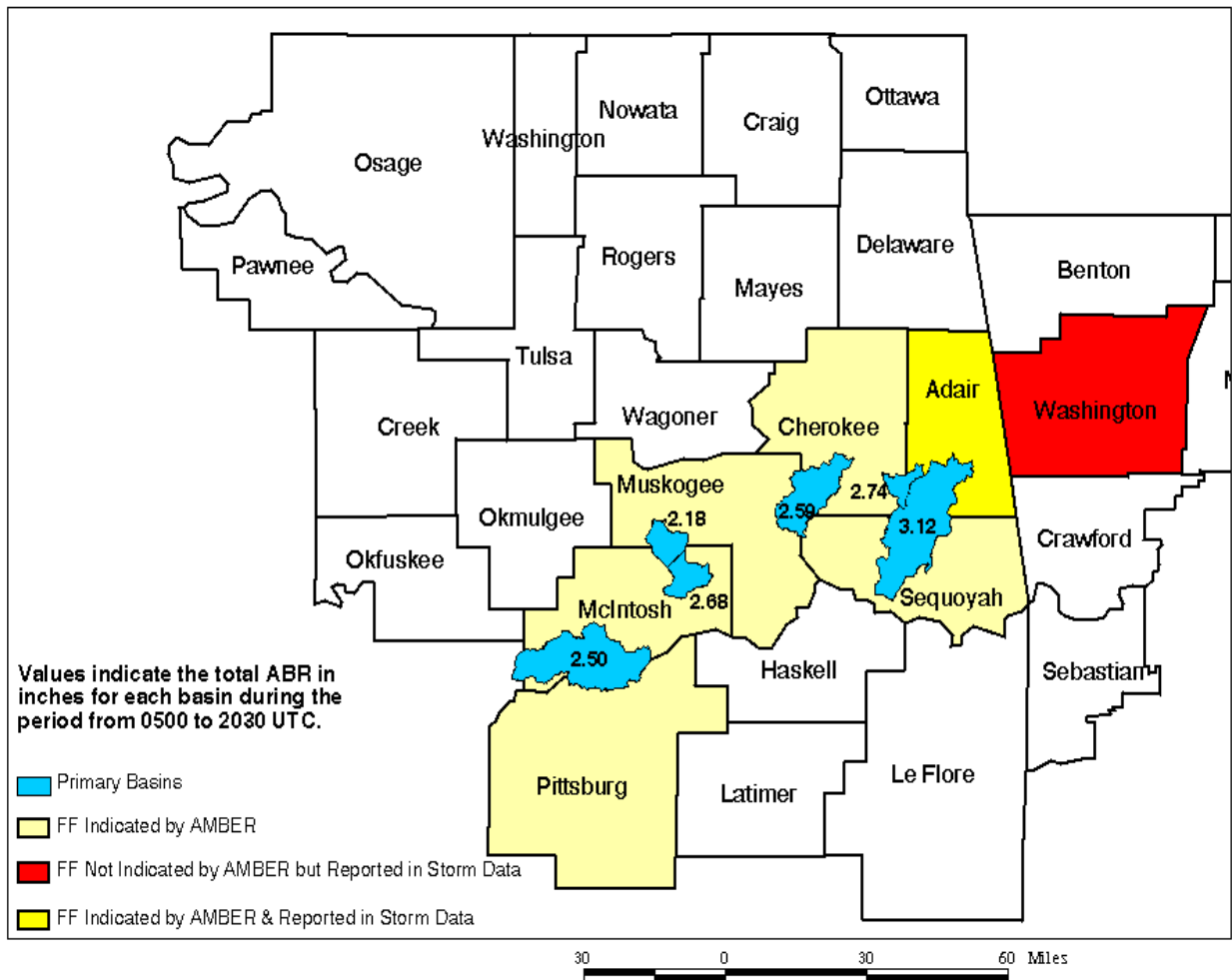


Figure A7.

Major Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 01/04/98

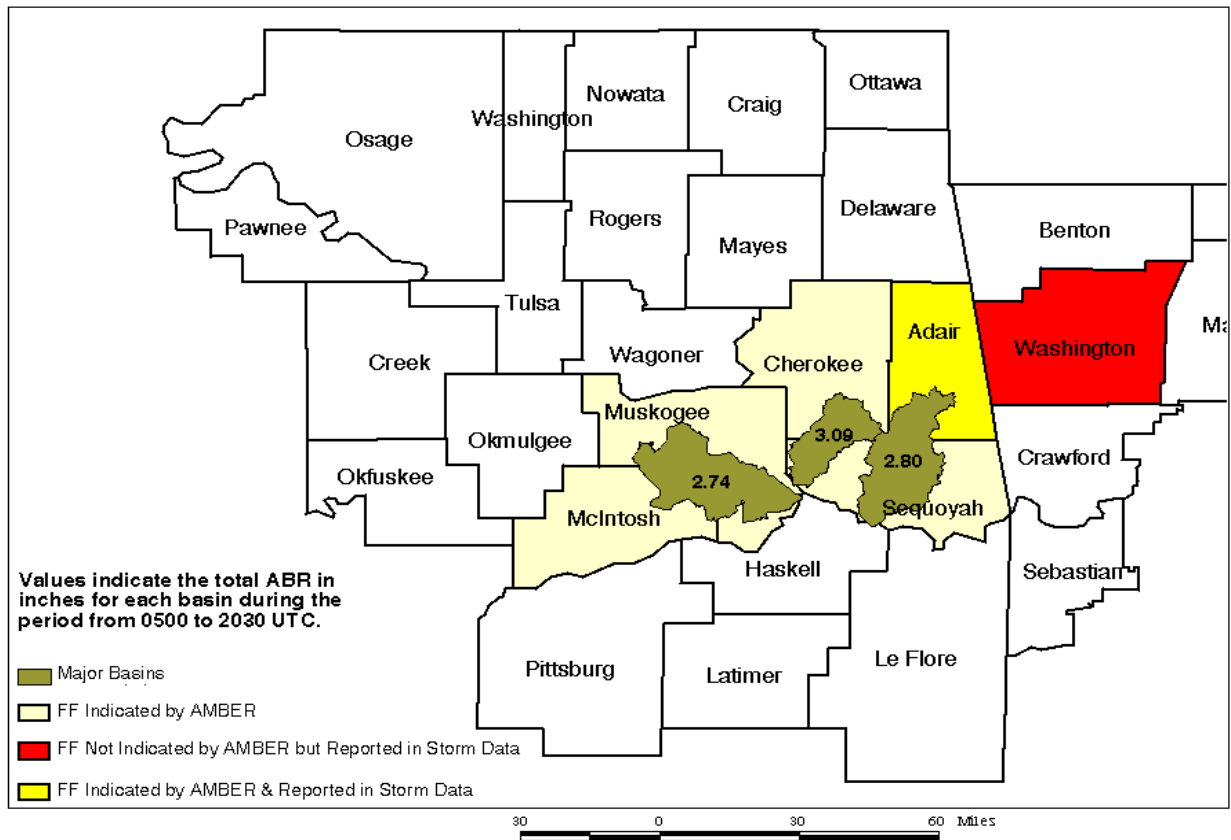


Figure A8.

RFC Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 01/04/98

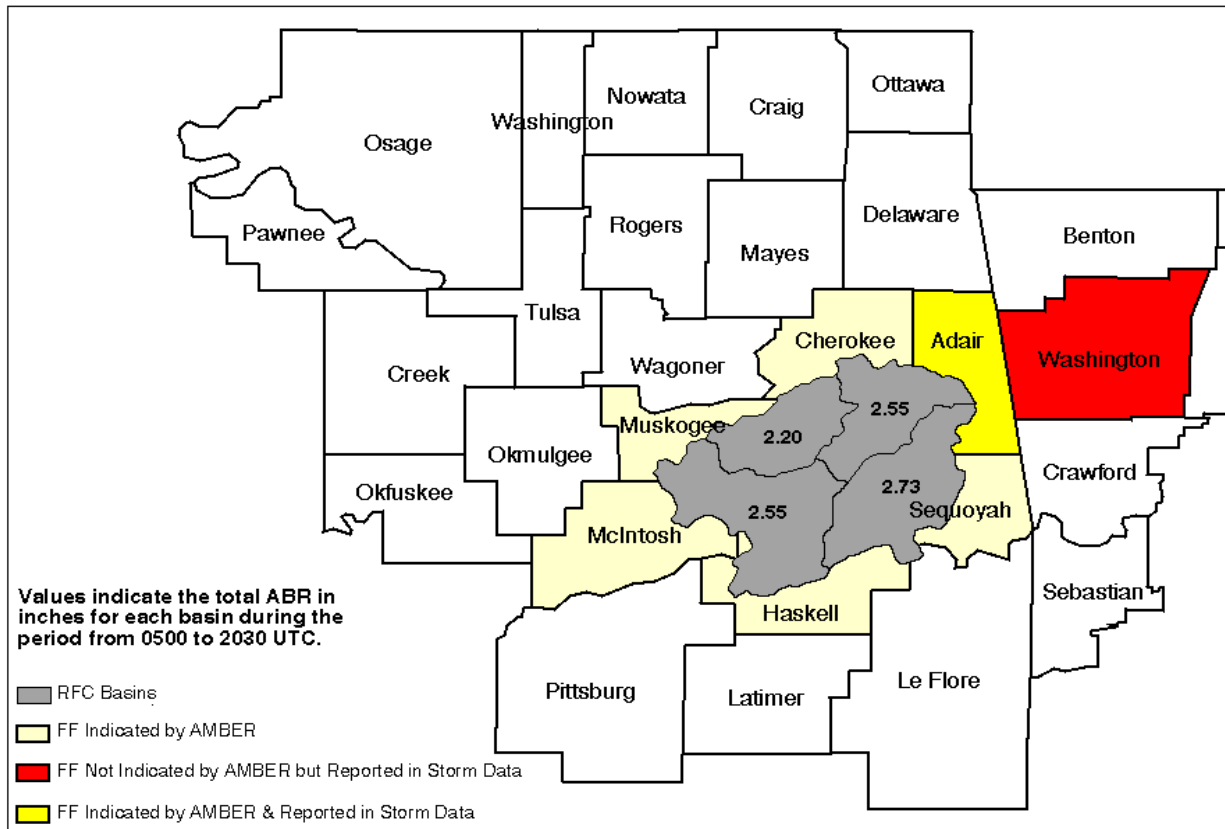


Figure A9.

Subdivision Basins Where Average Basin Rainfall Rates Equal or Exceeded 1.5 in/hr - 01/04/98

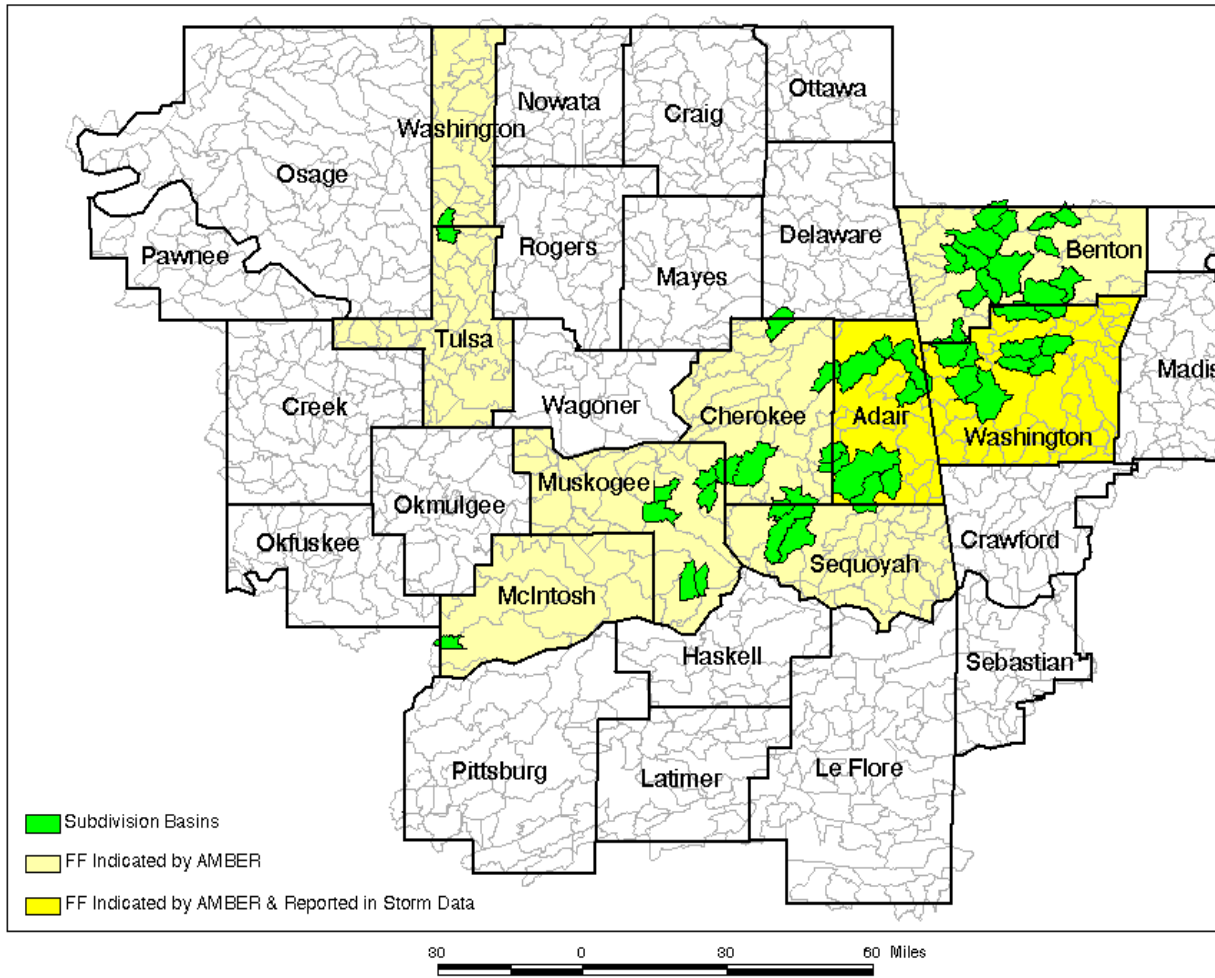


Figure A10.



**APPENDIX B**

**Tulsa Case Study #2 - September 14, 1998**

**DATA AND FIGURES**

Table B1. The first basin(s) in each county where ABR rate equaled or exceeded 1.0 inches/hour during the September 14, 1998 event according to KINX data. The ABR rate shown is the first rate to equal or exceed 1.0 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 1.0 inches/hour, and flash flood verification is based on reports in Storm Data.

| <b>Date / Time</b> | <b>Basin ID(s)</b>   | <b>Basin Type</b>        | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>          | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|----------------------|--------------------------|---------------------------------------|------------------------|-------------------------------|------------------------------------|
| <b>09/14 0340</b>  | <b>6187</b>          | <b>Subdivision</b>       | <b>58.0</b>                           | <b>Muskogee OK</b>     | <b>1.1</b>                    | <b>Yes / 0500</b>                  |
| <b>09/14 0345</b>  | <b>5961</b>          | <b>Subdivision</b>       | <b>25.1</b>                           | <b>Cherokee OK</b>     | <b>1.3</b>                    | <b>Yes / 0445</b>                  |
| <b>09/14 0525</b>  | <b>5668</b>          | <b>Subdivision</b>       | <b>11.2</b>                           | <b>Craig OK</b>        | <b>1.1</b>                    | <b>No</b>                          |
| <b>09/14 0550</b>  | <b>6201</b>          | <b>Subdivision</b>       | <b>35.9</b>                           | <b>Sequoyah OK</b>     | <b>1.1</b>                    | <b>Yes / 0900</b>                  |
| <b>09/14 0630</b>  | <b>6092<br/>6117</b> | <b>Subdivision<br/>“</b> | <b>13.3<br/>11.6</b>                  | <b>Adair<br/>OK</b>    | <b>1.4<br/>1.4</b>            | <b>Yes / 0630</b>                  |
| <b>09/14 0800</b>  | <b>5677</b>          | <b>Subdivision</b>       | <b>18.9</b>                           | <b>Delaware<br/>OK</b> | <b>1.1</b>                    | <b>Yes / 1015</b>                  |
| <b>09/14 0825</b>  | <b>5528</b>          | <b>Subdivision</b>       | <b>11.5</b>                           | <b>Ottawa<br/>OK</b>   | <b>1.0</b>                    | <b>Yes / 0830</b>                  |



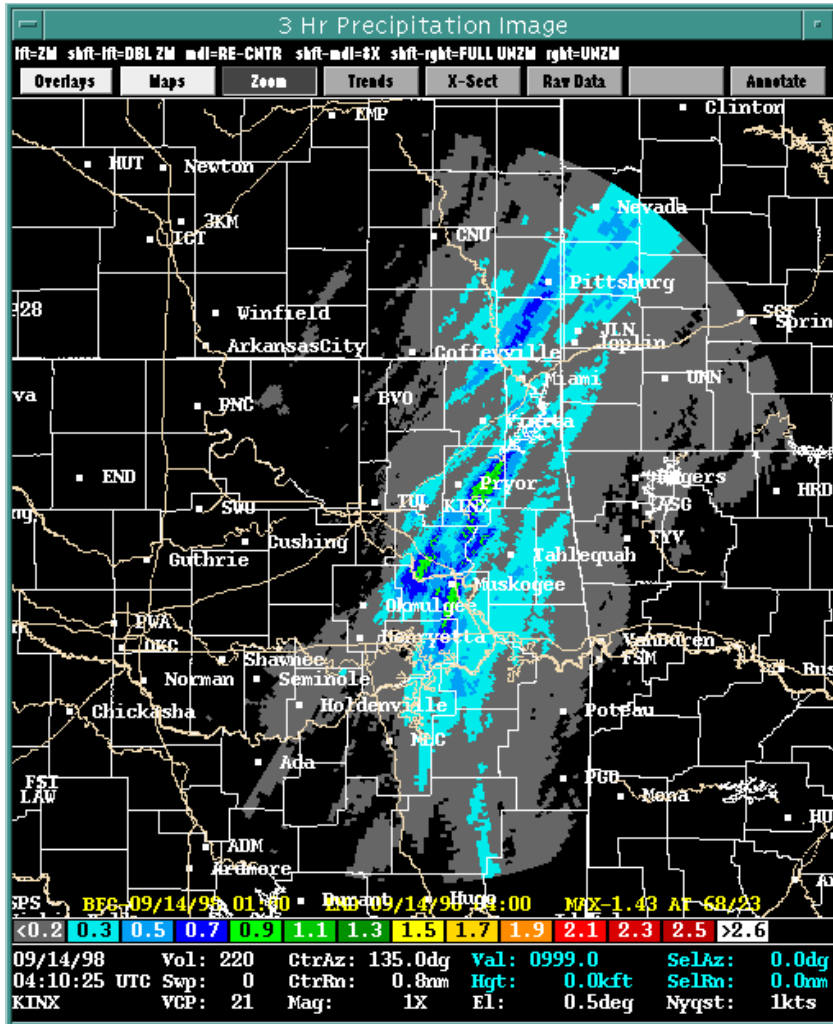


Figure B1. KINX 3-hour Precipitation Image: 09/14/98 0100-0400 UTC.

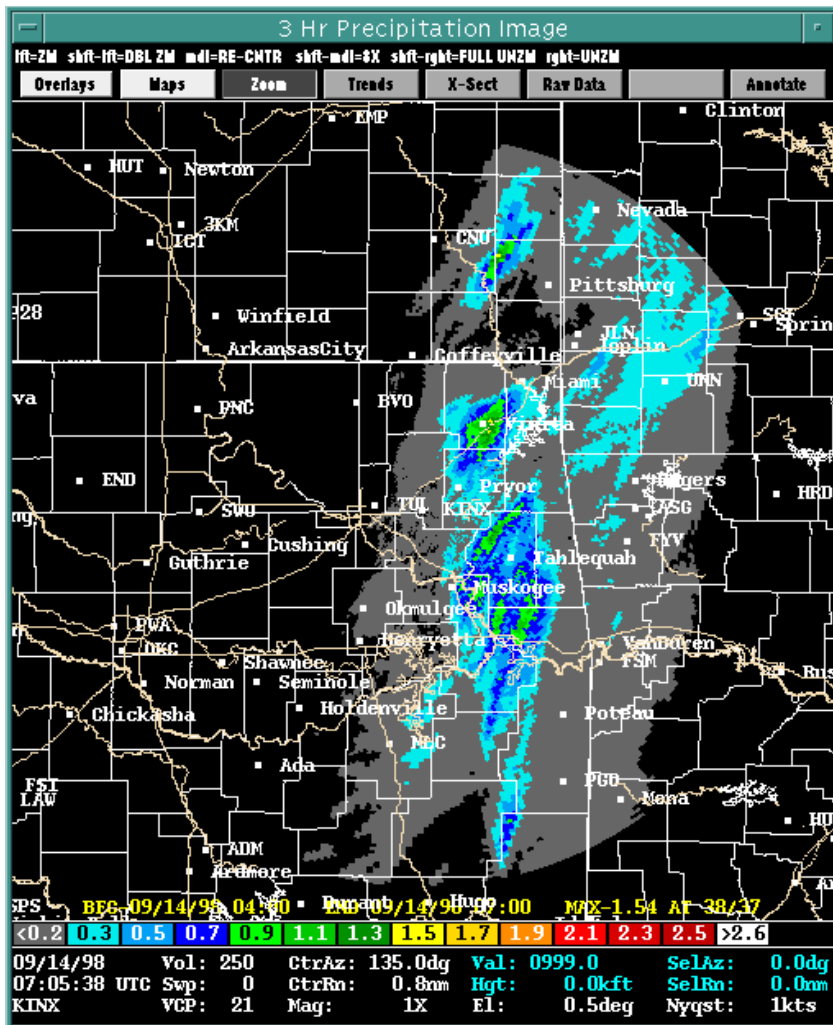


Figure B2. KINX 3-hour Precipitation Image: 09/14/98 0400-0700 UTC.

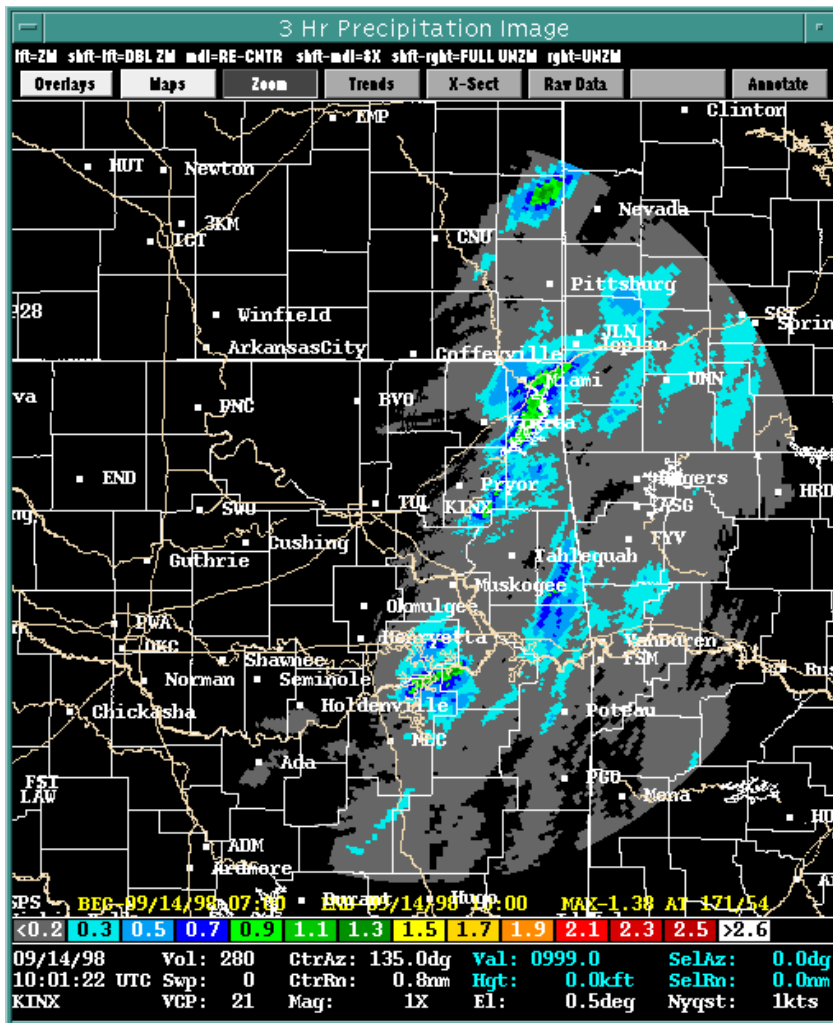


Figure B3. KINX 3-hour Precipitation Image: 09/14/98 0700-1000 UTC.

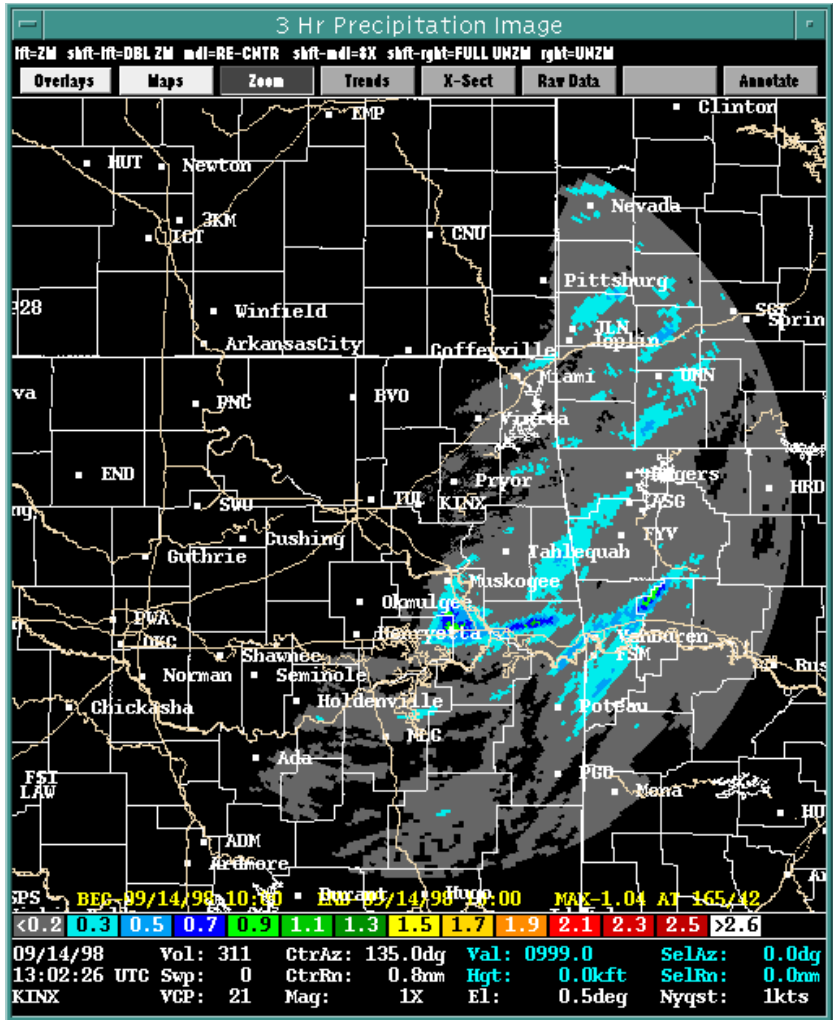


Figure B4. KINX 3-hour Precipitation Image: 09/14/98 1000-1300 UTC.

Rain Gage Totals  
and  
AMBER ABR Values  
for the  
Subdivision Basins

09/13/98 1200 UTC -  
09/14/98 1200 UTC

- Tulsa\_cwa.shp
- Rain Gage Totals (in.)
- 0.60 - 1.19
- 1.20 - 1.79
- 1.80 - 2.39
- 2.40 - 2.99
- 3.00 - 3.59
- 3.60 - 4.19
- 4.20 - 4.79
- 4.80 - 5.39
- 5.40 - 5.99
- 6.00 - 6.59
- 6.60 - 7.19
- 7.20 - 7.79
- 7.80 - 8.52
- Subdivision ABR (in.)
- 0.60 - 1.19
- 1.20 - 1.79
- 1.80 - 2.39
- 2.40 - 2.99
- 3.00 - 3.59

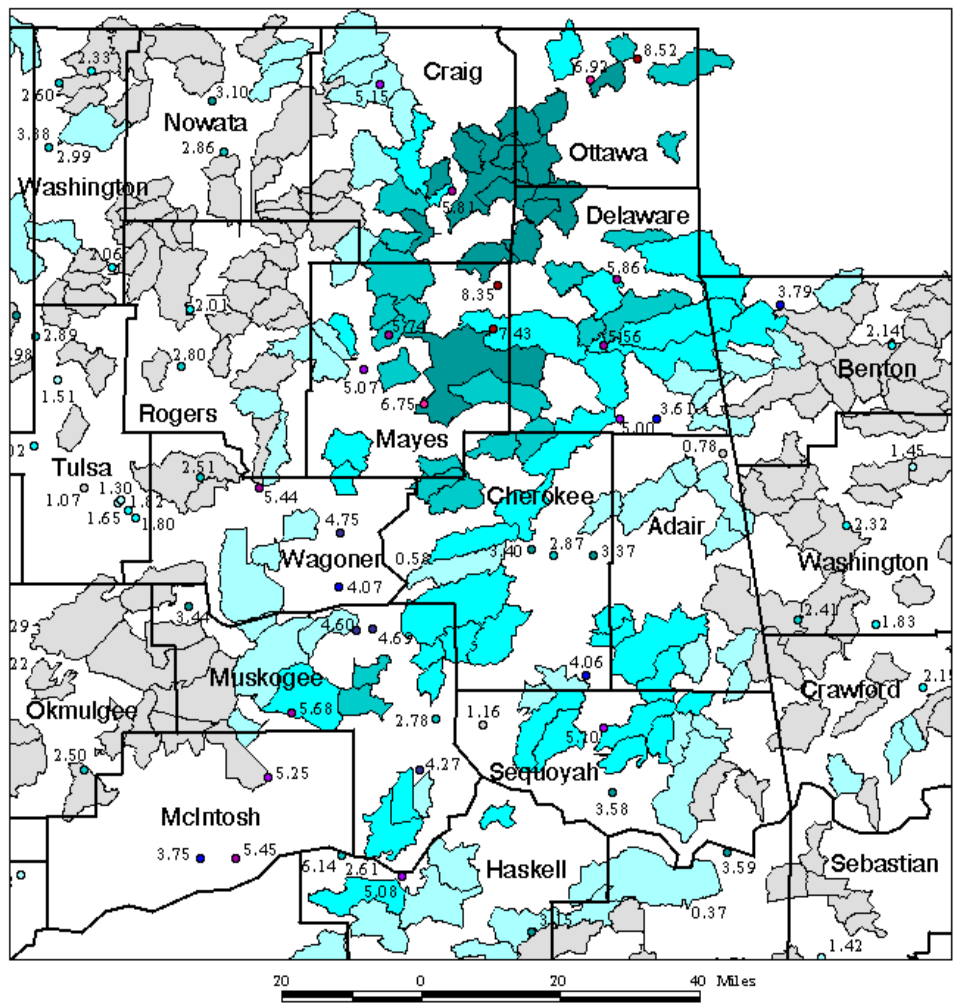


Figure B5.

Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 1.0 in/hr - 09/14/98

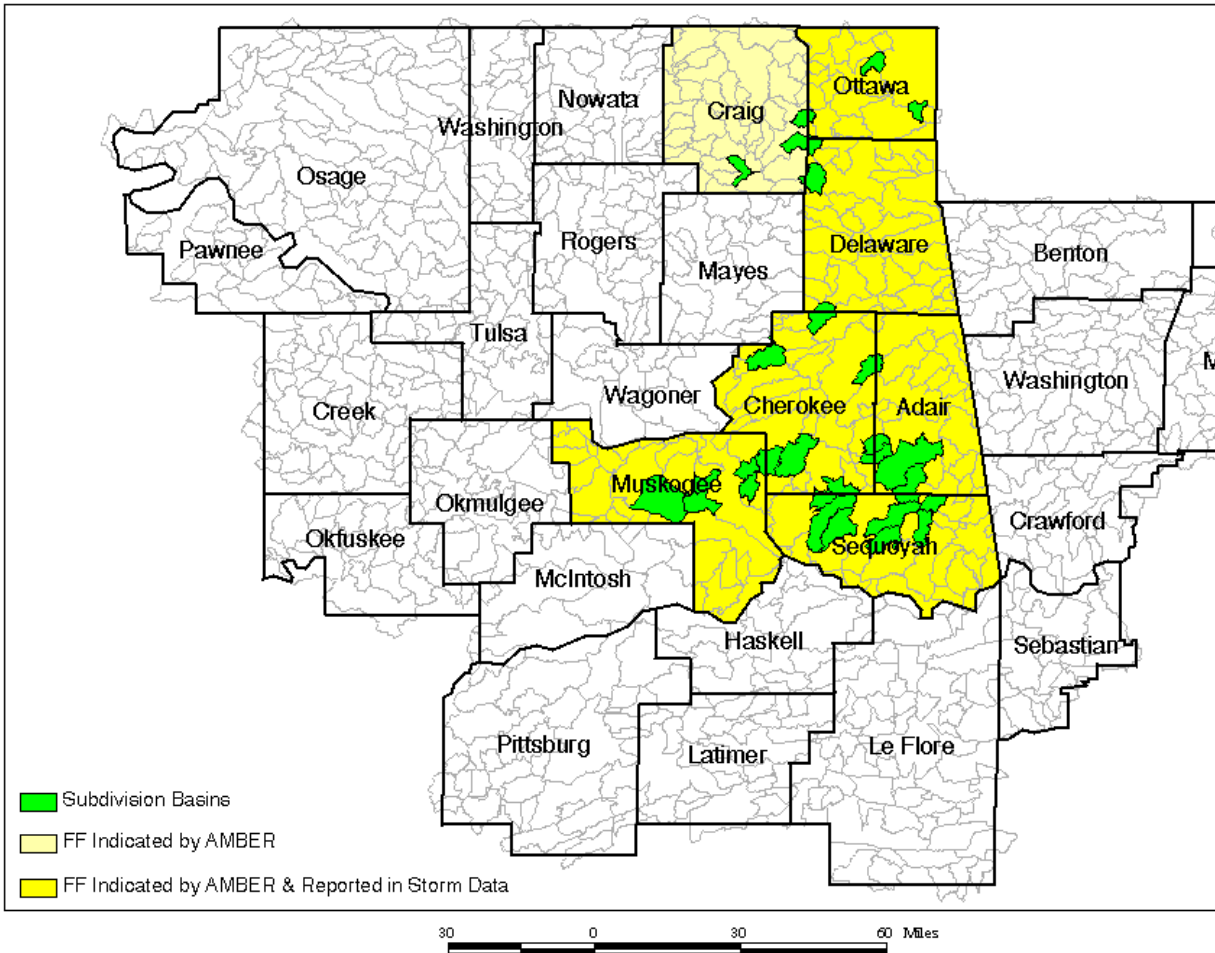


Figure B6.

Populations of Cities and Towns In or Near Subdivision Basins with ABR > FFG or Rate > 1.0 in/hr - 09/14/98

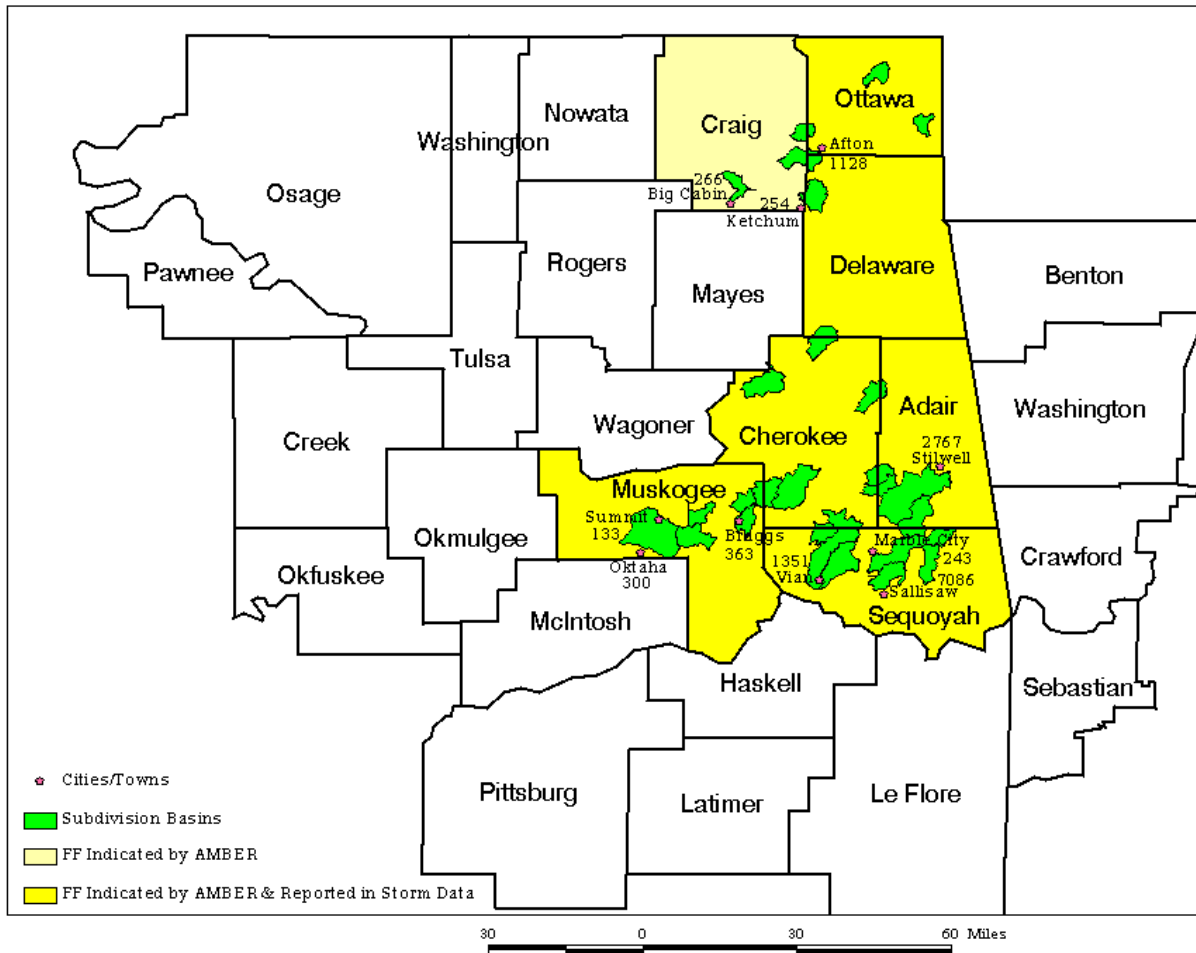


Figure B7.

**APPENDIX C**

**Tulsa Case Study #3 - October 5, 1998**

**DATA AND FIGURES**



Table C1. The first basin(s) in each county where ABR exceeded FFG during the October 5, 1998 event according to KINX data. The date and time (in UTC) indicate when ABR first exceeded FFG, and the ABR and FFG values over the specified time interval are included. Flash flood verification is based on reports in Storm Data.

| <b>Date / Time</b> | <b>Basin ID(s)</b>           | <b>Basin Type</b>                | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>   | <b>ABR / FFG / Time Interval</b>   | <b>Flash Flood Reported / Time</b> |
|--------------------|------------------------------|----------------------------------|---------------------------------------|-----------------|--|------------------------------------|
| 10/05<br>1333      | 6883                         | Subdivision                      | 113.8                                 | Delaware<br>OK  | 2.75 / 2.70 / 6-hr<br>(Mayes)  | Yes / 1200                         |
| 10/05<br>1628      | 506                          | Major                            | 184.8                                 | Cherokee<br>OK  | 2.47 / 2.40 / 3-hr   | Yes / 1100                         |
| 10/05<br>1628      | 506                          | Major                            | 184.8                                 | Sequoyah<br>OK  | 2.47 / 2.40 / 3-hr<br>(Cherokee)   | Yes / 1800                         |
| 10/05<br>1658      | 1243                         | Primary                          | 25.8                                  | Adair<br>OK     | 2.75 / 2.40 / 3-hr   | Yes / 1700                         |
| 10/05<br>1658      | 6261                         | Subdivision                      | 18.9                                  | Muskogee<br>OK  | 2.29 / 2.20 / 3-hr   | Yes / 1230                         |
| 10/05<br>1928      | 6466<br>6450                 | Subdivision<br>“                 | 23.8<br>13.3                          | Latimer<br>OK   | 2.09 / 2.00 / 3-hr<br>2.08 / 2.00 / 3-hr   | Yes / 1900                         |
| 10/05<br>2028      | 6525                         | Subdivision                      | 19.4                                  | LeFlore<br>OK   | 2.13 / 2.00 / 1-hr   | Yes / 1900                         |
| 10/05<br>2357      | 6517                         | Subdivision                      | 28.8                                  | Pittsburg<br>OK | 2.43 / 2.30 / 3-hr   | Yes / 1700                         |
| 10/06<br>0123      | 6415<br>6398<br>1318<br>1316 | Subdivision<br>“<br>Primary<br>“ | 19.5<br>15.3<br>61.6<br>54.5          | Sebastian<br>AR | 2.70 / 2.40 / 6-hr<br>2.66 / 2.40 / 6-hr<br>2.78 / 2.40 / 6-hr<br>2.53 / 2.40 / 6-hr | Yes / 1900                         |
| 10/06<br>0123      | 6393<br>1308                 | Subdivision<br>Primary           | 20.4<br>82.1                          | Haskell<br>OK   | 1.85 / 1.80 / 6-hr<br>2.03 / 1.80 / 6-hr   | Yes / 1500                         |

Table C2. The first basin(s) in each county where ABR rate equaled or exceeded 1.5 inches/hour during the October 5, 1998 event according to KINX data. The ABR rate shown is the first rate to equal or exceed 1.5 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 1.5 inches/hour, and flash flood verification is based on reports in Storm Data.

| <b>Date / Time</b> | <b>Basin ID(s)</b> | <b>Basin Type</b> | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b> | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|--------------------|-------------------|---------------------------------------|---------------|-------------------------------|------------------------------------|
| 10/05 0815         | 5708               | Subdivision       | 21.3                                  | Benton AR     | 1.5                           | Yes / 1030                         |
| 10/05 0815         | 5677               | Subdivision       | 18.9                                  | Delaware OK   | 1.5                           | Yes / 1200                         |
| 10/05 0830         | 5904               | Subdivision       | 16.1                                  | Cherokee OK   | 1.5                           | Yes / 1100                         |
| 10/05 1115         | 6211               | Subdivision       | 13.1                                  | Okfuskee OK   | 1.9                           | Yes / 1400                         |
| 10/05 1200         | 6098               | Subdivision       | 30.3                                  | Muskogee OK   | 1.8                           | Yes / 1230                         |
| 10/05 1500         | 6092<br>6117       | Subdivision<br>“  | 13.3<br>11.6                          | Adair<br>OK   | 1.6<br>1.6                    | Yes / 1700                         |
| 10/05 1510         | 6171               | Subdivision       | 12.4                                  | Sequoyah OK   | 1.9                           | Yes / 1800                         |
| 10/05 1600         | 5968               | Subdivision       | 26.2                                  | Washington AR | 1.8                           | Yes / 1500                         |
| 10/05 1620         | 6277               | Subdivision       | 9.8                                   | Haskell OK    | 1.5                           | Yes / 1500                         |
| 10/05 1620         | 6543               | Subdivision       | 14.4                                  | Pittsburg OK  | 2.0                           | Yes / 1700                         |
| 10/05 1715         | 6464               | Subdivision       | 14.8                                  | Latimer OK    | 1.5                           | Yes / 1900                         |
| 10/05 1845         | 6377               | Subdivision       | 16.4                                  | LeFlore OK    | 2.7                           | Yes / 1900                         |
| 10/05 1845         | 6218               | Subdivision       | 36.2                                  | Crawford AR   | 2.5                           | No                                 |
| 10/05 1930         | 6289               | Subdivision       | 14.9                                  | Sebastian AR  | 1.7                           | Yes / 1900                         |
| 10/05 2000         | 6026               | Subdivision       | 11.6                                  | Madison AR    | 3.0                           | No                                 |
| 10/05 2045         | 5857               | Subdivision       | 58.5                                  | Carroll AR    | 2.8                           | No                                 |

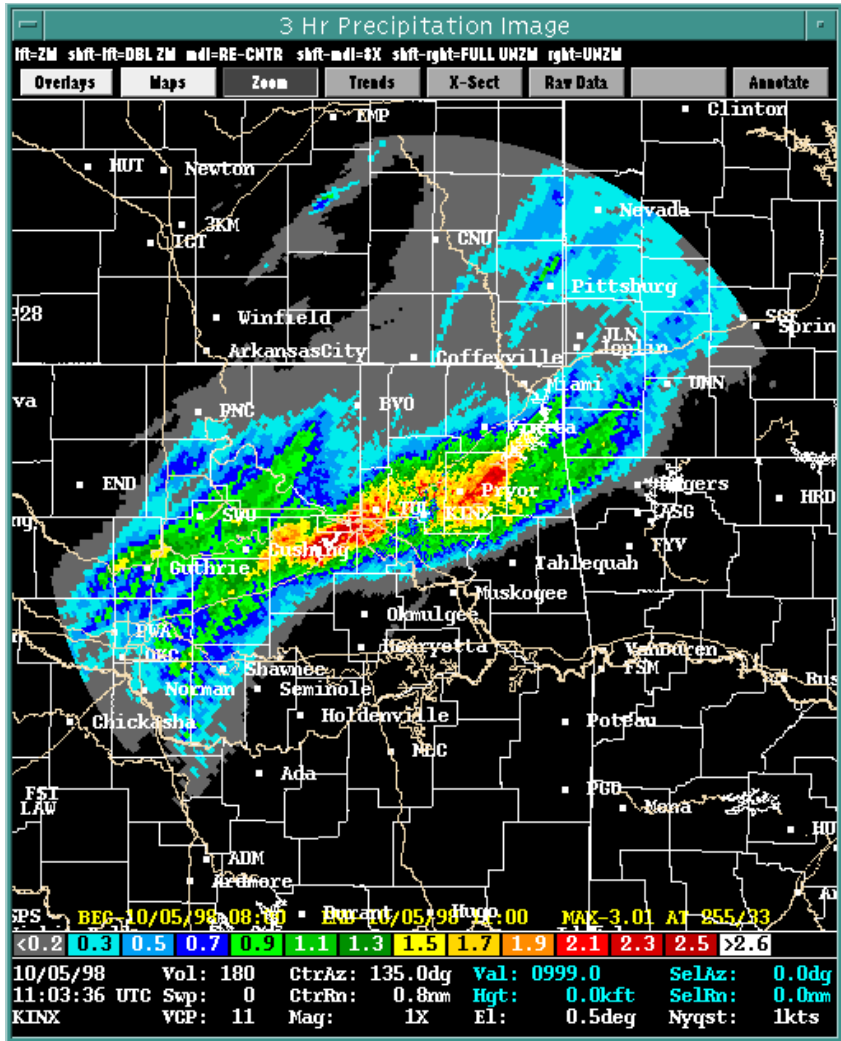


Figure C1. KINX 3-hour Precipitation Image: 10/05/98 0800-1100 UTC.

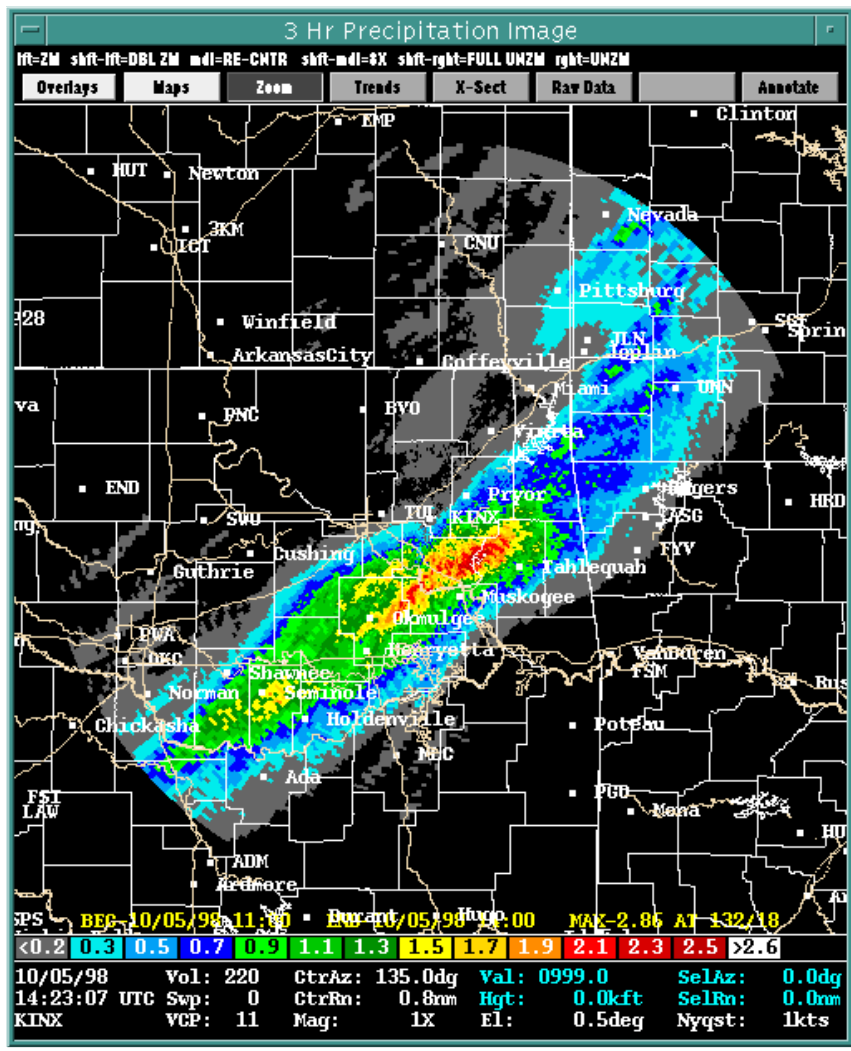


Figure C2. KINX 3-hour Precipitation Image: 10/05/98 1100-1400 UTC.

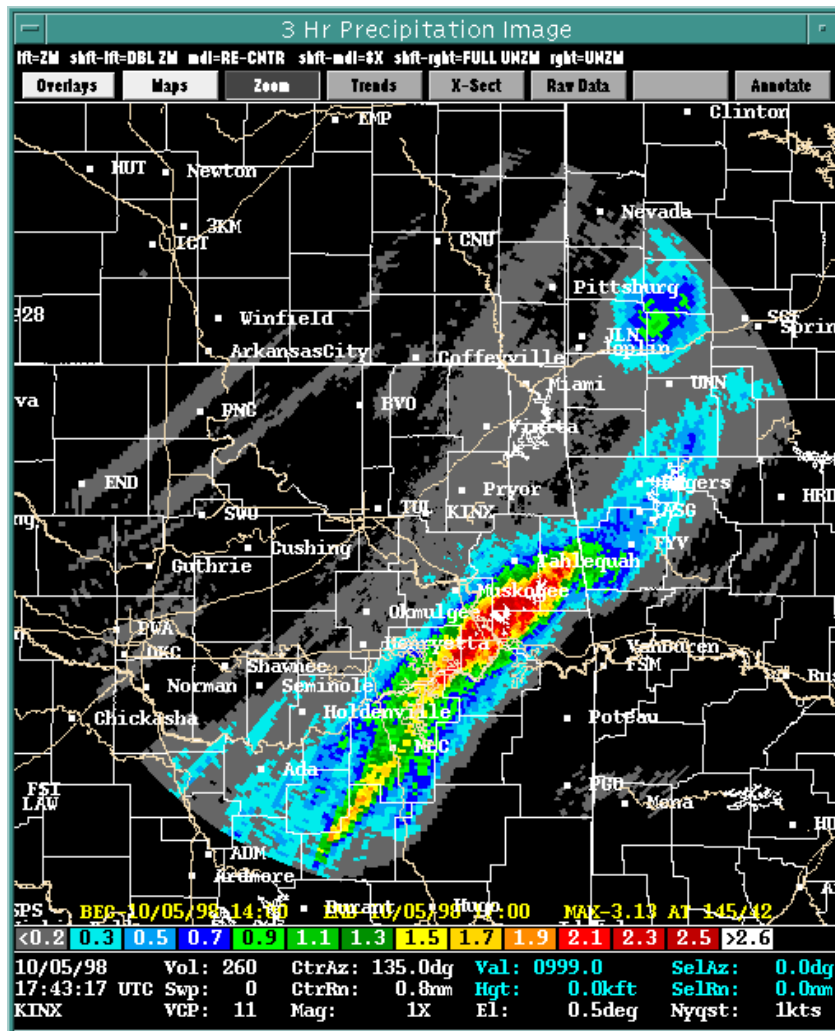


Figure C3. KINX 3-hour Precipitation Image: 10/05/98 1400-1700 UTC.

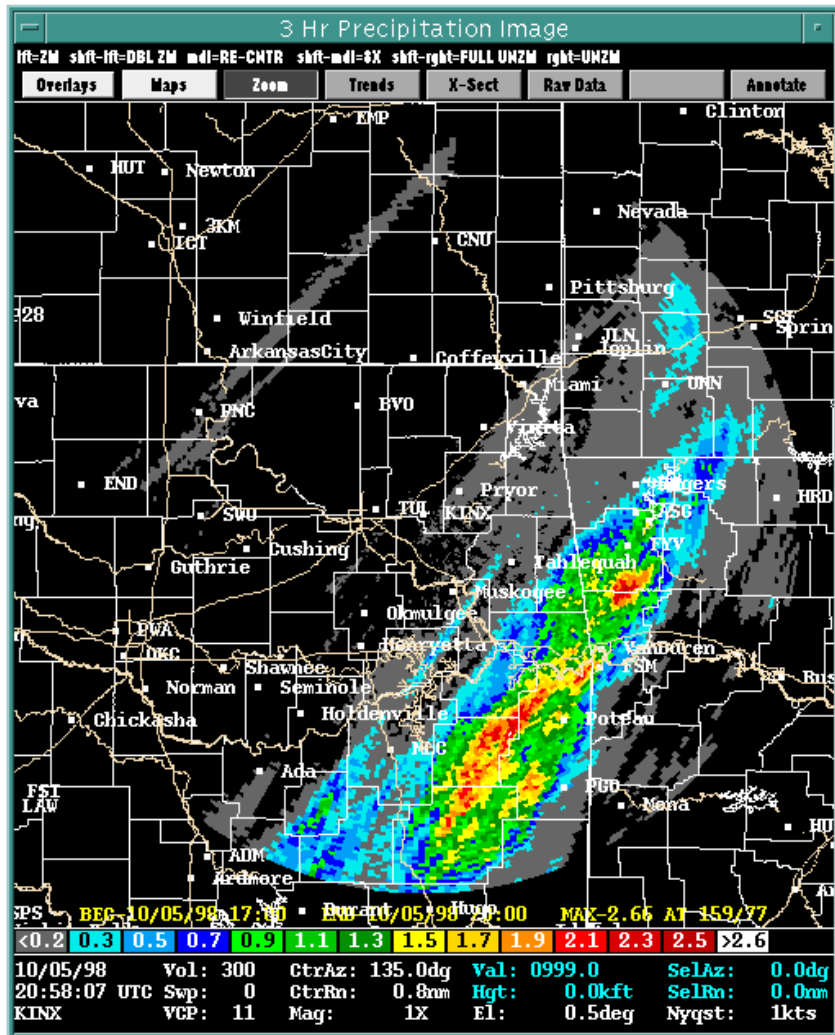


Figure C4. KINX 3-hour Precipitation Image: 10/05/98 1700-2000 UTC.

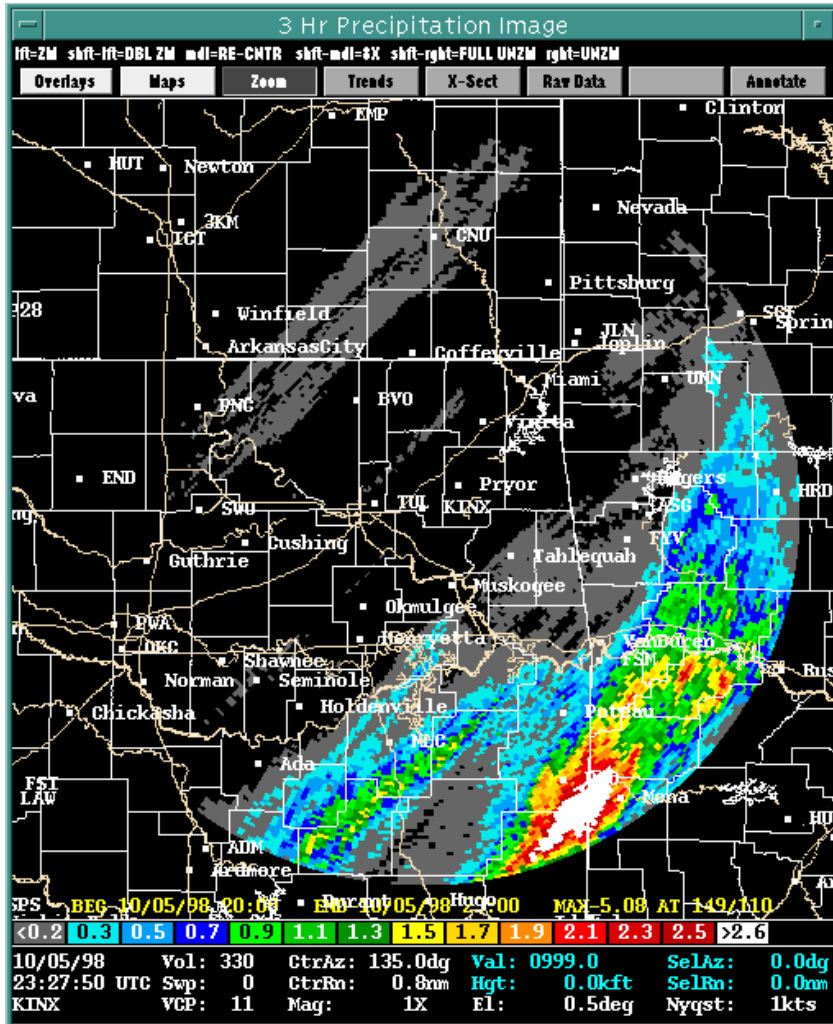


Figure C5. KINX 3-hour Precipitation Image: 10/05/98 2000-2300 UTC.

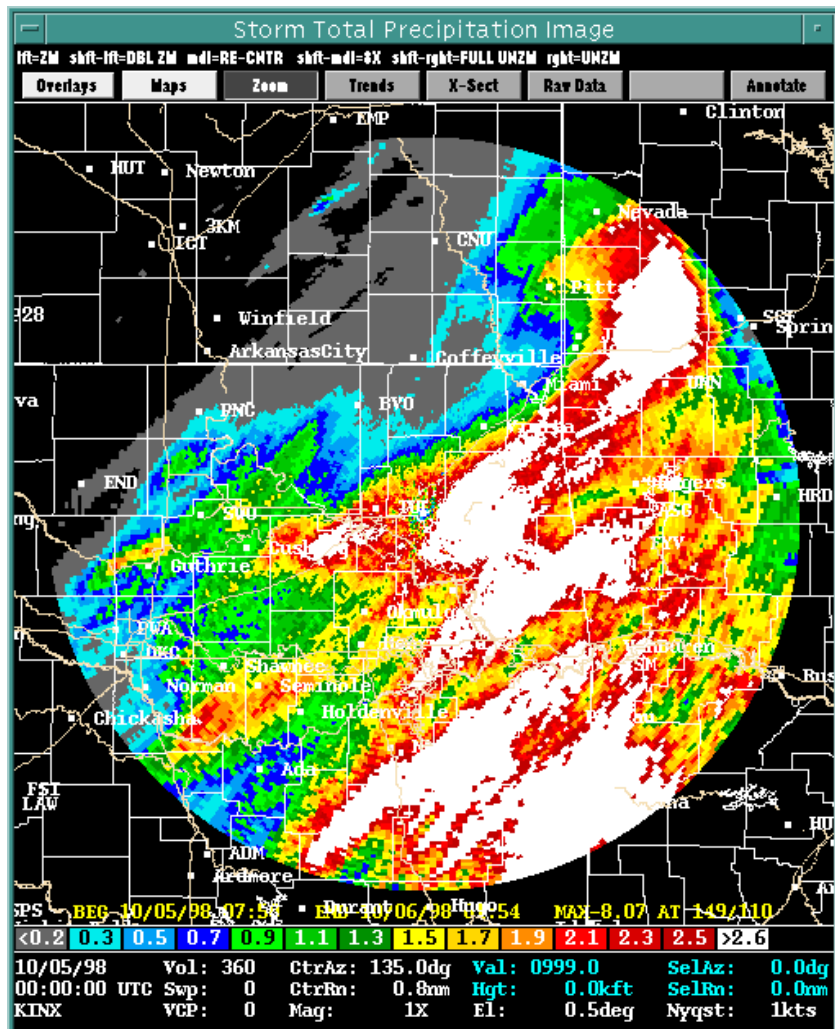
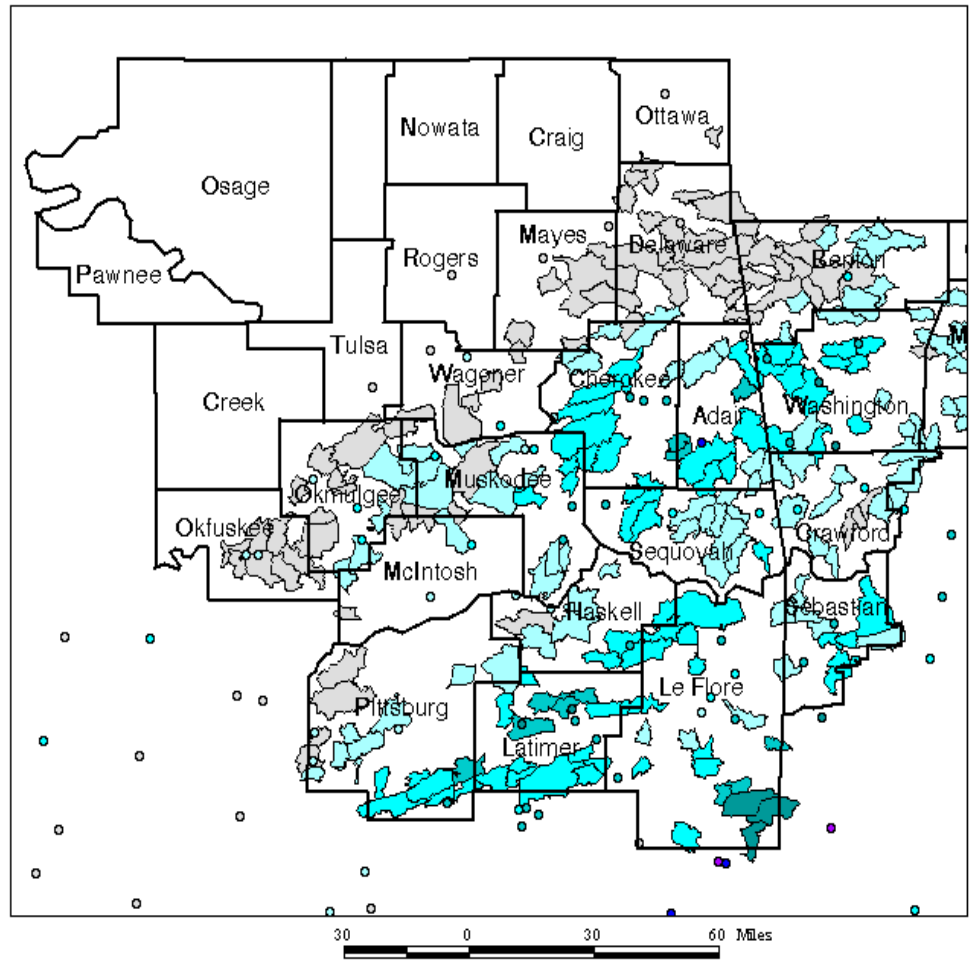
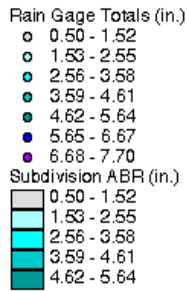


Figure C6. KINX Storm Total Precipitation Image: 10/05/98 0750-0151 UTC.



**Rain Gage Totals  
and  
AMBER ABR Values  
for the  
Subdivision Basins**

**10/05/98 1200 UTC -  
10/06/98 1200 UTC**



**Figure C7.**

Subdivision Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 10/05/98

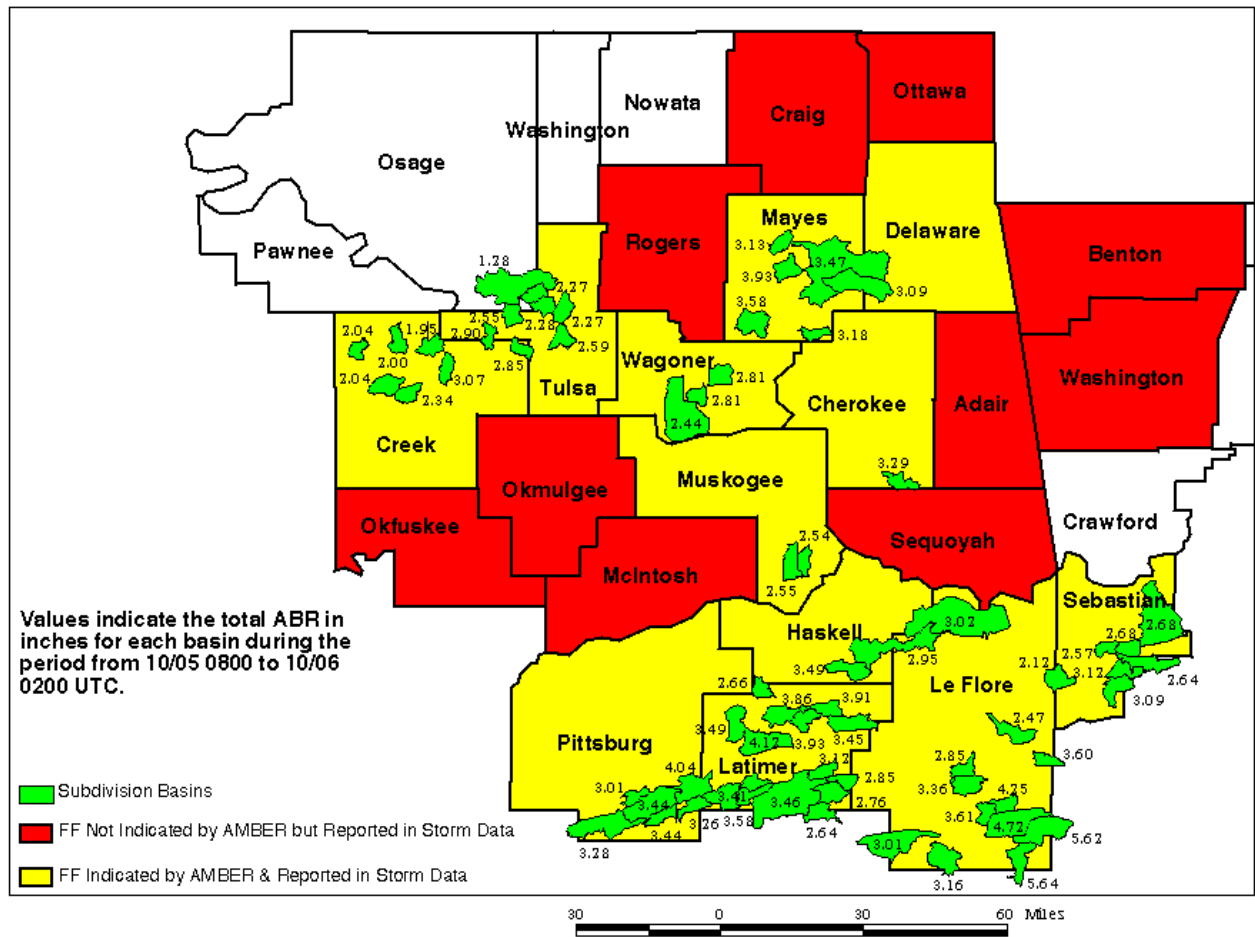


Figure C8.

Primary Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 10/05/98

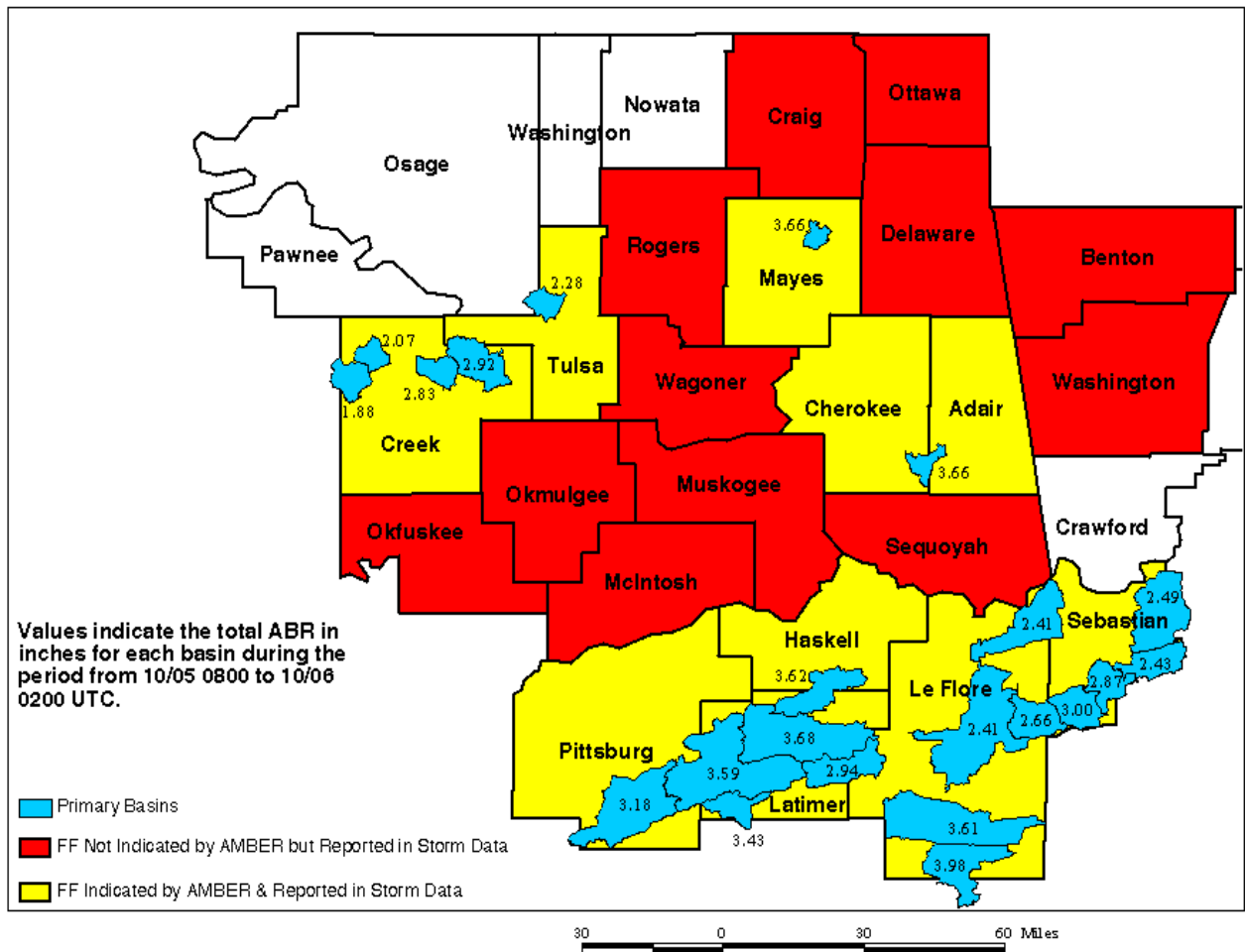


Figure C9.

Major Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 10/05/98

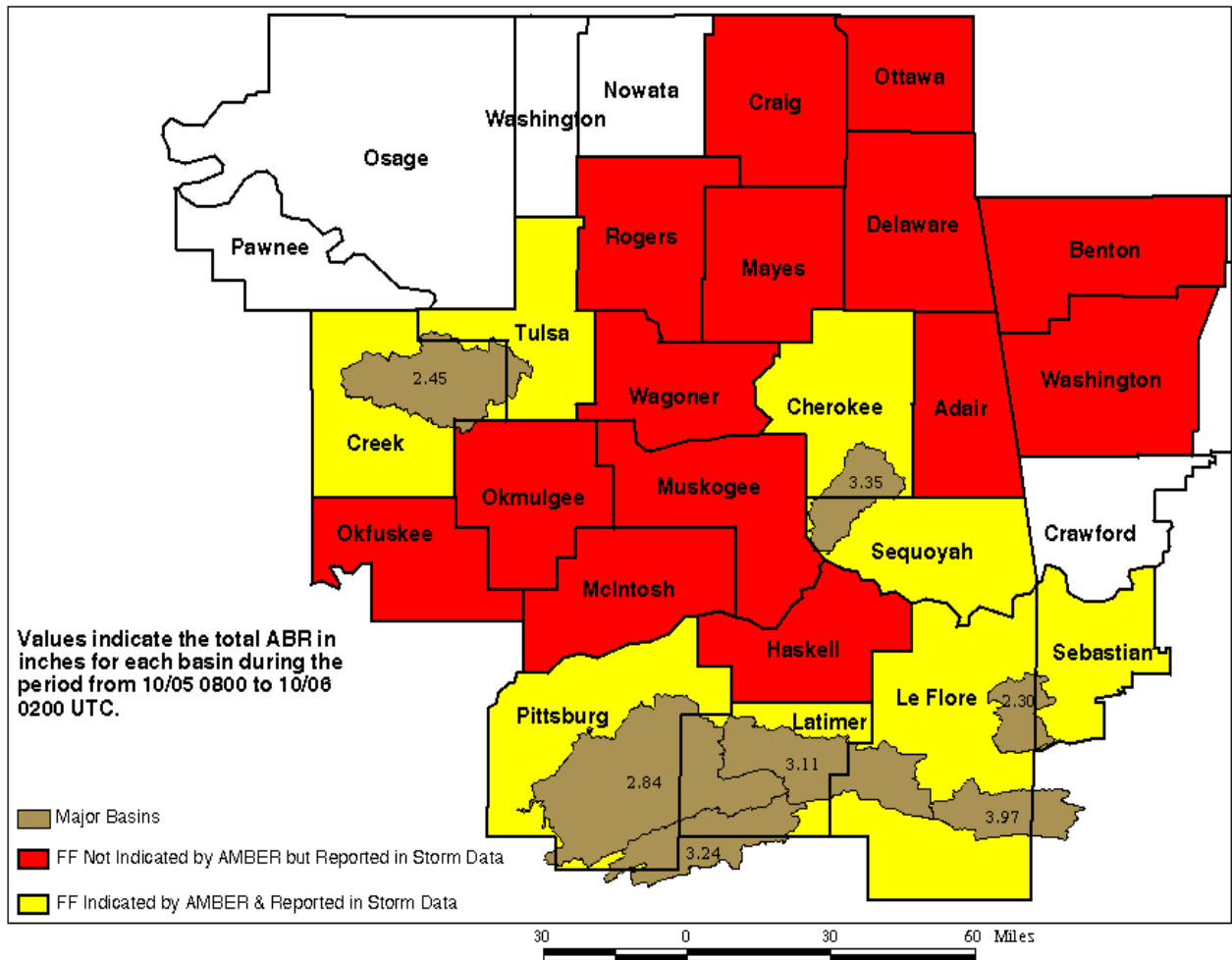


Figure C10.



Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 1.5 in/hr - 10/05/98

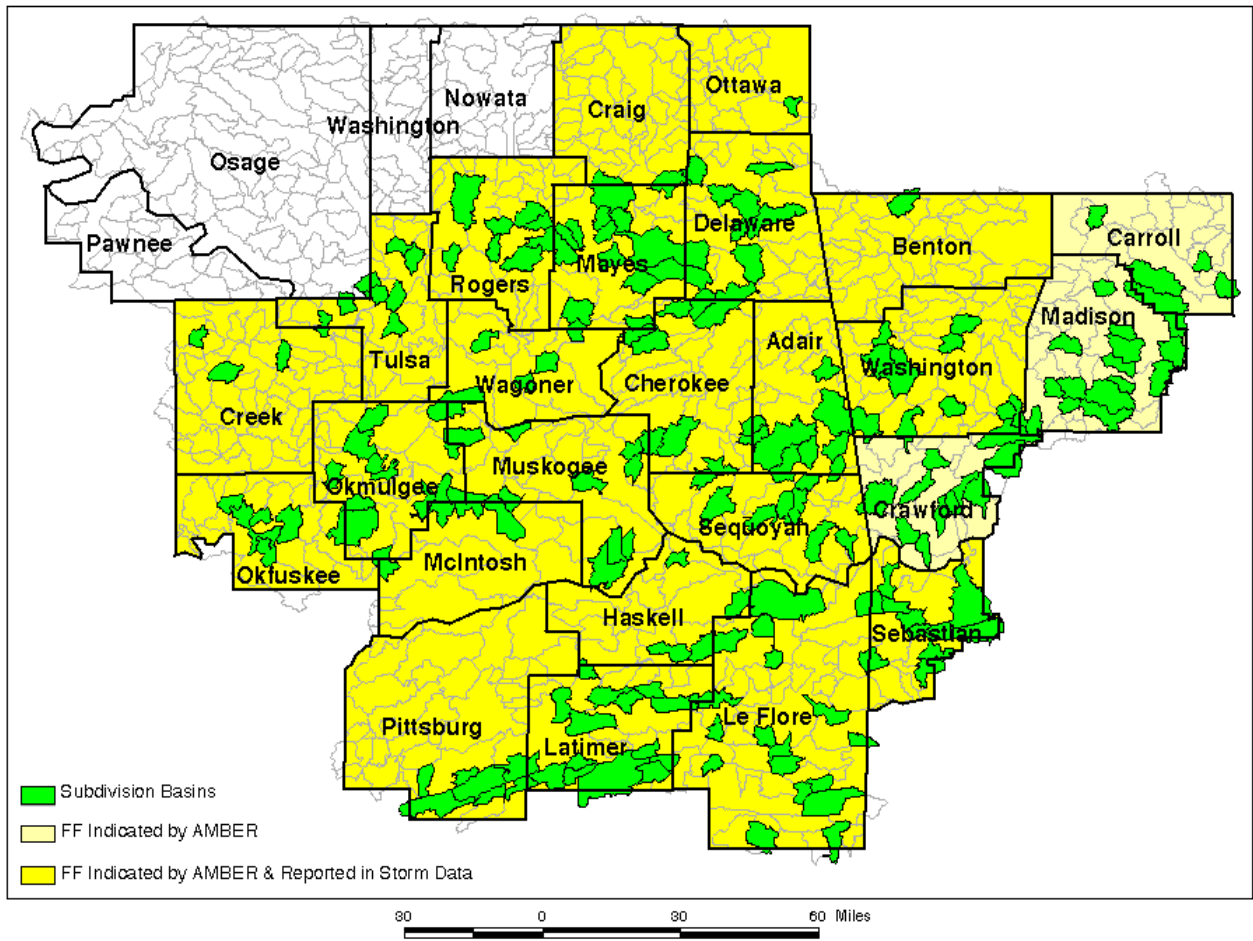


Figure C12.



**APPENDIX D**

**Tulsa Case Study #4 - April 25, 1999**

**DATA AND FIGURES**



Table D1. The first basin(s) in each county where ABR exceeded FFG during the April 25, 1999 event according to KINX data. The date and time (in UTC) indicate when ABR first exceeded FFG, and the ABR and FFG values over the specified time interval are included. Flash flood verification is based on reports in Storm Data.

| Date / Time   | Basin ID(s)  | Basin Type  | Drainage Area (mi <sup>2</sup> )   | County         | ABR / FFG / Time Interval  | Flash Flood Reported / Time |
|---------------|--|---|--|----------------|--|-----------------------------|
| 04/25<br>1108 | 5804<br>5826<br>5824<br>5747   | Subdivision<br>“<br>“<br>“  | 13.3<br>55.0<br>37.0<br>24.4   | Pawnee<br>OK   | 1.22 / 1.10 / 3-hr<br>1.15 / 1.10 / 3-hr<br>1.14 / 1.10 / 3-hr<br>1.12 / 1.10 / 3-hr   | No                          |
| 04/25<br>1208 | 5721<br>5684<br>5756   | Subdivision<br>“<br>“   | 14.0<br>12.4<br>38.6   | Osage<br>OK    | 1.51 / 1.30 / 3-hr<br>1.46 / 1.30 / 3-hr<br>1.46 / 1.30 / 3-hr   | Yes / 1430                  |
| 04/25<br>1338 | 5598<br>6844<br>1138   | Subdivision<br>“<br>Primary   | 10.9<br>23.1<br>52.3   | Nowata<br>OK   | 0.90 / 0.80 / 1-hr<br>1.33 / 1.20 / 3-hr<br>1.35 / 1.20 / 3-hr   | Yes / 1430                  |
| 04/25<br>1408 | 5674   | Subdivision   | 11.5   | Rogers<br>OK   | 2.13 / 2.10 / 6-hr   | Yes / 1430                  |
| 04/25<br>1438 | 5525<br>5505   | Subdivision<br>“  | 31.3<br>17.4   | Craig<br>OK    | 2.05 / 1.90 / 6-hr<br>2.01 / 1.90 / 6-hr   | Yes / 1430                  |
| 04/25<br>1508 | 5483<br>1106<br>1115   | Subdivision<br>Primary<br>“   | 21.9<br>51.8<br>31.3   | Ottawa<br>OK   | 1.84 / 1.70 / 6-hr<br>1.77 / 1.70 / 6-hr<br>1.74 / 1.70 / 6-hr   | Yes / 1430                  |
| 04/25<br>1538 | 6170   | Subdivision   | 14.8   | Okmulgee<br>OK | 1.71 / 1.50 / 3-hr   | No                          |
| 04/25<br>1715 | 5960   | Subdivision   | 13.3   | Wagoner<br>OK  | 1.73 / 1.50 / 3-hr   | Yes / 1430                  |
| 04/25<br>1813 | 6097<br>6031<br>6046<br>6038<br>6075<br>6113<br>6136<br>6148<br>6128<br>1223<br>560<br>567<br>122<br>120 | Subdivision<br>“<br>“<br>“<br>“<br>“<br>“<br>“<br>“<br>“<br>Primary<br>Major<br>“<br>MAP<br>“ | 13.8<br>11.6<br>12.8<br>13.7<br>14.5<br>14.0<br>15.7<br>10.2<br>15.6<br>78.3<br>357.9<br>252.9<br>77.2<br>39.5 | Creek<br>OK    | 1.12 / 0.90 / 3-hr<br>0.99 / 0.90 / 3-hr<br>1.23 / 0.90 / 3-hr<br>1.39 / 0.90 / 3-hr<br>1.12 / 0.90 / 3-hr<br>1.92 / 1.40 / 6-hr<br>1.72 / 1.40 / 6-hr<br>1.67 / 1.40 / 6-hr<br>1.57 / 1.40 / 6-hr<br>1.58 / 1.40 / 6-hr<br>1.54 / 1.40 / 6-hr<br>1.53 / 1.40 / 6-hr<br>1.58 / 1.40 / 6-hr<br>1.46 / 1.40 / 6-hr | Yes / 1430                  |
| 04/25<br>1813 | 1433<br>1194<br>5796<br>5795<br>5803<br>5894<br>5767   | Primary<br>“<br>Subdivision<br>“<br>“<br>“<br>“   | 18.9<br>461.9<br>11.2<br>36.5<br>11.6<br>24.7<br>11.7  | Mayes<br>OK    | 0.72 / 0.70 / 1-hr<br>1.53 / 1.50 / 6-hr<br>1.65 / 1.50 / 6-hr<br>1.57 / 1.50 / 6-hr<br>1.55 / 1.50 / 6-hr<br>1.53 / 1.50 / 6-hr<br>1.53 / 1.50 / 6-hr   | Yes / 1430                  |

|               |  |   |   |                  |  |            |
|---------------|--|---|---|------------------|--|------------|
| 04/25<br>1813 | 6182<br>6184<br>6186<br>6222<br>6242<br>6181<br>6256<br>1268<br>1263 | Subdivision<br>"<br>"<br>"<br>"<br>"<br>"<br>Primary<br>" | 28.4<br>10.1<br>47.0<br>27.0<br>9.8<br>18.2<br>27.9<br>47.9<br>90.4 | Okfuskee<br>OK   | 1.92 / 1.40 / 6-hr<br>1.78 / 1.40 / 6-hr<br>1.66 / 1.40 / 6-hr<br>1.54 / 1.40 / 6-hr<br>1.50 / 1.40 / 6-hr<br>1.45 / 1.40 / 6-hr<br>1.44 / 1.40 / 6-hr<br>1.62 / 1.40 / 6-hr<br>1.61 / 1.40 / 6-hr | No         |
| 04/25<br>1813 | 105<br>5979<br>5813<br>5924<br>5832<br>5764<br>1176                  | MAP<br>Subdivision<br>"<br>"<br>"<br>"<br>Primary         | 562.4<br>11.2<br>11.1<br>9.7<br>14.4<br>17.7<br>35.0                | Tulsa<br>OK      | 1.10 / 0.90 / 3-hr<br>1.10 / 0.90 / 3-hr<br>1.60 / 1.40 / 6-hr<br>1.58 / 1.40 / 6-hr<br>1.56 / 1.40 / 6-hr<br>1.49 / 1.40 / 6-hr<br>1.65 / 1.40 / 6-hr   | Yes / 1430 |
| 04/25<br>1813 | 1161<br>6867<br>6854<br>5671   | Primary<br>Subdivision<br>"<br>"                          | 51.4<br>11.8<br>11.3<br>19.3  | Washington<br>OK | 1.87 / 1.80 / 6-hr<br>1.86 / 1.80 / 6-hr<br>1.86 / 1.80 / 6-hr<br>1.81 / 1.80 / 6-hr   | Yes / 1430 |

Table D2. The first basin(s) in each county where ABR rate equaled or exceeded 1.5 inches/hour during the April 25, 1999 event according to KINX data. The ABR rate shown is the first rate to equal or exceed 1.5 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 1.5 inches/hour, and flash flood verification is based on reports in Storm Data.

| <b>Date / Time</b> | <b>Basin ID(s)</b> | <b>Basin Type</b> | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>  | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|--------------------|-------------------|---------------------------------------|----------------|-------------------------------|------------------------------------|
| 04/25<br>0715      | 6047               | Subdivision       | 33.3                                  | Creek<br>OK    | 1.5                           | Yes / 1430                         |
| 04/25<br>0820      | 5882               | Subdivision       | 17.6                                  | Osage<br>OK    | 2.1                           | Yes / 1430                         |
| 04/25<br>1045      | 5855               | Subdivision       | 15.1                                  | Tulsa<br>OK    | 2.0                           | Yes / 1430                         |
| 04/25<br>1045      | 5823               | Subdivision       | 13.5                                  | Pawnee<br>OK   | 1.6                           | No                                 |
| 04/25<br>1230      | 6182<br>6256       | Subdivision<br>“  | 28.4<br>27.9                          | Okfuskee<br>OK | 2.1<br>1.8                    | No                                 |
| 04/25<br>1300      | 6177               | Subdivision       | 11.3                                  | Okmulgee<br>OK | 2.4                           | No                                 |
| 04/25<br>1400      | 5796<br>5803       | Subdivision<br>“  | 11.6                                  | Mayes<br>OK    | 1.5<br>1.6                    | Yes / 1430                         |
| 04/25<br>1415      | 6860               | Subdivision       | 11.4                                  | Craig<br>OK    | 1.5                           | Yes / 1430                         |
| 04/25<br>1630      | 5960               | Subdivision       | 13.3                                  | Wagoner<br>OK  | 1.6                           | Yes / 1430                         |
| 04/25<br>1720      | 5921               | Subdivision       | 19.1                                  | Rogers<br>OK   | 1.8                           | Yes / 1430                         |

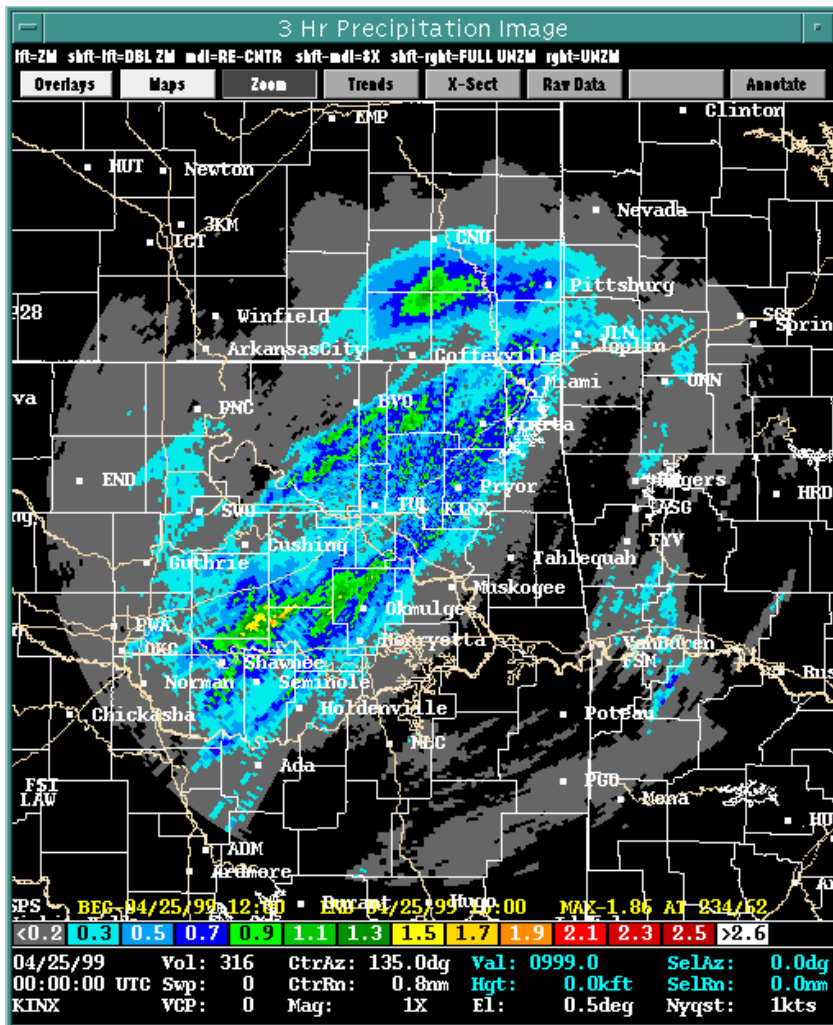


Figure D1. KINX 3-hour Precipitation Image: 04/25/99 1200-1500 UTC.

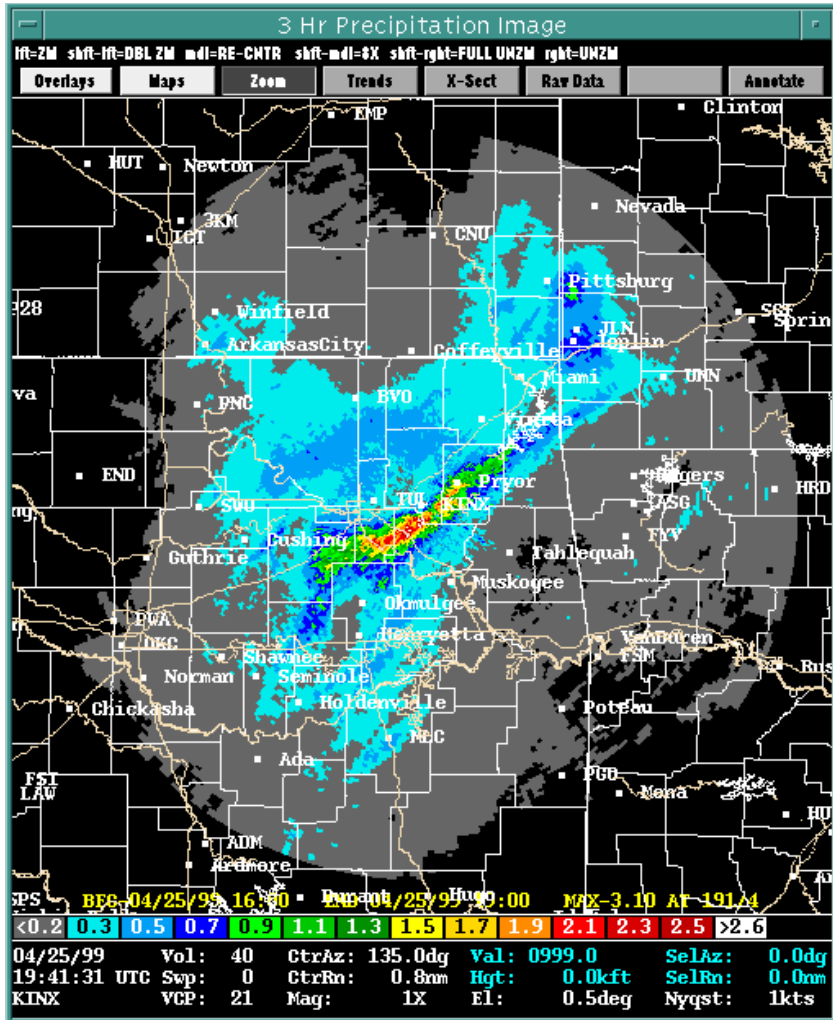


Figure D2. KINX 3-hour Precipitation Image: 04/25/99 1600-1900 UTC.

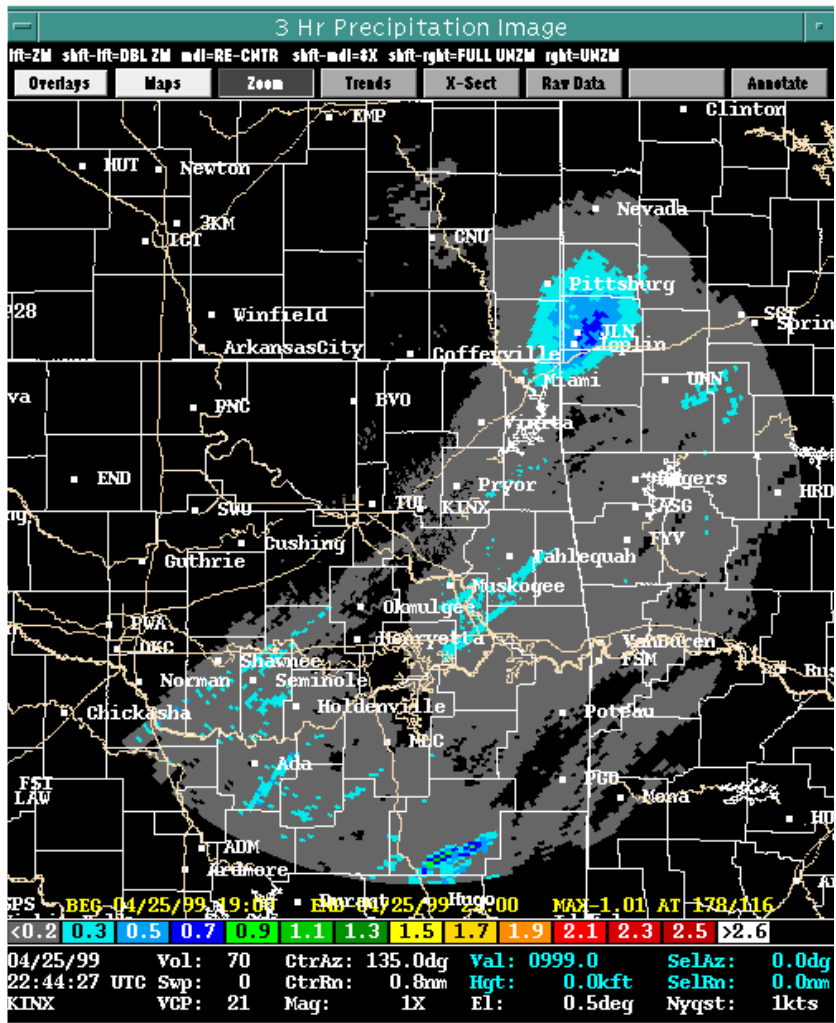


Figure D3. KINX 3-hour Precipitation Image: 04/25/99 1900-2200 UTC.

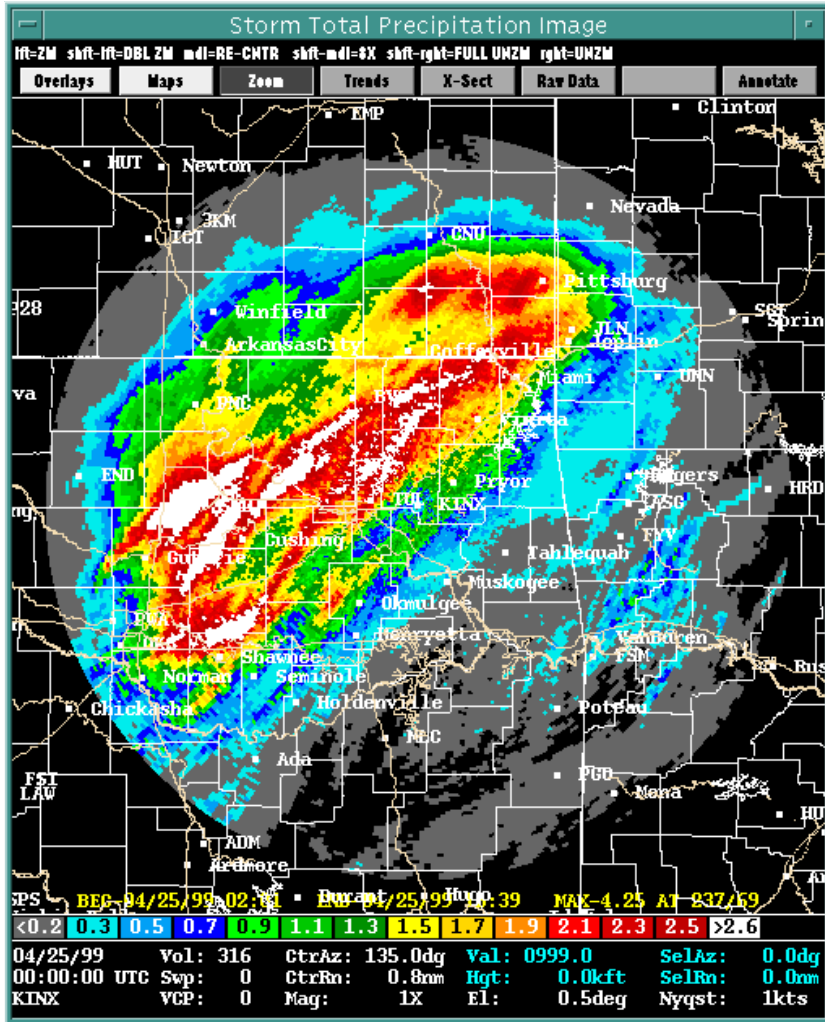
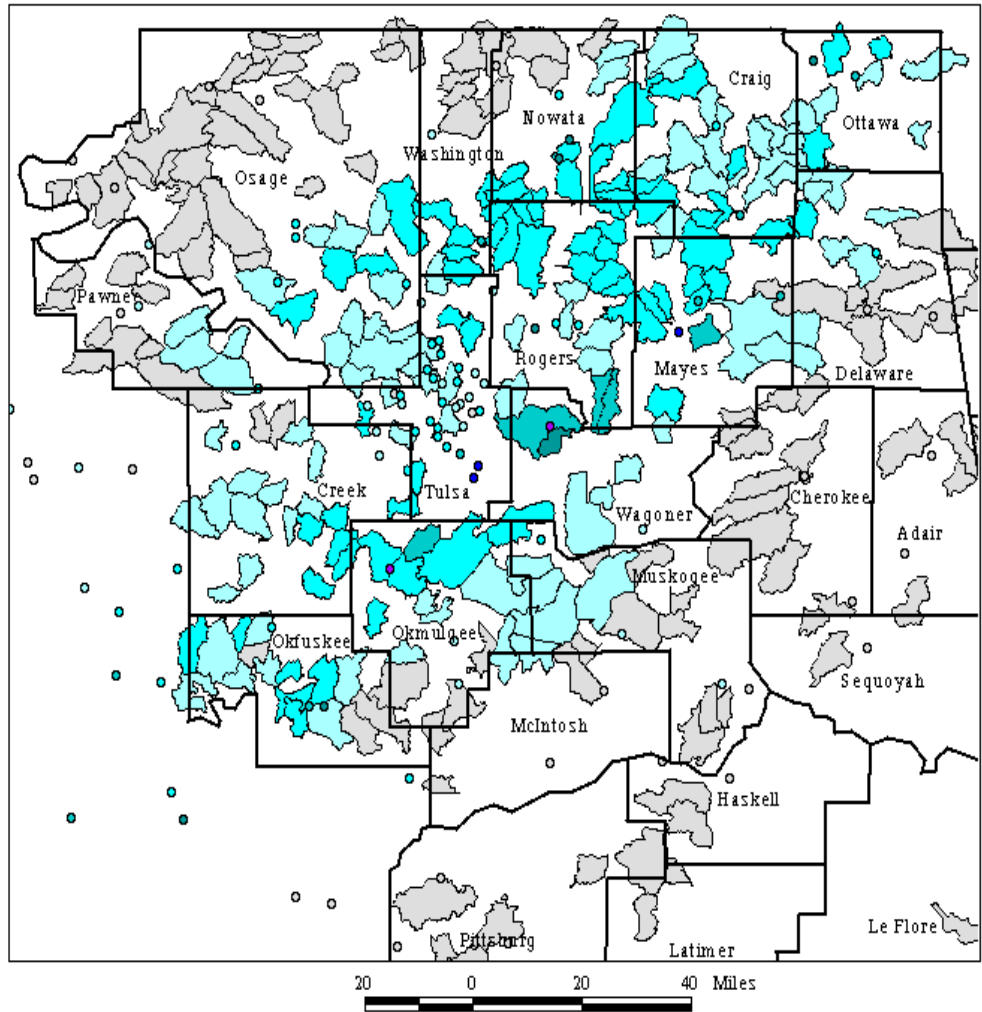


Figure D4. KINX Storm Total Precipitation Image: 04/25/99 0231-1539 UTC.

**Rain Gage Totals  
and  
AMBER ABR Values  
for the  
Subdivision Basins**

**04/25/99 1200 UTC -  
04/26/99 1200 UTC**

- Rain Gage Totals (in.)
- 0.50 - 1.09
  - 1.10 - 1.69
  - 1.70 - 2.29
  - 2.30 - 2.89
  - 2.90 - 3.49
  - 3.50 - 4.09
  - 4.10 - 4.69
- Subdivision ABR (in.)
- 0.50 - 1.09
  - 1.10 - 1.69
  - 1.70 - 2.29
  - 2.30 - 2.89
  - 2.90 - 3.49



**Figure D5.**



Subdivision Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 04/25/99

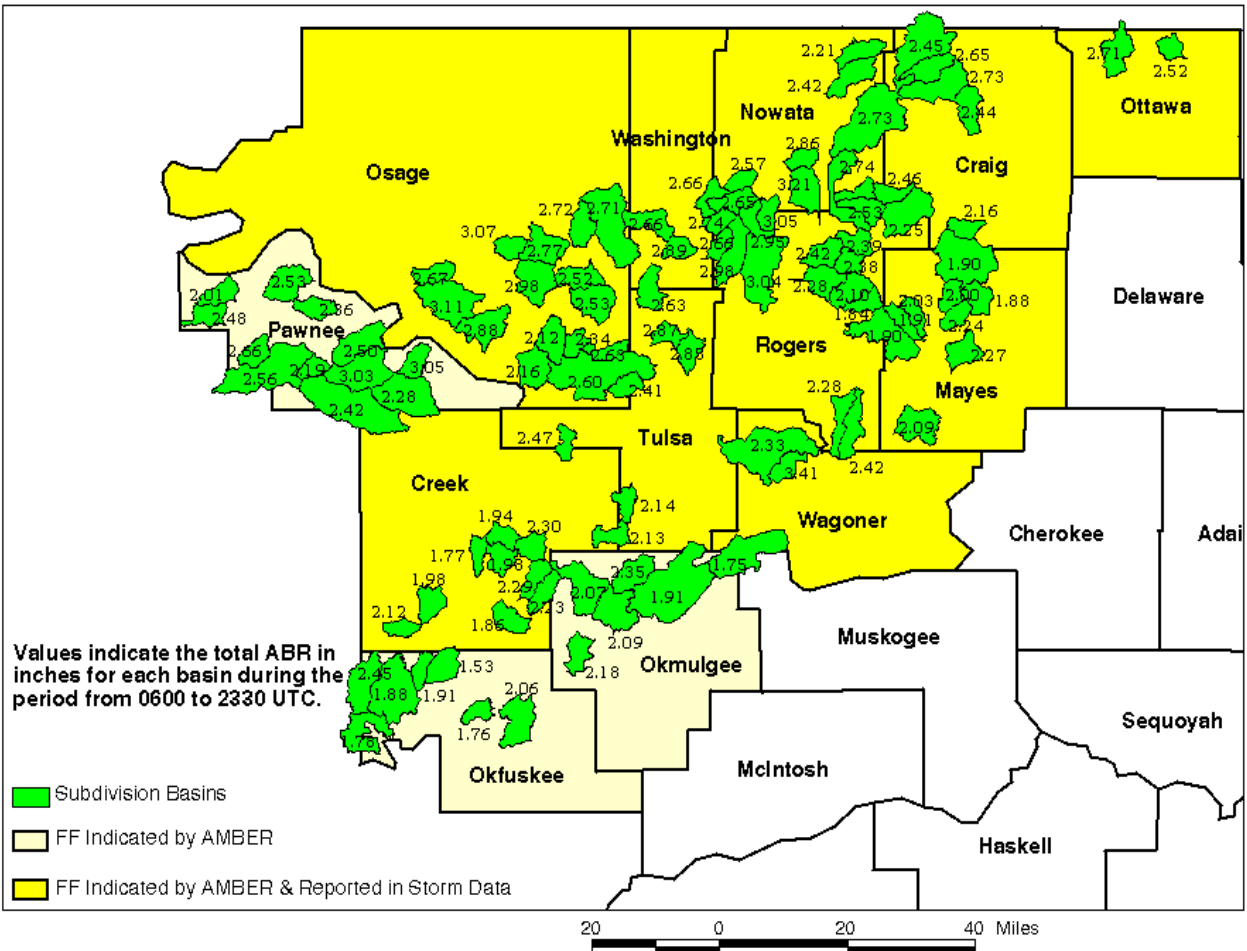


Figure D6.

Primary Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 04/25/99

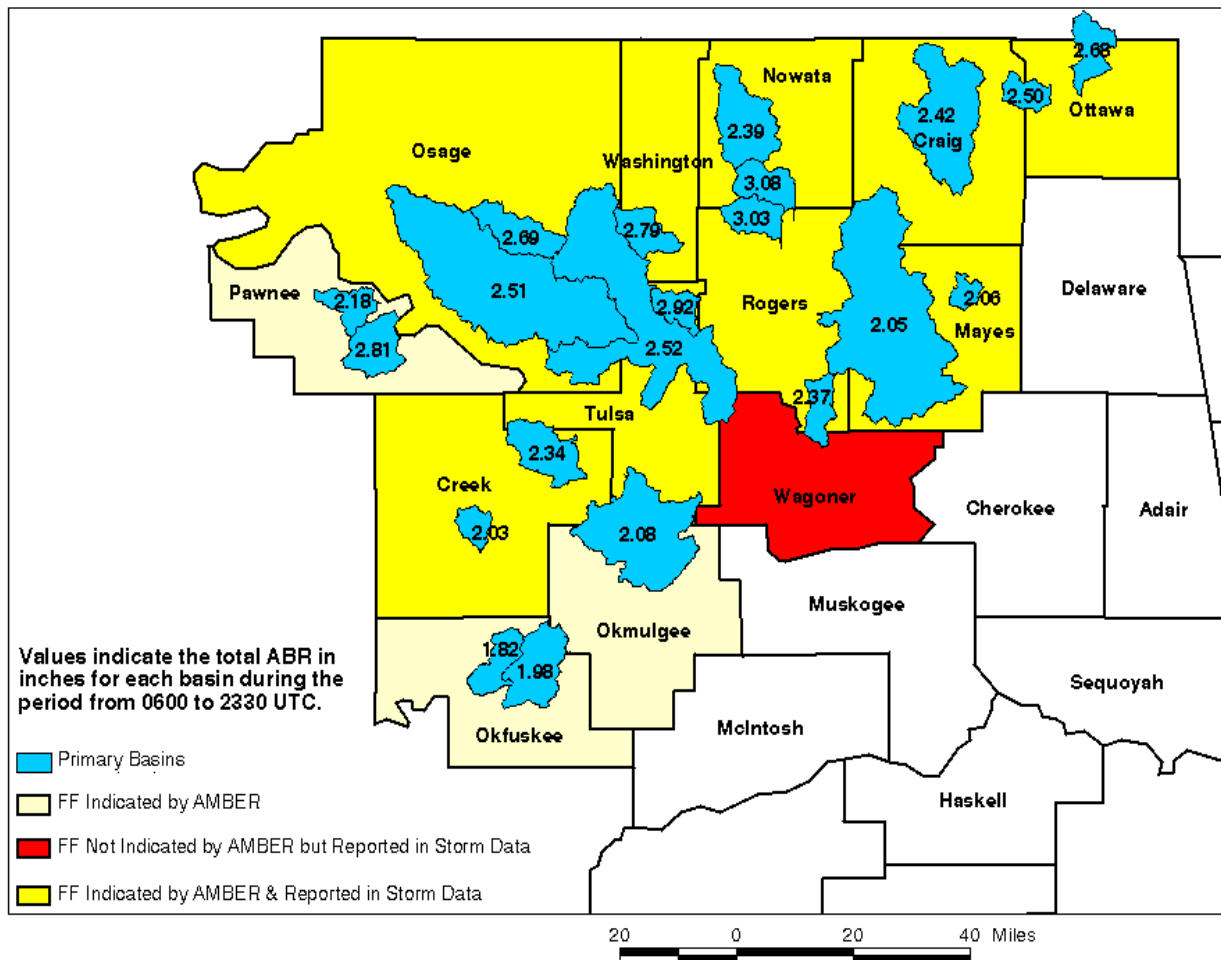


Figure D7.

Major Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 04/25/99

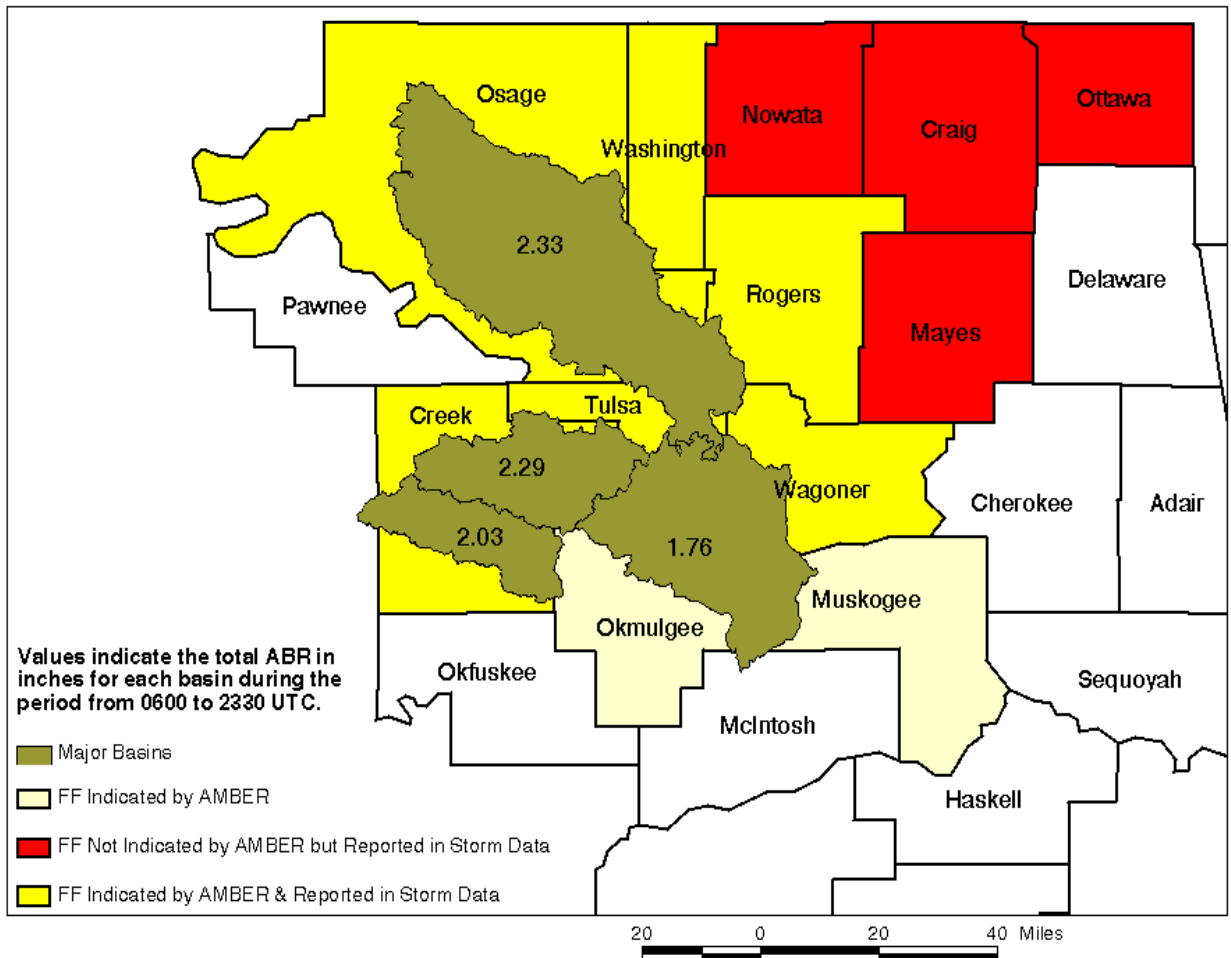


Figure D8.

RFC Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 04/25/99

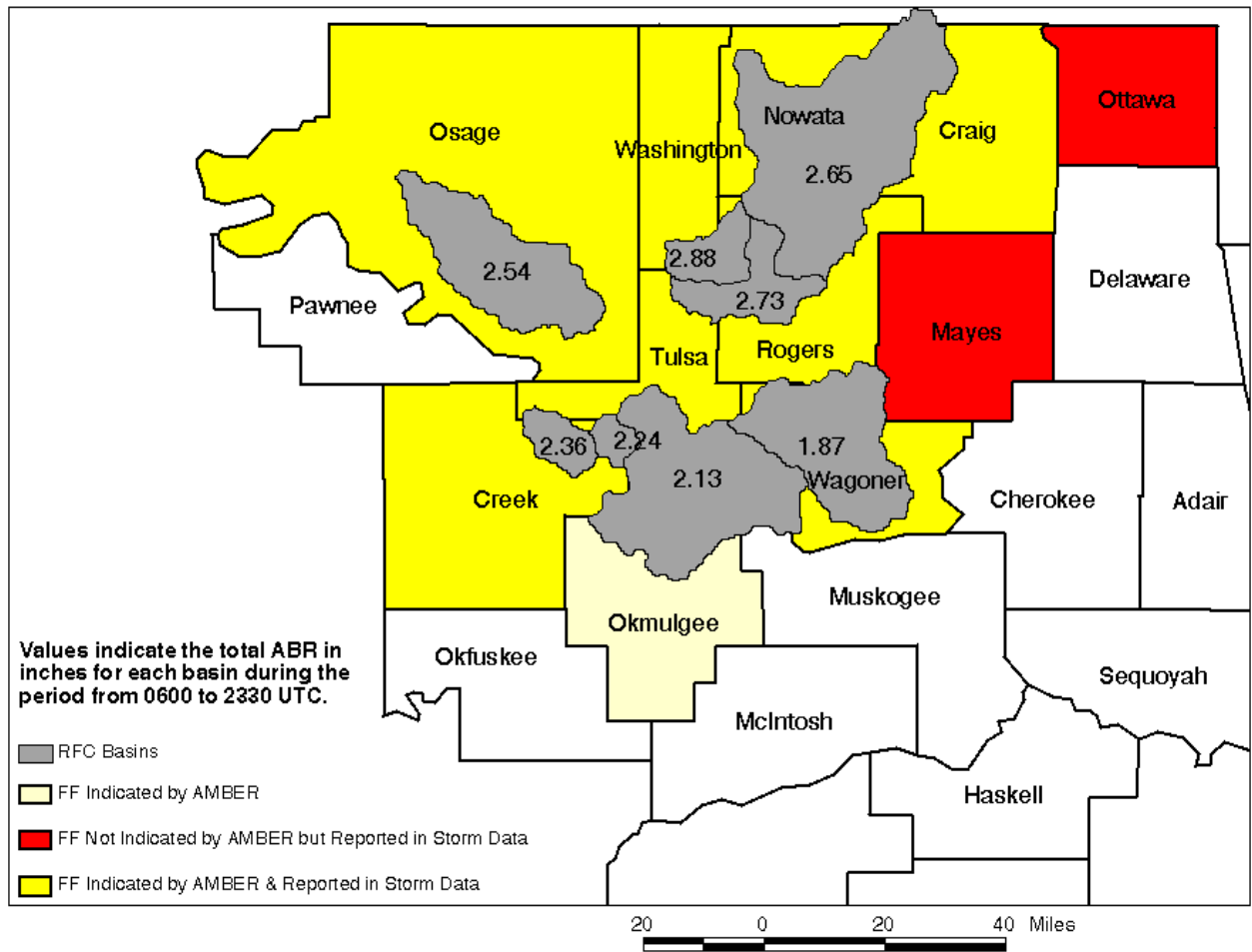


Figure D9.

Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 1.5 in/hr - 04/25/99

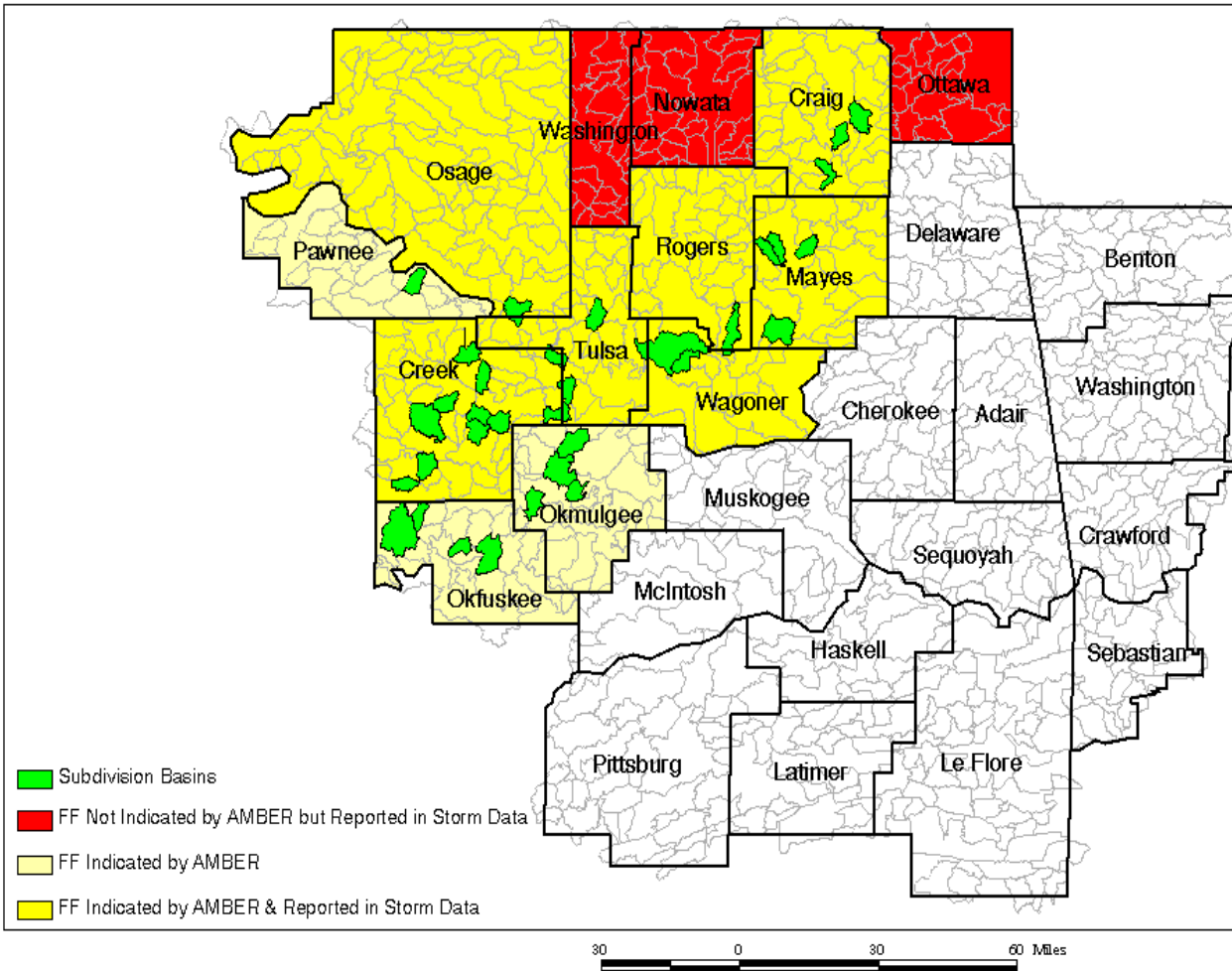


Figure D10.



**APPENDIX E**

**Tulsa Case Study #5 - June 20, 1999**

**DATA AND FIGURES**

Table E1. The first basin(s) in each county where ABR exceeded FFG during the June 20, 1999 event according to KINX data. The date and time (in UTC) indicate when ABR first exceeded FFG, and the ABR and FFG values over the specified time interval are included. Flash flood verification is based on reports in Storm Data.

| <b>Date / Time</b>    | <b>Basin ID(s)</b>   | <b>Basin Type</b>              | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>          | <b>ABR / FFG / Time Interval</b>                 | <b>Flash Flood Reported / Time</b> |
|-----------------------|----------------------|--------------------------------|---------------------------------------|------------------------|--|------------------------------------|
| <b>06/20<br/>0926</b> | <b>5750<br/>1433</b> | <b>Subdivision<br/>Primary</b> | <b>15.4<br/>18.9</b>                  | <b>Mayes<br/>OK</b>    | <b>1.59 / 1.40 / 1-hr<br/>1.53 / 1.40 / 1-hr</b> | <b>Yes / 1045</b>                  |
| <b>06/20<br/>1154</b> | <b>5685<br/>5691</b> | <b>Subdivision<br/>“</b>       | <b>29.4<br/>13.3</b>                  | <b>Rogers<br/>OK</b>   | <b>1.54 / 1.40 / 3-hr<br/>1.42 / 1.40 / 3-hr</b> | <b>Yes / 1300</b>                  |
| <b>06/20<br/>1223</b> | <b>5634<br/>5626</b> | <b>Subdivision<br/>“</b>       | <b>11.4<br/>16.7</b>                  | <b>Craig<br/>OK</b>    | <b>1.30 / 1.30 / 3-hr<br/>1.30 / 1.30 / 3-hr</b> | <b>Yes / 1300</b>                  |
| <b>06/20<br/>1223</b> | <b>5651<br/>6857</b> | <b>Subdivision<br/>“</b>       | <b>14.7<br/>36.2</b>                  | <b>Nowata<br/>OK</b>   | <b>1.17 / 0.90 / 3-hr<br/>1.07 / 0.90 / 3-hr</b> | <b>Yes / 1545</b>                  |
| <b>06/20<br/>1253</b> | <b>5953</b>          | <b>Subdivision</b>             | <b>15.6</b>                           | <b>Cherokee<br/>OK</b> | <b>2.52 / 2.50 / 3-hr</b>                        | <b>Yes / 0945</b>                  |
| <b>06/20<br/>1421</b> | <b>6142</b>          | <b>Subdivision</b>             | <b>10.6</b>                           | <b>Muskogee<br/>OK</b> | <b>2.03 / 2.00 / 3-hr</b>                        | <b>No</b>                          |
| <b>06/20<br/>1648</b> | <b>5783<br/>5798</b> | <b>Subdivision<br/>“</b>       | <b>19.7<br/>10.2</b>                  | <b>Osage<br/>OK</b>    | <b>1.46 / 1.40 / 3-hr<br/>1.44 / 1.40 / 3-hr</b> | <b>No</b>                          |



Table E2. The first basin(s) in each county where ABR rate equaled or exceeded 1.5 inches/hour during the June 20, 1999 event according to KINX data. The ABR rate shown is the first rate to equal or exceed 1.5 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 1.5 inches/hour, and flash flood verification is based on reports in Storm Data.

| <b>Date / Time</b> | <b>Basin ID(s)</b> | <b>Basin Type</b>  | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>      | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|--------------------|--------------------|---------------------------------------|--------------------|-------------------------------|------------------------------------|
| <b>06/20 0845</b>  | <b>5796</b>        | <b>Subdivision</b> | <b>11.2</b>                           | <b>Mayes OK</b>    | <b>1.7</b>                    | <b>Yes / 1045</b>                  |
| <b>06/20 0850</b>  | <b>5904</b>        | <b>Subdivision</b> | <b>16.1</b>                           | <b>Cherokee OK</b> | <b>1.7</b>                    | <b>Yes / 0945</b>                  |
| <b>06/20 1405</b>  | <b>5760</b>        | <b>Subdivision</b> | <b>19.1</b>                           | <b>Rogers OK</b>   | <b>1.5</b>                    | <b>Yes / 1300</b>                  |

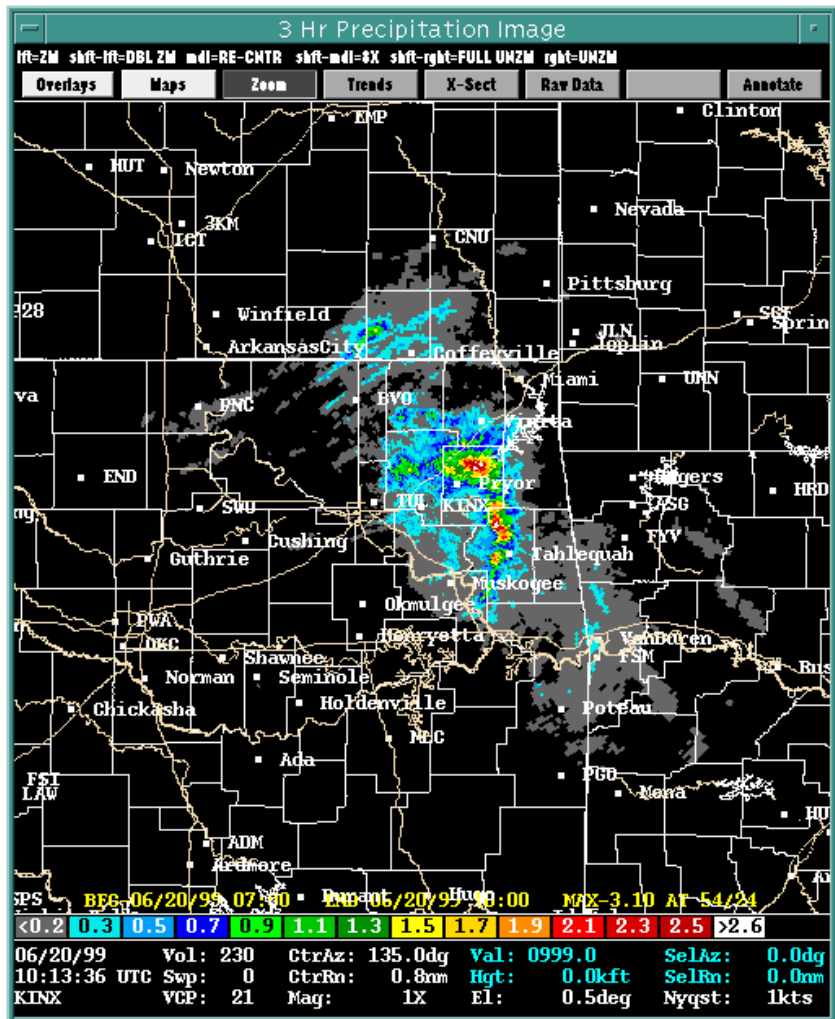


Figure E1. KINX 3-hour Precipitation Image: 06/20/99 0400-0700 UTC.

**Figure E2. KINX 3-hour Precipitation Image: 06/20/99 0700-1000 UTC.**

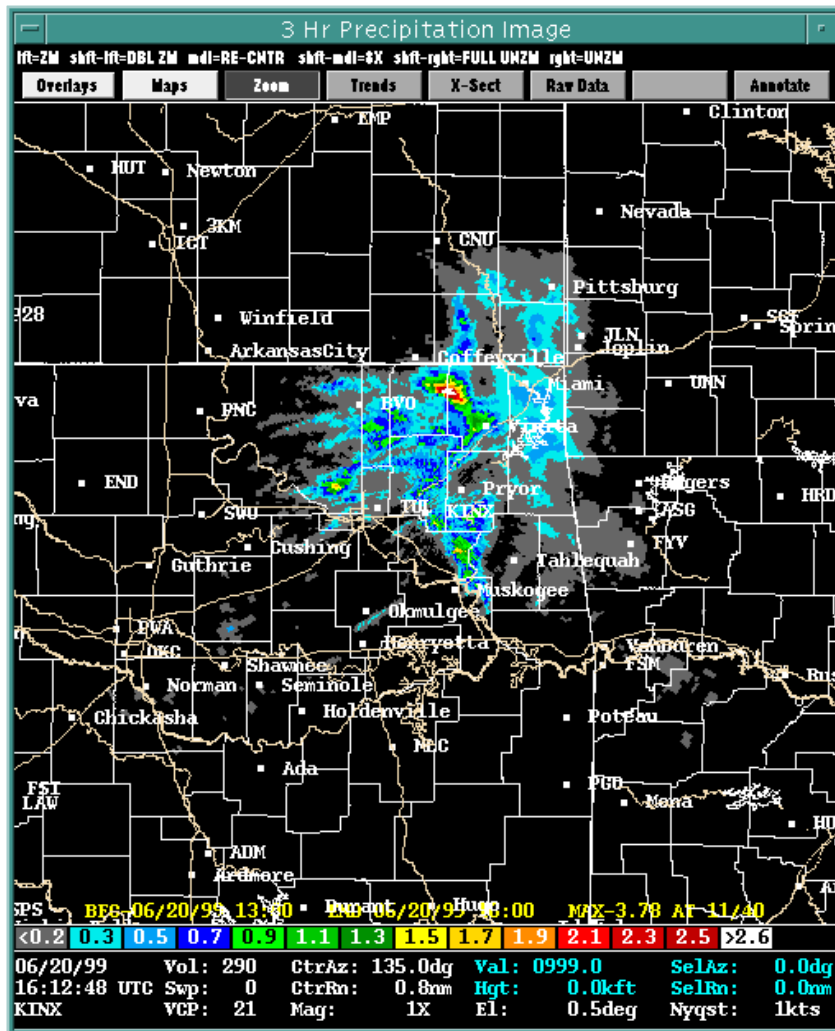


Figure E3. KINX 3-hour Precipitation Image: 06/20/99 1000-1300 UTC.

**Figure E4. KINX 3-hour Precipitation Image: 06/20/99 1300-1600 UTC.**

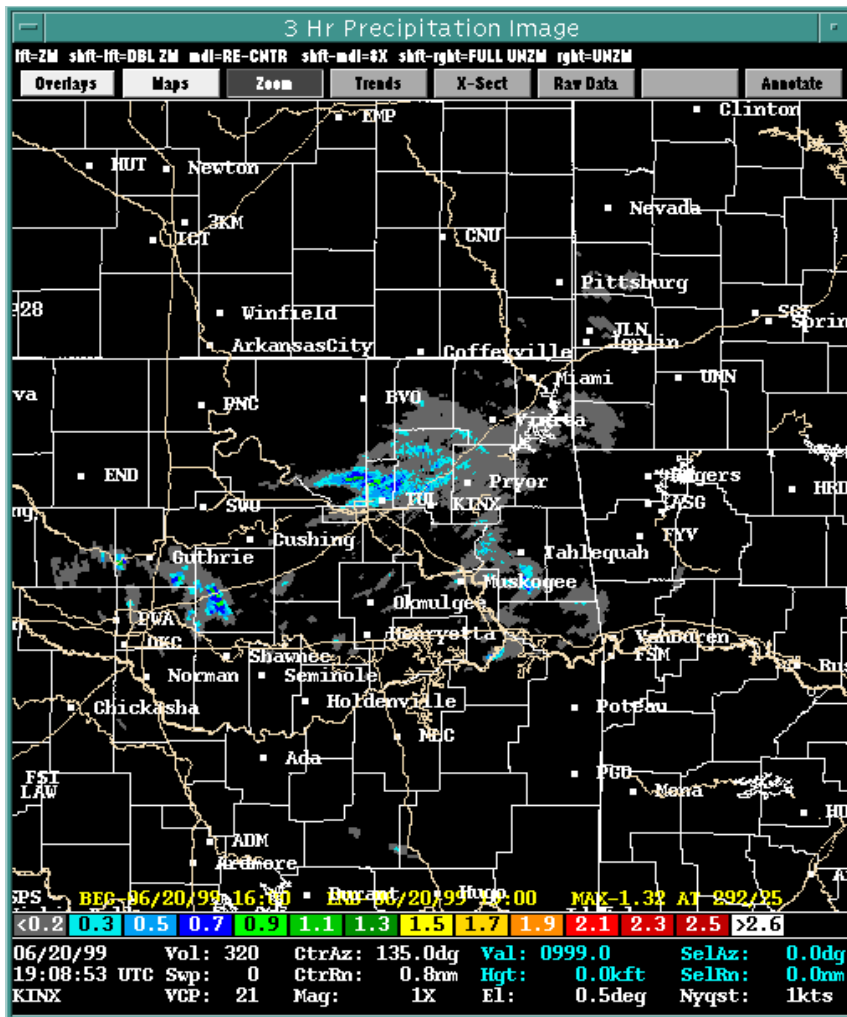


Figure E5. KINX 3-hour Precipitation Image: 06/20/99 1600-1900 UTC.

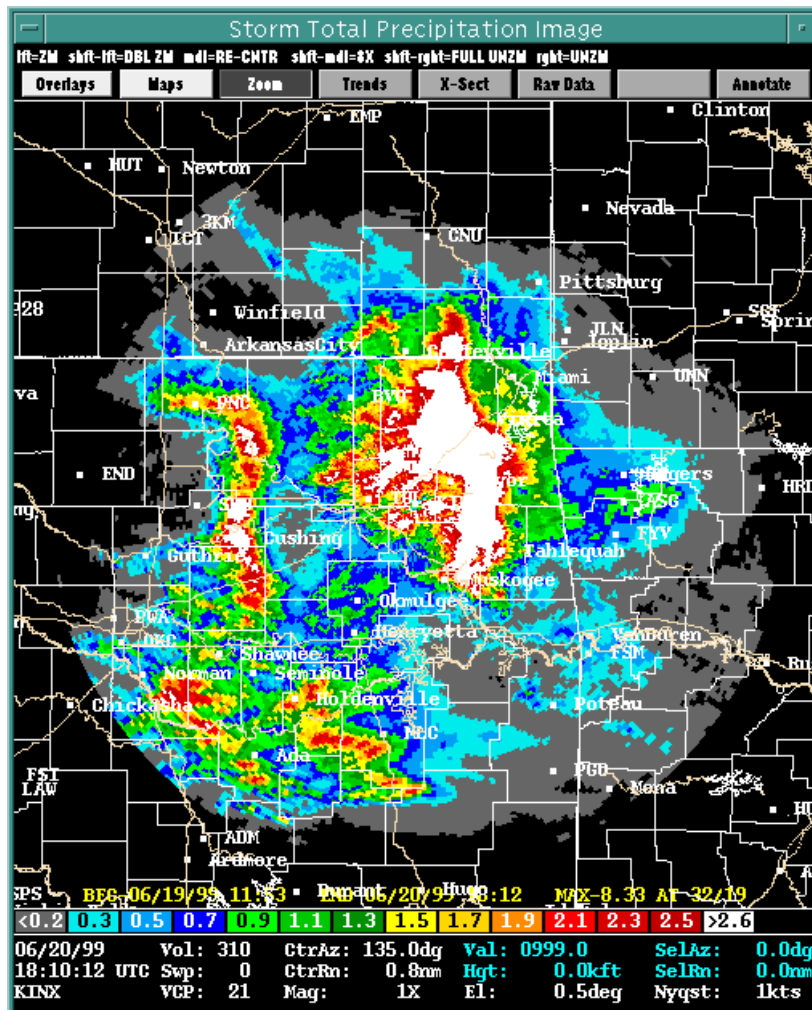


Figure E6. KINX Storm Total Precipitation Image: 06/19/99 1133 - 06/20/99 1812 UTC.

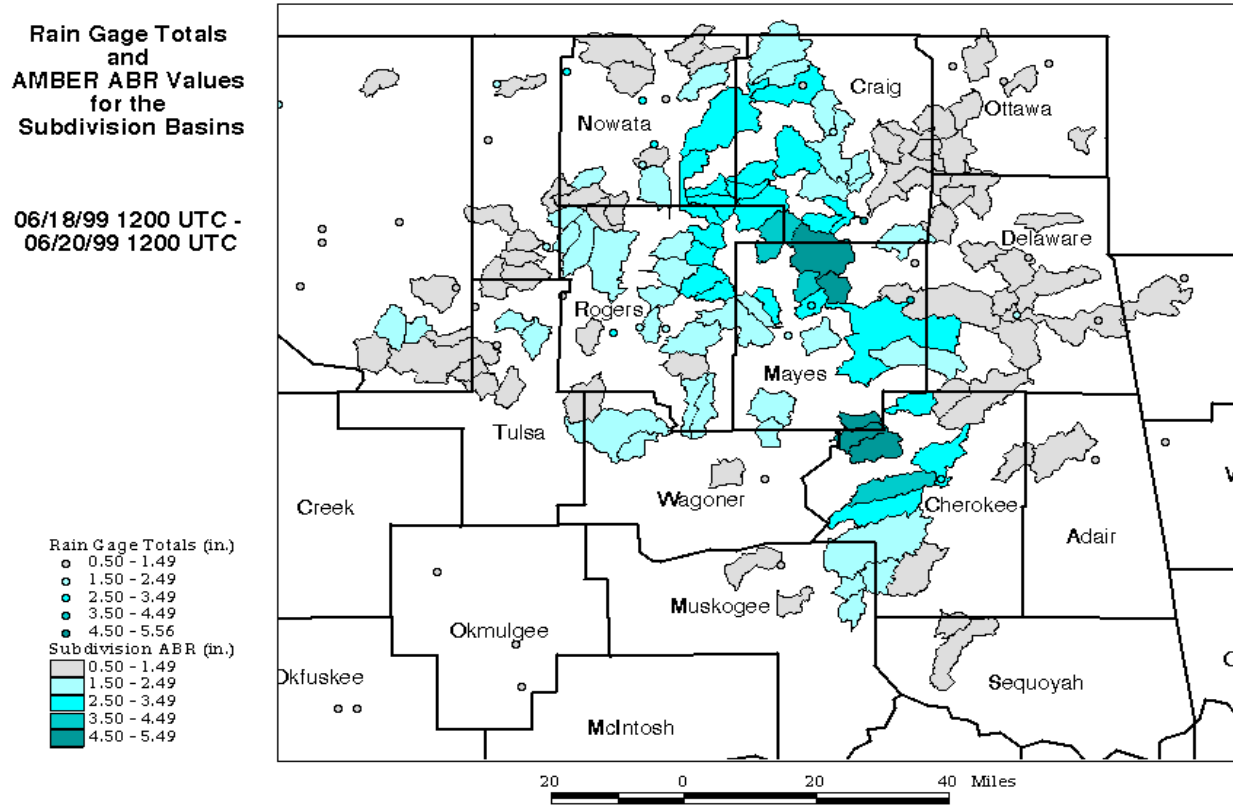


Figure E7.



Subdivision Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 06/20/99

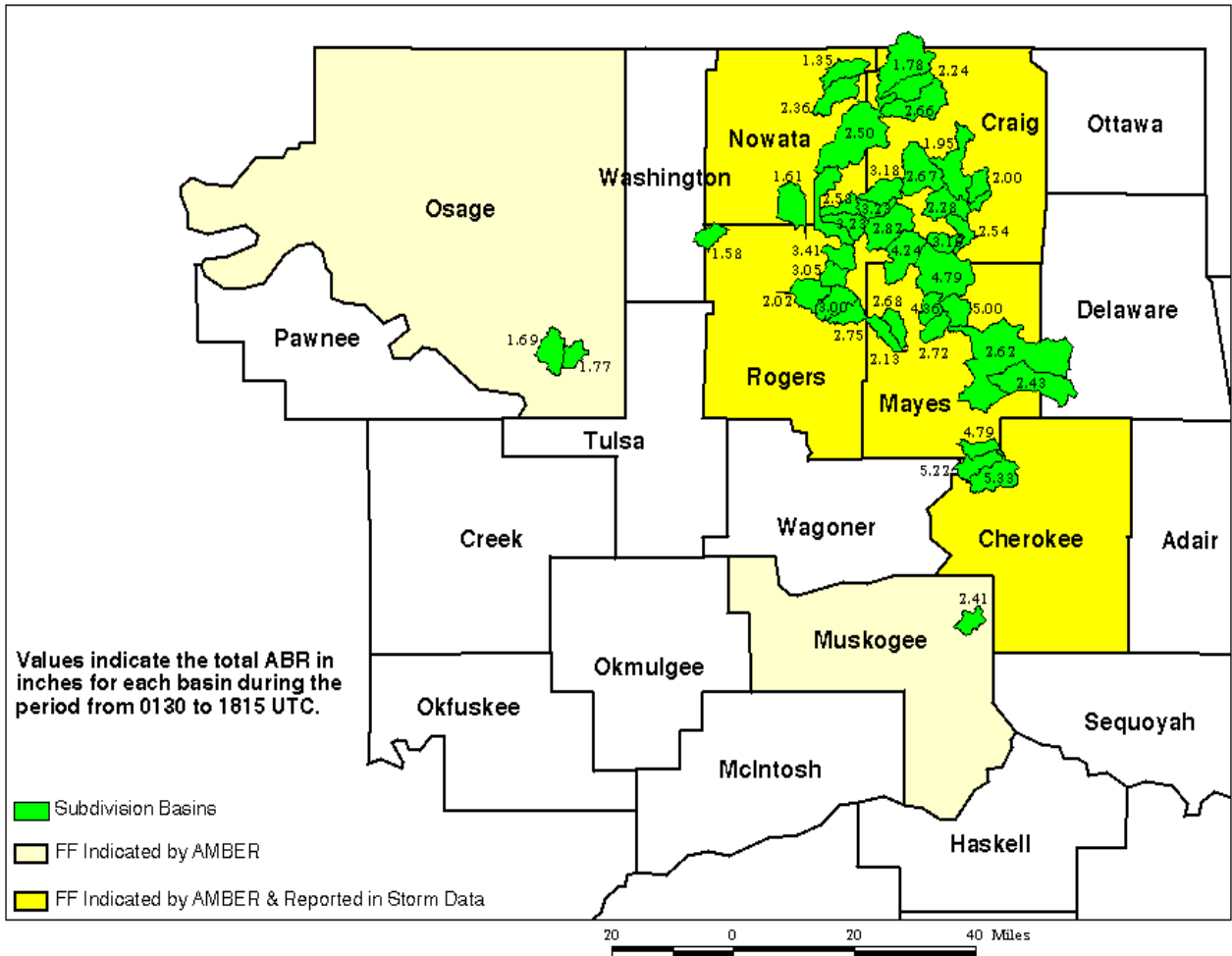


Figure E8.

Primary Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 06/20/99

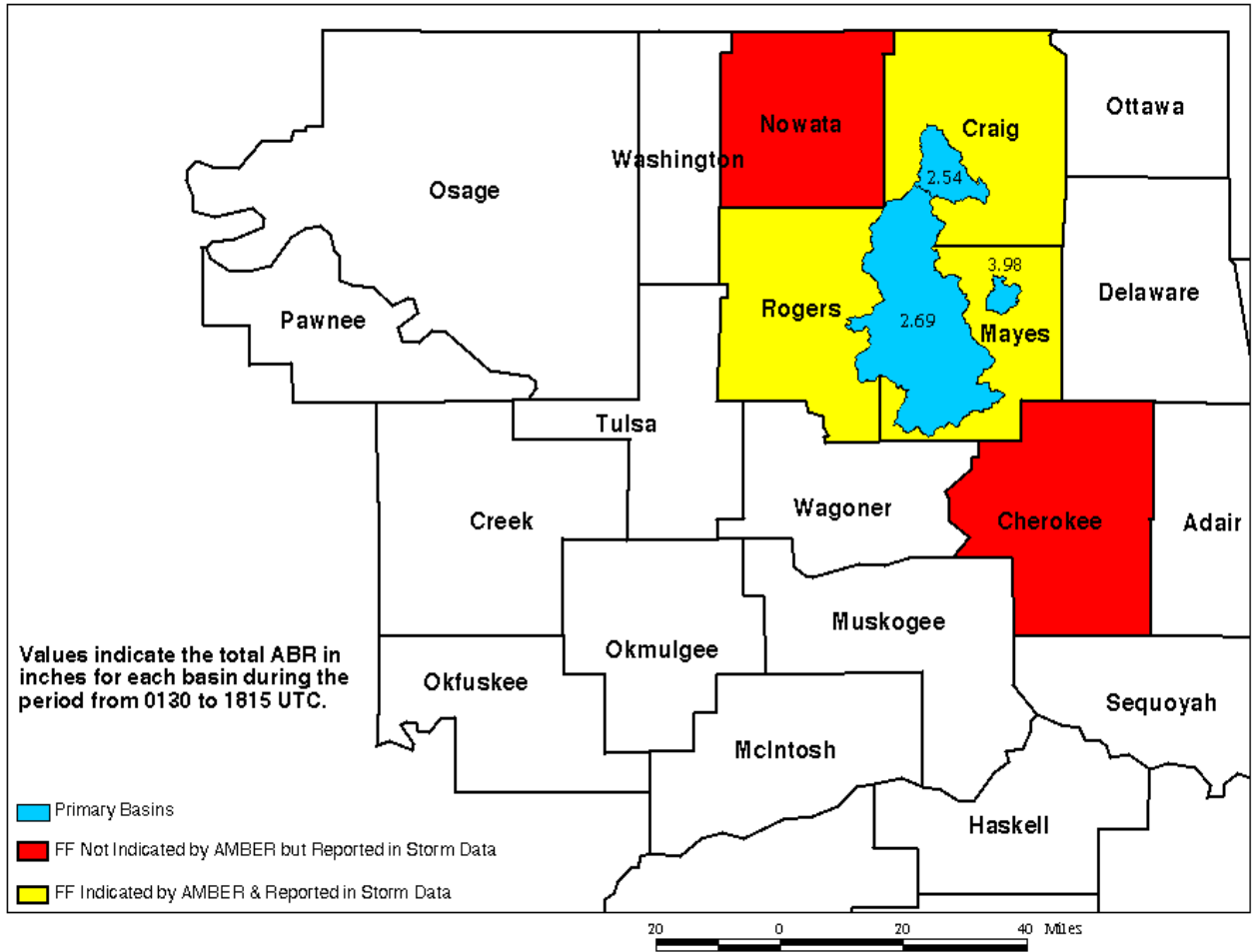


Figure E9.

Major Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 06/20/99

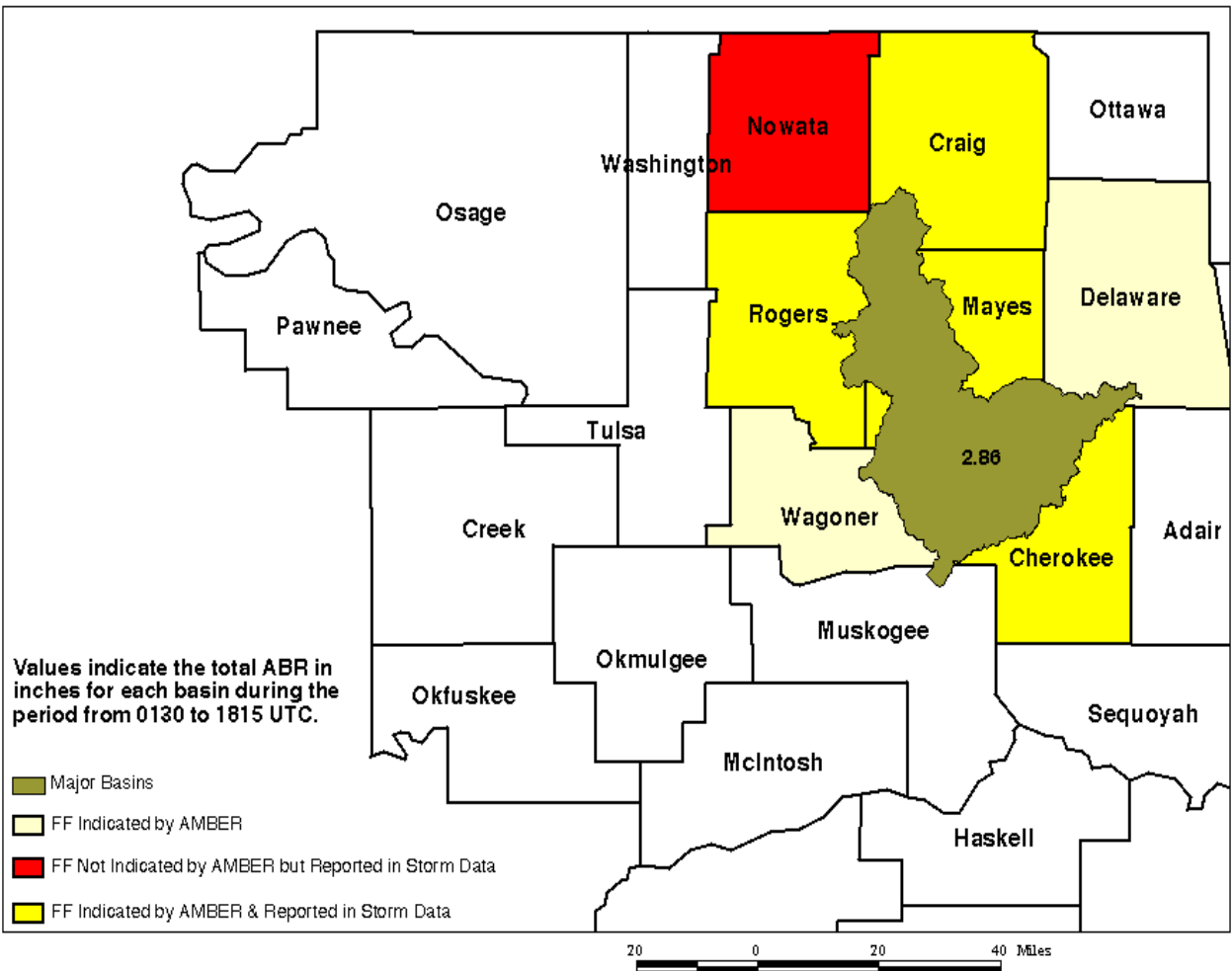


Figure E10.

RFC Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 06/20/99

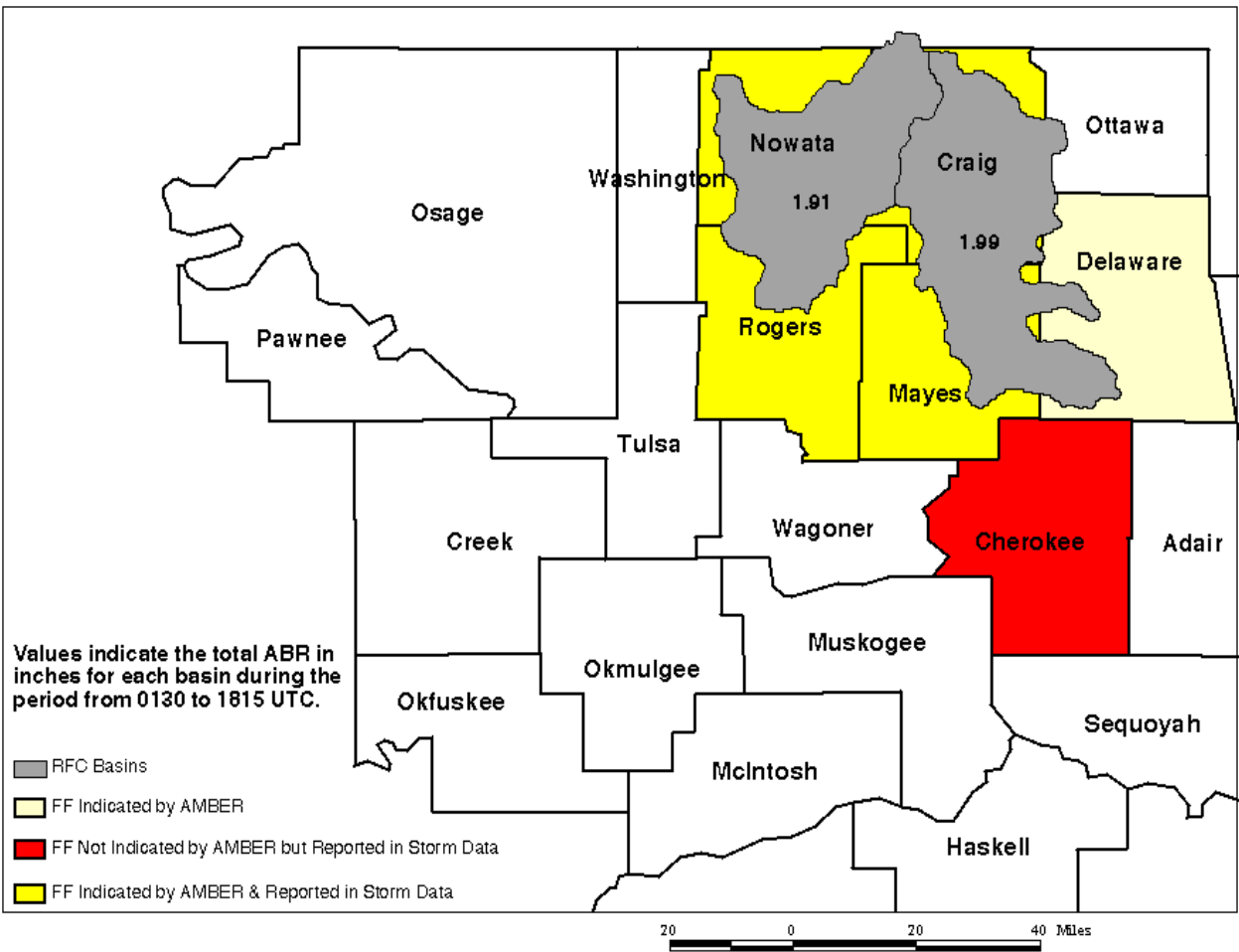


Figure E11.

Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 1.5 in/hr - 06/20/99

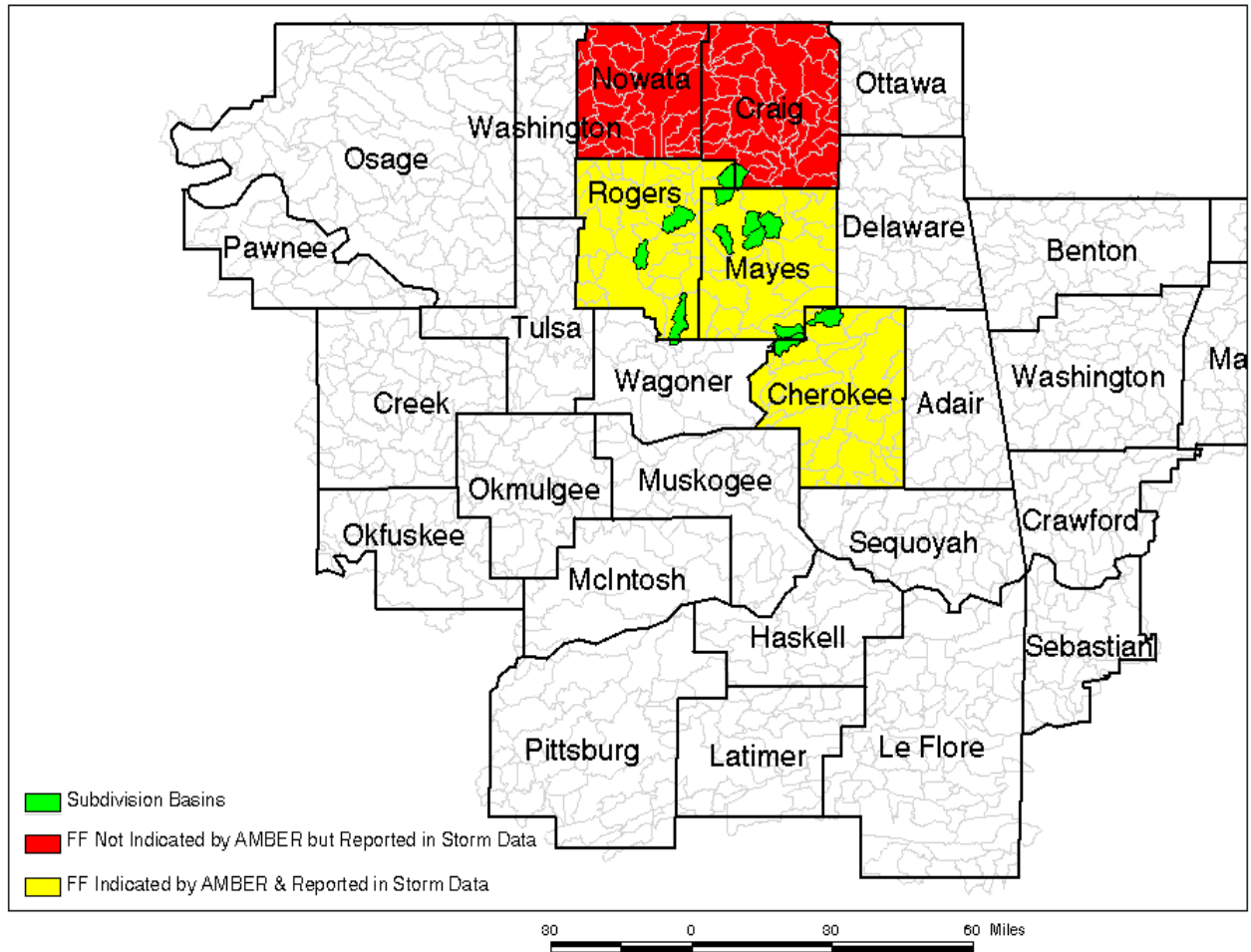


Figure E12.

Populations of Cities and Towns In or Near Subdivision Basins with ABR > FFG or Rate > 1.5 in/hr - 06/20/99

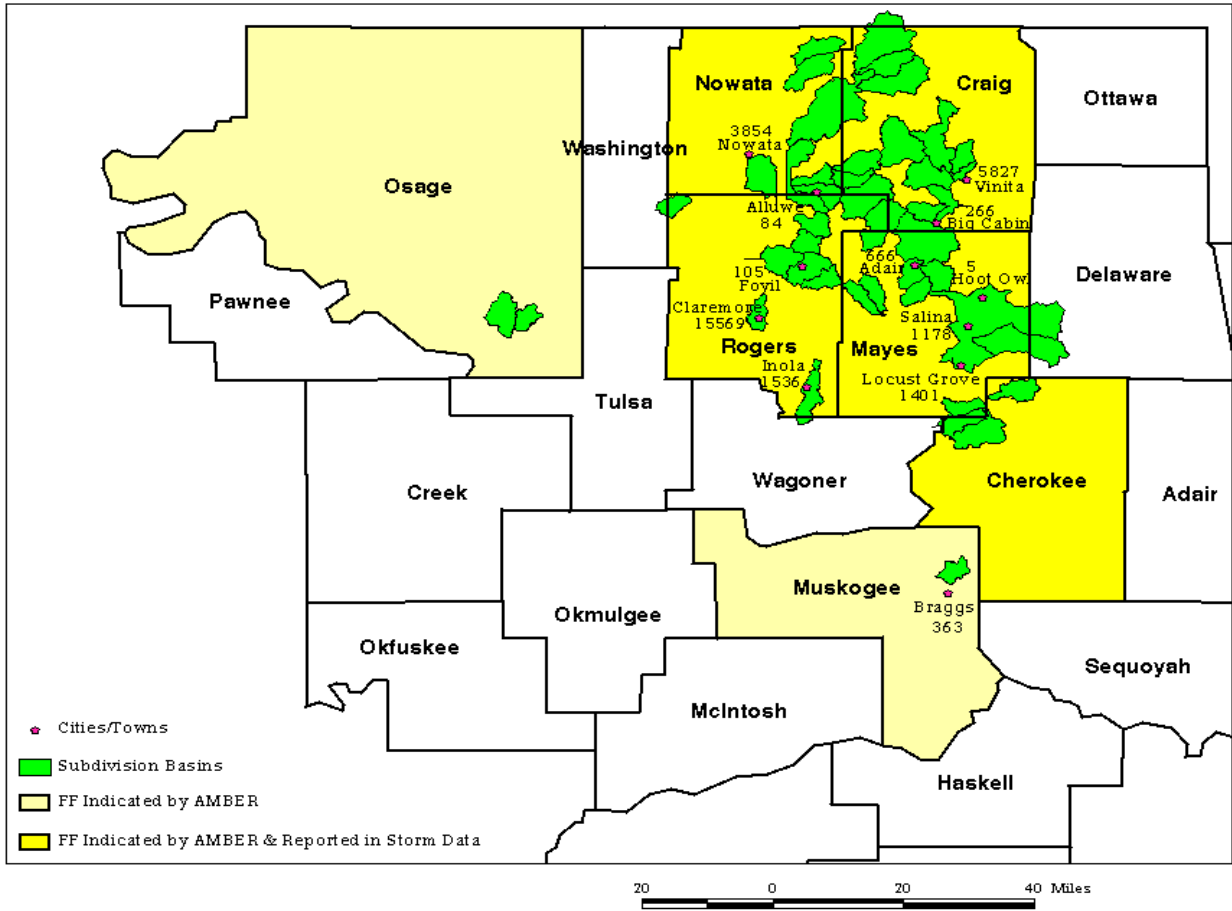


Figure E13.

**APPENDIX F**

**Sterling Case Study #1 - June 27, 1995**

**DATA AND FIGURES**

Table F1. The first basin(s) in each county where ABR exceeded FFG during the June 27, 1995 event according to KLWX data. The date and time (in UTC) indicate when ABR first exceeded FFG, and the ABR and FFG values over the specified time interval are included. Flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b>    | <b>Basin ID(s)</b> | <b>Basin Type</b>  | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>         | <b>ABR / FFG / Time Interval</b> | <b>Flash Flood Reported / Time</b> |
|-----------------------|--------------------|--------------------|---------------------------------------|-----------------------|----------------------------------|------------------------------------|
| <b>06/27<br/>1605</b> | <b>6075</b>        | <b>Subdivision</b> | <b>39.4</b>                           | <b>Madison<br/>VA</b> | <b>2.04 / 1.70 / 3-hr</b>        | <b>Yes / 1030</b>                  |
| <b>06/27<br/>1802</b> | <b>6091</b>        | <b>Subdivision</b> | <b>27.3</b>                           | <b>Greene<br/>VA</b>  | <b>2.57 / 2.30 / 6-hr</b>        | <b>Yes / 1430</b>                  |



Table F2. The first basin(s) in each county where ABR rate equaled or exceeded 0.6 inches/hour during the June 27-28, 1995 event according to KLWX data. The ABR rate shown is the first rate to equal or exceed 0.6 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 0.6 inches/hour, and flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b> | <b>Basin ID(s)</b> | <b>Basin Type</b>      | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>      | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|--------------------|------------------------|---------------------------------------|--------------------|-------------------------------|------------------------------------|
| 06/27<br>0630      | 6146               | Subdivision            | 30.9                                  | Madison<br>VA      | 1.0                           | Yes / 1030                         |
| 06/27<br>0630      | 6157               | Subdivision            | 38.4                                  | Orange<br>VA       | 0.8                           | Yes / 1030                         |
| 06/27<br>0640      | 5811               | Subdivision            | 23.4                                  | Loudoun<br>VA      | 0.9                           | No                                 |
| 06/27<br>0640      | 5620               | Subdivision            | 12.7                                  | Berkeley<br>WV     | 0.9                           | No                                 |
| 06/27<br>0645      | 6184               | Subdivision            | 20.0                                  | Greene<br>VA       | 0.7                           | Yes / 1430                         |
| 06/27<br>0700      | 5773               | Subdivision            | 10.0                                  | Clarke<br>VA       | 0.6                           | No                                 |
| 06/27<br>0715      | 6035               | Subdivision            | 11.9                                  | Rappahannock<br>VA | 1.1                           | Yes / 1230                         |
| 06/27<br>0740      | 5904               | Subdivision            | 9.3                                   | Fauquier<br>VA     | 0.9                           | Yes / 1230                         |
| 06/27<br>0915      | 6105               | Subdivision            | 10.3                                  | Culpeper<br>VA     | 1.2                           | Yes / 1300                         |
| 06/27<br>1050      | 5886               | Subdivision            | 30.0                                  | Warren<br>VA       | 0.7                           | Yes / 1230                         |
| 06/27<br>1220      | 5779               | Subdivision            | 17.4                                  | Frederick<br>VA    | 0.6                           | Yes / 1330                         |
| 06/27<br>1225      | 6187               | Subdivision            | 10.2                                  | Albemarle<br>VA    | 1.0                           | Yes / 0300<br>06/28                |
| 06/28<br>0000      | 6294<br>1305       | Subdivision<br>Primary | 10.5<br>20.7                          | Nelson<br>VA       | 1.1<br>0.7                    | Yes / 0400                         |

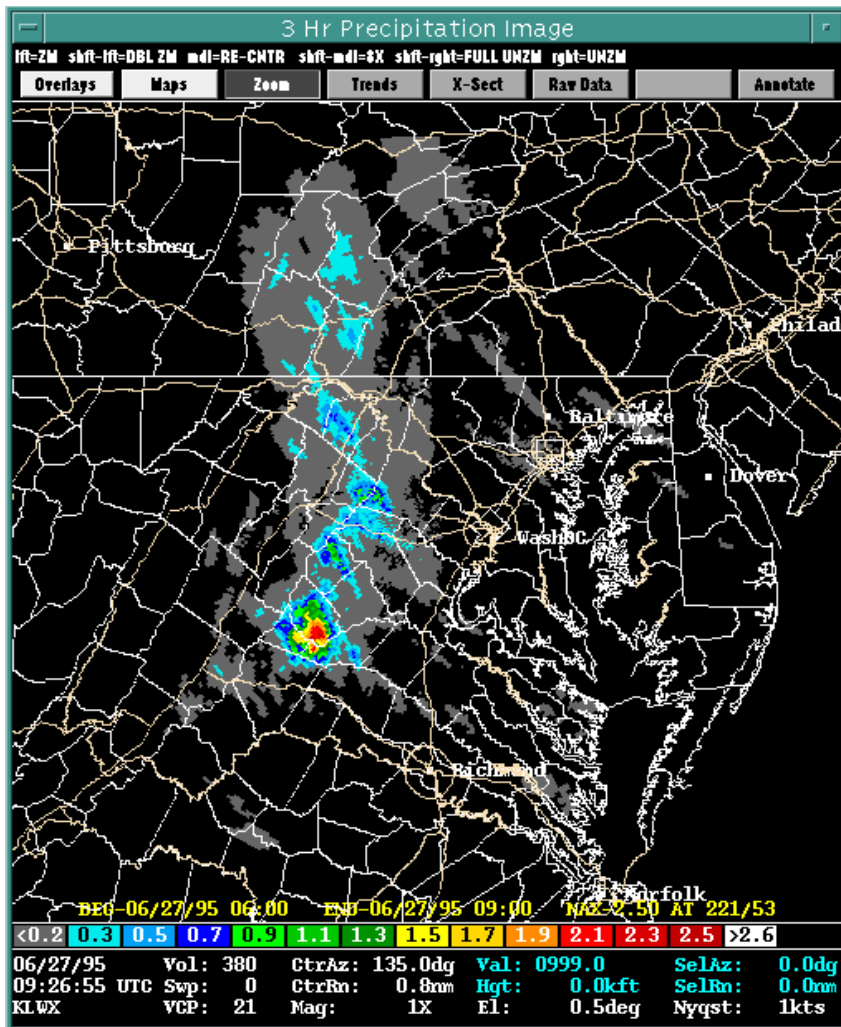


Figure F1. KLWX 3-hour Precipitation Image: 06/27/95 0600-0900 UTC.

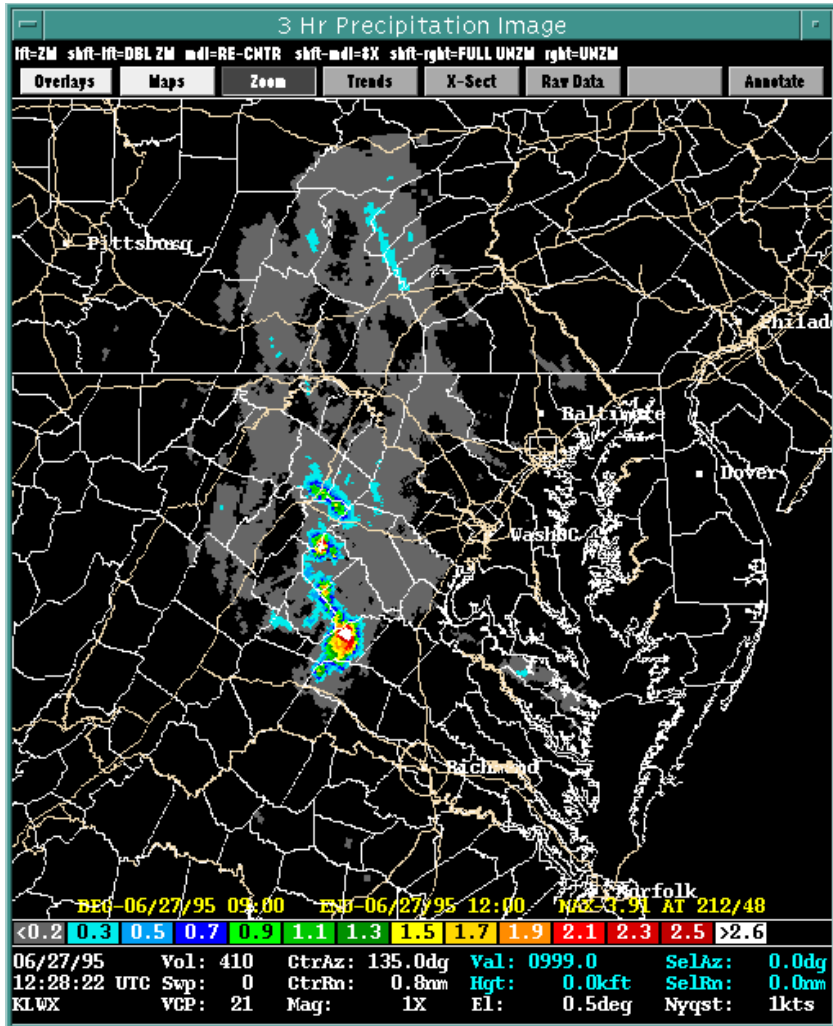


Figure F2. KLWX 3-hour Precipitation Image: 06/27/95 0900-1200 UTC.

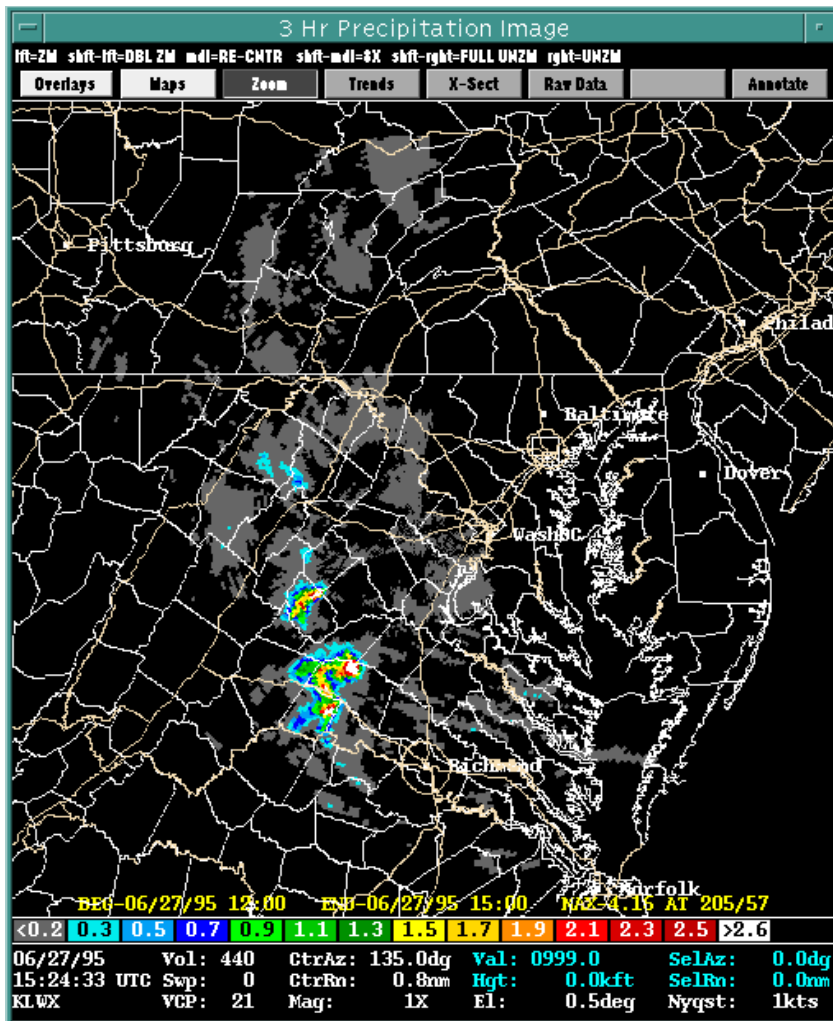


Figure F3. KLWX 3-hour Precipitation Image: 06/27/95 1200-1500 UTC.



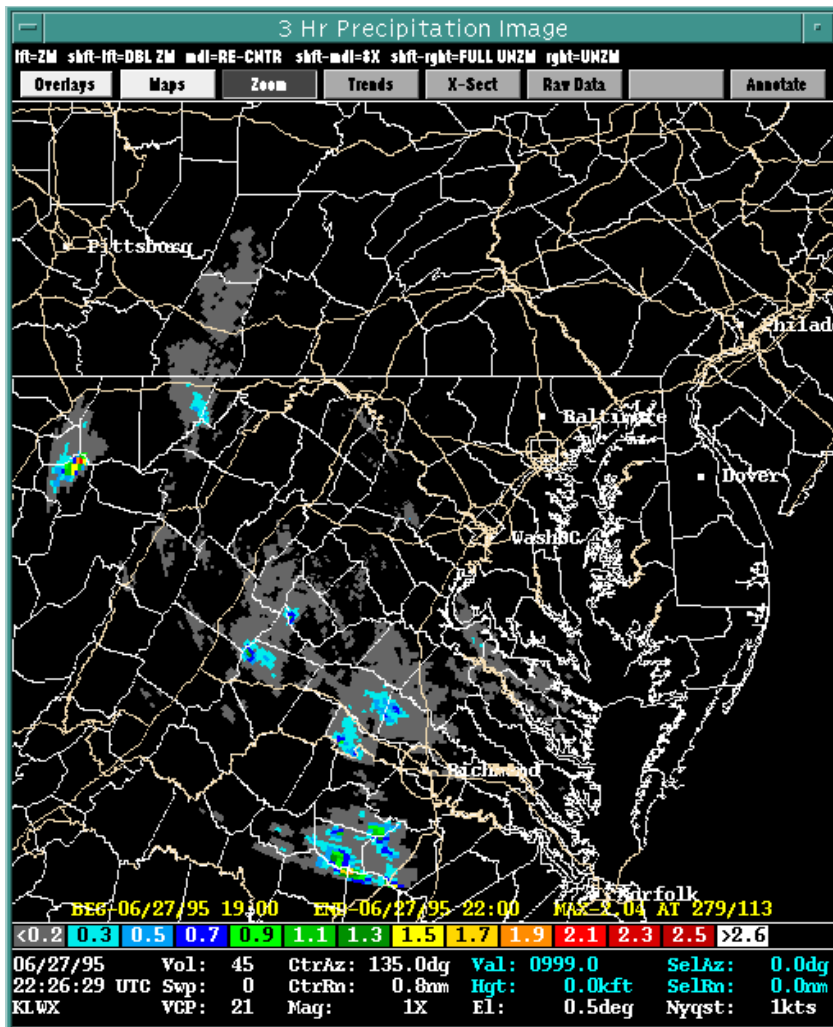


Figure F5. KLWX 3-hour Precipitation Image: 06/27/95 1900-2200 UTC.

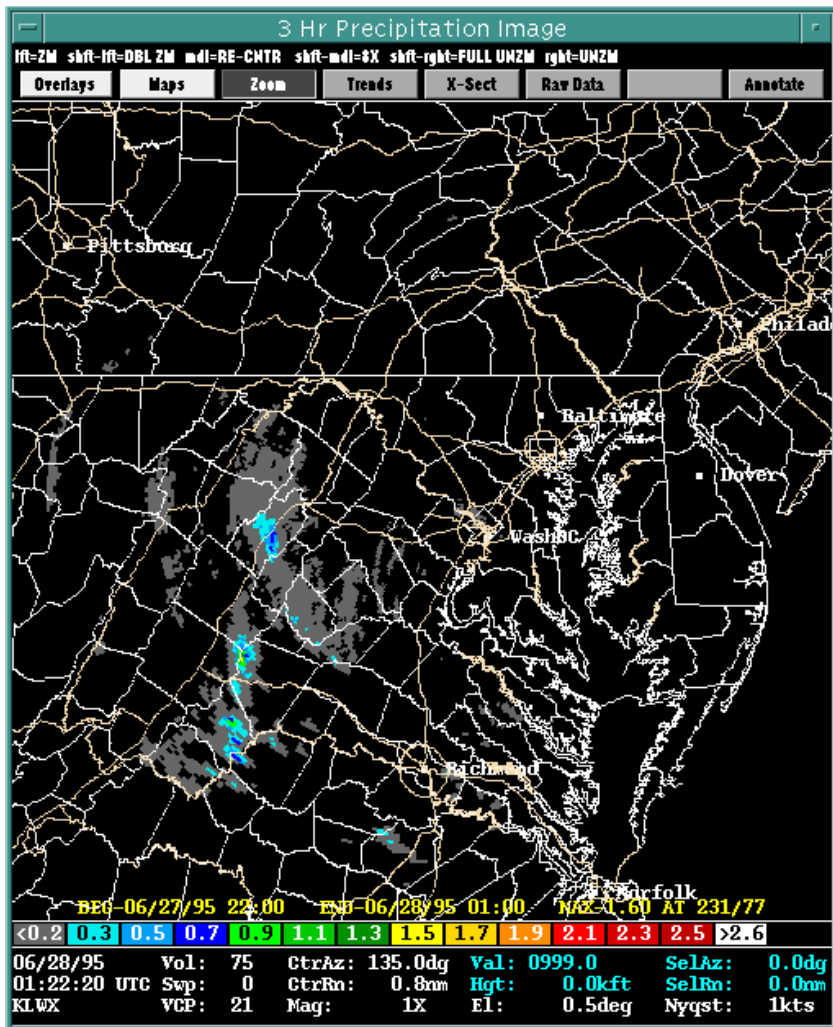


Figure F6. KLWX 3-hour Precipitation Image: 06/27/95 2200 - 06/28/95 0100 UTC.

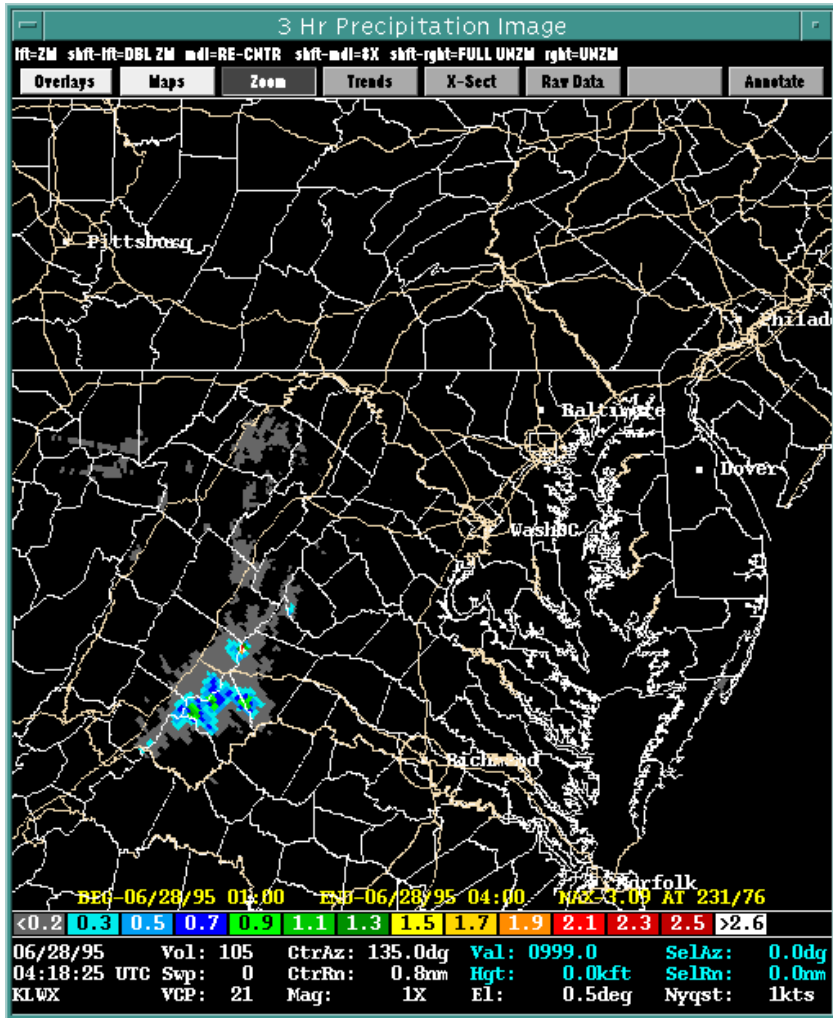


Figure F7. KLWX 3-hour Precipitation Image: 06/28/95 0100-0400 UTC.





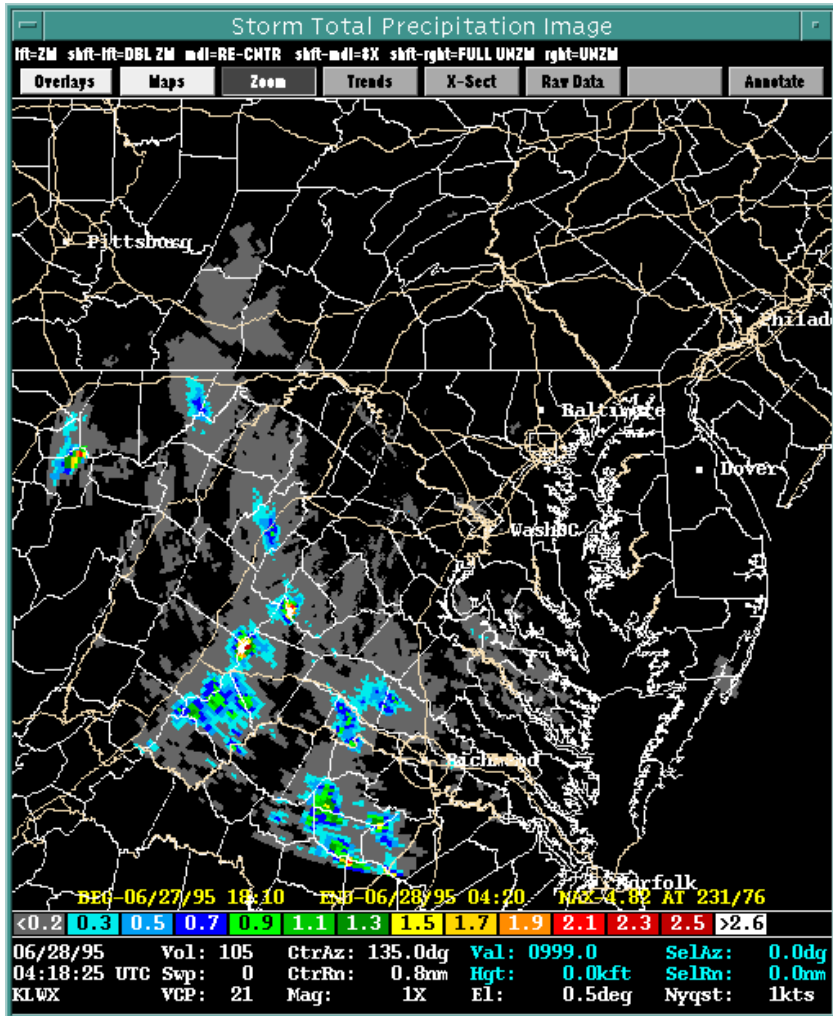


Figure F9. KLWX Storm Total Precipitation Image: 06/27/95 1810 - 06/28/95 0420 UTC.



Subdivision Basins with Accumulated Basin Rainfall Exceeding Flash Flood Guidance Values - 06/27/95

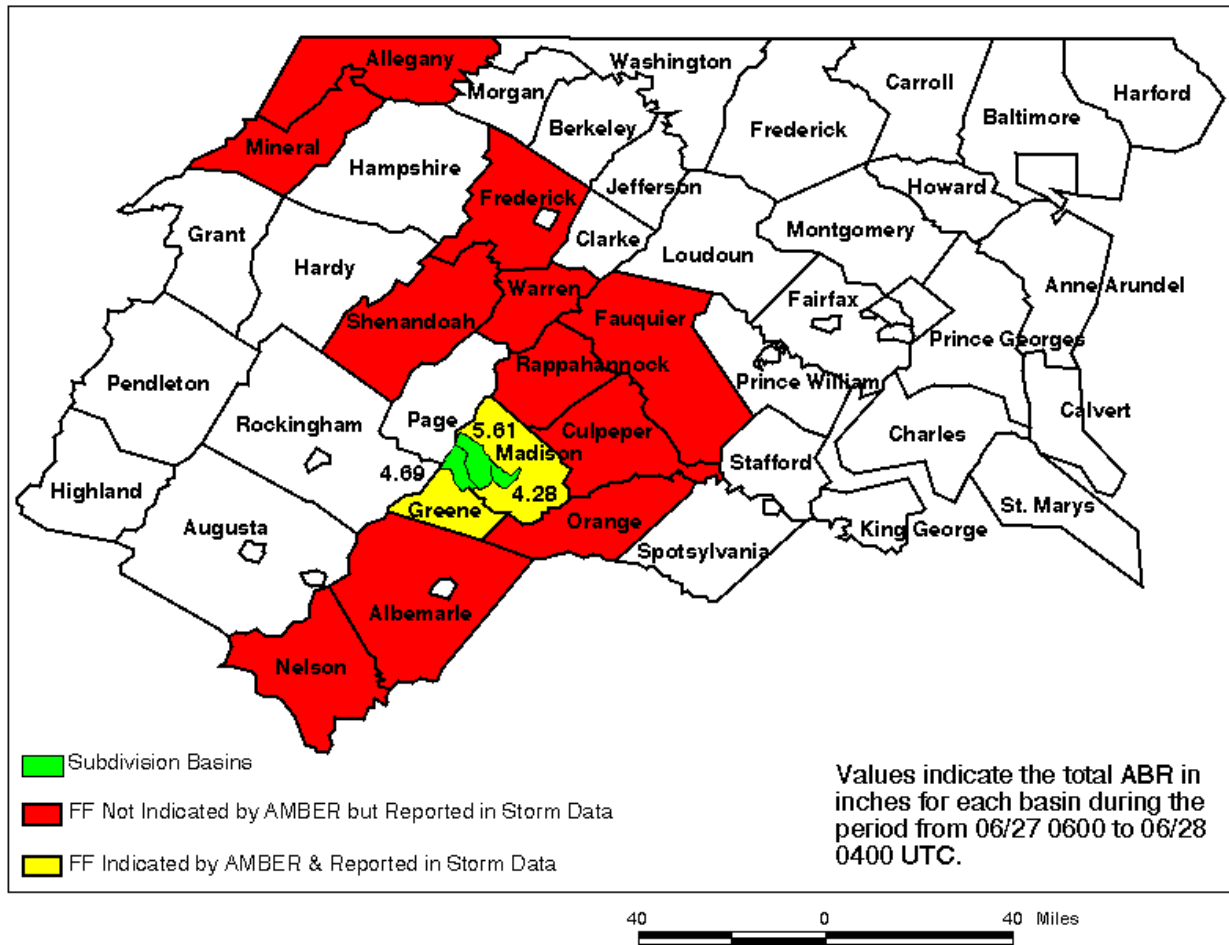


Figure F11.

Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 0.6 in/hr - 06/27/95

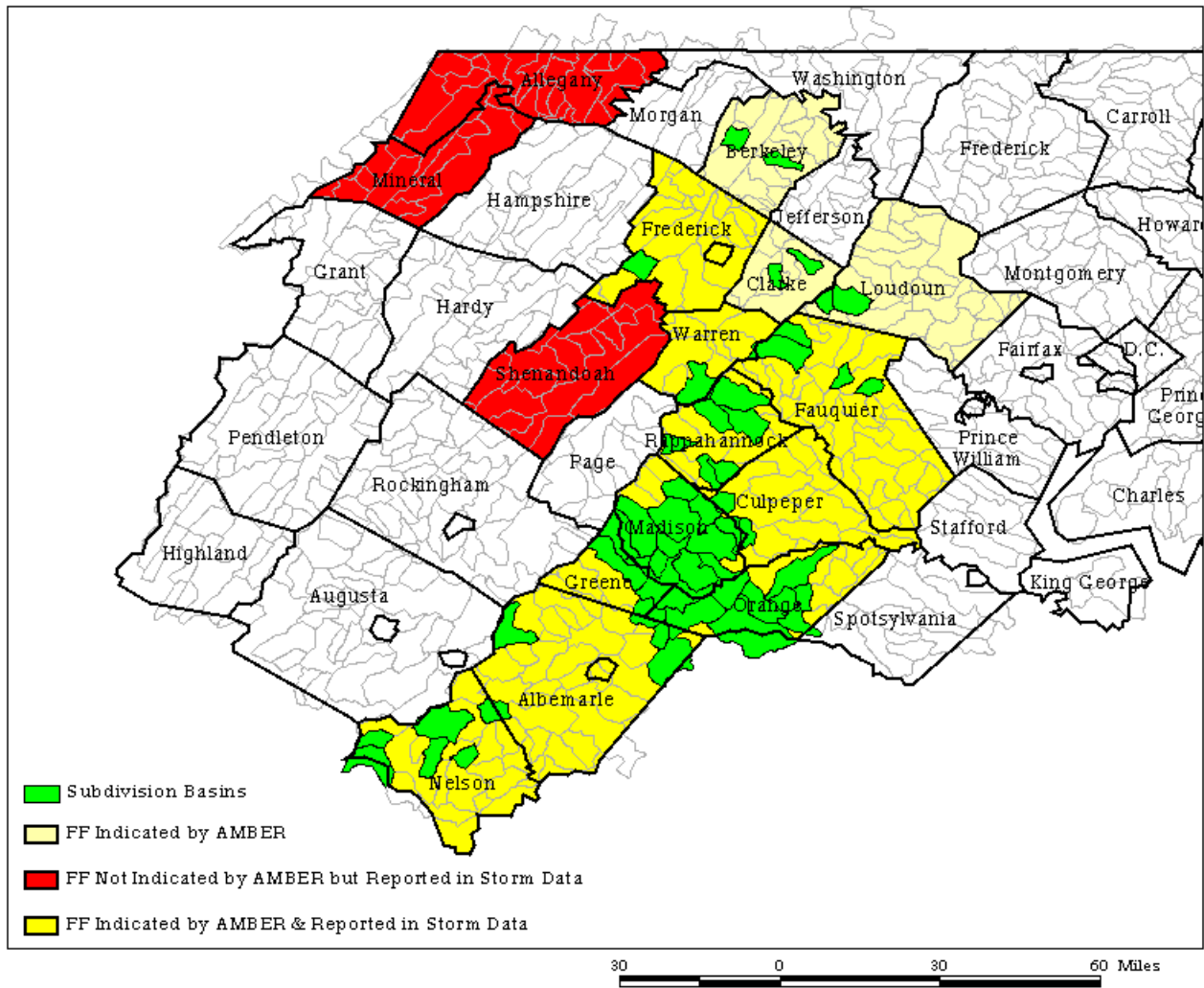


Figure F12.

Populations of Cities and Towns In or Near Subdivision Basins with ABR Rate > 0.6 in/hr - 06/27/95

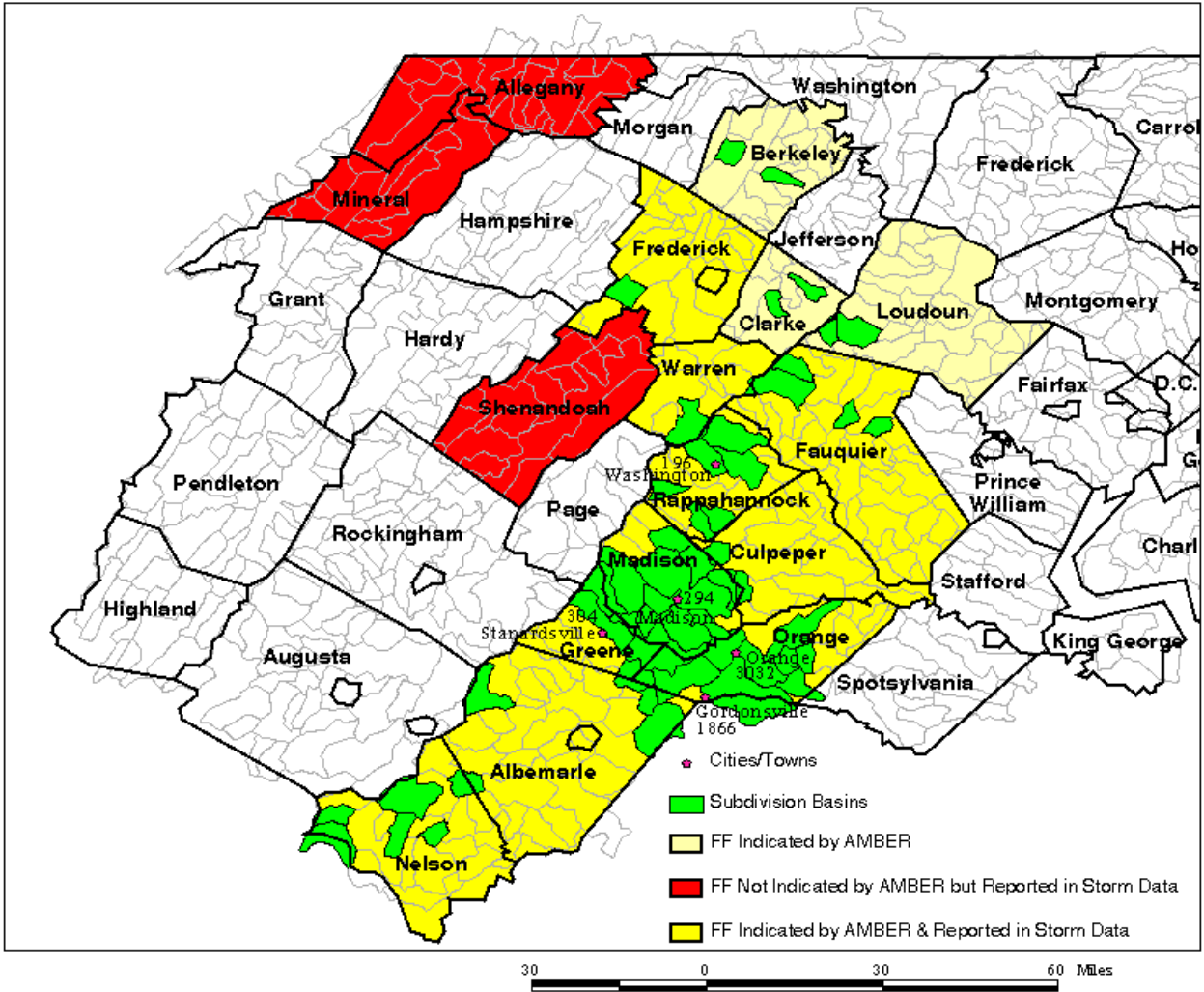


Figure F13.

**APPENDIX G**

**Sterling Case Study #2 - October 20-21, 1995**

**DATA AND FIGURES**

Table G1. The first basin(s) in each county where ABR rate equaled or exceeded 0.6 inches/hour during the October 20-21, 1995 event according to KLWX data. The ABR rate shown is the first rate to equal or exceed 0.6 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 0.6 inches/hour, and flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b> | <b>Basin ID(s)</b> | <b>Basin Type</b> | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>   | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|--------------------|-------------------|---------------------------------------|-----------------|-------------------------------|------------------------------------|
| 10/20 2315         | 6670               | Subdivision       | 20.7                                  | Fauquier VA     | 0.7                           | No                                 |
| 10/21 0005         | 6307               | Subdivision       | 9.9                                   | Nelson VA       | 0.8                           | Yes / 0145                         |
| 10/21 0005         | 5681<br>6619       | Subdivision<br>“  | 12.3<br>2.8                           | Frederick VA    | 0.8<br>0.7                    | No                                 |
| 10/21 0020         | 5930               | Subdivision       | 10.1                                  | Rockingham VA   | 0.6                           | Yes / 0200                         |
| 10/21 0025         | 5803               | Subdivision       | 11.5                                  | Hardy WV        | 0.7                           | No                                 |
| 10/21 0045         | 5725               | Subdivision       | 15.4                                  | Hampshire WV    | 0.7                           | No                                 |
| 10/21 0115         | 5620               | Subdivision       | 12.7                                  | Berkeley WV     | 0.7                           | No                                 |
| 10/21 0115         | 6240               | Subdivision       | 15.1                                  | Albemarle VA    | 0.7                           | No                                 |
| 10/21 0130         | 5885               | Subdivision       | 9.6                                   | Shenandoah VA   | 0.7                           | Yes / 0430                         |
| 10/21 0230         | 6184               | Subdivision       | 20.0                                  | Greene VA       | 0.8                           | No                                 |
| 10/21 0235         | 6144               | Subdivision       | 9.8                                   | Madison VA      | 0.9                           | Yes / 0430                         |
| 10/21 0250         | 5886               | Subdivision       | 30.0                                  | Warren VA       | 0.7                           | Yes / 0330                         |
| 10/21 0300         | 5966               | Subdivision       | 13.1                                  | Page VA         | 0.7                           | Yes / 0330                         |
| 10/21 0315         | 5969               | Subdivision       | 21.0                                  | Rappahannock VA | 0.9                           | No                                 |
| 10/21 0330         | 6192               | Subdivision       | 12.7                                  | Spotsylvania VA | 0.8                           | No                                 |
| 10/21 0340         | 5718               | Subdivision       | 14.9                                  | Jefferson WV    | 0.9                           | No                                 |
| 10/21 0355         | 6109               | Subdivision       | 10.5                                  | Orange VA       | 0.8                           | No                                 |
| 10/21 0400         | 5756<br>5773       | Subdivision<br>“  | 12.7<br>10.0                          | Clarke VA       | 0.7<br>0.7                    | No                                 |



|               |  |   |   |                       |   |    |
|---------------|--|---|---|-----------------------|---|----|
| 10/21<br>0405 | 6638   | Subdivision                               | 3.9   | Loudoun<br>VA         | 0.7   | No |
| 10/21<br>0410 | 6060   | Subdivision                               | 9.9   | Fauquier<br>VA        | 0.7   | No |
| 10/21<br>0415 | 6664   | Subdivision                               | 1.5   | Fairfax<br>VA         | 0.7   | No |
| 10/21<br>0455 | 5731<br>5746<br>5775                                 | Subdivision<br>“<br>“                     | 19.2<br>9.9<br>16.1                               | Montgomery<br>MD      | 1.2<br>0.8<br>0.8                             | No |
| 10/21<br>0455 | 5645<br>5654<br>5705<br>6587<br>6596<br>6616<br>6864 | Subdivision<br>“<br>“<br>“<br>“<br>“<br>“ | 10.3<br>13.1<br>15.6<br>3.1<br>6.7<br>6.9<br>85.2 | Frederick<br>MD       | 0.7<br>0.8<br>0.7<br>0.9<br>0.8<br>1.2<br>0.8 | No |
| 10/21<br>0505 | 5873   | Subdivision                               | 34.7  | Prince William<br>VA  | 0.7   | No |
| 10/21<br>0615 | 5729   | Subdivision                               | 9.5   | Howard<br>MD          | 1.1   | No |
| 10/21<br>0715 | 6166   | Subdivision                               | 14.9  | King George<br>VA     | 1.0   | No |
| 10/21<br>0720 | 5529   | Subdivision                               | 9.3   | Harford<br>MD         | 0.9   | No |
| 10/21<br>0725 | 6078   | Subdivision                               | 39.3  | Charles<br>MD         | 1.0   | No |
| 10/21<br>0805 | 5990   | Subdivision                               | 9.8   | Prince George's<br>MD | 0.8   | No |

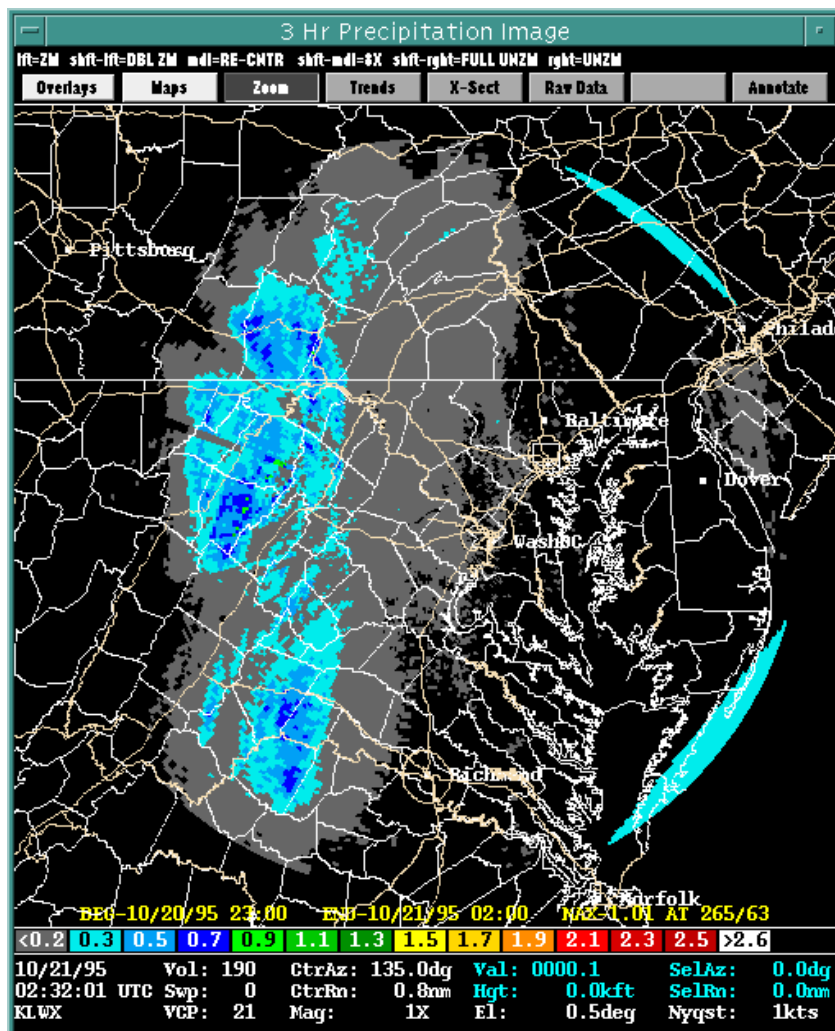


Figure G1. KLWX 3-hour Precipitation Image: 10/20/95 2300 - 10/21/95 0200 UTC.

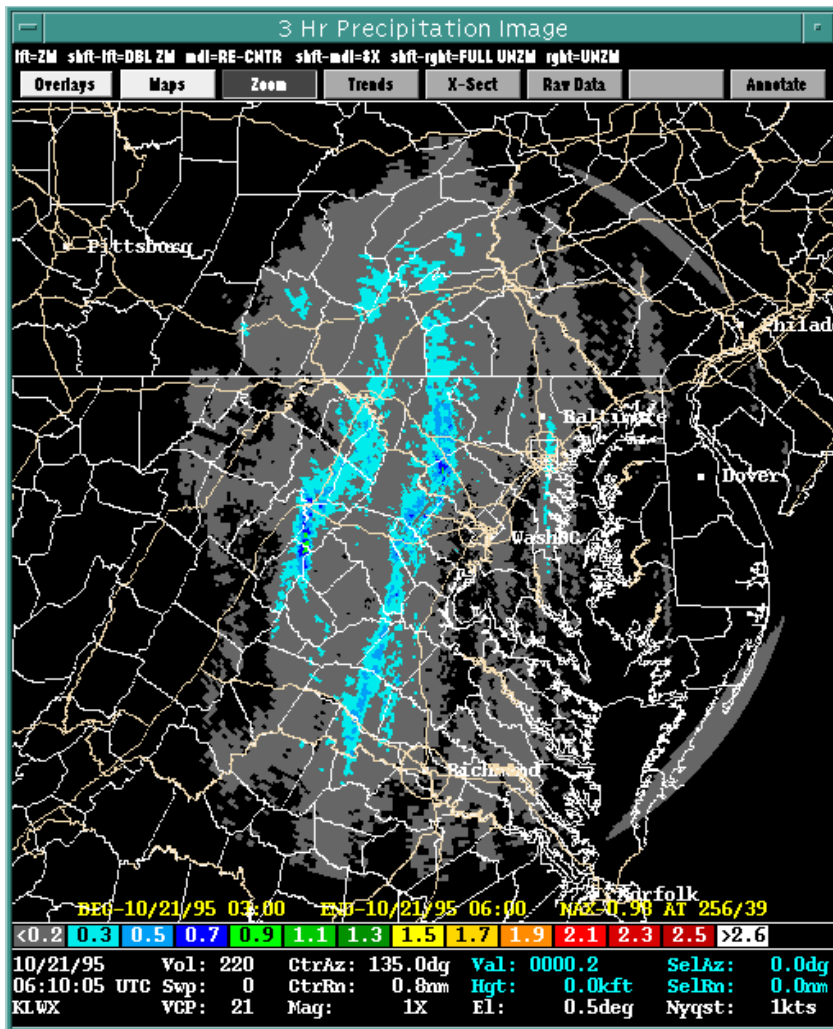


Figure G2. KLWX 3-hour Precipitation Image: 10/21/95 0300-0600 UTC.

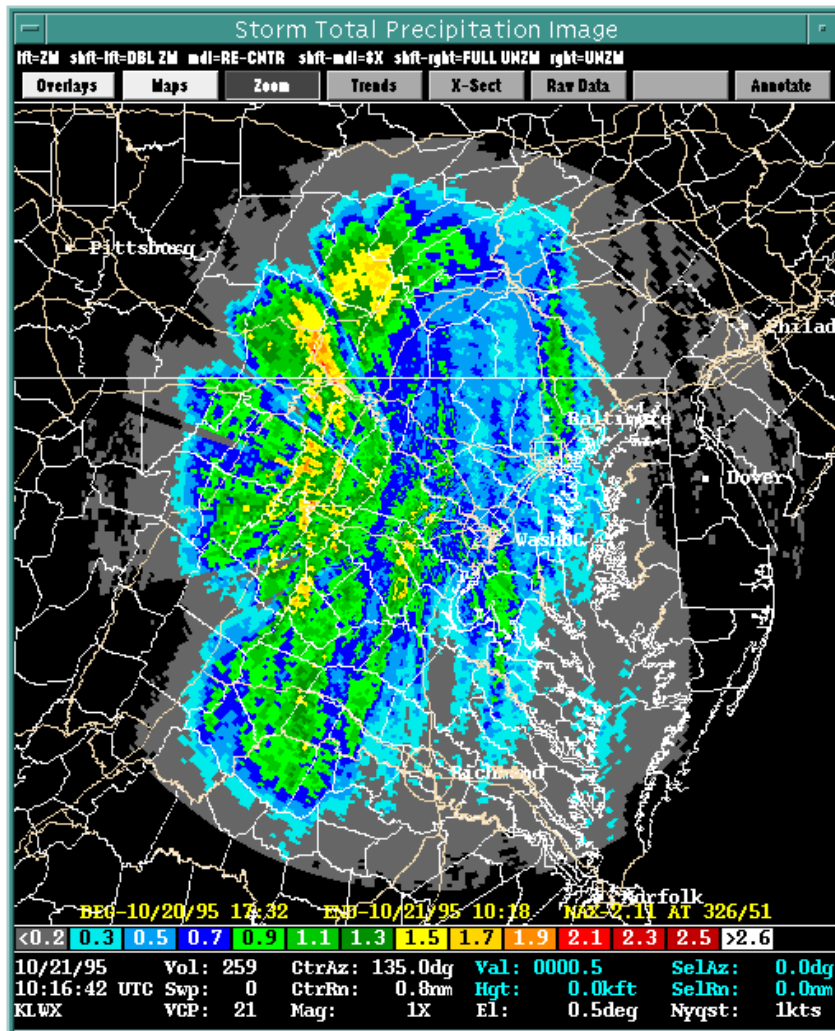


Figure G3. KLWX 3-hour Precipitation Image: 10/21/95 0600-0900 UTC.

**Figure G4. KLWX Storm Total Precipitation Image: 10/20/95 1732 - 10/21/95 1018 UTC.**

Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 0.6 in/hr - 10/21/95

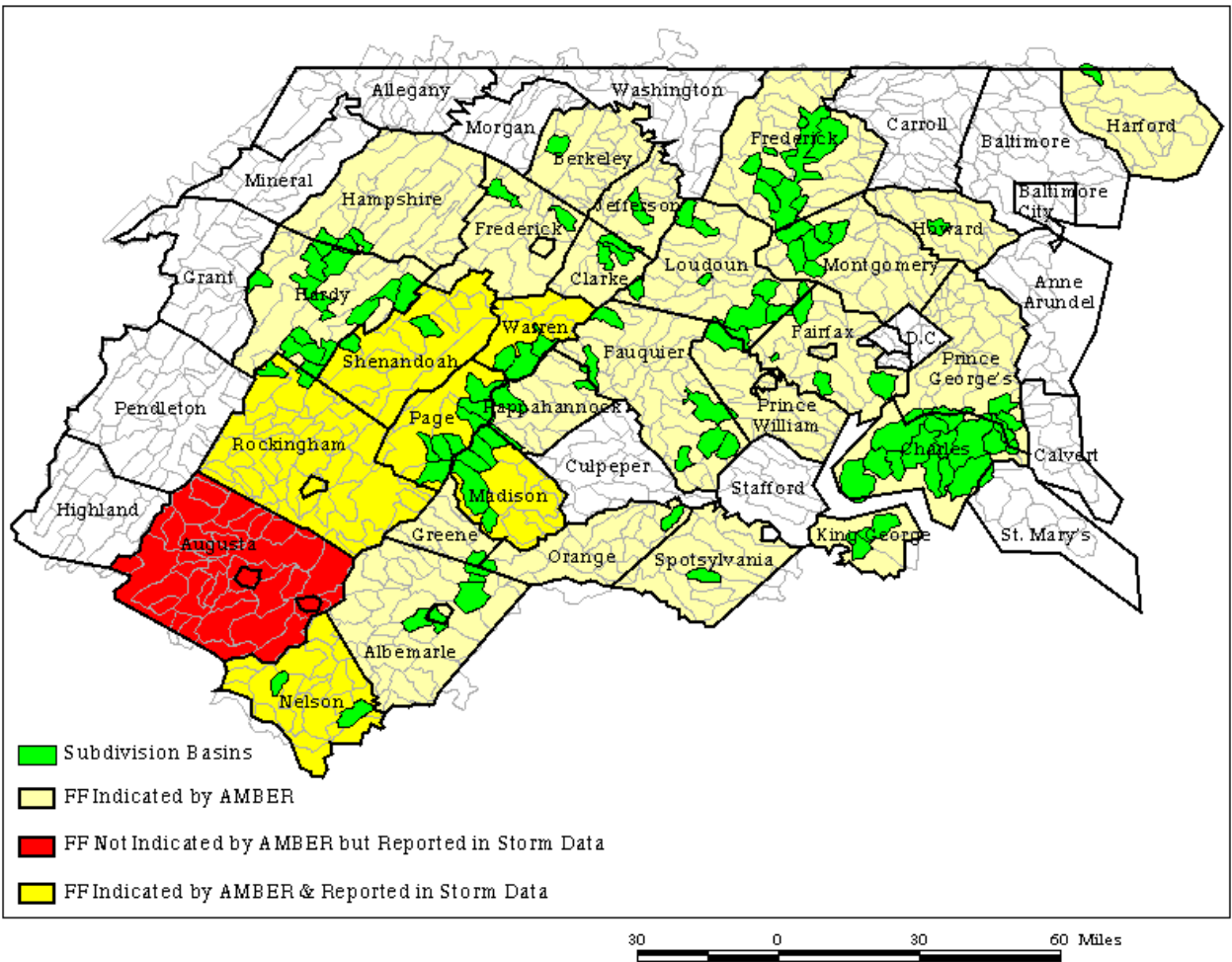


Figure G5.

Populations of Cities and Towns In or Near Subdivision Basins with ABR Rate > 0.6 in/hr - 10/21/95

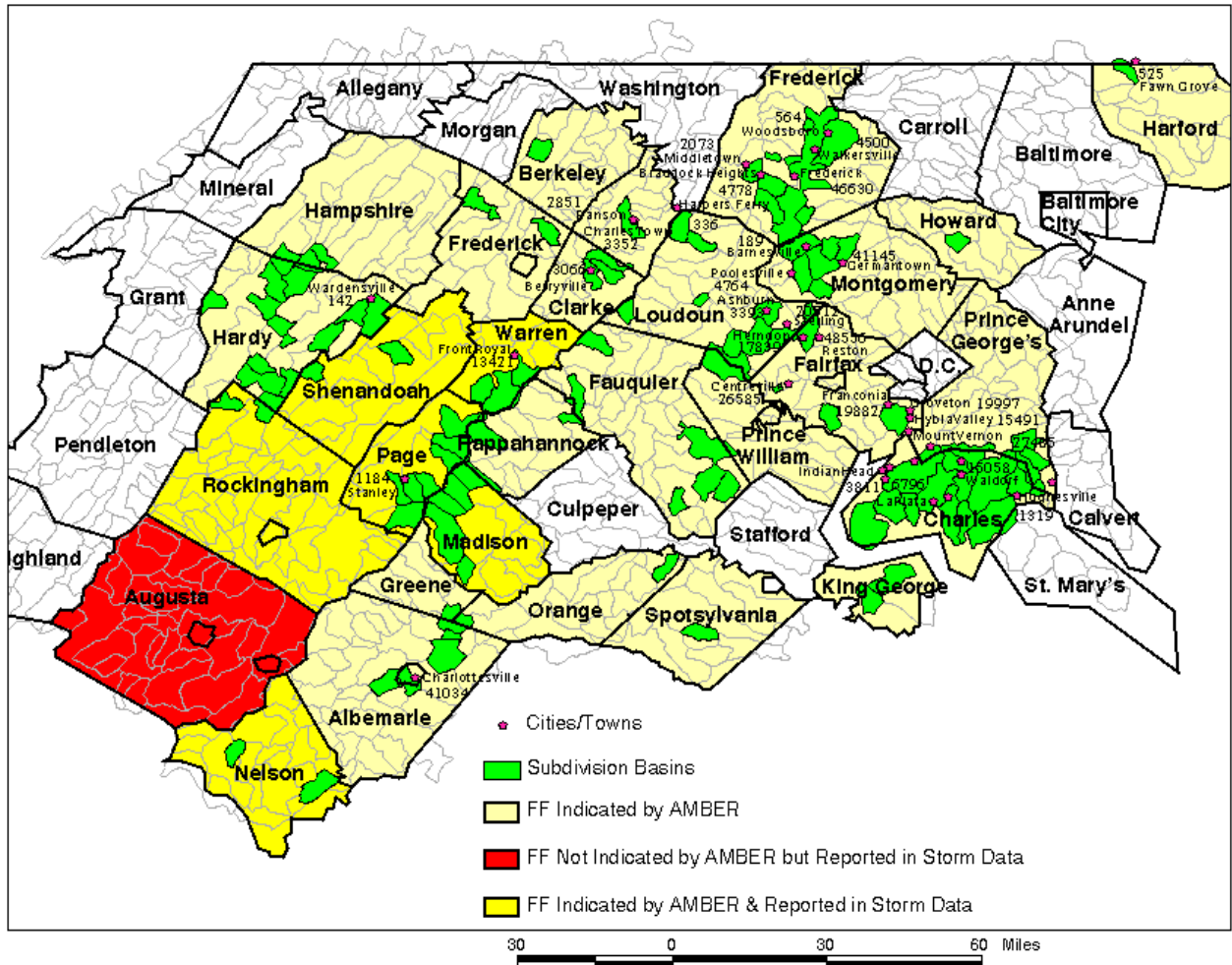


Figure G6.

AMBER Results Using a Threshold ABR Rate of 0.9 in/hr - 10/21/95

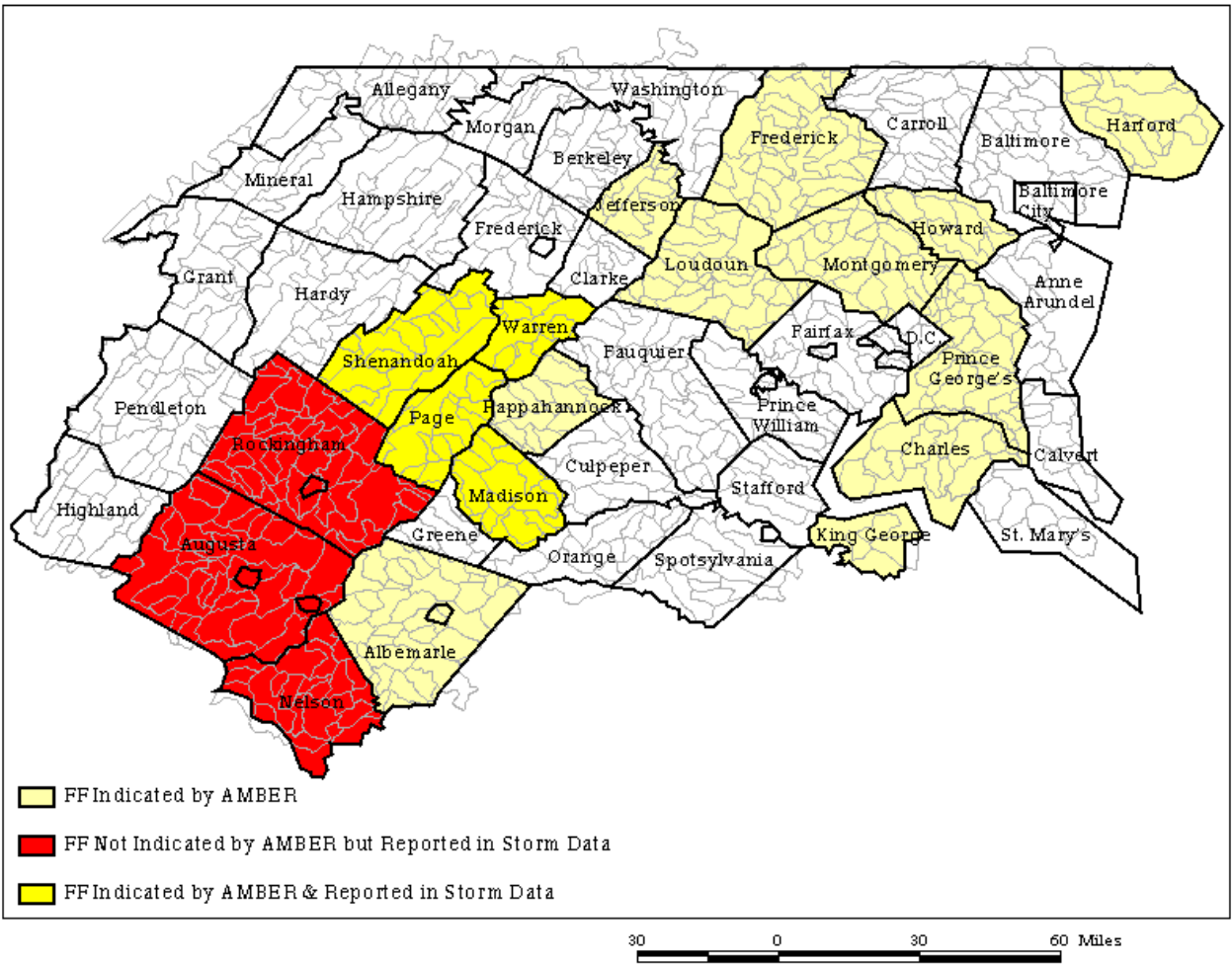


Figure G7.



**APPENDIX H**

**Sterling Case Study #3 - January 19, 1996**

**DATA AND FIGURES**

Table H1. The first basin(s) in each county where ABR rate equaled or exceeded 0.5 inches/hour during the January 19, 1996 event according to KLWX data. The ABR rate shown is the first rate to equal or exceed 0.5 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 0.5 inches/hour, and flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b> | <b>Basin ID(s)</b>   | <b>Basin Type</b>           | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b> | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|--------------------|----------------------|-----------------------------|---------------------------------------|---------------|-------------------------------|------------------------------------|
| 01/19 1015         | 5562                 | Subdivision                 | 72.7                                  | Allegany MD   | 0.6                           | Yes / 0800                         |
| 01/19 1040         | 5818<br>6643         | Subdivision<br>“            | 10.6<br>8.3                           | Grant WV      | 0.6<br>0.5                    | Yes / 0800                         |
| 01/19 1045         | 5700                 | Subdivision                 | 19.2                                  | Mineral WV    | 0.5                           | Yes / 0800                         |
| 01/19 1105         | 5935                 | Subdivision                 | 16.6                                  | Hardy WV      | 0.5                           | Yes / 0900                         |
| 01/19 1115         | 5588                 | Subdivision                 | 14.9                                  | Hampshire WV  | 0.5                           | Yes / 0900                         |
| 01/19 1130         | 5888                 | Subdivision                 | 24.4                                  | Shenandoah VA | 0.5                           | Yes / 1000                         |
| 01/19 1140         | 6307<br>6760         | Subdivision<br>“            | 9.9<br>44.9                           | Nelson VA     | 0.7<br>0.5                    | Yes / 0630                         |
| 01/19 1140         | 6179                 | Subdivision                 | 18.8                                  | Augusta VA    | 0.5                           | Yes / 0630                         |
| 01/19 1215         | 5924                 | Subdivision                 | 10.2                                  | Pendleton WV  | 0.5                           | Yes / 0900                         |
| 01/19 1300         | 6301                 | Subdivision                 | 13.9                                  | Albemarle VA  | 0.5                           | Yes / 0630                         |
| 01/19 1330         | 5528<br>5585<br>1123 | Subdivision<br>“<br>Primary | 10.4<br>44.4<br>147.0                 | Morgan WV     | 1.2<br>0.5<br>0.5             | Yes / 1000                         |
| 01/19 1330         | 5681<br>5708<br>5779 | Subdivision<br>“<br>“       | 12.3<br>38.7<br>17.4                  | Frederick VA  | 0.5<br>0.5<br>0.6             | Yes / 1000                         |
| 01/19 1340         | 6157                 | Subdivision                 | 38.4                                  | Orange VA     | 1.0                           | Yes / 1300                         |
| 01/19 1340         | 5966<br>5974<br>1228 | Subdivision<br>“<br>Primary | 13.1<br>19.3<br>34.9                  | Page VA       | 0.5<br>0.5<br>0.5             | Yes / 0630                         |
| 01/19 1340         | 6138<br>6146         | Subdivision                 | 12.4<br>30.9                          | Madison VA    | 0.6<br>0.6                    | Yes / 0630                         |
| 01/19 1340         | 6814                 | Subdivision                 | 27.2                                  | Washington MD | 0.8                           | Yes / 1000                         |
| 01/19 1345         | 5548<br>5559<br>5620 | Subdivision<br>“<br>“       | 20.7<br>26.7<br>12.7                  | Berkeley WV   | 0.6<br>0.5<br>0.7             | Yes / 1100                         |

|               |  |  |   |                      |   |            |
|---------------|--|--|---|----------------------|---|------------|
| 01/19<br>1345 | 5883   | Subdivision                                | 14.2  | Warren<br>VA         | 0.6   | Yes / 1100 |
| 01/19<br>1410 | 5927<br>5939   | Subdivision<br>“                           | 9.6<br>15.6   | Fauquier<br>VA       | 0.6<br>0.6                                    | Yes / 1200 |
| 01/19<br>1410 | 5679   | Subdivision                                | 8.9   | Jefferson<br>WV      | 0.7   | Yes / 1100 |
| 01/19<br>1410 | 5726   | Subdivision                                | 9.0   | Clarke<br>VA         | 0.8   | Yes / 1100 |
| 01/19<br>1410 | 5998   | Subdivision                                | 16.9  | Culpeper<br>VA       | 1.1   | Yes / 1300 |
| 01/19<br>1420 | 6114<br>6161<br>6174<br>6192<br>6196<br>6199<br>6204 | Subdivision<br>“<br>“<br>“<br>“<br>“<br>“  | 19.3<br>49.3<br>15.9<br>12.7<br>9.7<br>41.0<br>18.3 | Spotsylvania<br>VA   | 1.1<br>0.6<br>0.7<br>0.8<br>0.8<br>0.7<br>0.6 | Yes / 1500 |
| 01/19<br>1425 | 5795<br>5811<br>6647<br>1195<br>1387<br>1425         | Subdivision<br>“<br>“<br>Primary<br>“<br>“ | 21.4<br>23.4<br>8.1<br>55.0<br>50.1<br>336.4        | Loudoun<br>VA        | 0.6<br>0.5<br>0.7<br>0.5<br>0.7<br>0.7        | Yes / 1200 |
| 01/19<br>1425 | 5892<br>5951<br>6677                                 | Subdivision<br>“<br>“                      | 33.9<br>23.9<br>76.1                                | Prince William<br>VA | 0.5<br>0.6<br>0.5                             | Yes / 1400 |
| 01/19<br>1435 | 6061   | Subdivision                                | 15.5  | Stafford<br>VA       | 1.0   | Yes / 1500 |
| 01/19<br>1445 | 5863<br>5898<br>6664<br>6837<br>1393                 | Subdivision<br>“<br>“<br>“<br>Primary      | 46.6<br>9.3<br>1.5<br>41.0<br>61.7                  | Fairfax<br>VA        | 0.6<br>0.9<br>0.7<br>0.9<br>0.7               | Yes / 1400 |
| 01/19<br>1445 | 5558<br>5664<br>5714                                 | Subdivision<br>“<br>“                      | 21.0<br>17.0<br>11.2                                | Frederick<br>MD      | 0.5<br>0.6<br>0.6                             | Yes / 1200 |
| 01/19<br>1455 | 5780   | Subdivision                                | 12.7  | Montgomery<br>MD     | 0.5   | Yes / 1400 |
| 01/19<br>1515 | 5694   | Subdivision                                | 28.7  | Howard<br>MD         | 0.5   | Yes / 1400 |
| 01/19<br>1515 | 5596<br>6582<br>6821                                 | Subdivision<br>“<br>“                      | 23.2<br>27.5<br>1.4                                 | Carroll<br>MD        | 0.5<br>0.7<br>0.9                             | Yes / 1200 |
| 01/19<br>1515 | 6053<br>6069<br>6078<br>6682                         | Subdivision<br>“<br>“<br>“                 | 22.3<br>13.1<br>39.3<br>49.2                        | Charles<br>MD        | 0.8<br>1.0<br>0.5<br>0.6                      | No         |

|               |                                      |                                 |                                      |                         |                                 |            |
|---------------|--------------------------------------|---------------------------------|--------------------------------------|-------------------------|---------------------------------|------------|
| 01/19<br>1515 | 6655                                 | Subdivision                     | 7.5                                  | Prince George's<br>MD   | 0.7                             | Yes / 1500 |
| 01/19<br>1515 | 5895                                 | Subdivision                     | 20.6                                 | Arlington<br>VA         | 1.2                             | Yes / 1600 |
| 01/19<br>1520 | 6131<br>6166                         | Subdivision<br>“                | 23.6<br>14.9                         | King George<br>VA       | 1.0<br>0.8                      | No         |
| 01/19<br>1535 | 6835                                 | Subdivision                     | 29.1                                 | District of<br>Columbia | 1.0                             | Yes / 1600 |
| 01/19<br>1540 | 5648                                 | Subdivision                     | 9.1                                  | Baltimore<br>MD         | 0.5                             | Yes / 1400 |
| 01/19<br>1550 | 6101<br>6104                         | Subdivision<br>“                | 36.2<br>30.6                         | St. Mary's<br>MD        | 0.9<br>0.7                      | No         |
| 01/19<br>1610 | 5697                                 | Subdivision                     | 38.3                                 | Baltimore City<br>MD    | 0.9                             | Yes / 1600 |
| 01/19<br>1610 | 5920                                 | Subdivision                     | 12.3                                 | Anne Arundel<br>MD      | 0.5                             | Yes / 1600 |
| 01/19<br>1615 | 5973<br>6017<br>6041<br>6064<br>6086 | Subdivision<br>“<br>“<br>“<br>“ | 21.0<br>26.7<br>13.6<br>13.9<br>23.8 | Calvert<br>MD           | 0.7<br>0.9<br>1.2<br>0.8<br>0.6 | No         |
| 01/19<br>1615 | 5557<br>5631                         | Subdivision<br>“                | 12.6<br>56.3                         | Harford<br>MD           | 0.7<br>0.6                      | Yes / 1400 |

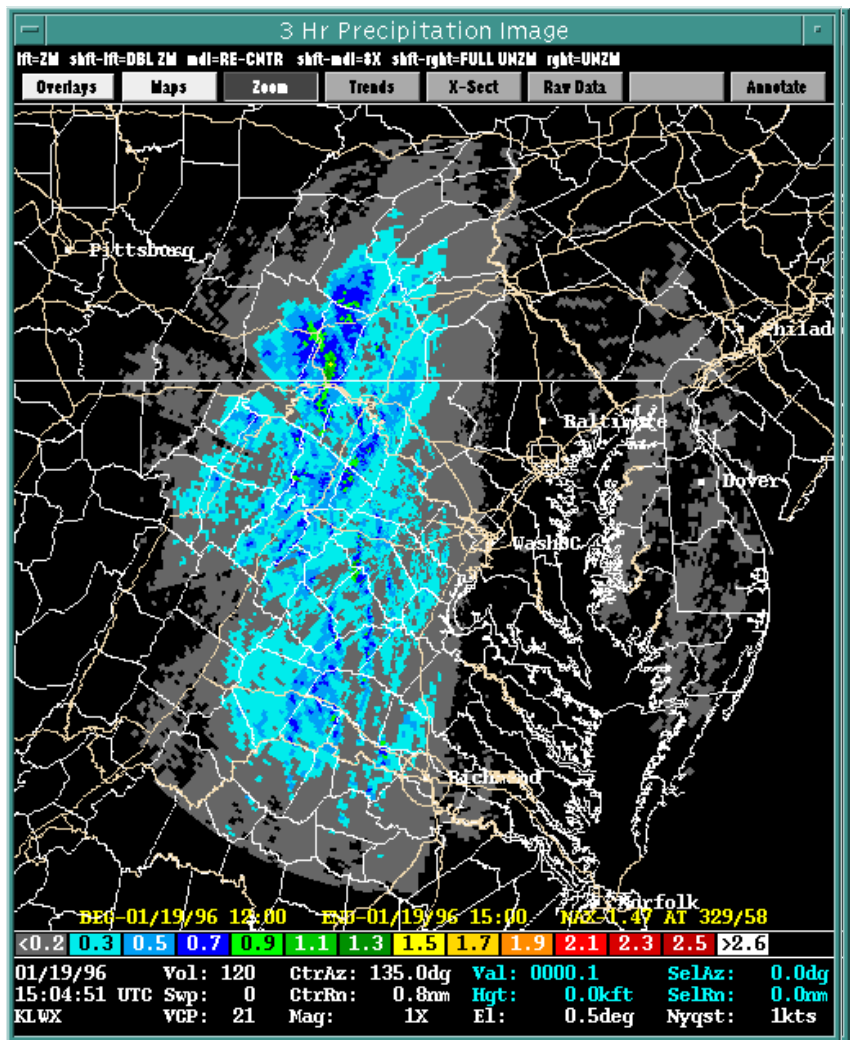


Figure H1. KLWX 3-hour Precipitation Image: 01/19/96 0900-1200 UTC.

**Figure H2. KLWX 3-hour Precipitation Image: 01/19/96 1200-1500 UTC.**

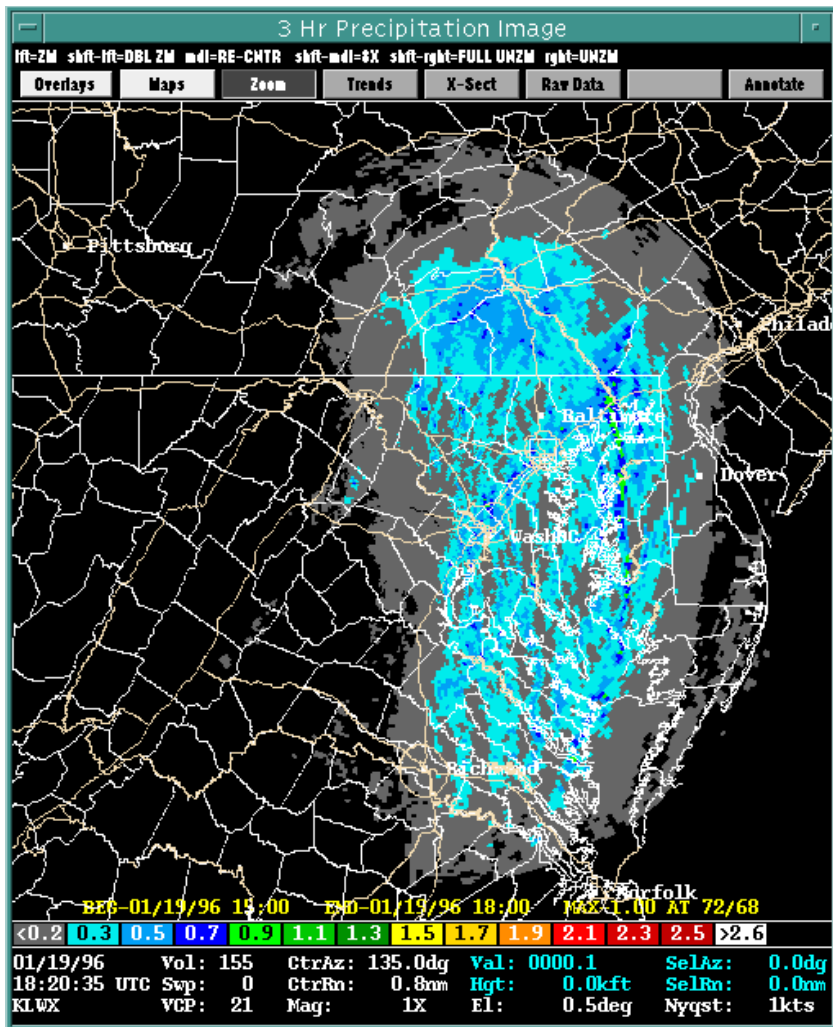


Figure H3. KLWX 3-hour Precipitation Image: 01/19/96 1500-1800 UTC.

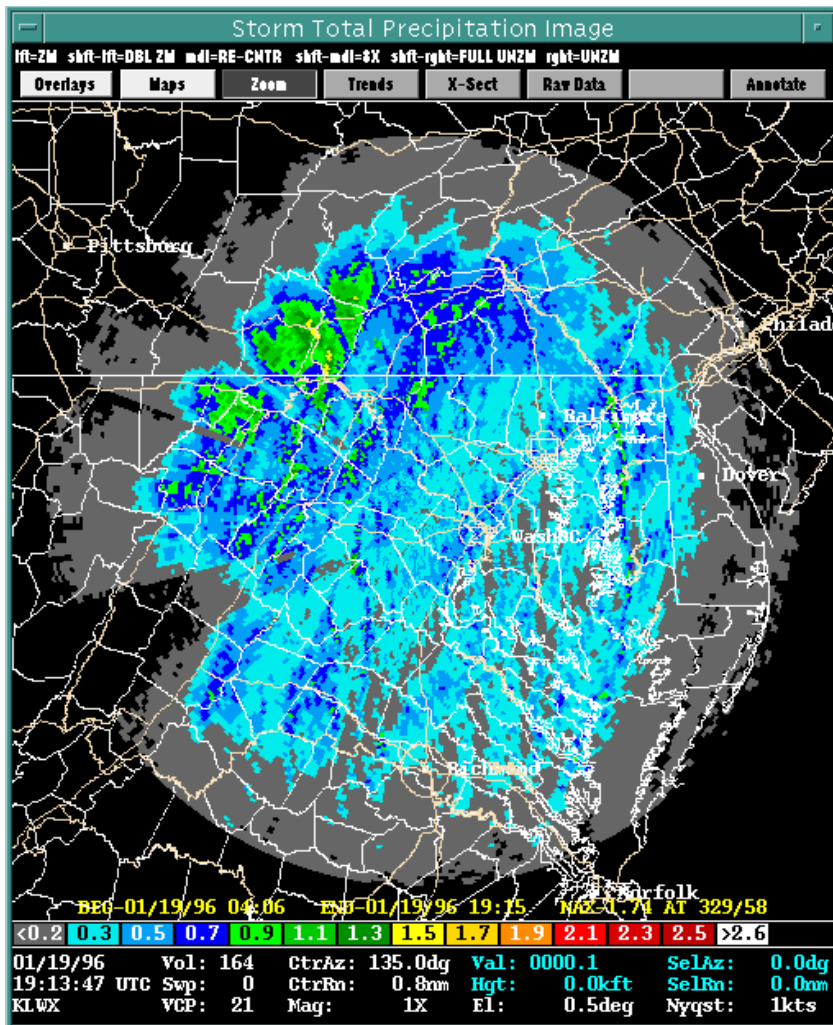


Figure H4. KLWX Storm Total Precipitation Image: 01/19/96 0406-1915 UTC.



Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 0.5 in/hr - 01/19/96

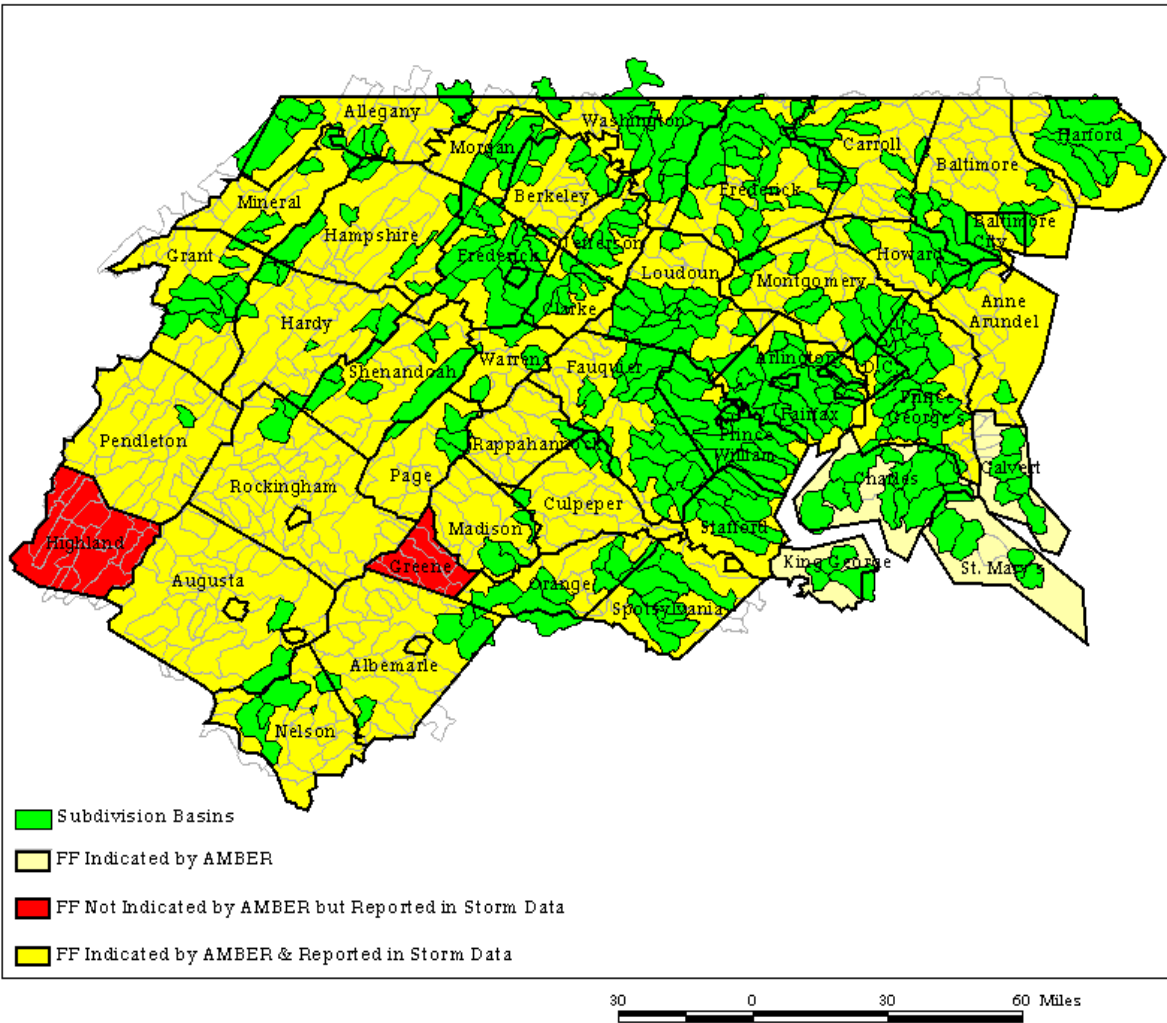


Figure H5.

**APPENDIX I**

**Sterling Case Study #4 - July 1-2, 1997**

**DATA AND FIGURES**

Table I1. The first basin(s) in each county where ABR rate equaled or exceeded 0.6 inches/hour during the July 1-2, 1995 event according to KLWX data. The ABR rate shown is the first rate to equal or exceed 0.6 inches/hour and is not necessarily the peak rate during the event. The date and time (in UTC) indicate when ABR rate first equaled or exceeded 0.6 inches/hour, and flash flood verification is based on reports in *Storm Data*.

| <b>Date / Time</b>    | <b>Basin ID(s)</b>   | <b>Basin Type</b>        | <b>Drainage Area (mi<sup>2</sup>)</b> | <b>County</b>              | <b>ABR Rate (inches/hour)</b> | <b>Flash Flood Reported / Time</b> |
|-----------------------|----------------------|--------------------------|---------------------------------------|----------------------------|-------------------------------|------------------------------------|
| <b>07/02<br/>0040</b> | <b>6140<br/>6150</b> | <b>Subdivision<br/>“</b> | <b>44.1<br/>27.8</b>                  | <b>Greene<br/>VA</b>       | <b>0.6<br/>0.6</b>            | <b>Yes / 0200</b>                  |
| <b>07/02<br/>0115</b> | <b>6669<br/>6670</b> | <b>Subdivision<br/>“</b> | <b>9.5<br/>20.7</b>                   | <b>Fauquier<br/>VA</b>     | <b>0.6<br/>0.6</b>            | <b>No</b>                          |
| <b>07/02<br/>0105</b> | <b>6096</b>          | <b>Subdivision</b>       | <b>13.9</b>                           | <b>Madison<br/>VA</b>      | <b>0.6</b>                    | <b>Yes / 0200</b>                  |
| <b>07/02<br/>0315</b> | <b>6713</b>          | <b>Subdivision</b>       | <b>83.2</b>                           | <b>Orange<br/>VA</b>       | <b>0.7</b>                    | <b>Yes / 0300</b>                  |
| <b>07/02<br/>0645</b> | <b>6183</b>          | <b>Subdivision</b>       | <b>15.8</b>                           | <b>Spotsylvania<br/>VA</b> | <b>0.6</b>                    | <b>No</b>                          |
| <b>07/02<br/>0715</b> | <b>6085</b>          | <b>Subdivision</b>       | <b>57.6</b>                           | <b>Stafford<br/>VA</b>     | <b>0.6</b>                    | <b>No</b>                          |
| <b>07/02<br/>0815</b> | <b>6104</b>          | <b>Subdivision</b>       | <b>30.6</b>                           | <b>St. Mary’s<br/>MD</b>   | <b>0.6</b>                    | <b>No</b>                          |

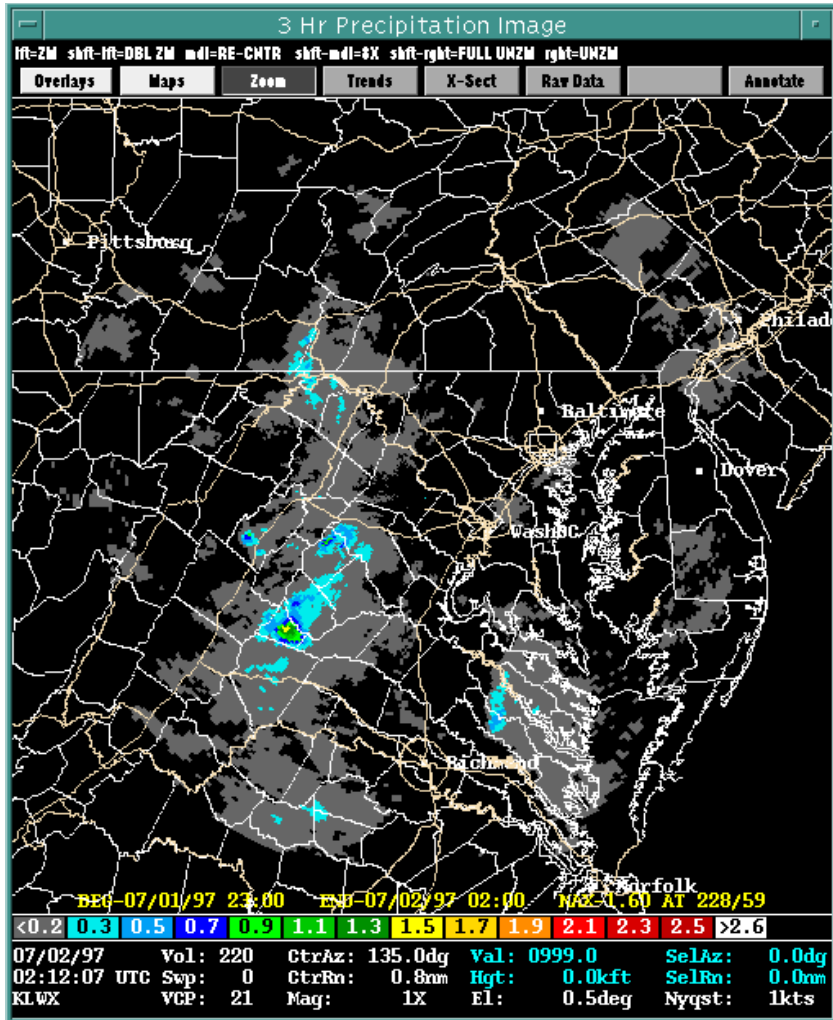


Figure 11. KLWX 3-hour Precipitation Image: 07/01/97 2300 - 07/02/97 0200 UTC.

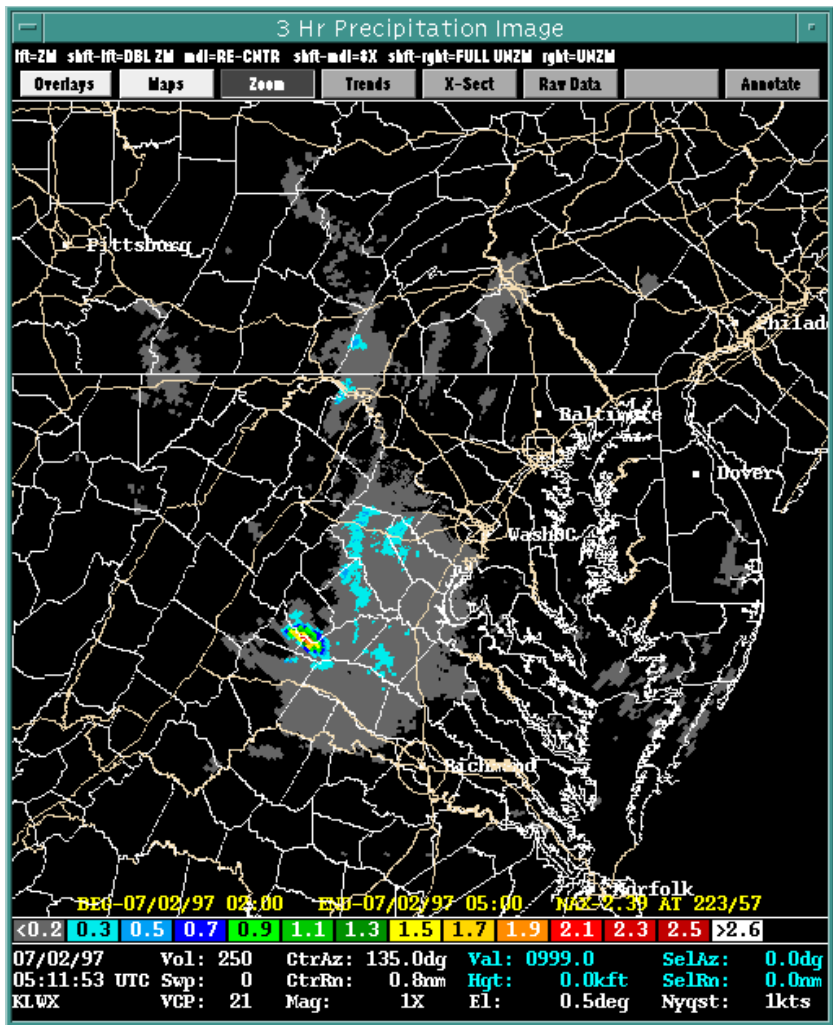


Figure I2. KLWX 3-hour Precipitation Image: 07/02/97 0200-0500 UTC.

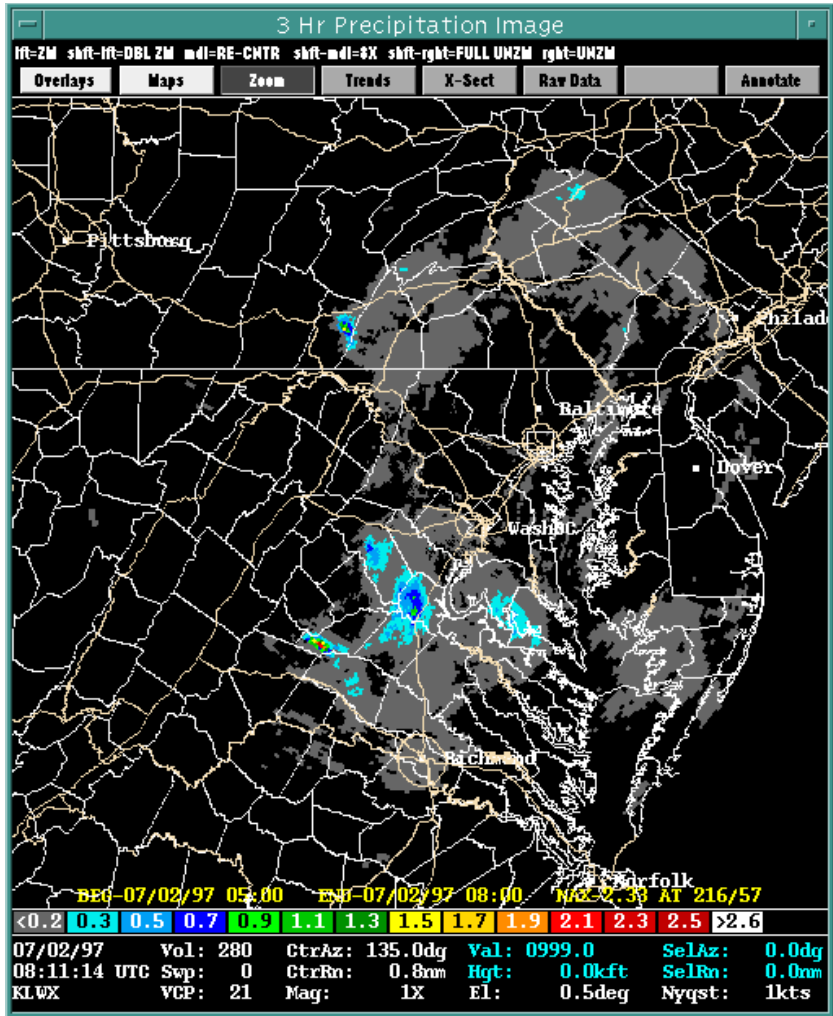


Figure I3. KLWX 3-hour Precipitation Image: 07/02/97 0500-0800 UTC.

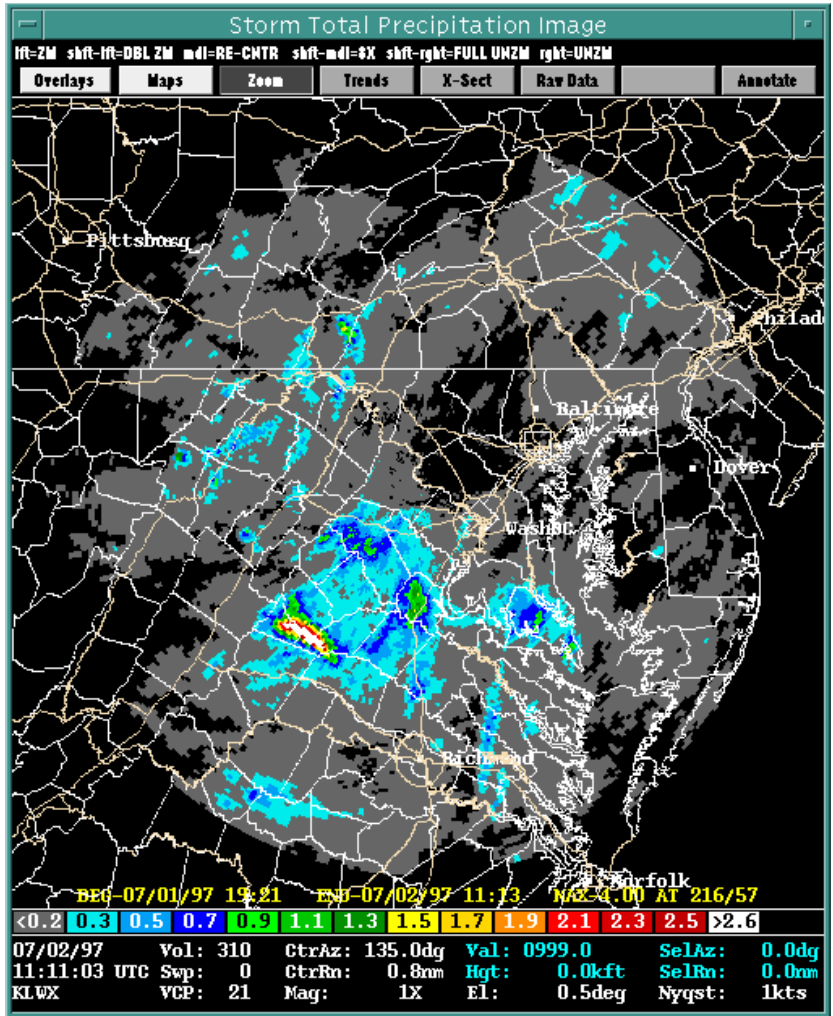


Figure I4. KLWX Storm Total Precipitation Image: 07/02/97 0921-1113 UTC.

Subdivision Basins with Average Basin Rainfall Rates Equal to or Exceeding 0.6 in/hr - 07/02/97

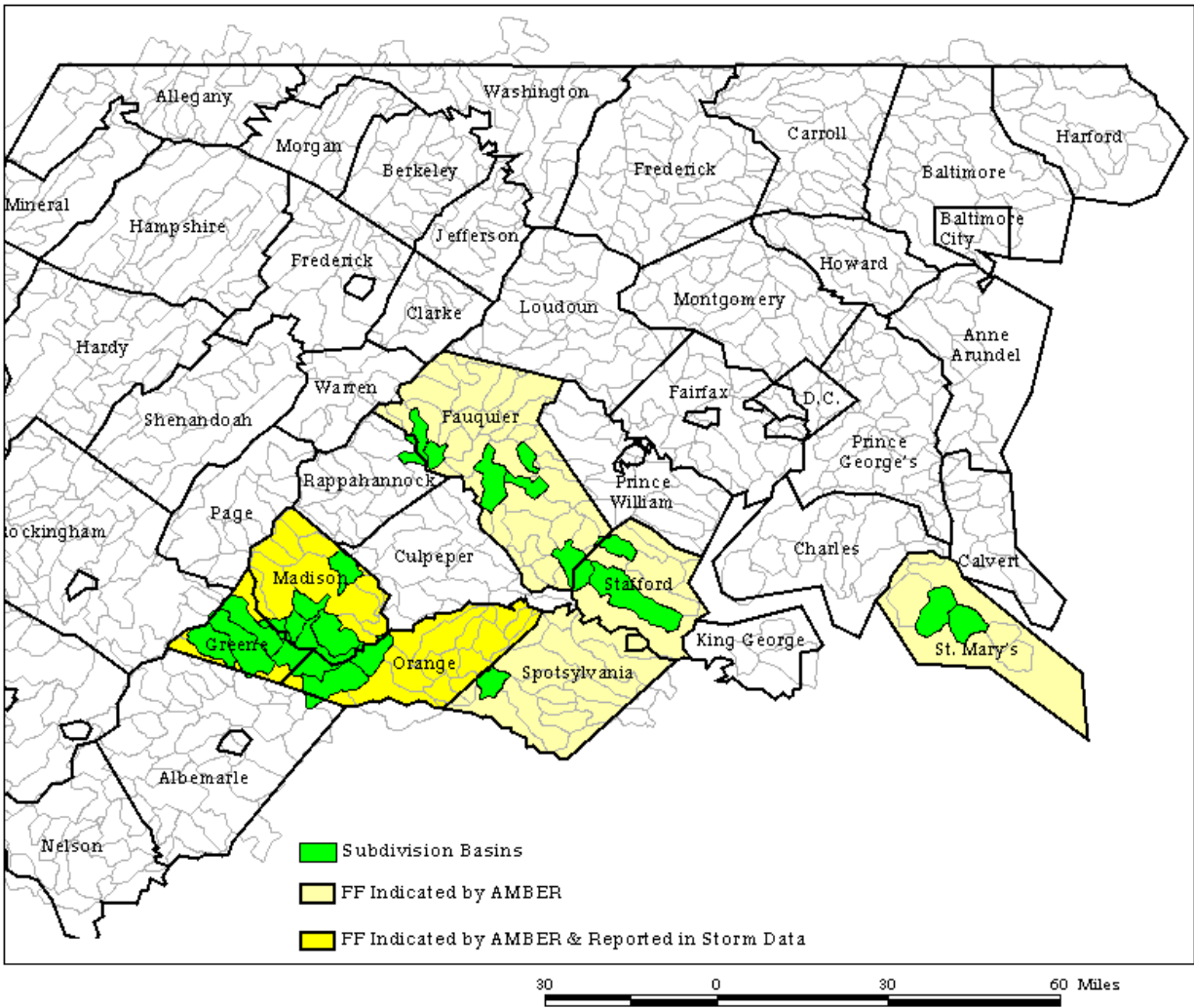


Figure I5.



Populations of Cities and Towns In or Near Subdivision Basins with ABR Rate > 0.6 in/hr - 07/02/97

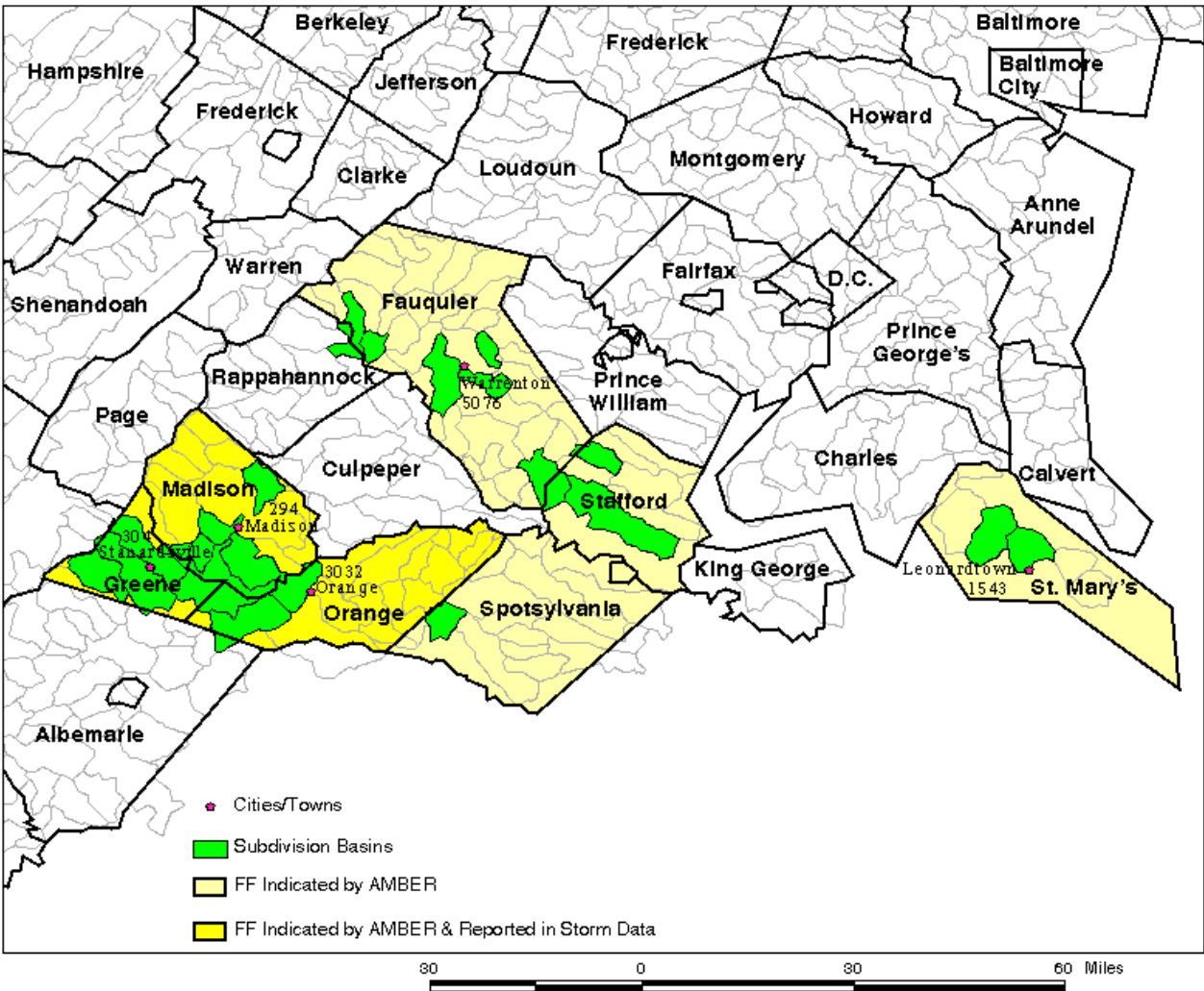


Figure I6.