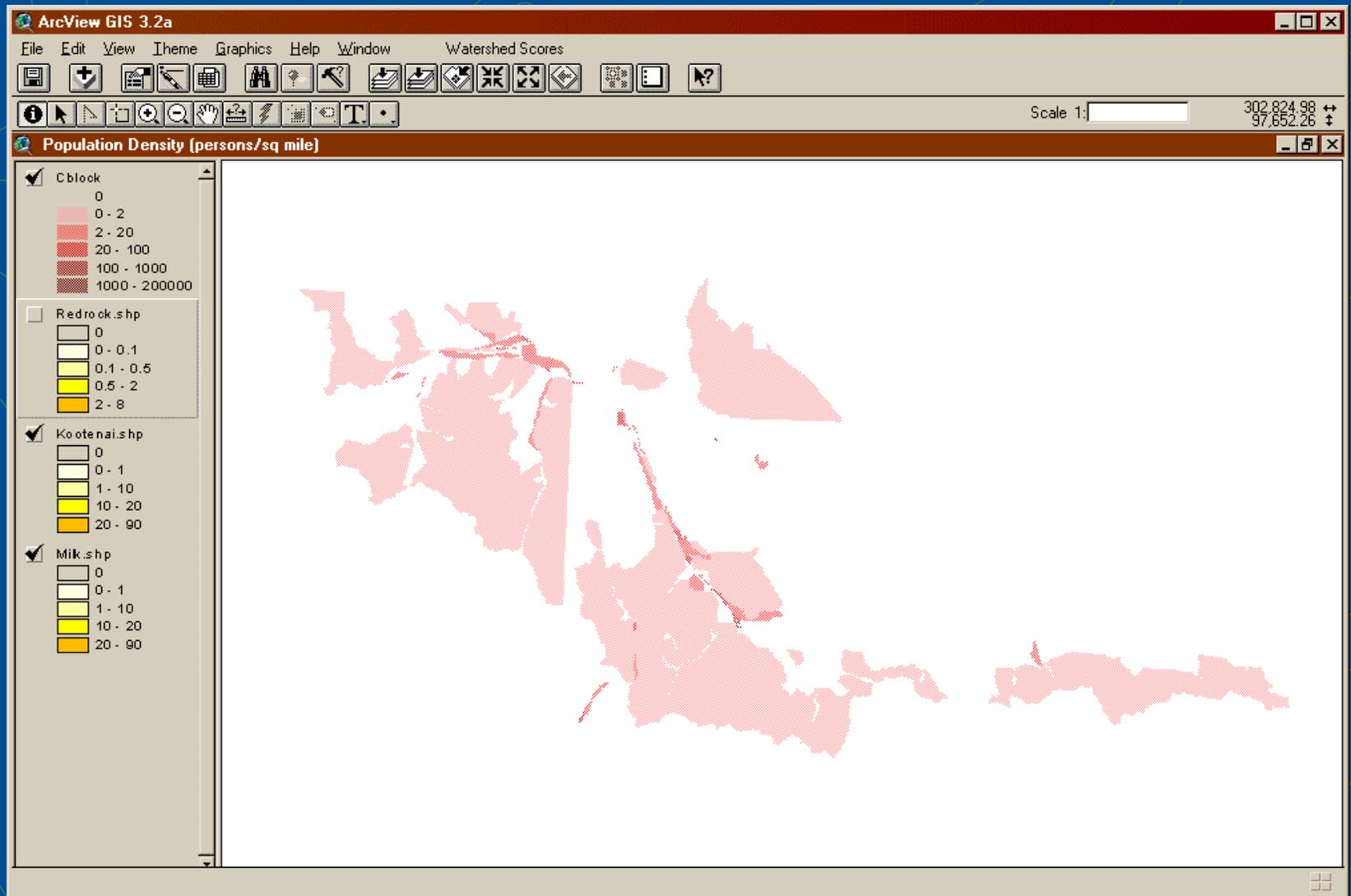




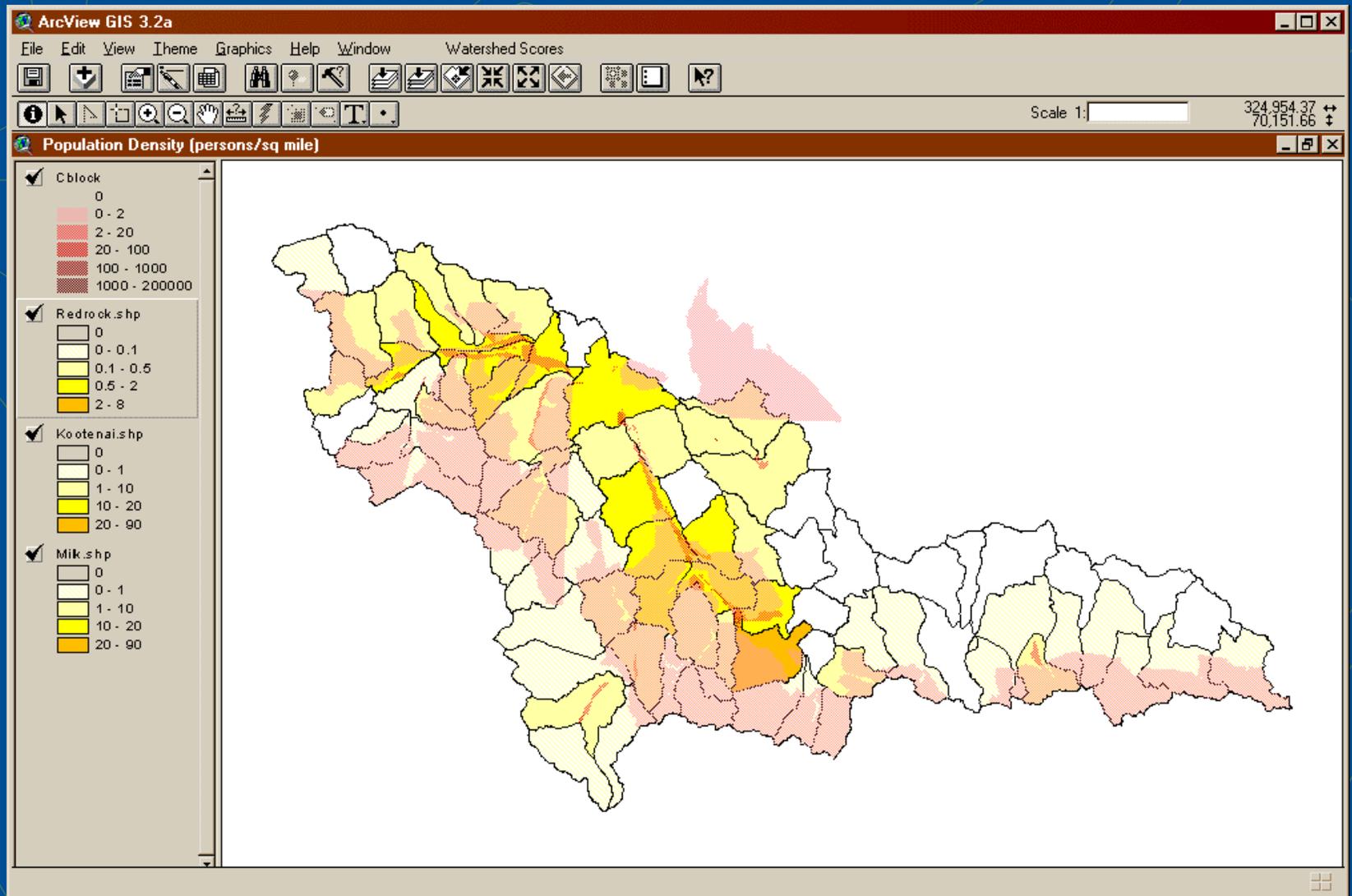
# GIS Landscape Assessment Tool: Watershed Characterization for Factors that Have an Impact on Wetlands

Gerry Daumiller  
Natural Resource Information System  
Montana State Library

# Take a Phenomenon on the Landscape



# Figure its Values in Each Watershed



# Assign Weights to Multiple Phenomena

**Set Factor Weights**

Choose the weight (-10 to 10) to apply to each factor

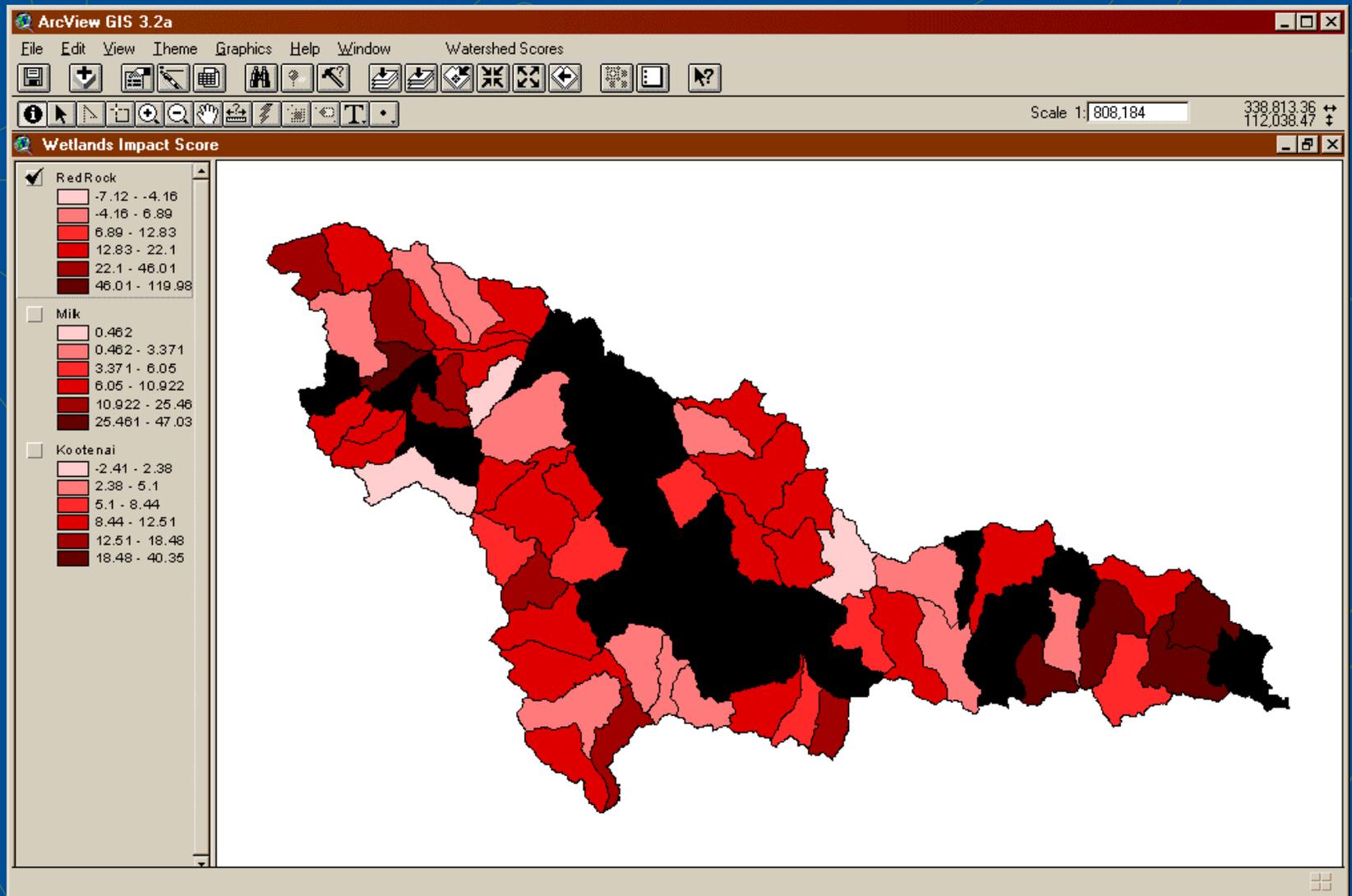
Land Cover -- Water	<input type="text" value="2.00"/>
Land Cover -- Snow	<input type="text" value="4.00"/>
Land Cover -- Residential (low)	<input type="text" value="-4.00"/>
Land Cover -- Residential (high)	<input type="text" value="-6.00"/>
Land Cover -- Commerce/Industrial	<input type="text" value="-9.00"/>
Land Cover -- Barren	<input type="text" value="1.00"/>
Land Cover -- Mines/Quarries	<input type="text" value="-9.00"/>
Land Cover -- Forest	<input type="text" value="4.00"/>
Land Cover -- Shrubs	<input type="text" value="3.00"/>
Land Cover -- Orchards	<input type="text" value="0.00"/>
Land Cover -- Grassland	<input type="text" value="5.00"/>
Land Cover -- Pasture	<input type="text" value="-1.00"/>
Land Cover -- Crops	<input type="text" value="-3.00"/>
Land Cover -- Wetland	<input type="text" value="4.00"/>

**Set Factor Weights**

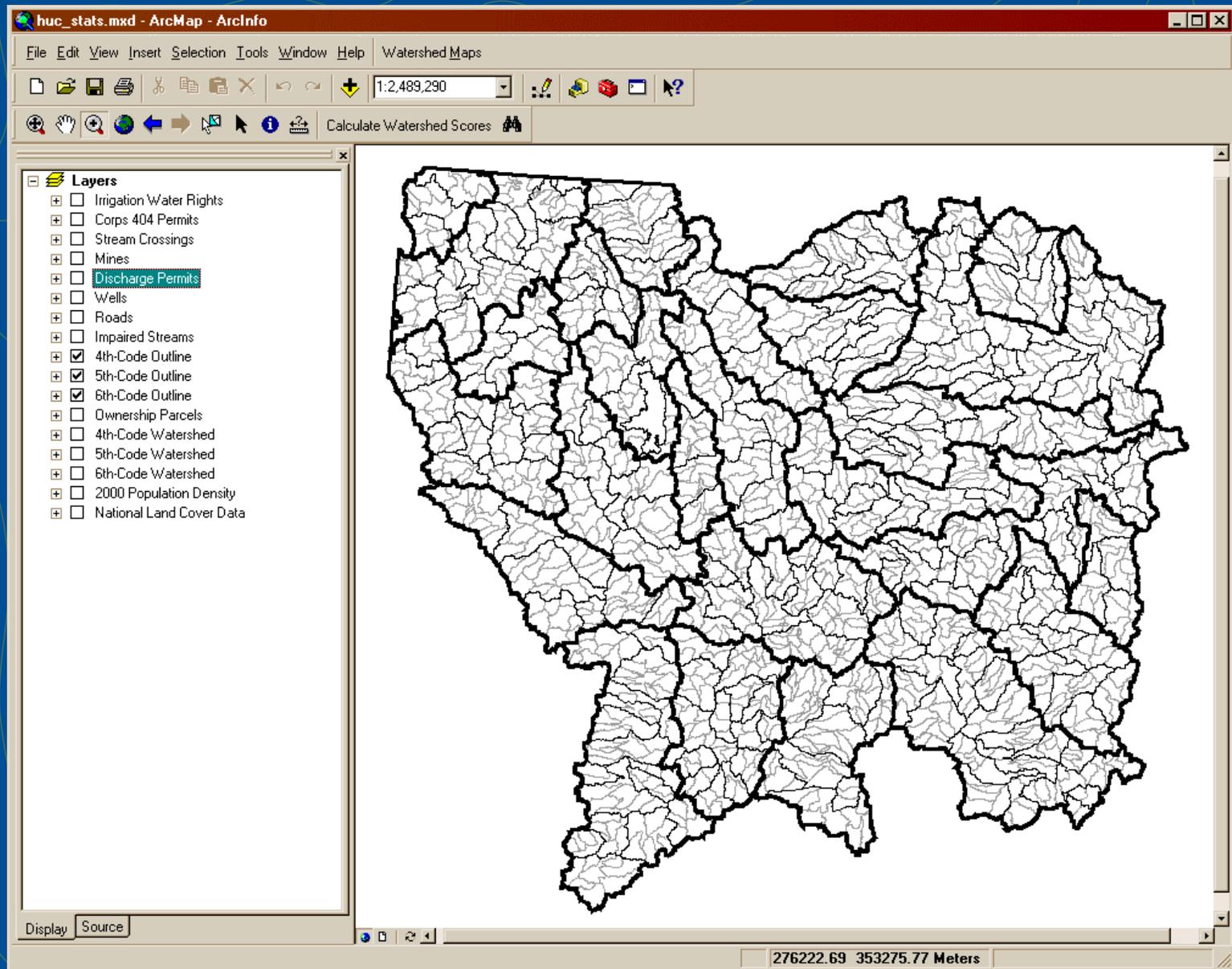
Choose the weight (-10 to 10) to apply to each factor

Water Rights Irrigation	<input type="text" value="-5.00"/>
Population Density	<input type="text" value="-5.00"/>
Corps 404 Stream/Wetland Permits	<input type="text" value="-7.00"/>
S303d Listed Streams	<input type="text" value="-5.00"/>
Road Density	<input type="text" value="-7.00"/>
Well Density	<input type="text" value="-4.00"/>
Mine Density	<input type="text" value="-7.00"/>
Discharge Permit Density	<input type="text" value="-6.00"/>
Road/Stream Crossings	<input type="text" value="-4.00"/>
Federal Land	<input type="text" value="4.00"/>
USFWS Easements	<input type="text" value="6.00"/>
Wilderness	<input type="text" value="10.00"/>

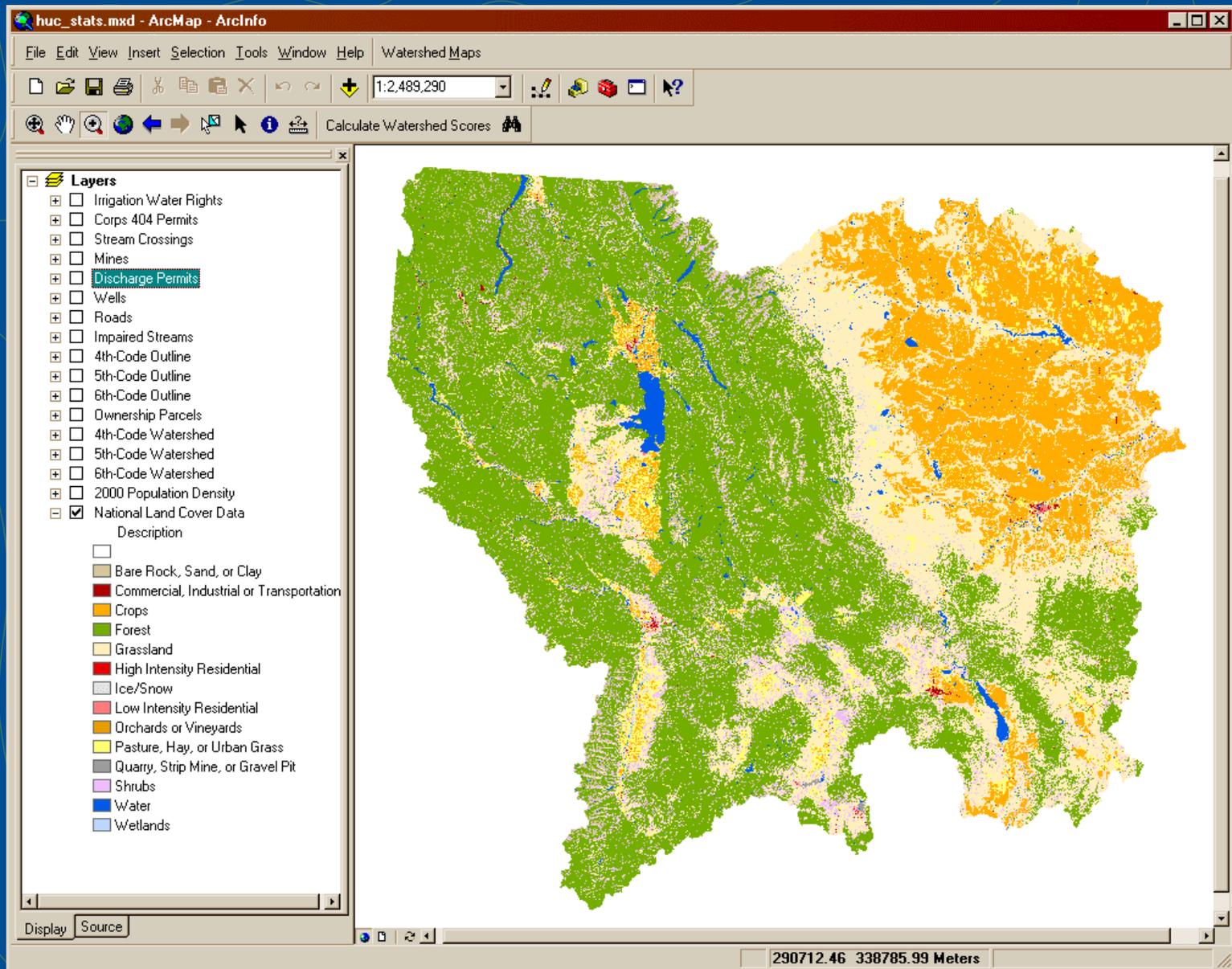
# and Calculate Watershed Scores



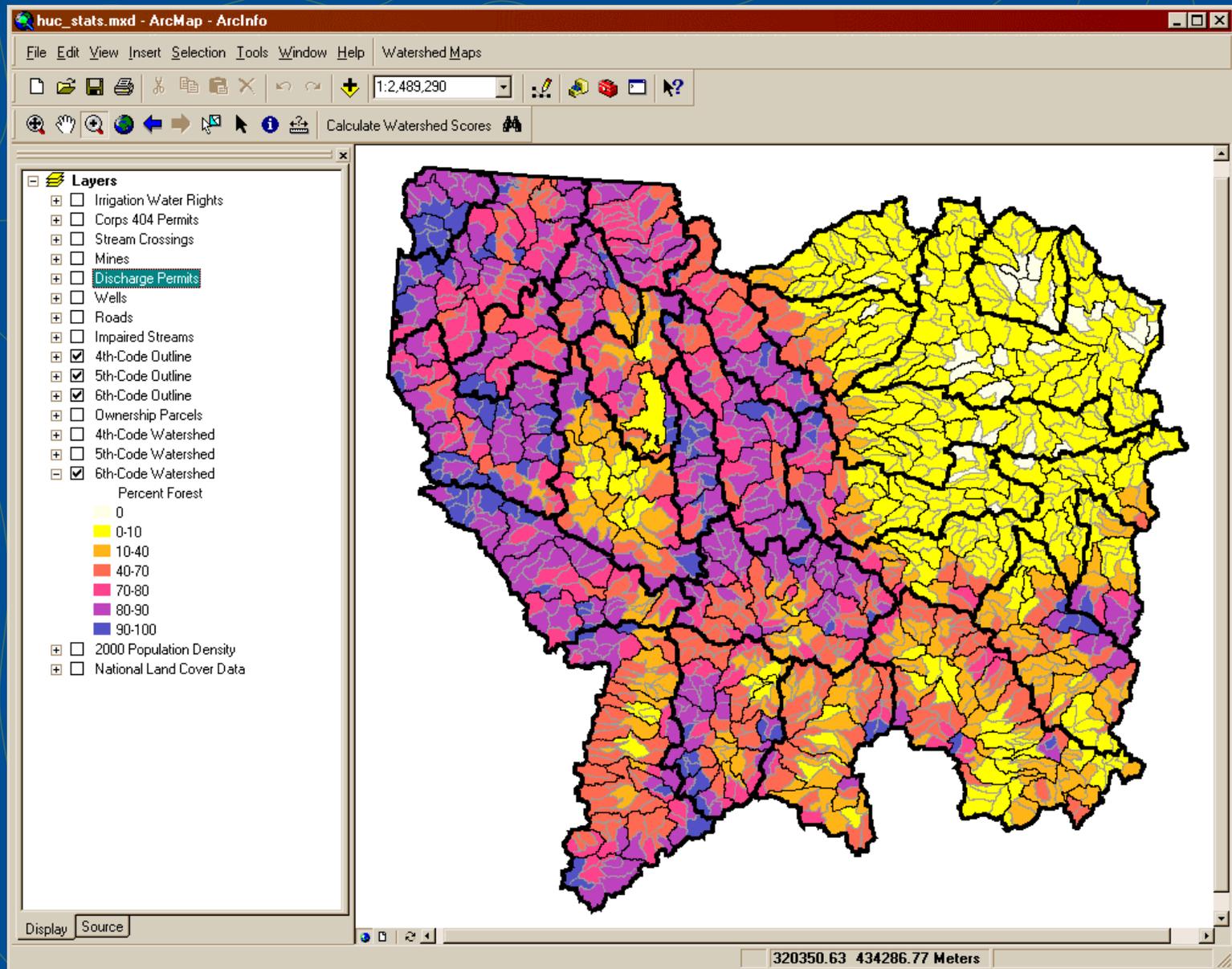
# Expand Pilot to All Available 6<sup>th</sup> Code Watersheds



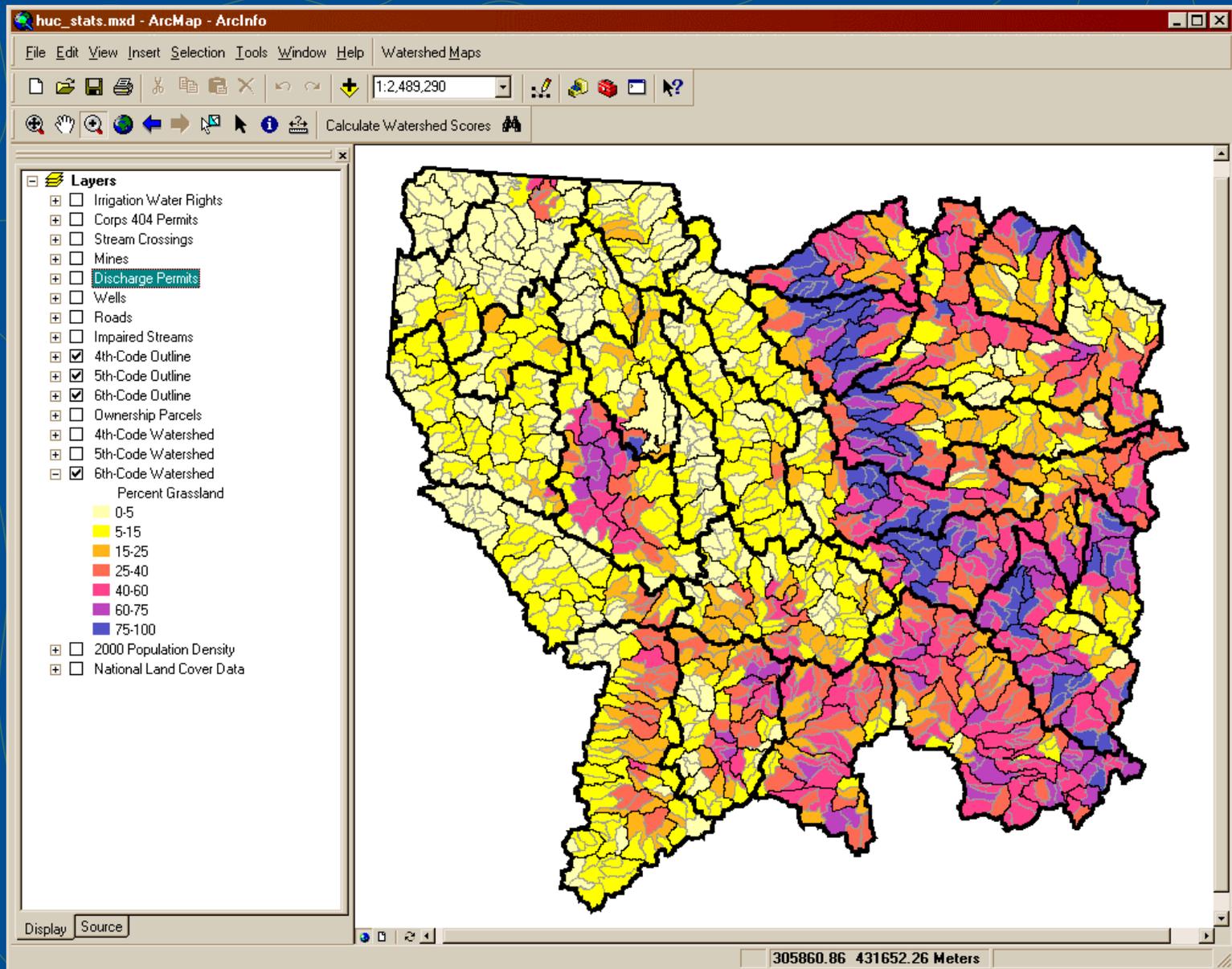
# Phenomena: Land Cover



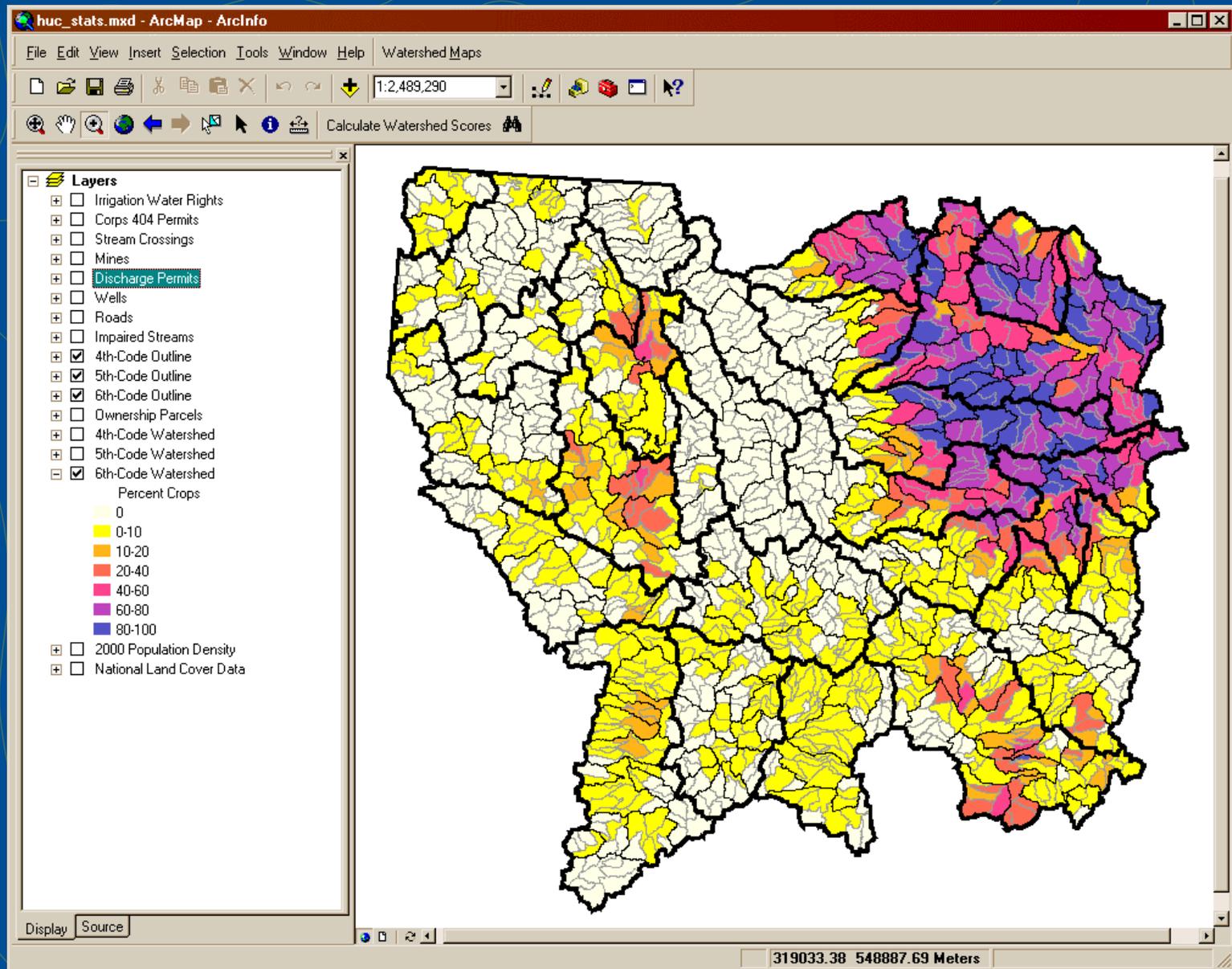
# Phenomena: Land Cover -- Forests



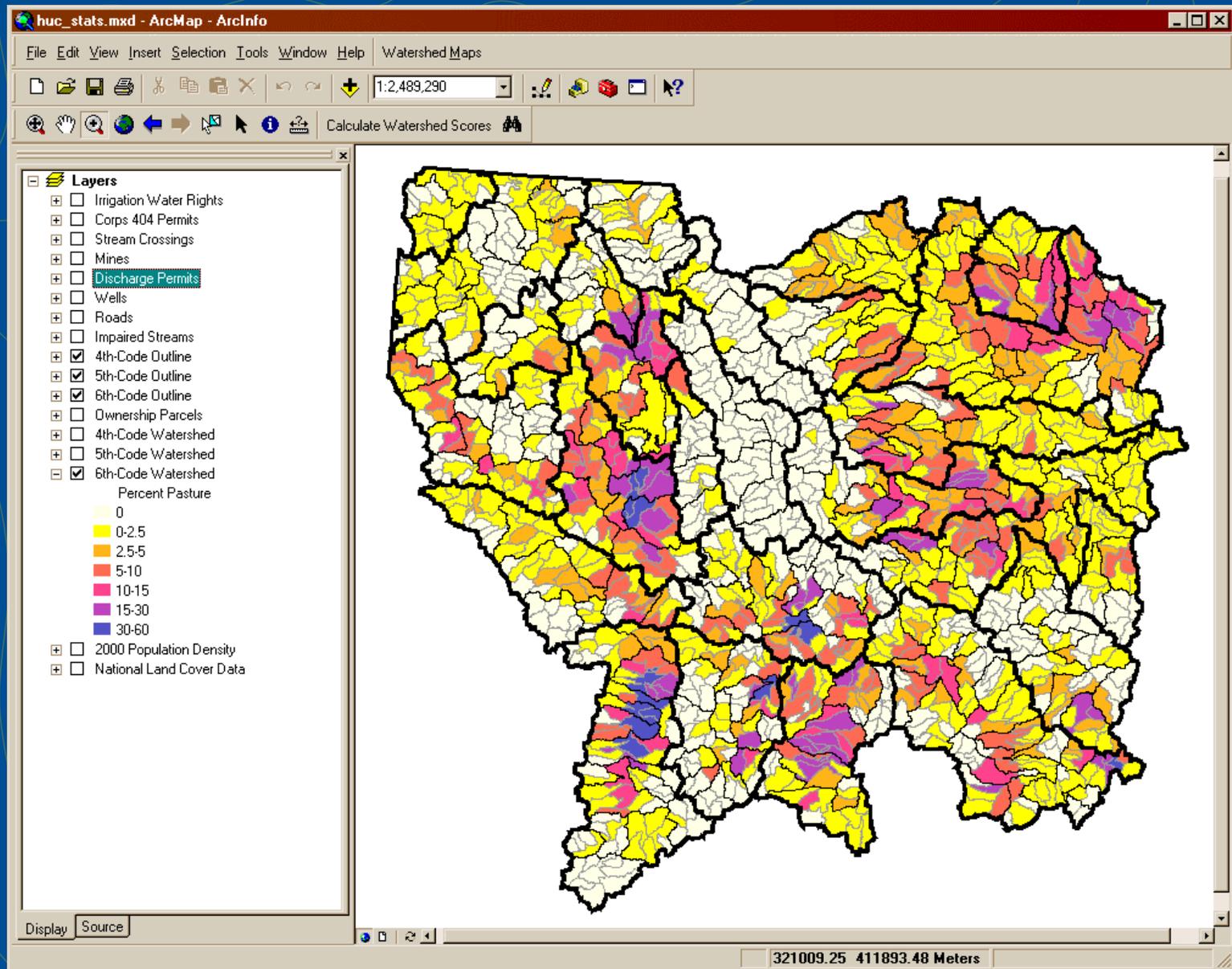
# Phenomena: Land Cover -- Grassland



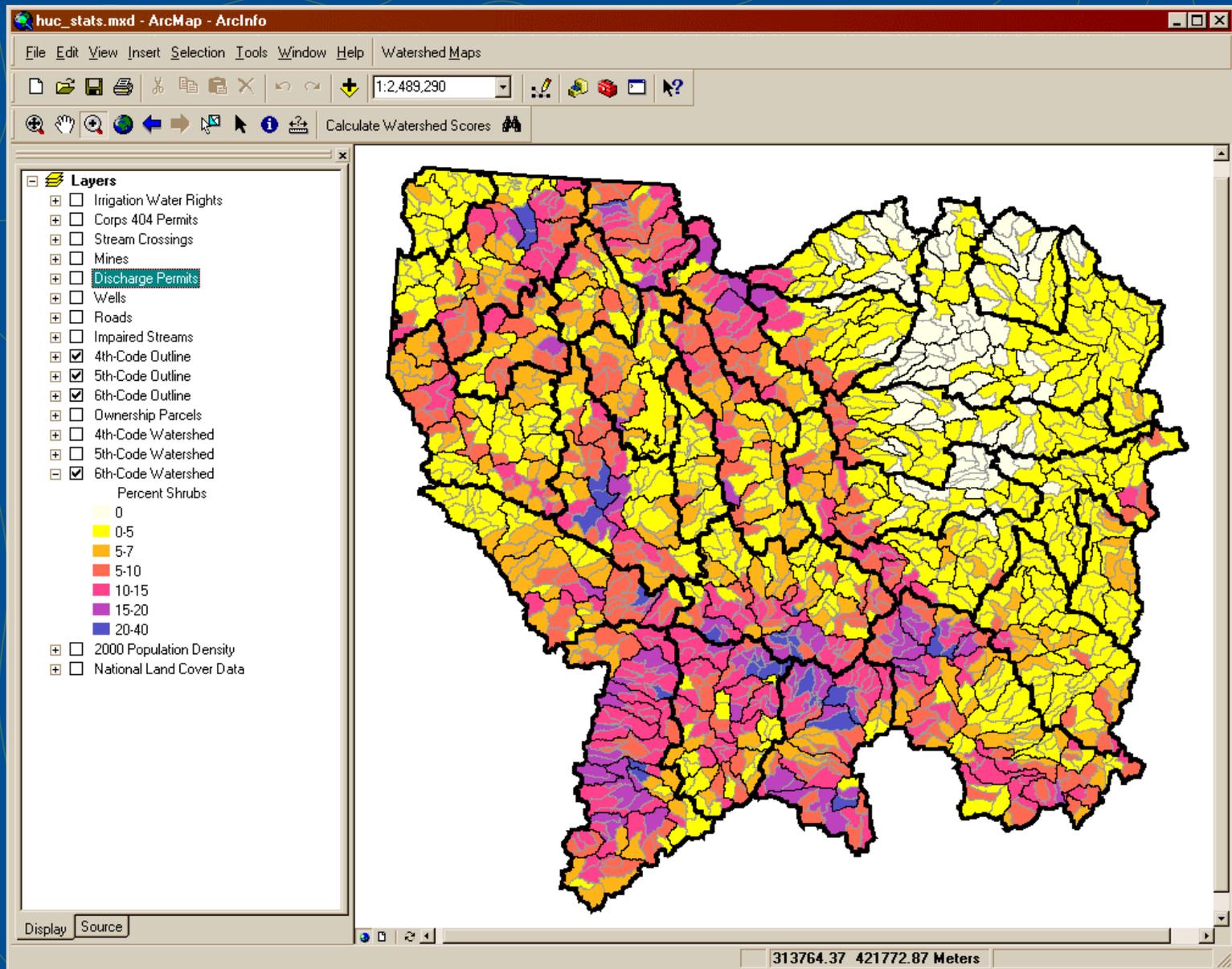
# Phenomena: Land Cover -- Crops



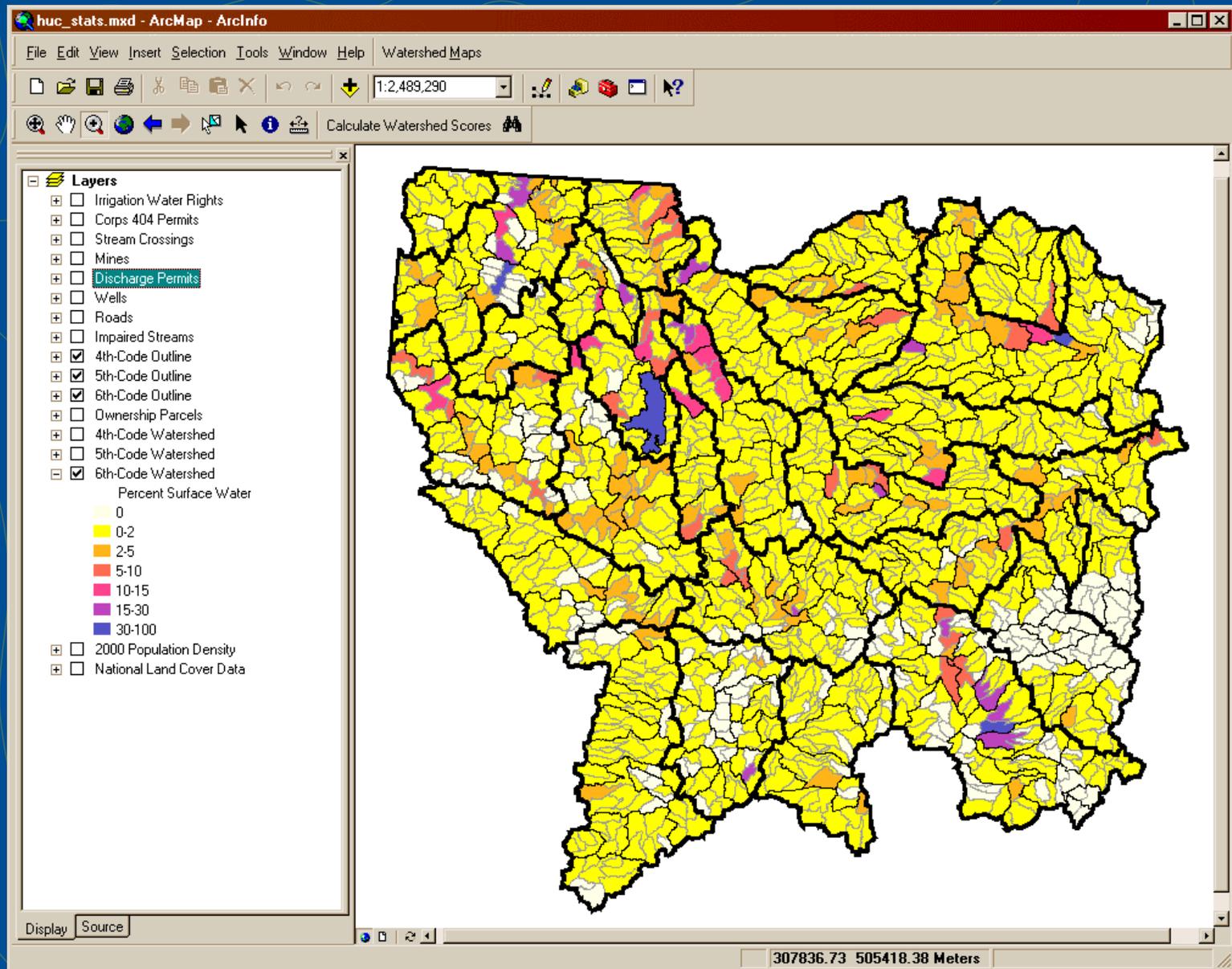
# Phenomena: Land Cover -- Pasture



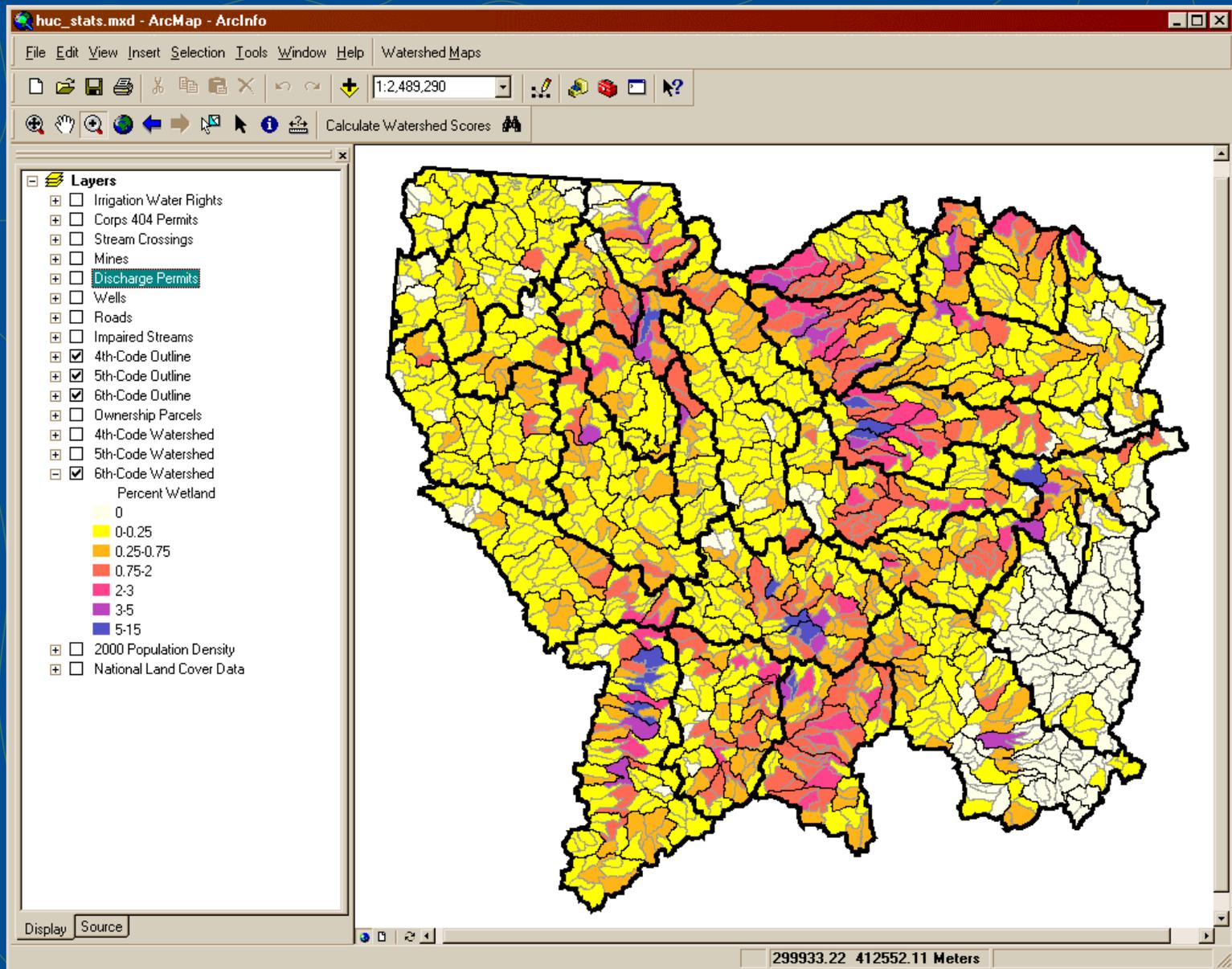
# Phenomena: Land Cover -- Shrubs



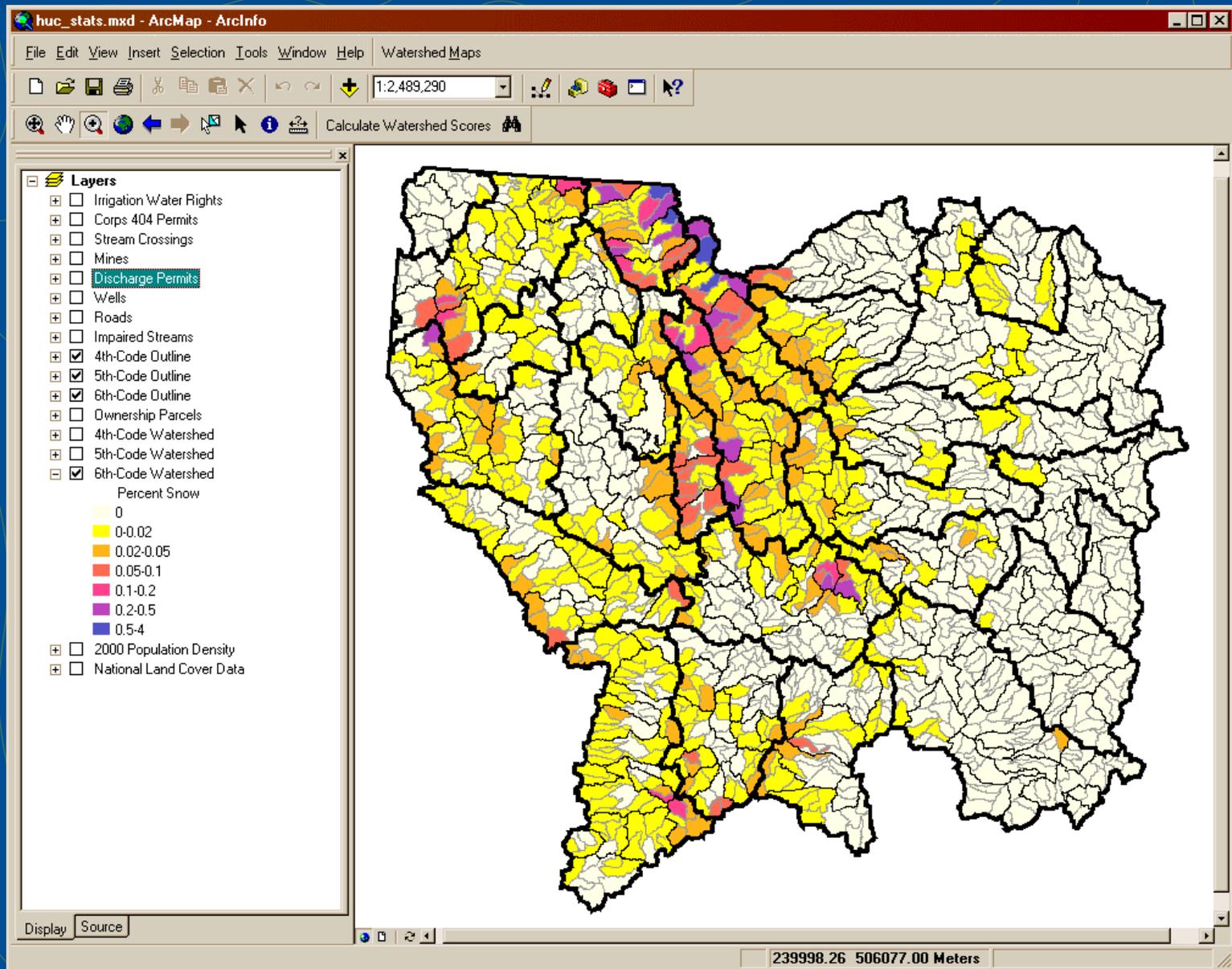
# Phenomena: Land Cover -- Water



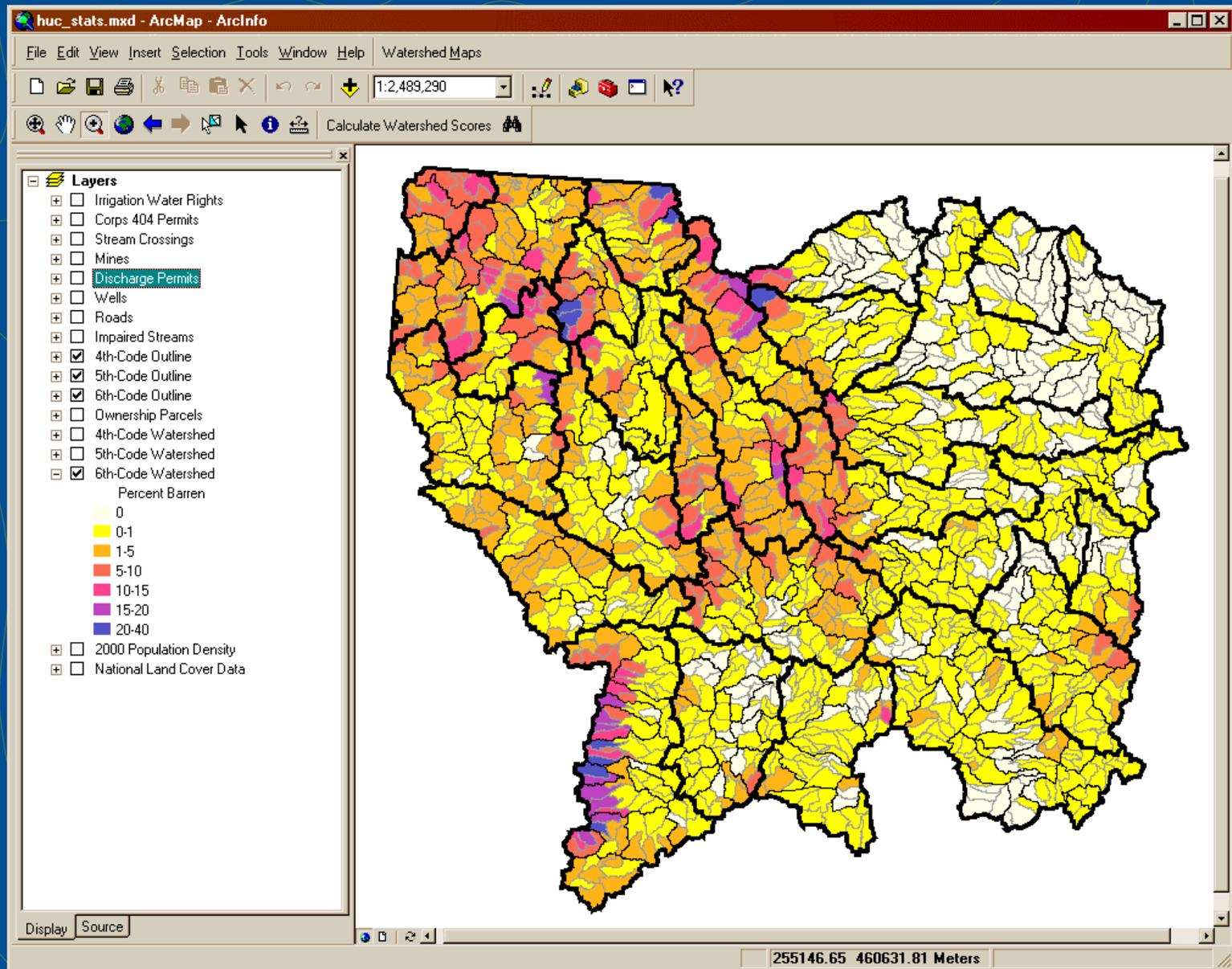
# Phenomena: Land Cover – Wetlands



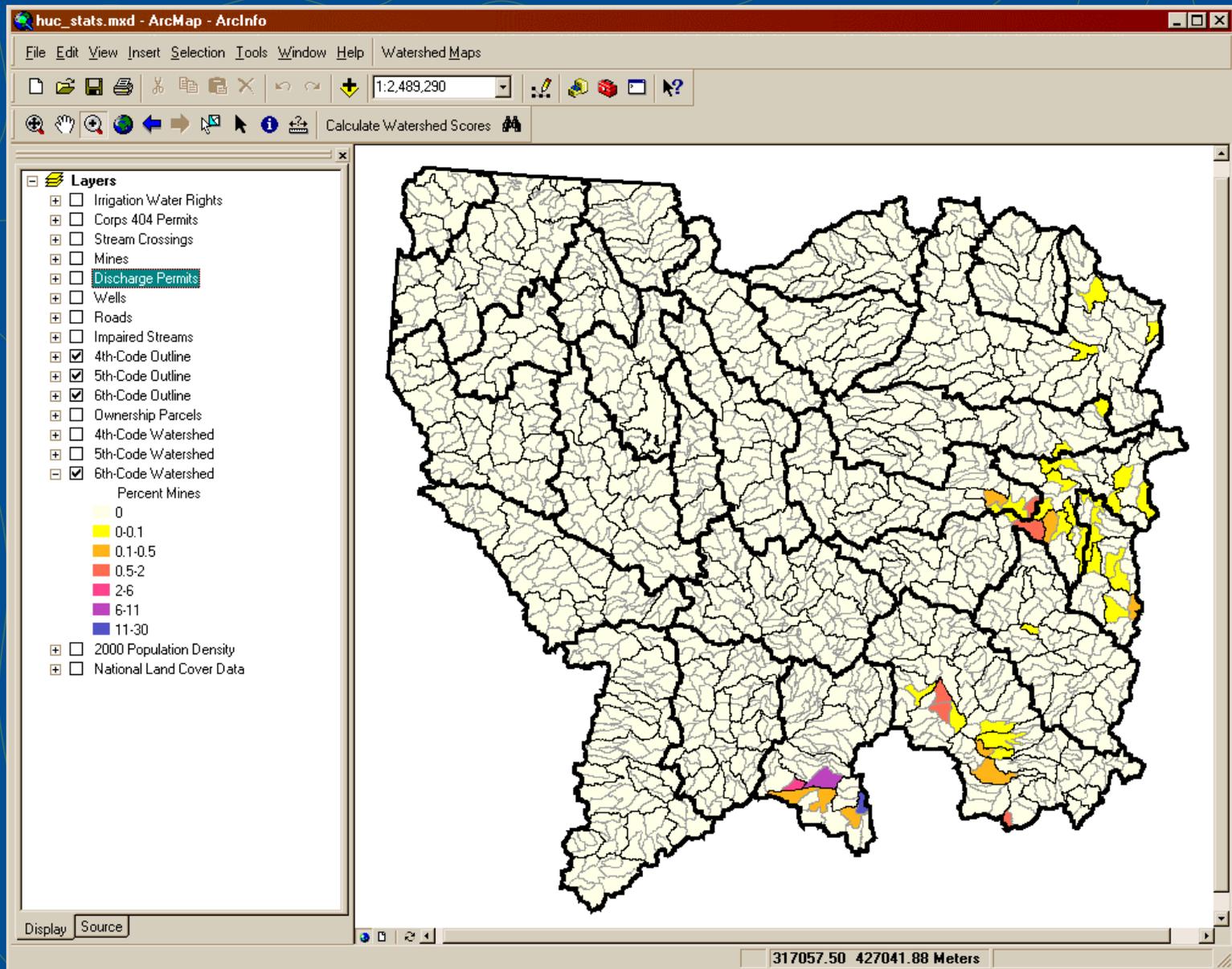
# Phenomena: Land Cover – Ice and Snow



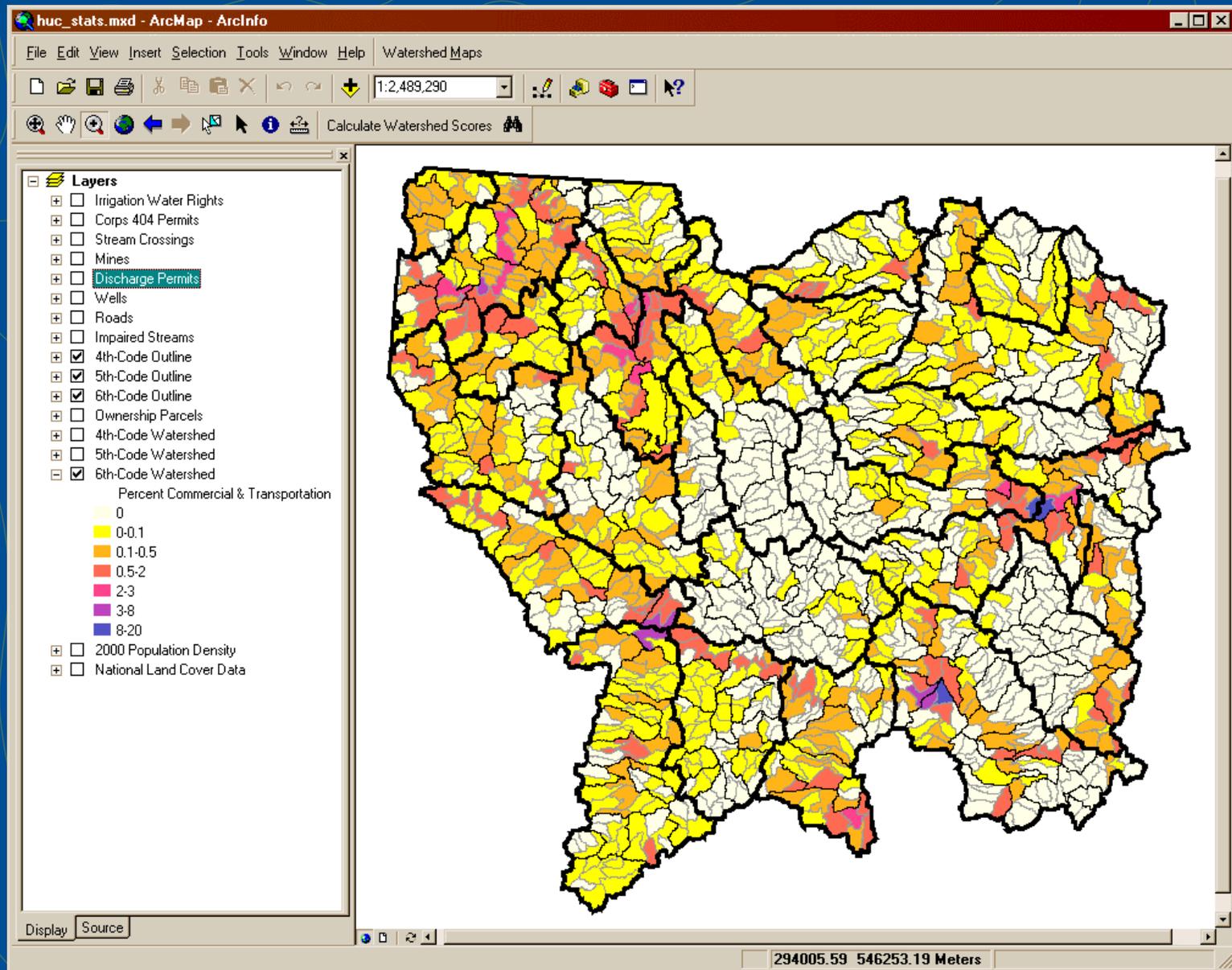
# Phenomena: Land Cover – Barren



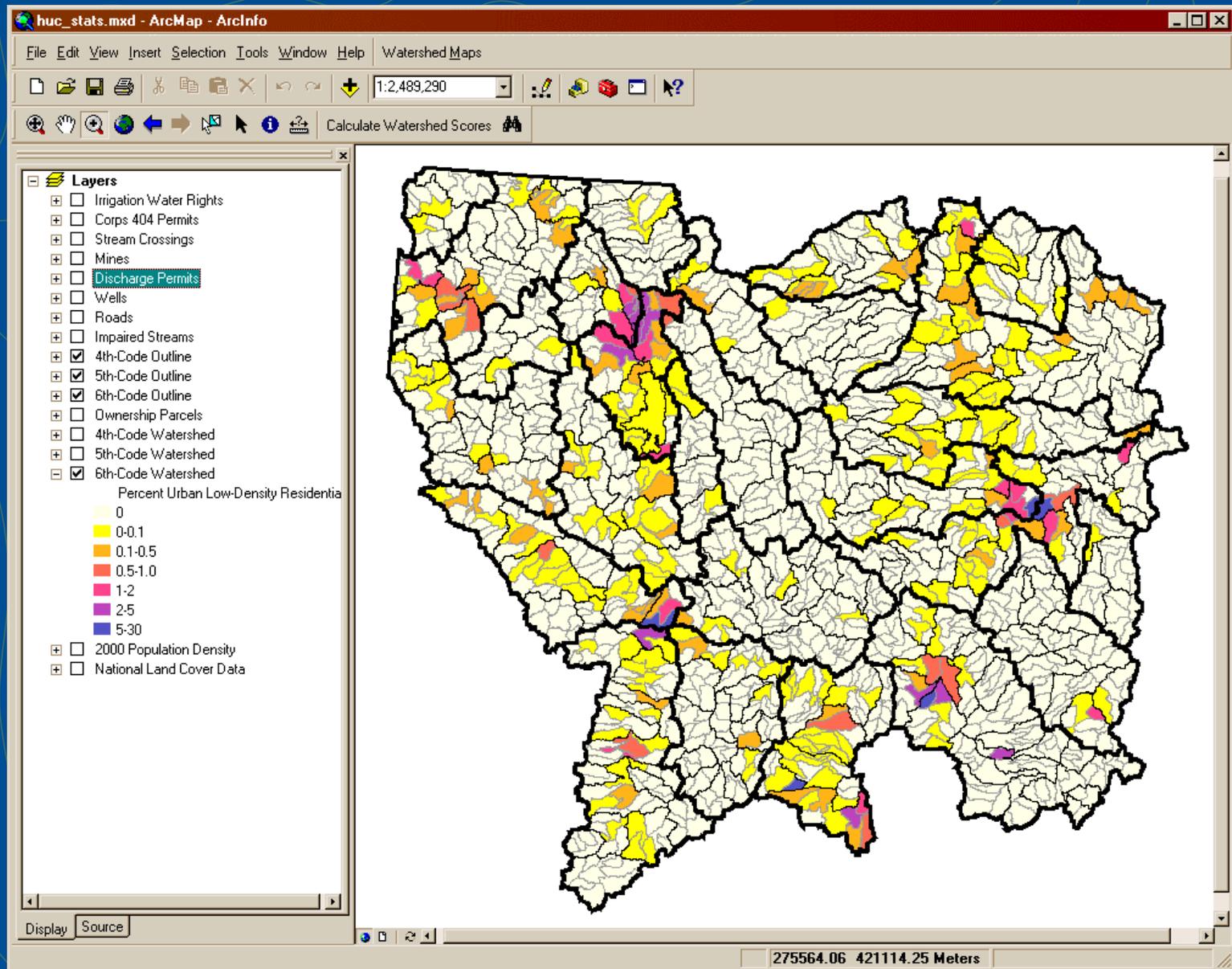
# Phenomena: Land Cover – Mines



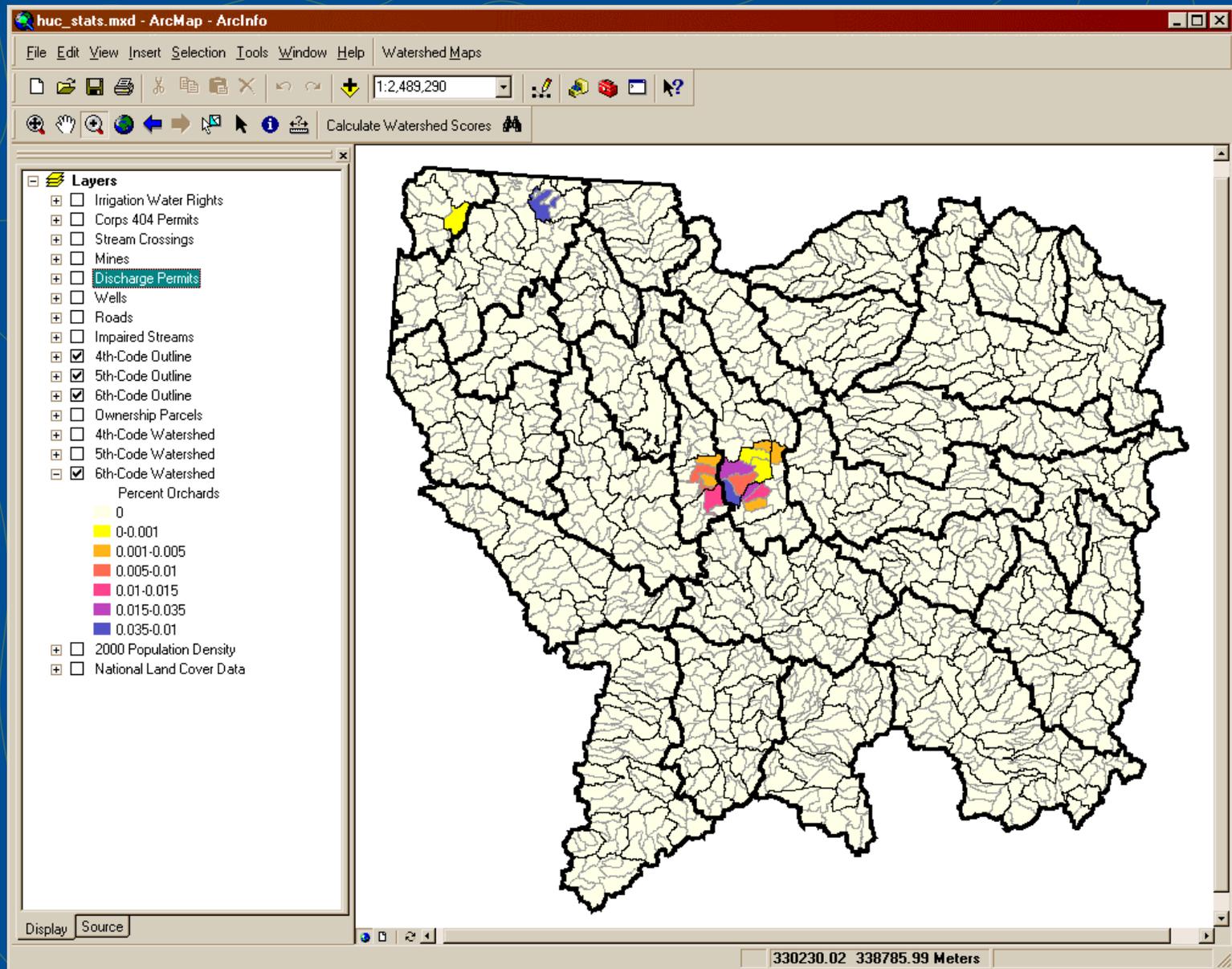
# Phenomena: Land Cover – Commerce & Roads



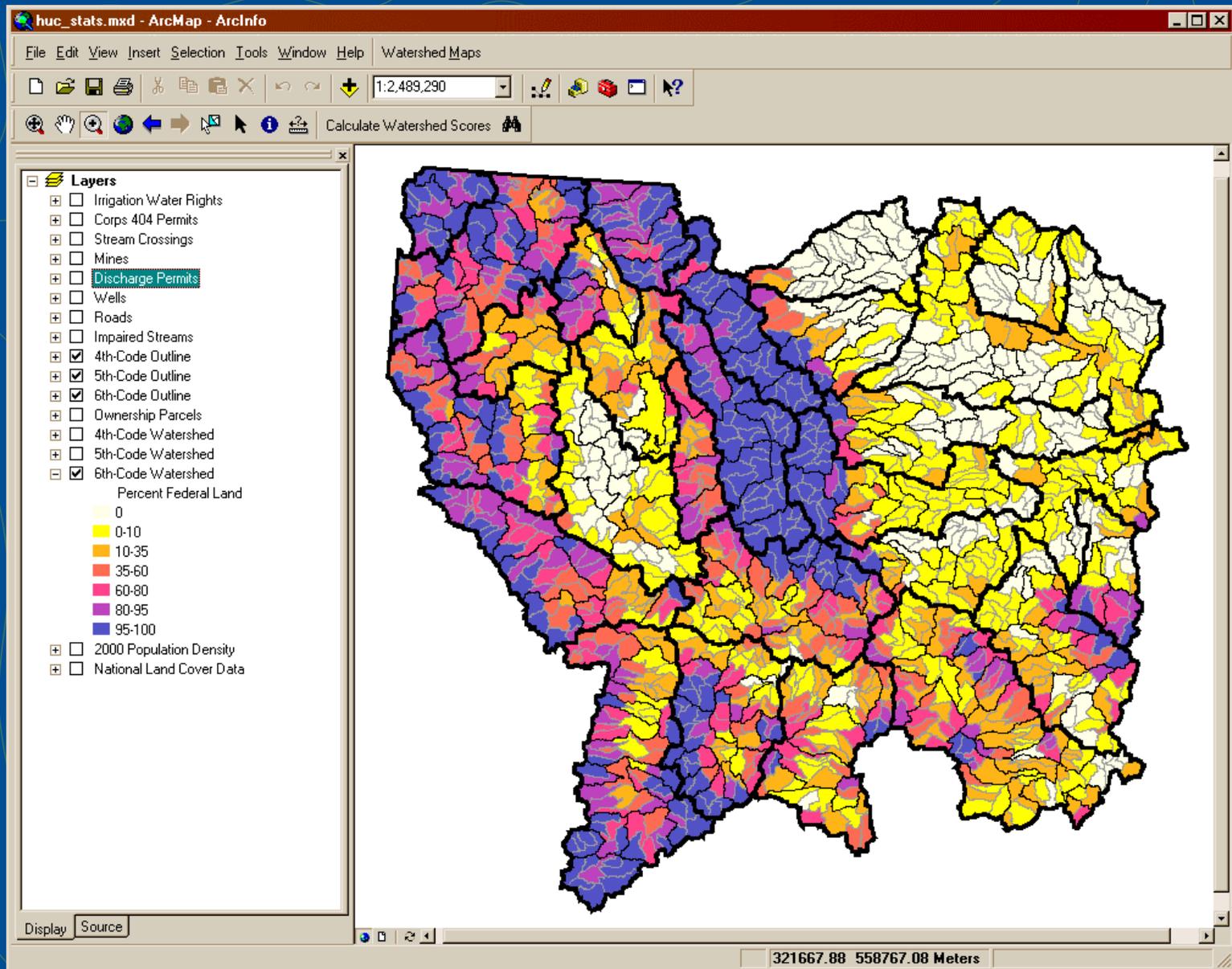
# Phenomena: Land Cover – Residential



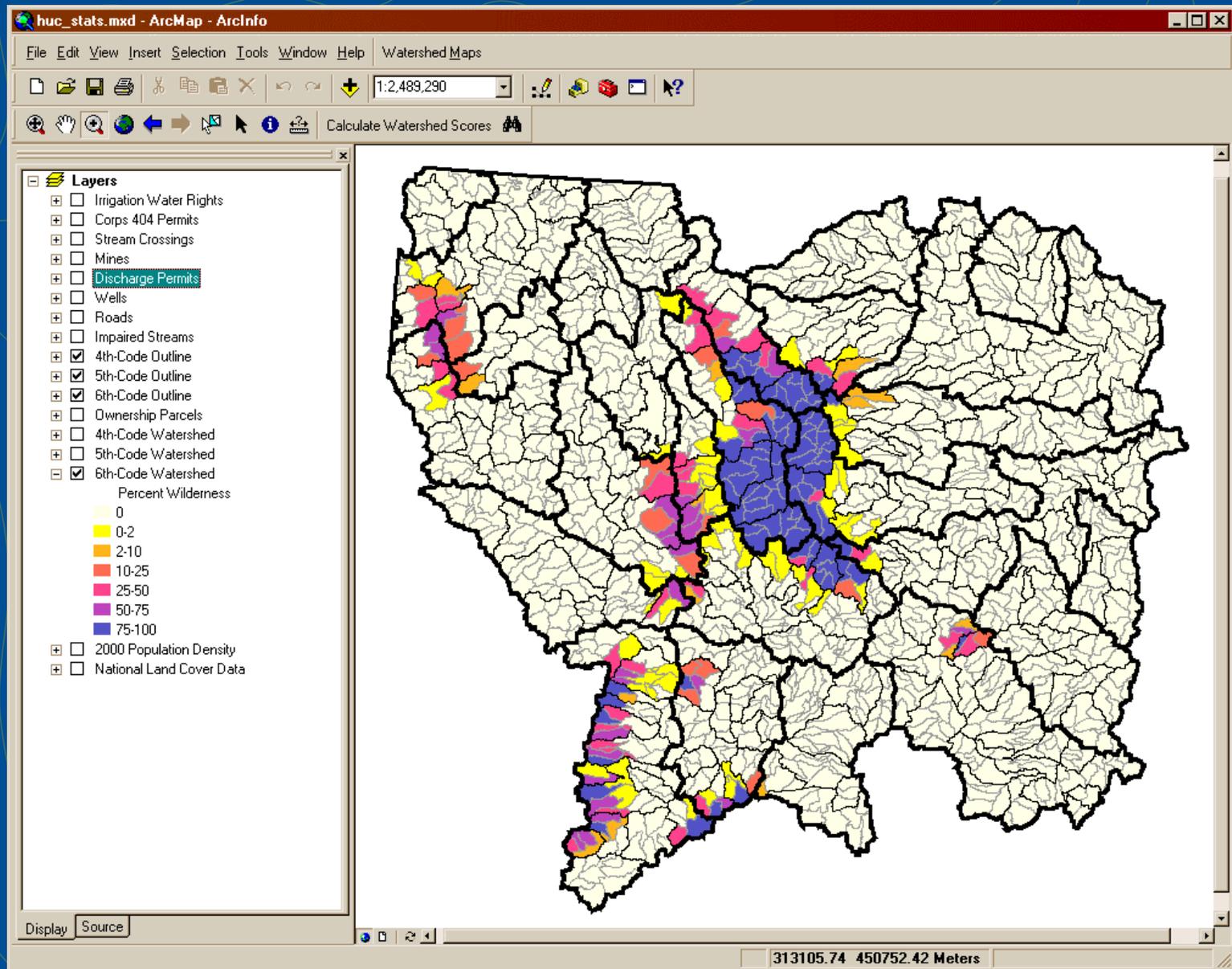
# Phenomena: Land Cover – Orchards



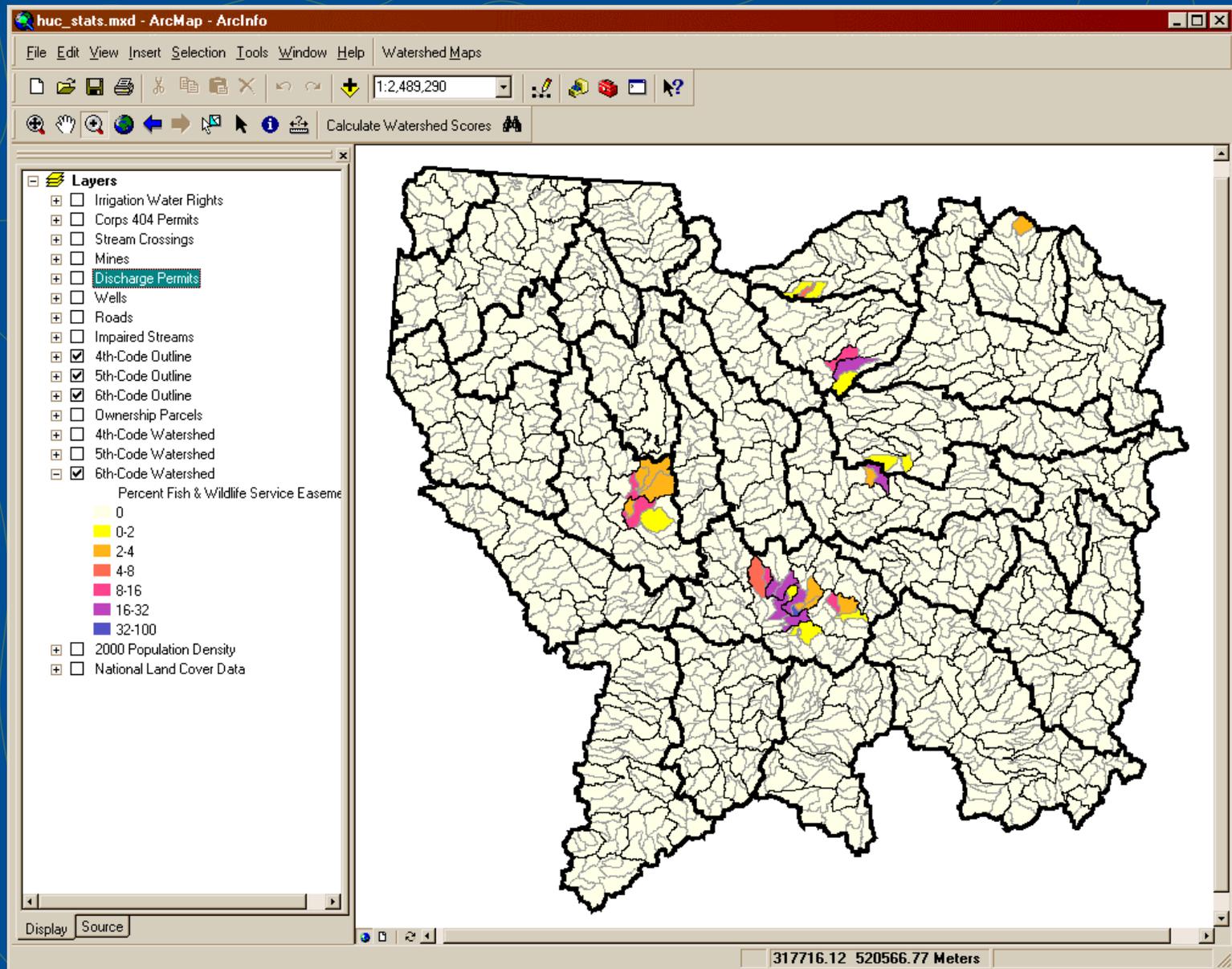
# Phenomena: Percent Federal Land



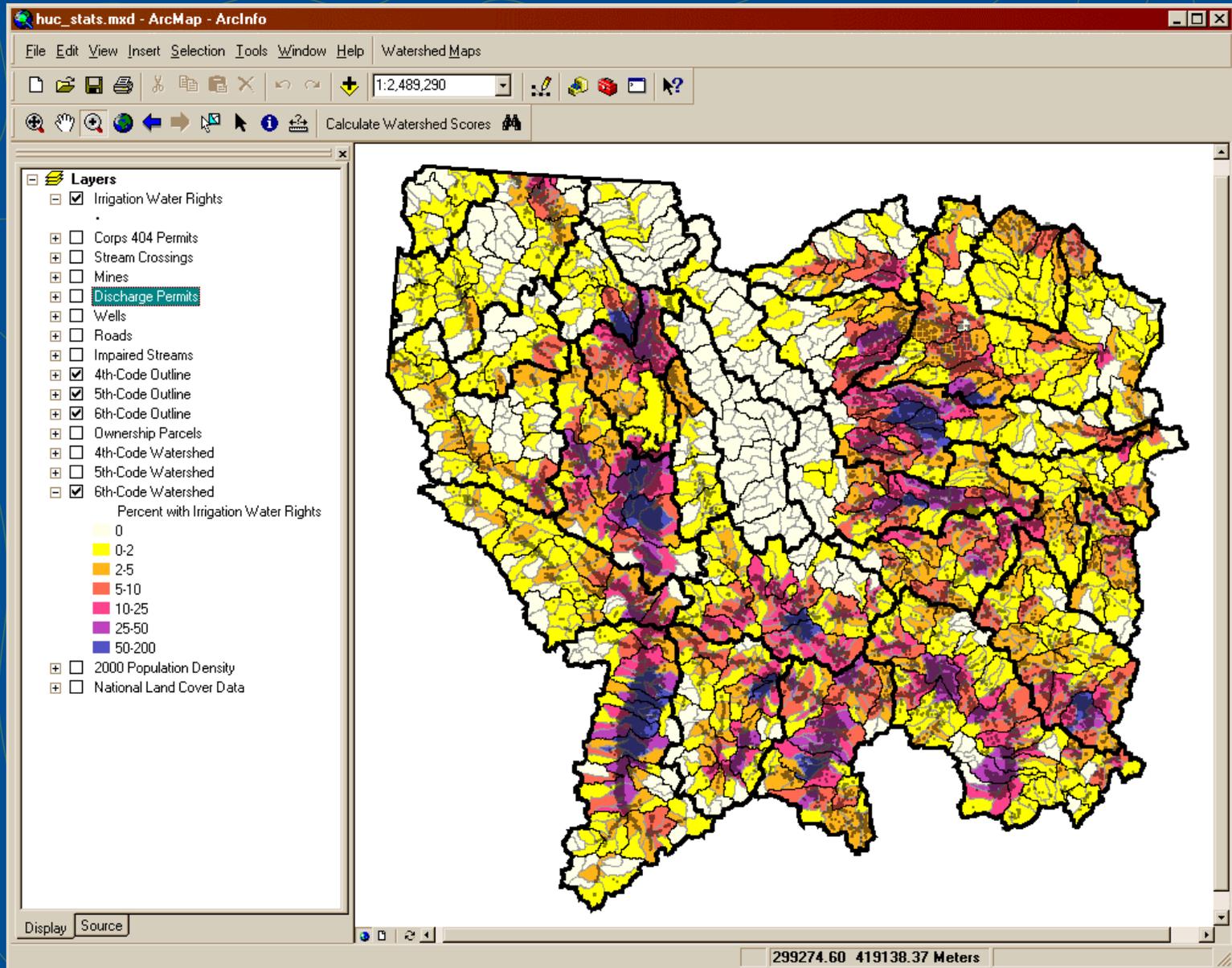
# Phenomena: Percent Wilderness



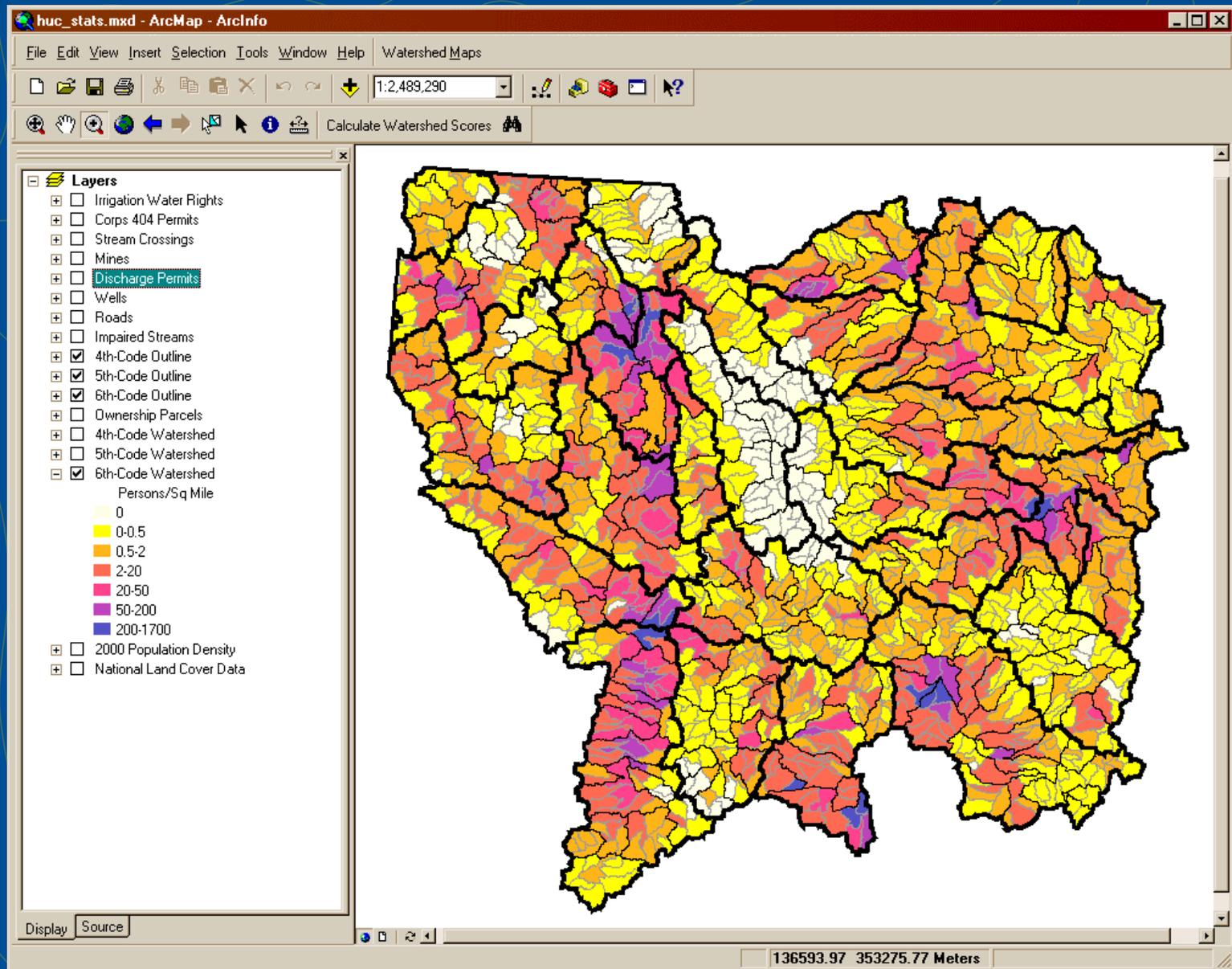
# Phenomena: Percent USFWS Easements



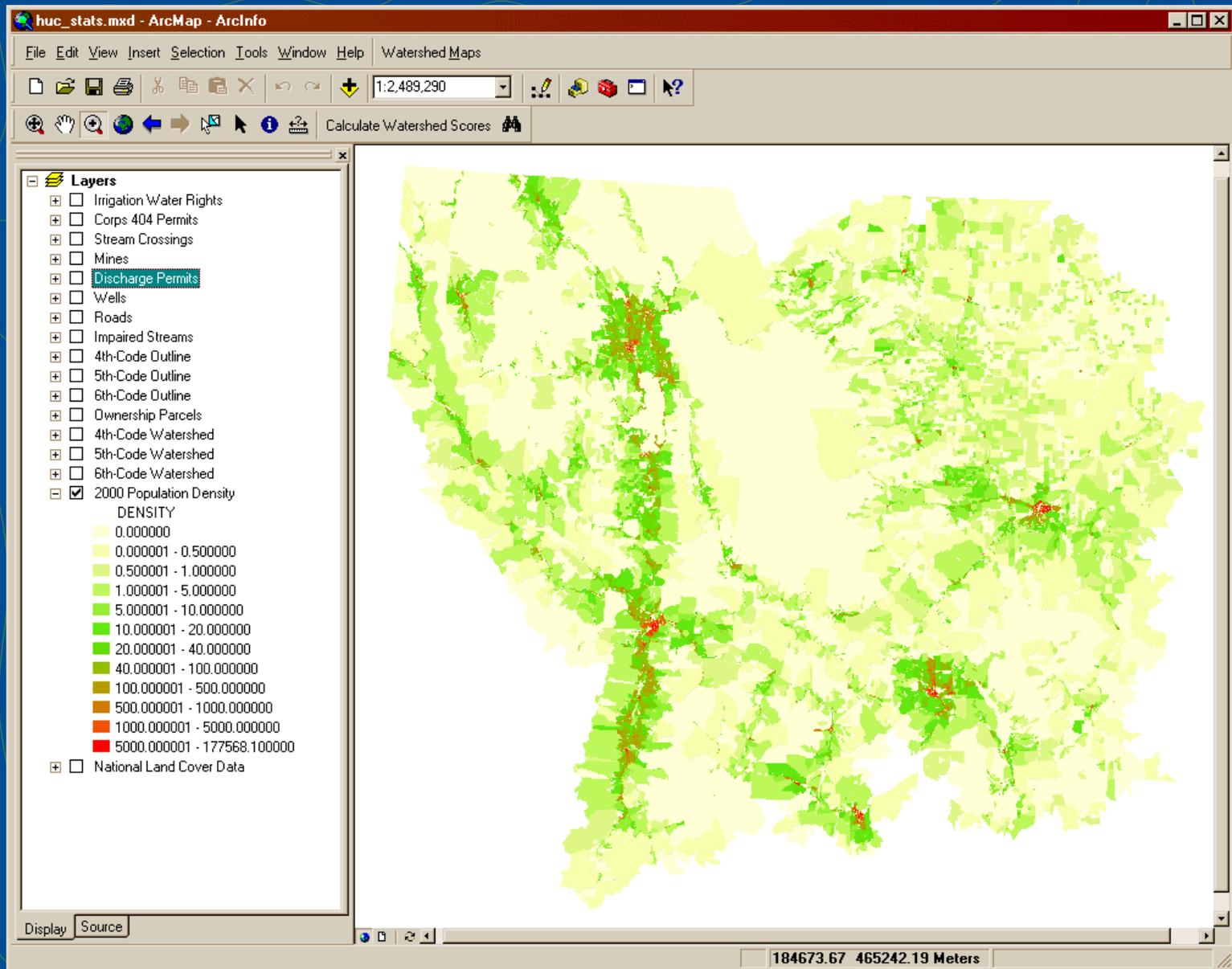
# Phenomena: Percent with Irrigation Water Rights



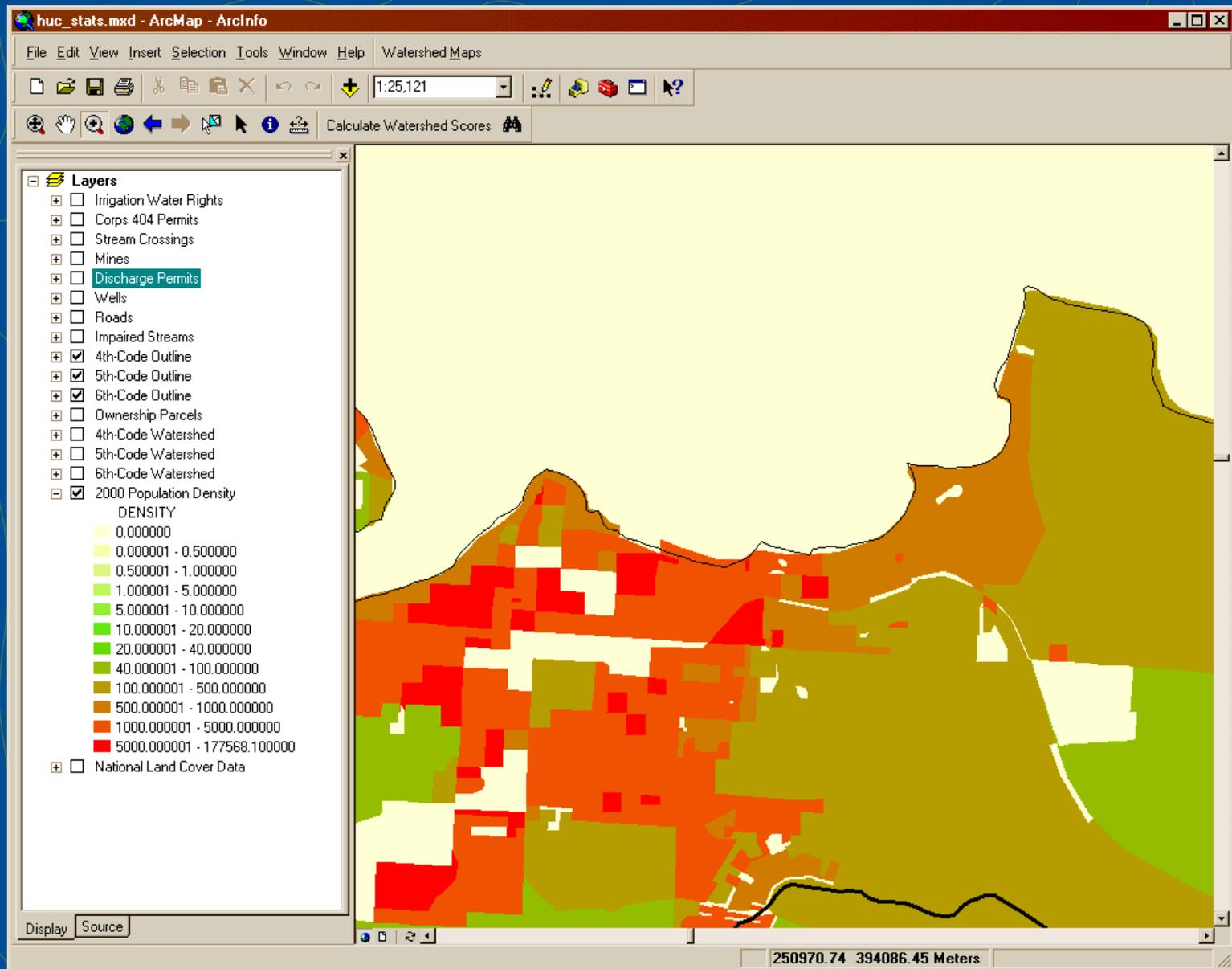
# Phenomena: Persons per Square Mile



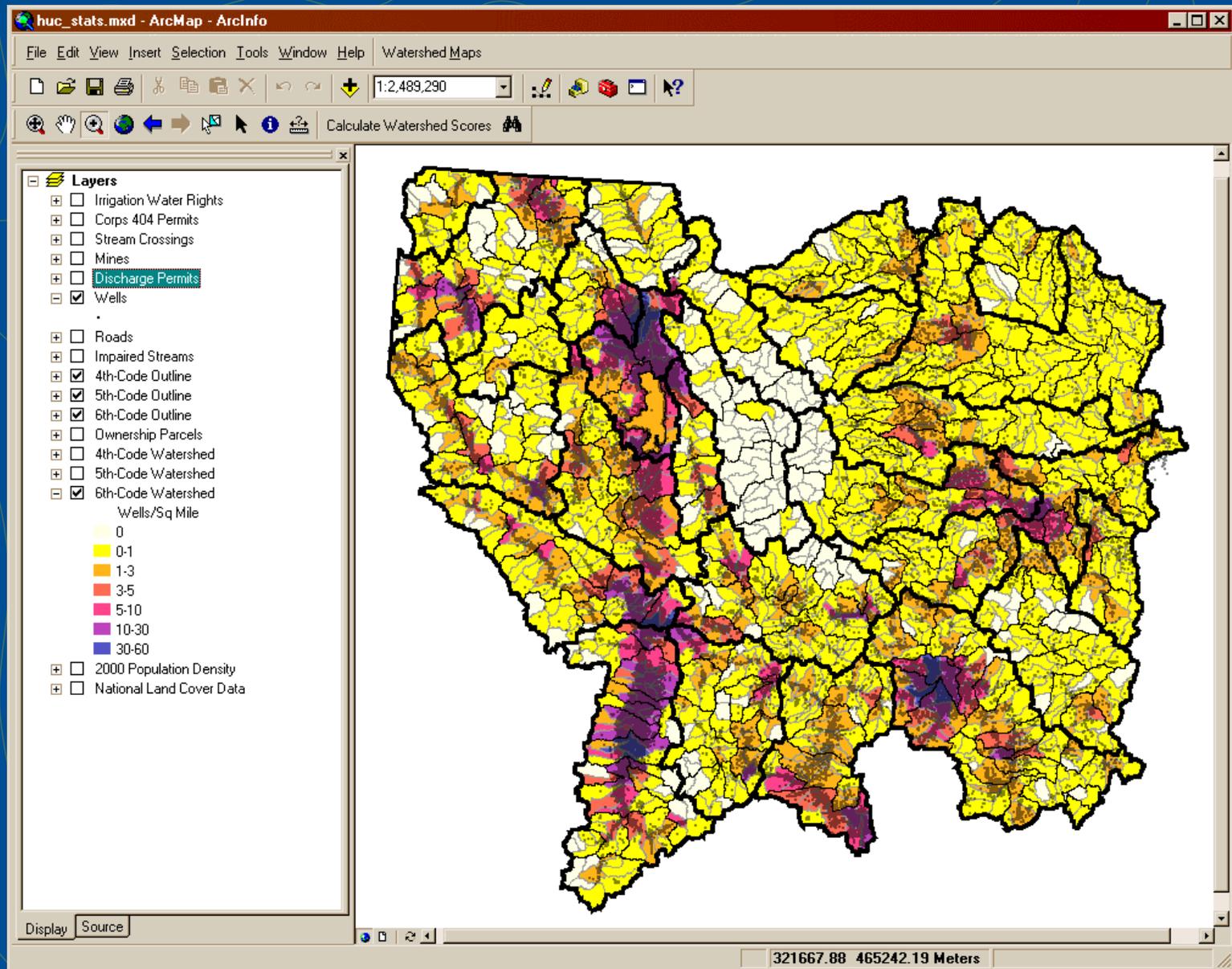
# Phenomena: Persons per Square Mile



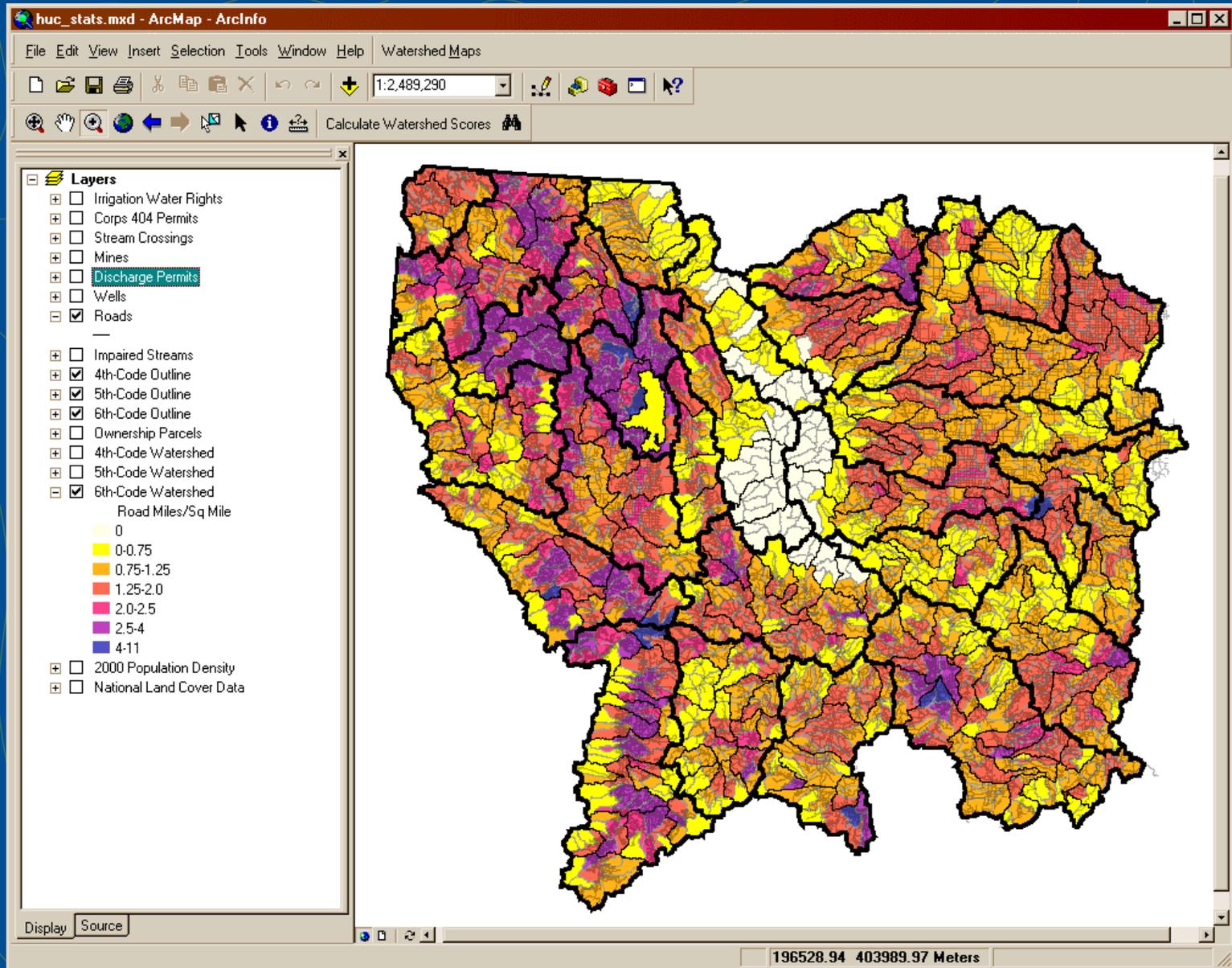
# Phenomena: Persons per Square Mile



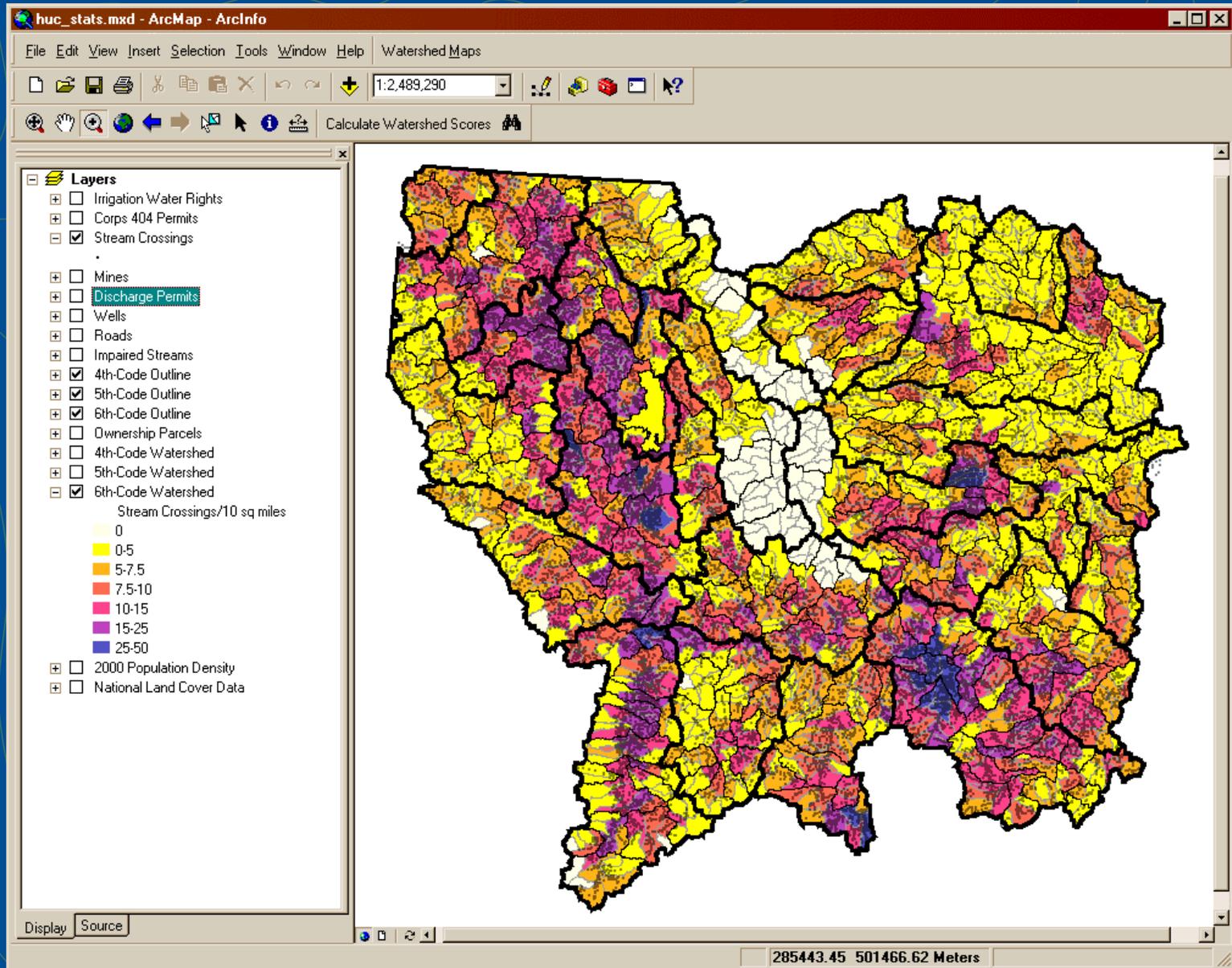
# Phenomena: Wells per Square Mile



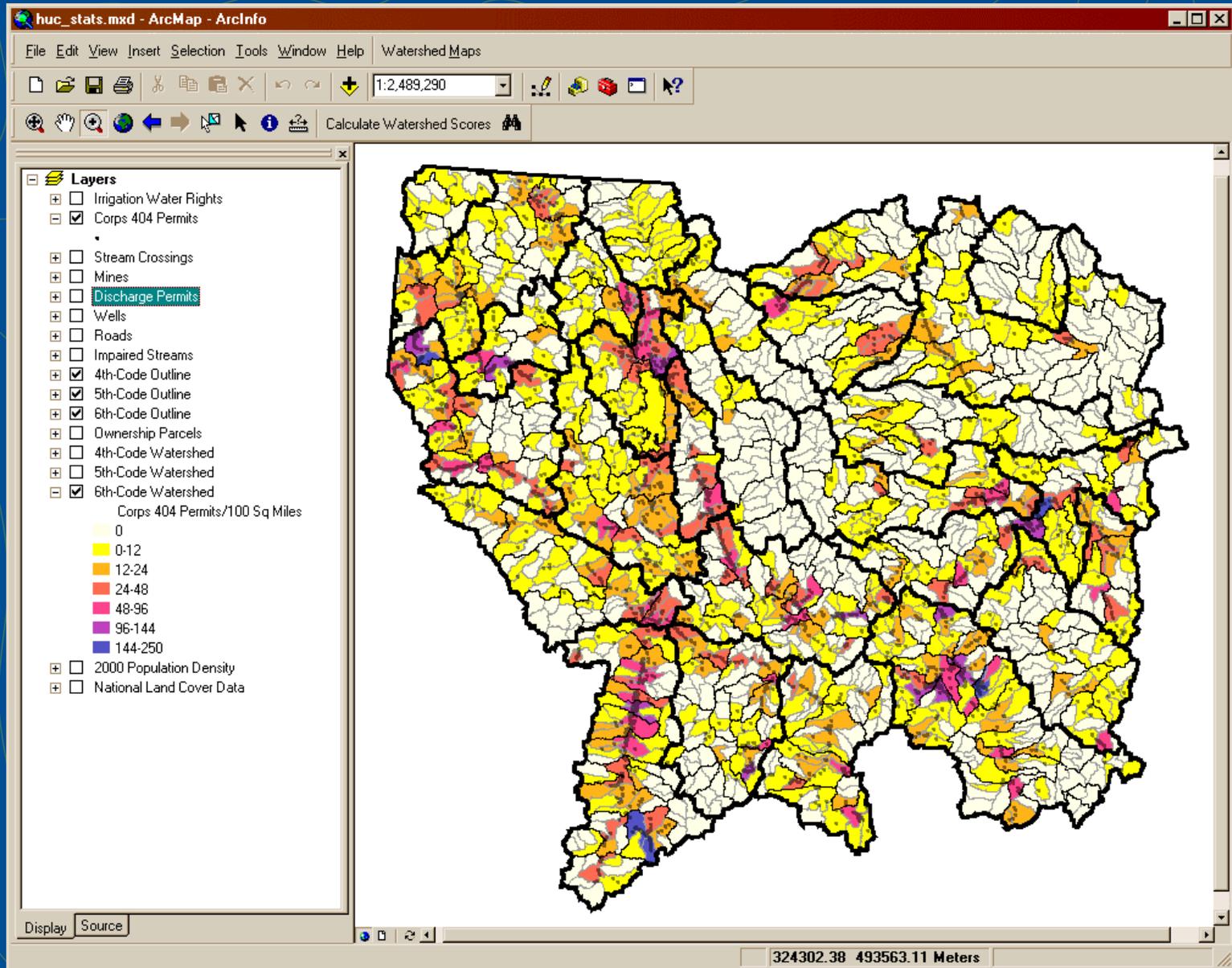
# Phenomena: Road Miles per Square Mile



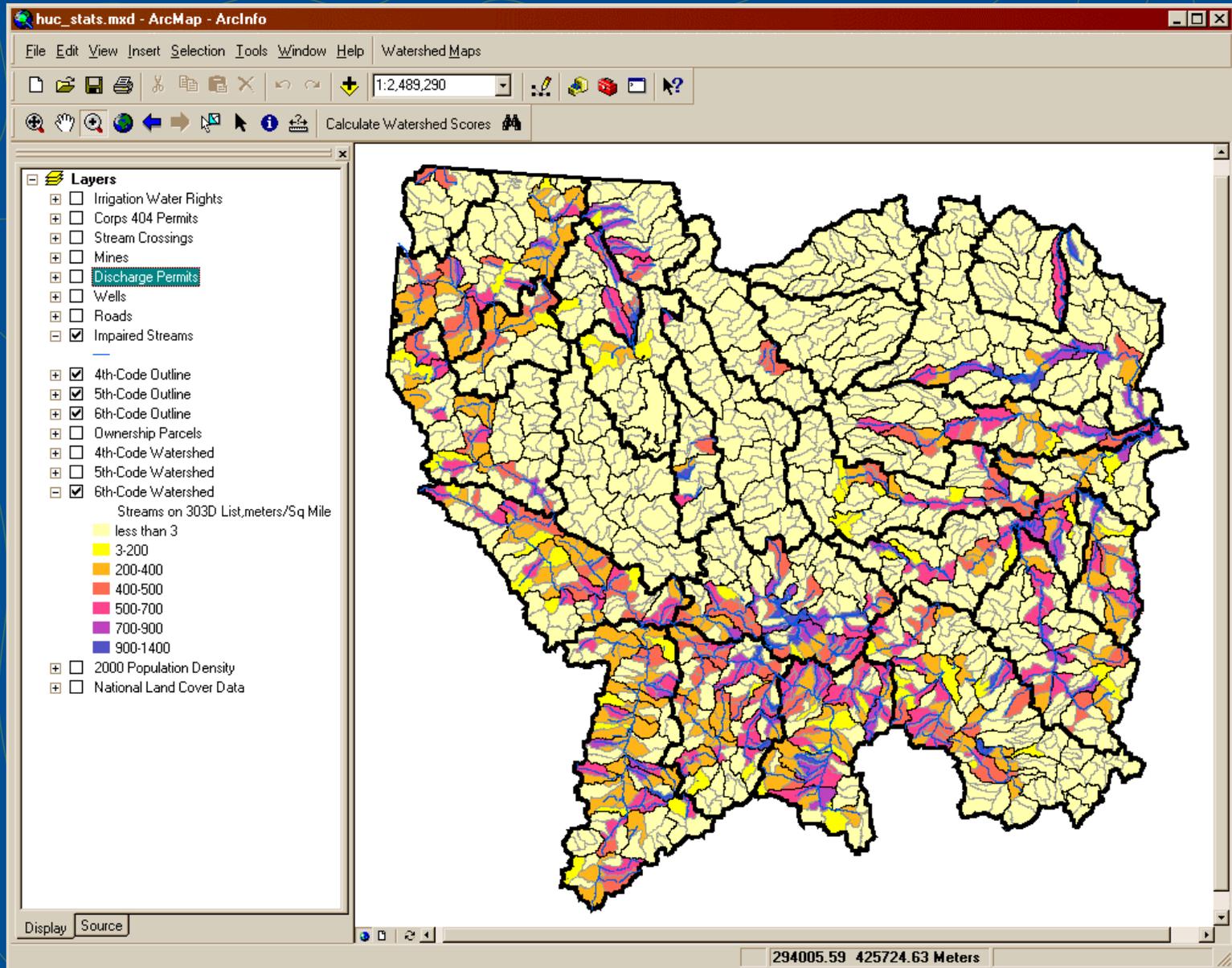
# Phenomena: Stream Crossings / 10 Square Miles



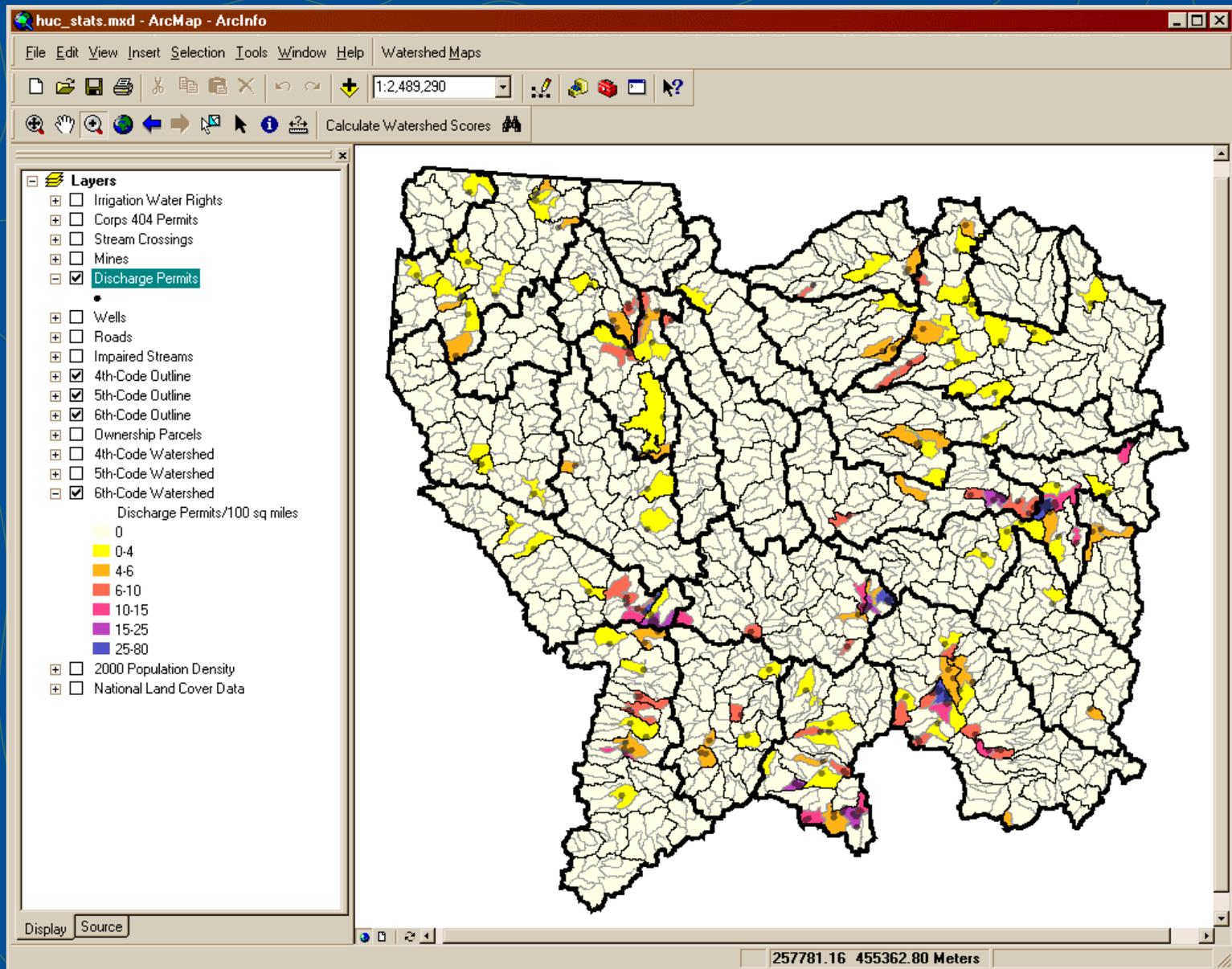
# Phenomena: Corps 404 Permits / 100 Square Miles



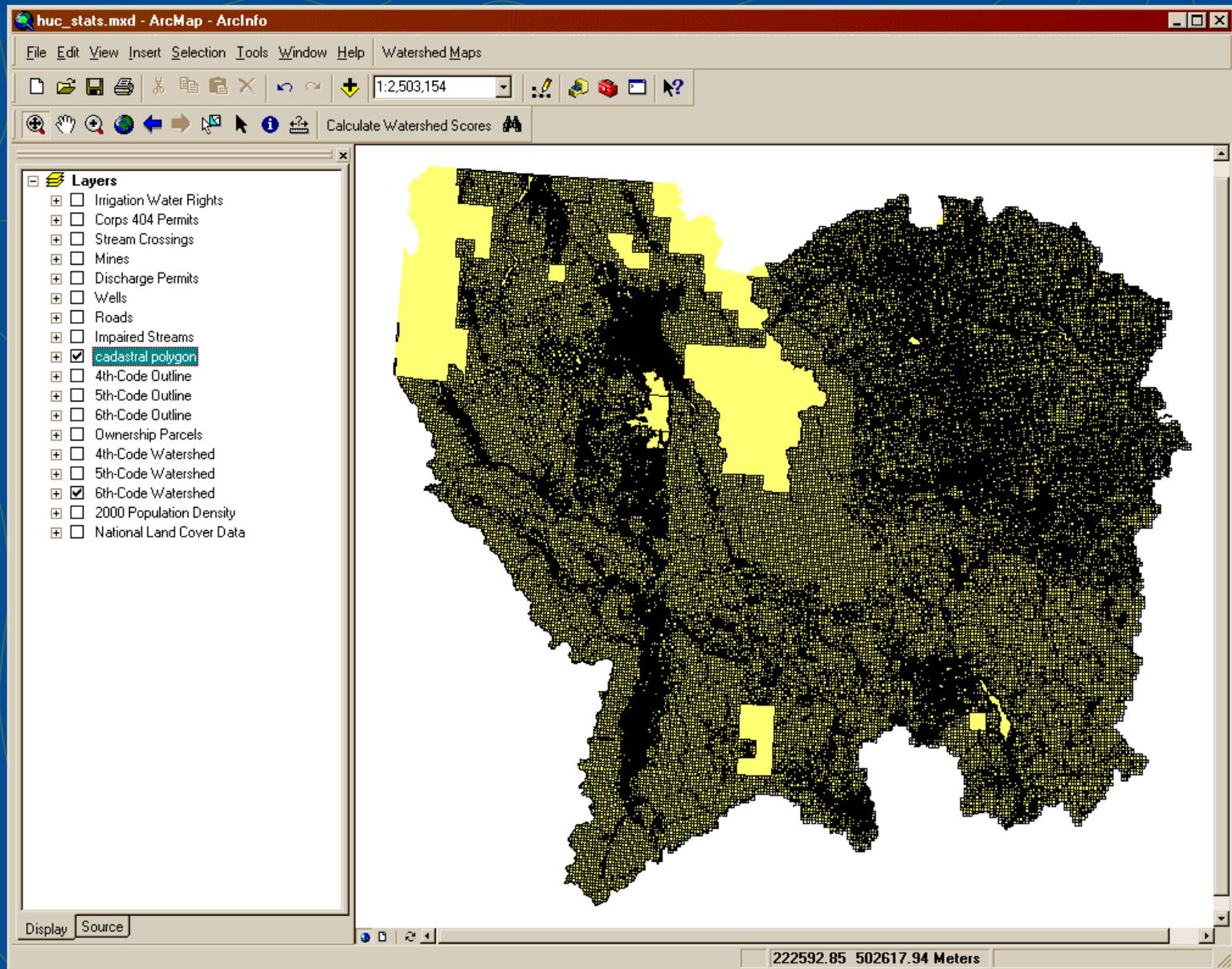
# Phenomena: S303d Stream Meters / Square Mile



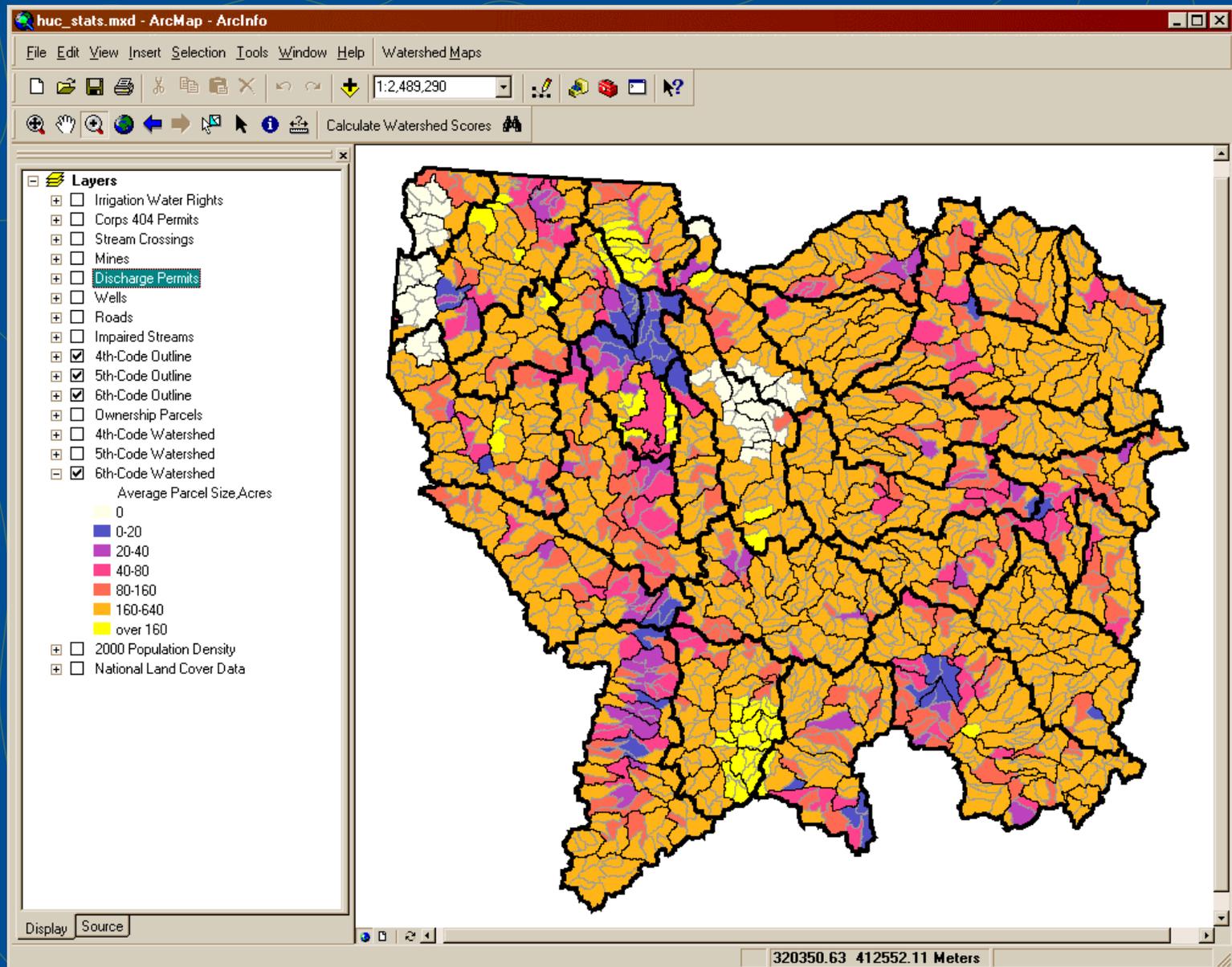
# Phenomena: Discharge Permits / 100 Square Miles



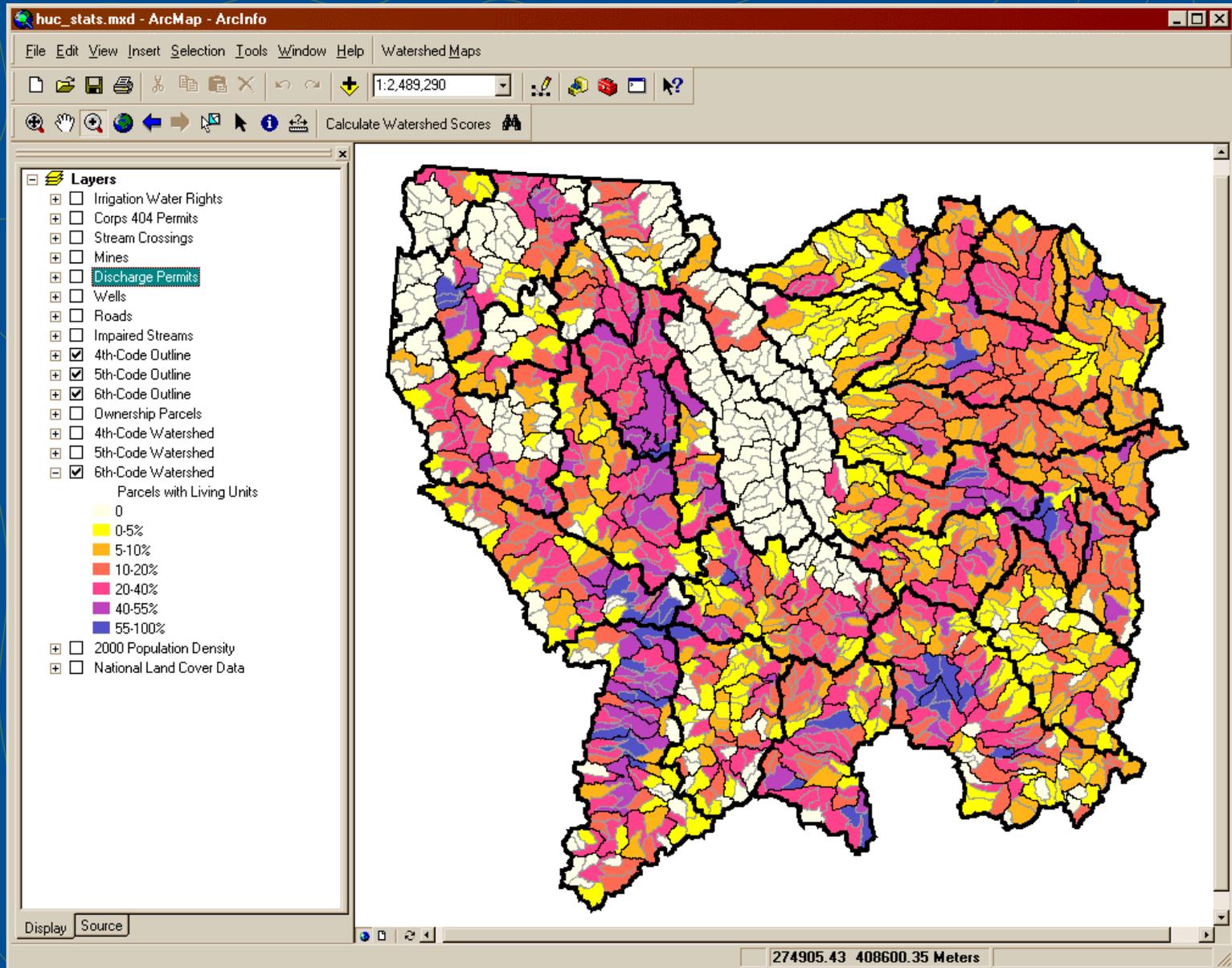
# Cadastral Parcel-Based Phenomena



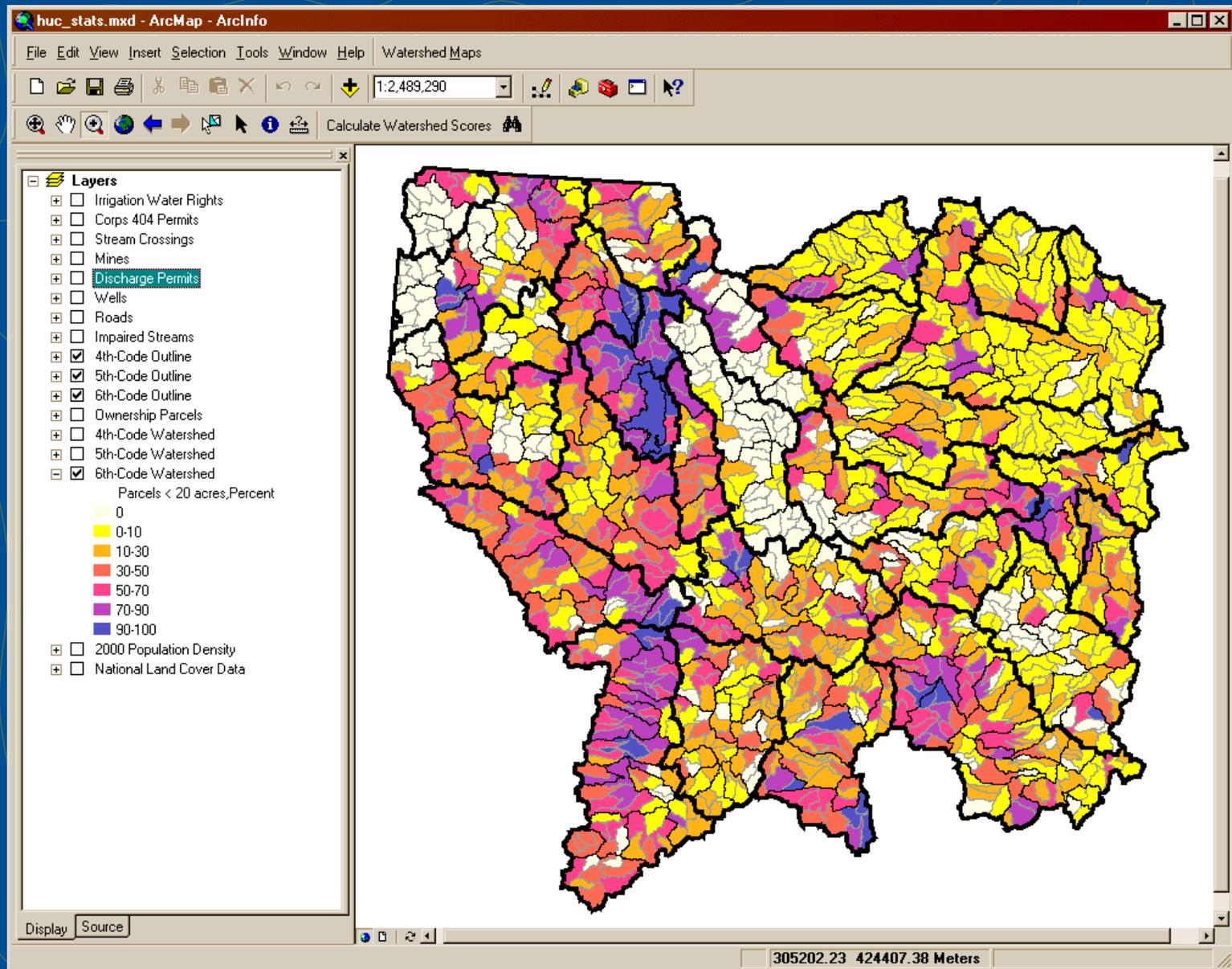
# Phenomena: Average Parcel Size



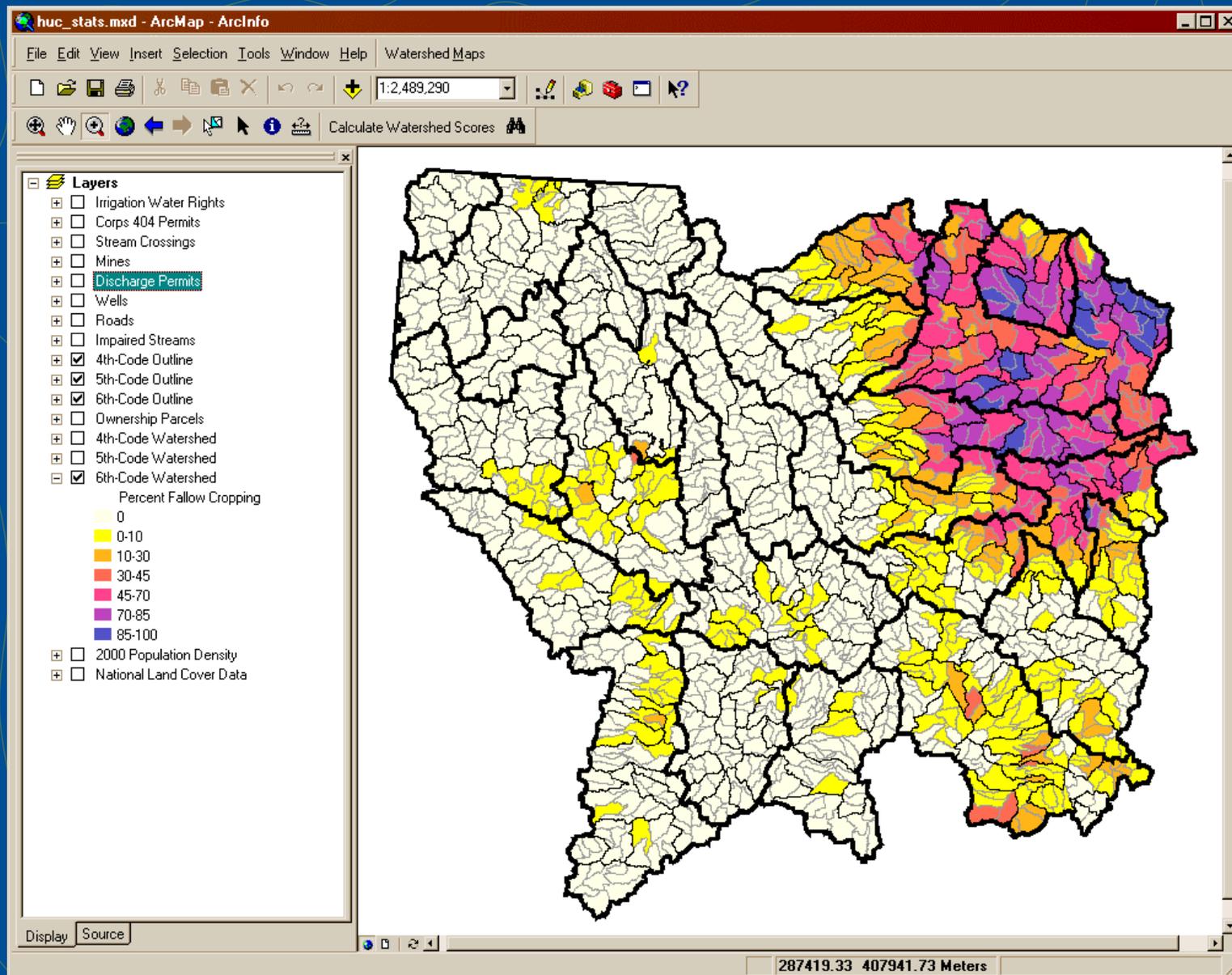
# Phenomena: Percent Parcels With Dwellings



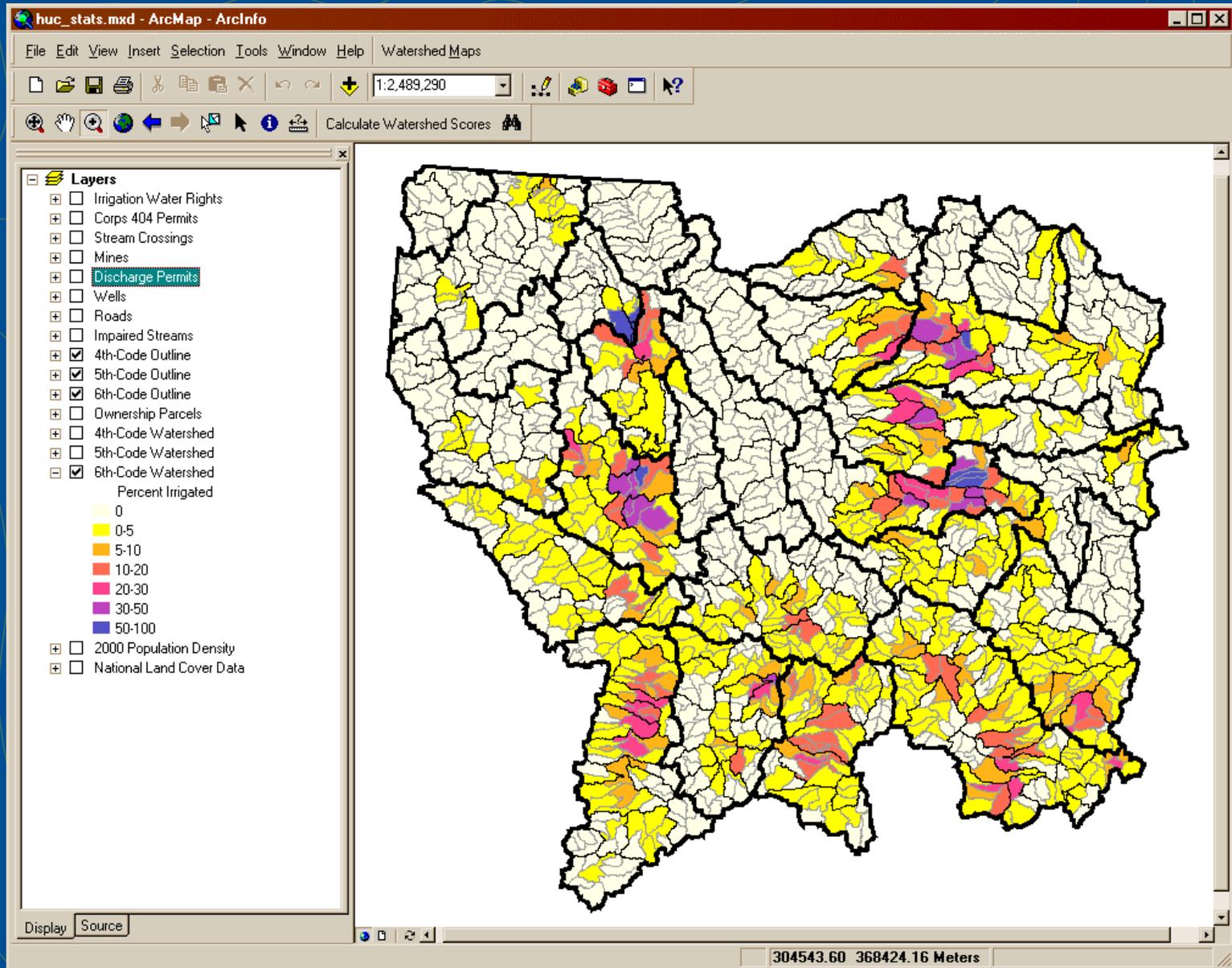
# Phenomena: Percent Parcels Less than 20 Acres



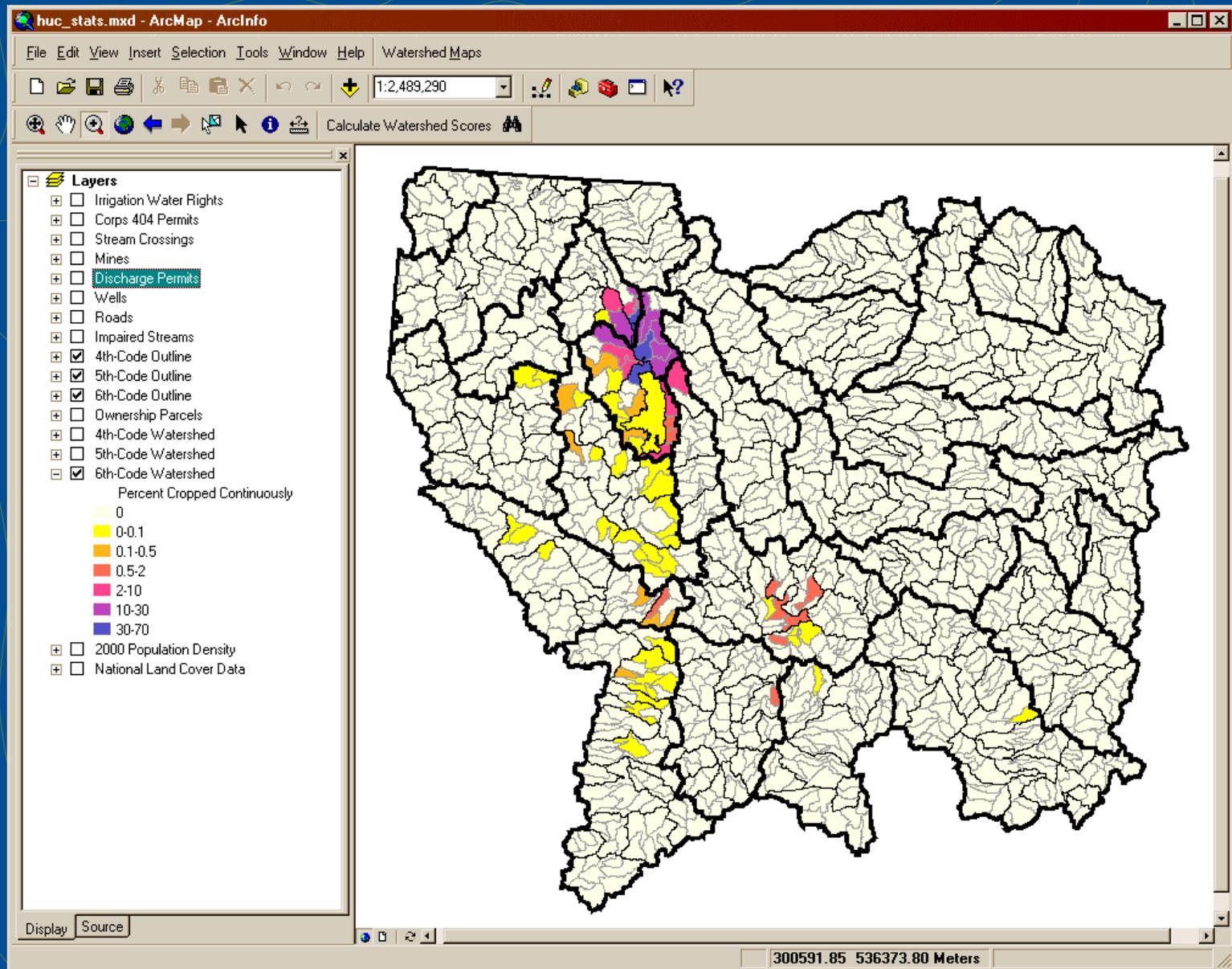
# Phenomena: Percent Fallow Cropping



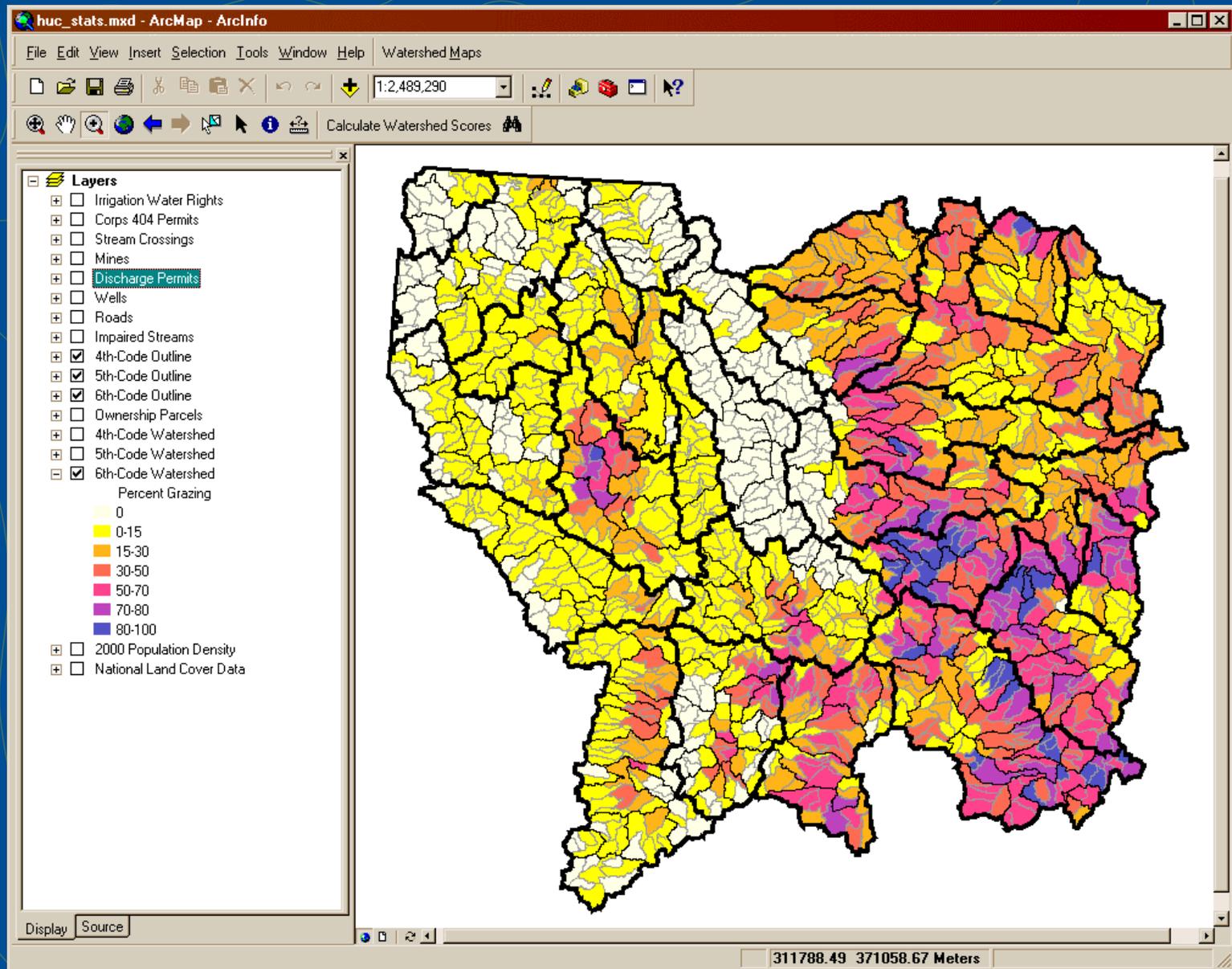
# Phenomena: Percent Irrigated Cropping



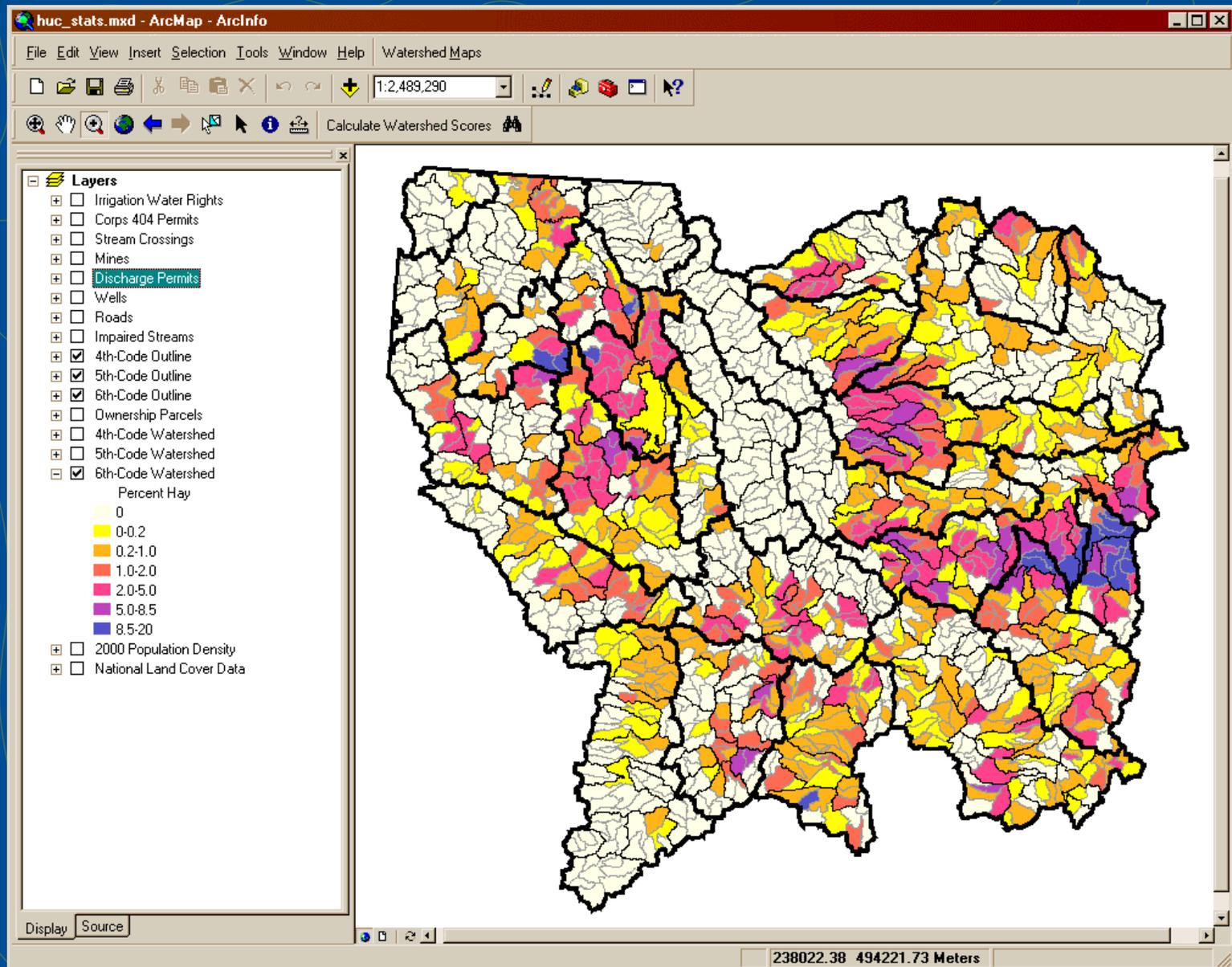
# Phenomena: Percent Continuous Cropping



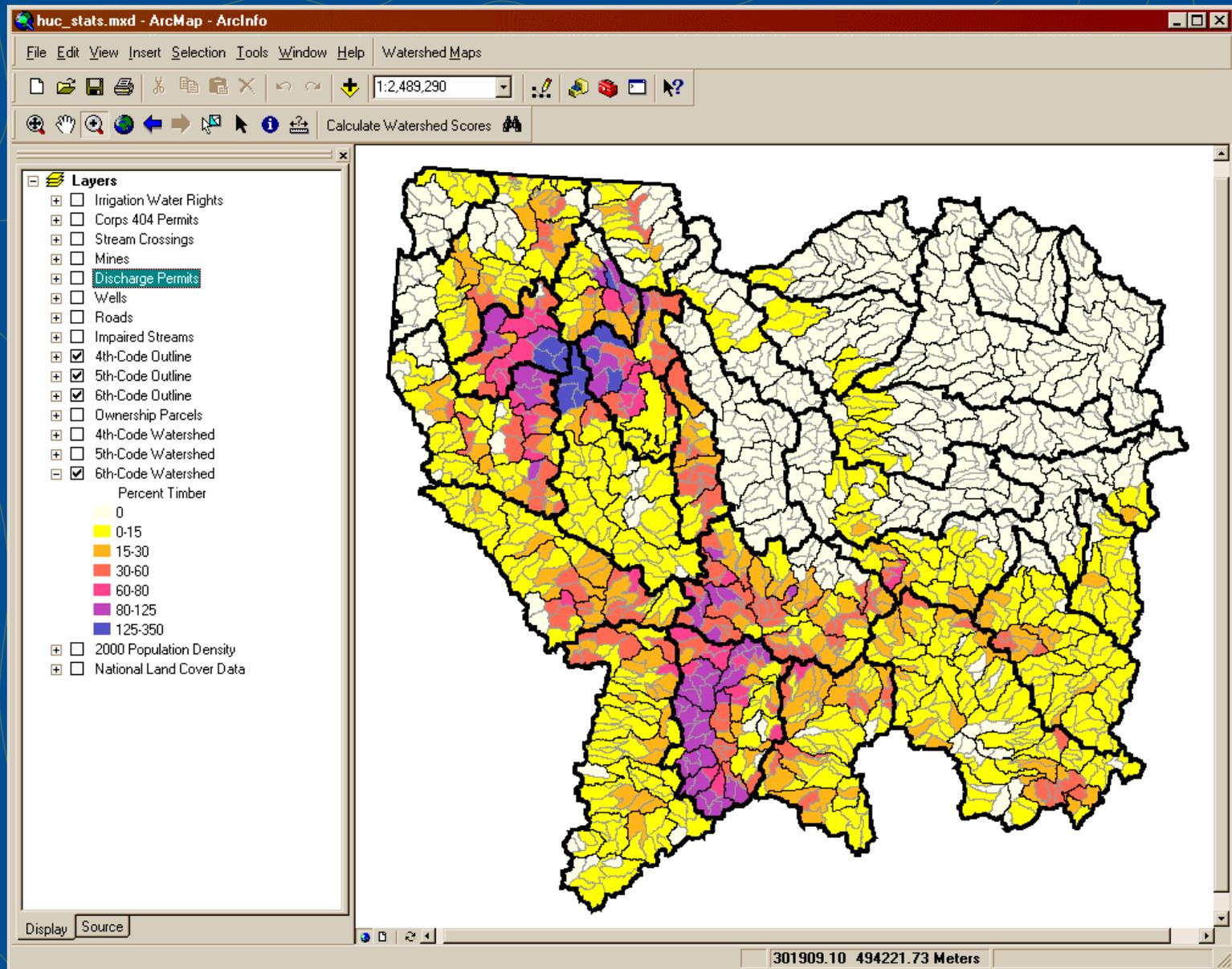
# Phenomena: Percent Grazing



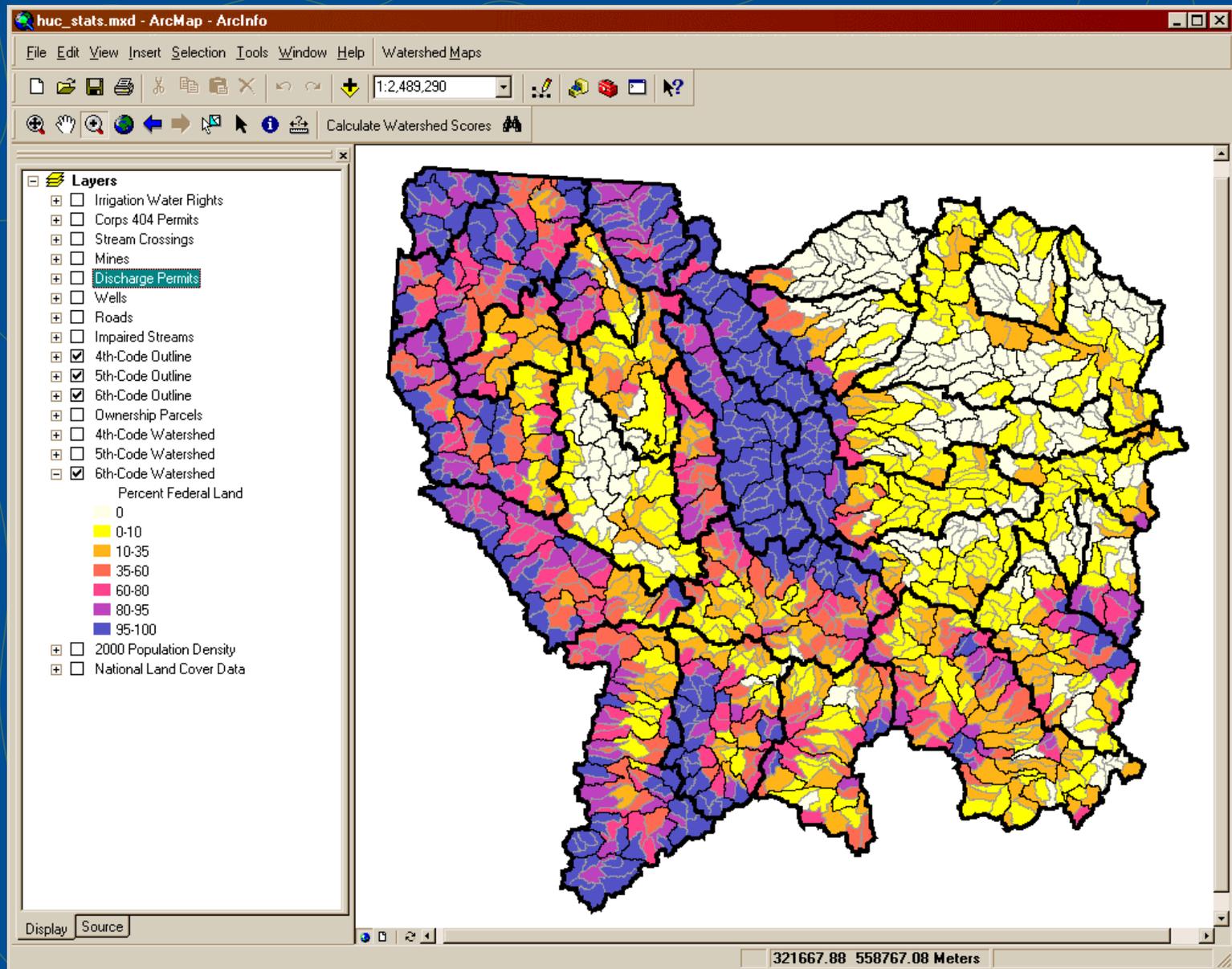
# Phenomena: Percent Hay



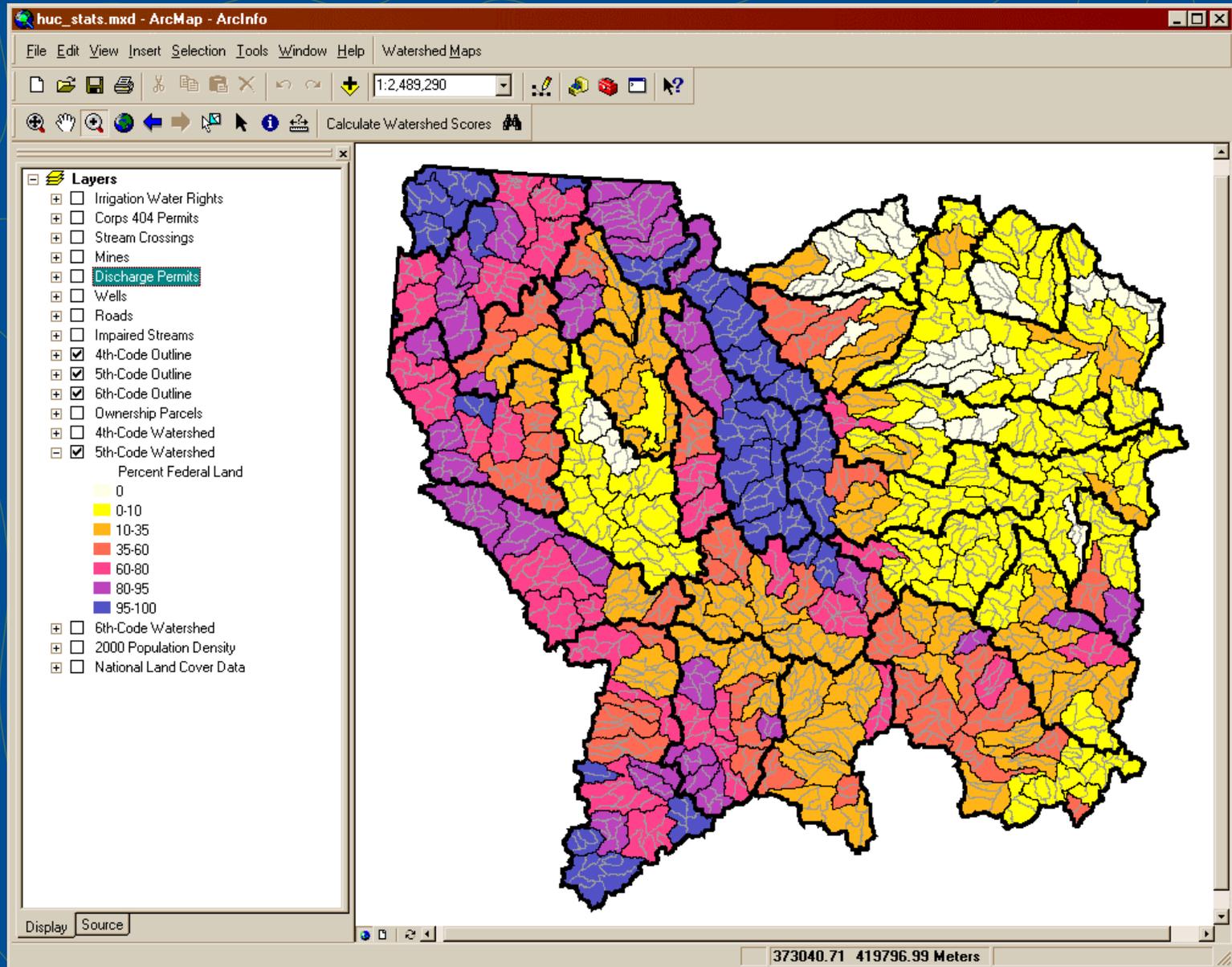
# Phenomena: Percent Commercial Timber



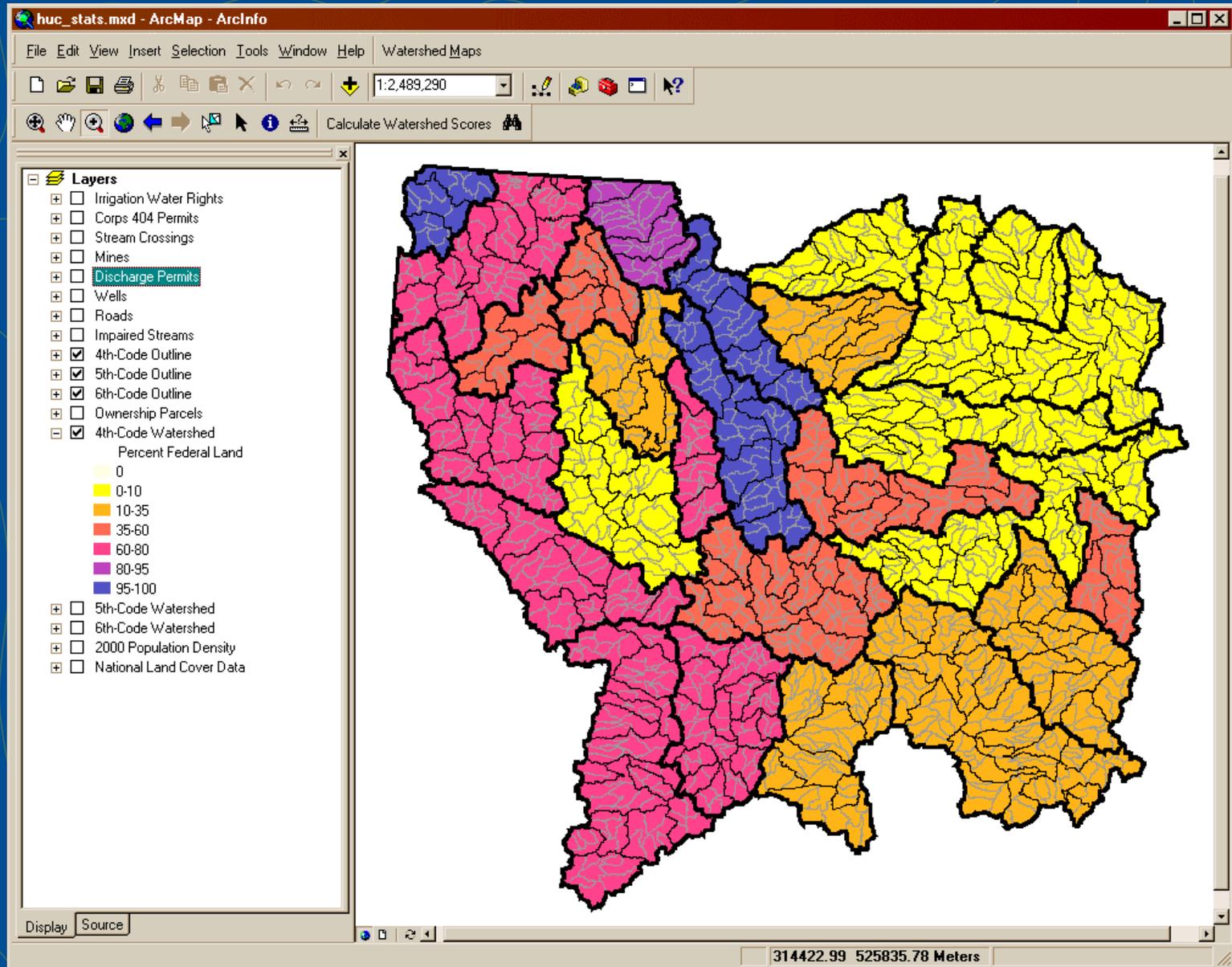
# 3 Watershed Levels – 6<sup>th</sup> Code



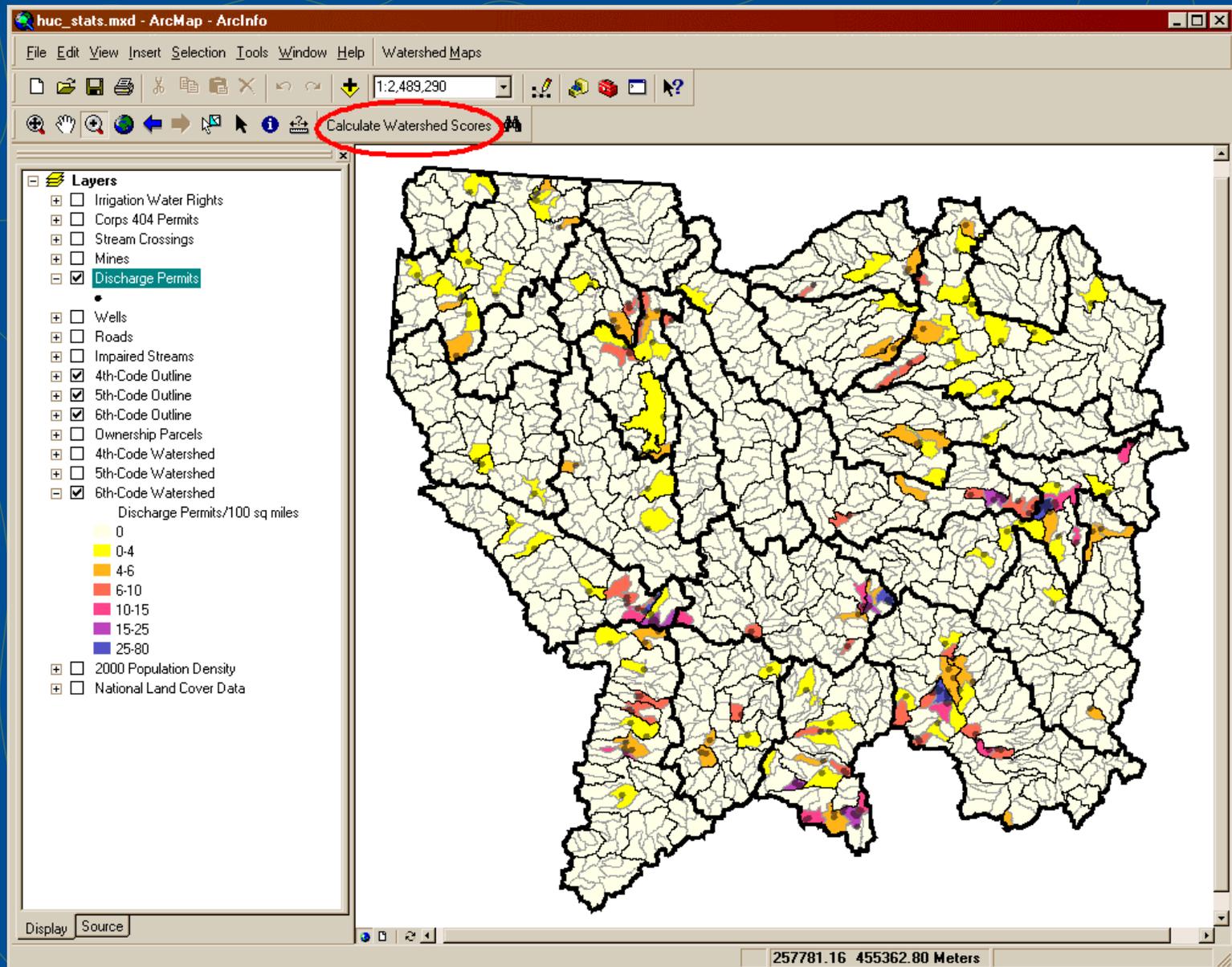
# 3 Watershed Levels – 5<sup>th</sup> Code



# 3 Watershed Levels – 4<sup>th</sup> Code



# Assign Weights to Phenomena



# Assign Weights to Phenomena

**Watershed Scores** [X]

Enter a value between -10 and +10 to weight the relative positive or negative impact of each factor on the wetland score.

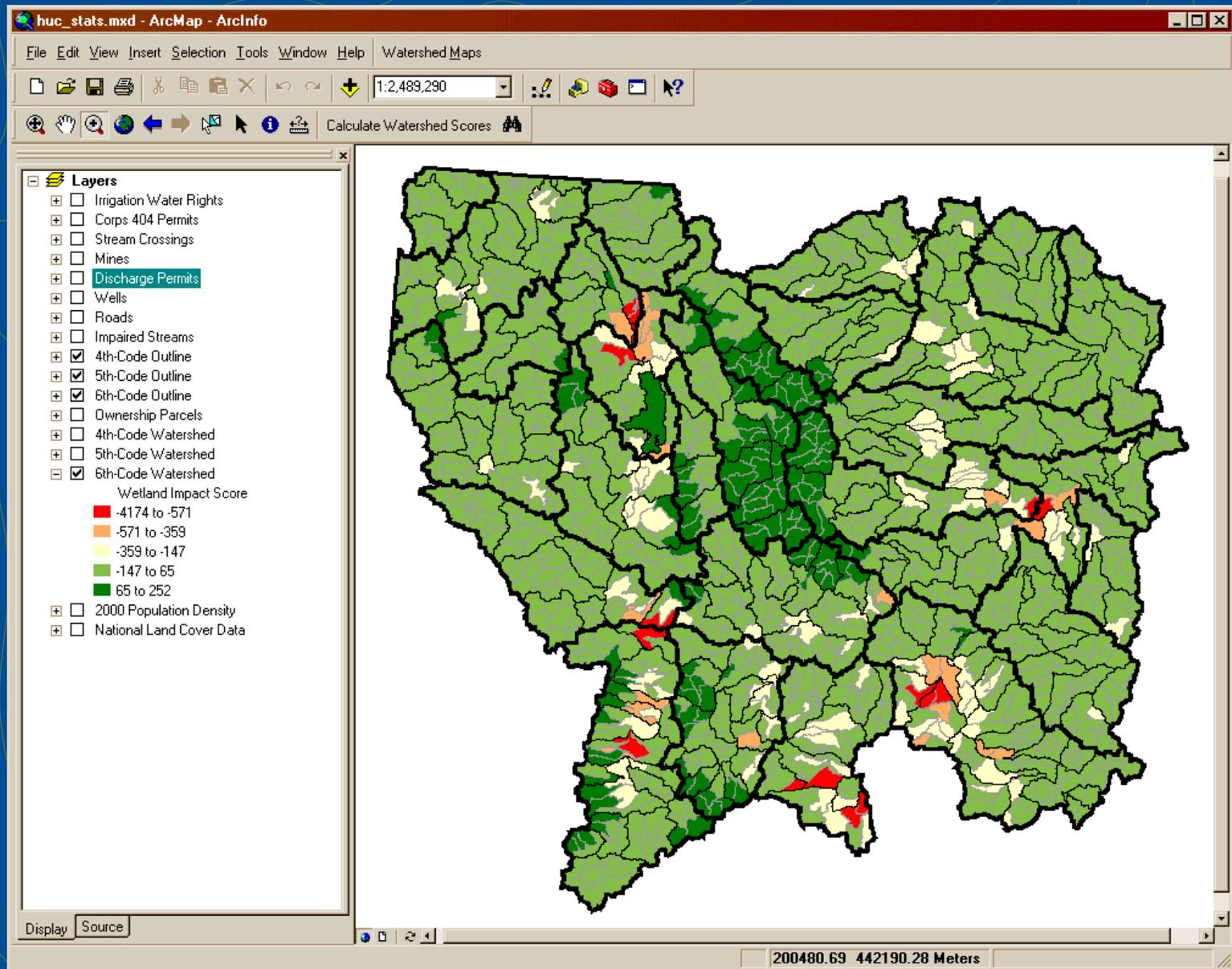
Blue numbers are the Statewide value for each factor

General		National Land Cover Data	
Corps 404 Permits	<input type="text" value="-5"/> <b>7.23</b>	Barren	<input type="text" value="0"/> <b>1.15</b>
Stream Crossings	<input type="text" value="-4"/> <b>7.06</b>	Commercial	<input type="text" value="-3"/> <b>0.13</b>
Federal Land	<input type="text" value="4"/> <b>28.9</b>	Crops	<input type="text" value="-3"/> <b>18.6</b>
FWS Easements	<input type="text" value="0"/> <b>0.17</b>	Forest	<input type="text" value="5"/> <b>22.6</b>
Mines	<input type="text" value="-7"/> <b>5.09</b>	Grassland	<input type="text" value="3"/> <b>44.7</b>
Discharge Permits	<input type="text" value="-5"/> <b>0.46</b>	Water	<input type="text" value="1"/> <b>1.05</b>
Population	<input type="text" value="-5"/> <b>6.14</b>	Mines	<input type="text" value="-4"/> <b>2.80</b>
Roads	<input type="text" value="-6"/> <b>1.09</b>	Orchards	<input type="text" value="0"/> <b>0.00006</b>
303d Listed Streams	<input type="text" value="-4"/> <b>98.7</b>	Pasture	<input type="text" value="-1"/> <b>2.34</b>
Wells	<input type="text" value="-5"/> <b>1.27</b>	Low-Dens Residential	<input type="text" value="-2"/> <b>0.080</b>
Wilderness	<input type="text" value="8"/> <b>3.70</b>	Hi-Dens Residential	<input type="text" value="0"/> <b>0.002</b>
Irrigation Water Rights	<input type="text" value="-5"/> <b>0.45</b>	Shrubs	<input type="text" value="1"/> <b>8.77</b>

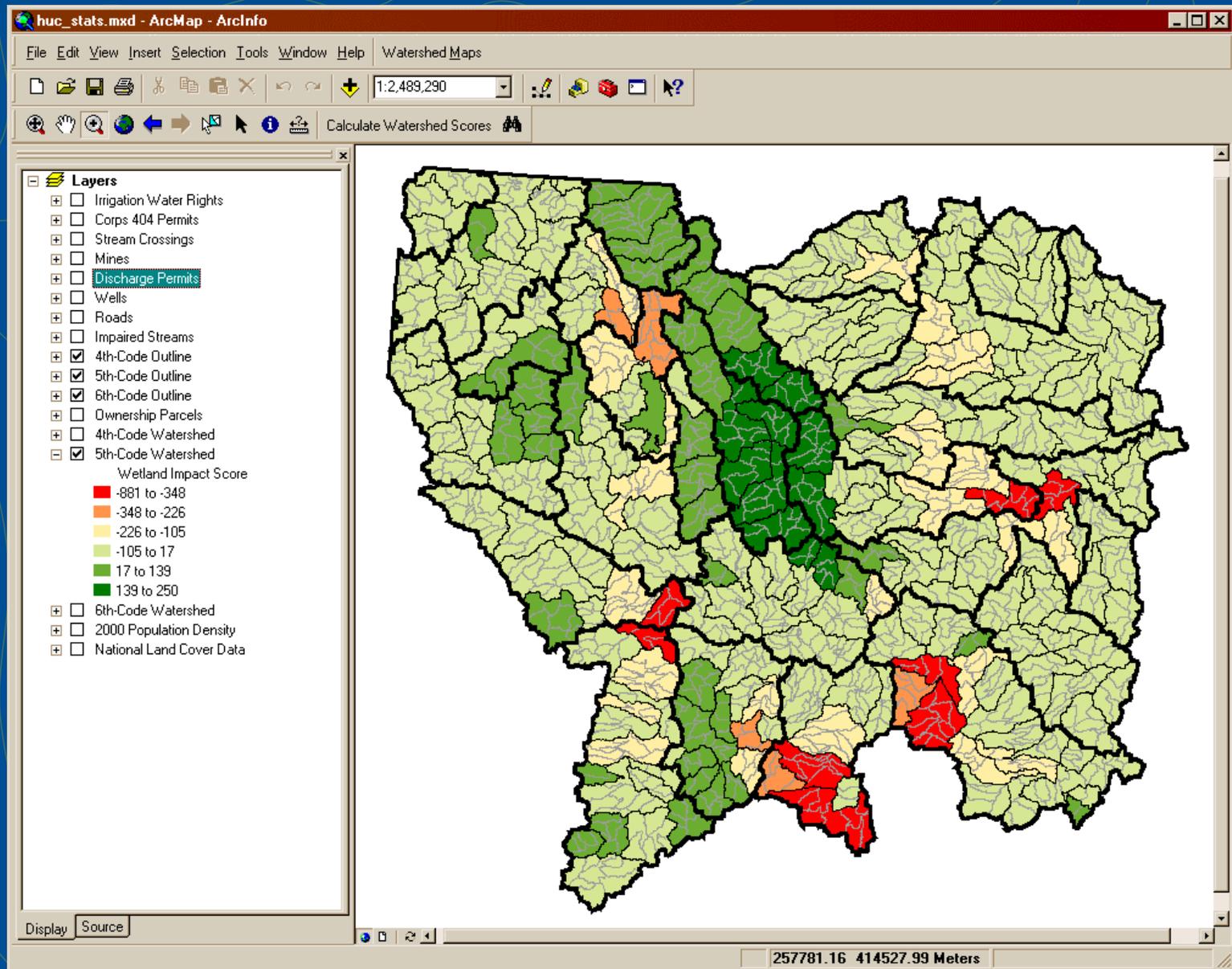
Parcel Agriculture Data		Parcel Information	
Hay	<input type="text" value="-2"/> <b>0.92</b>	Avg Parcel Size, Acres	<input type="text" value="0"/> <b>208</b>
Continuous Cropping	<input type="text" value="0"/> <b>0.086</b>	Parcels w/ Living Units	<input type="text" value="0"/> <b>35.8</b>
Fallow Crops	<input type="text" value="-4"/> <b>13.1</b>	Parcels < 20 Acres	<input type="text" value="0"/> <b>52.0</b>
Grazing	<input type="text" value="-5"/> <b>38.0</b>		
Irrigated	<input type="text" value="-5"/> <b>1.84</b>		
Timber	<input type="text" value="3"/> <b>5.43</b>		

Calculations Remaining: 0

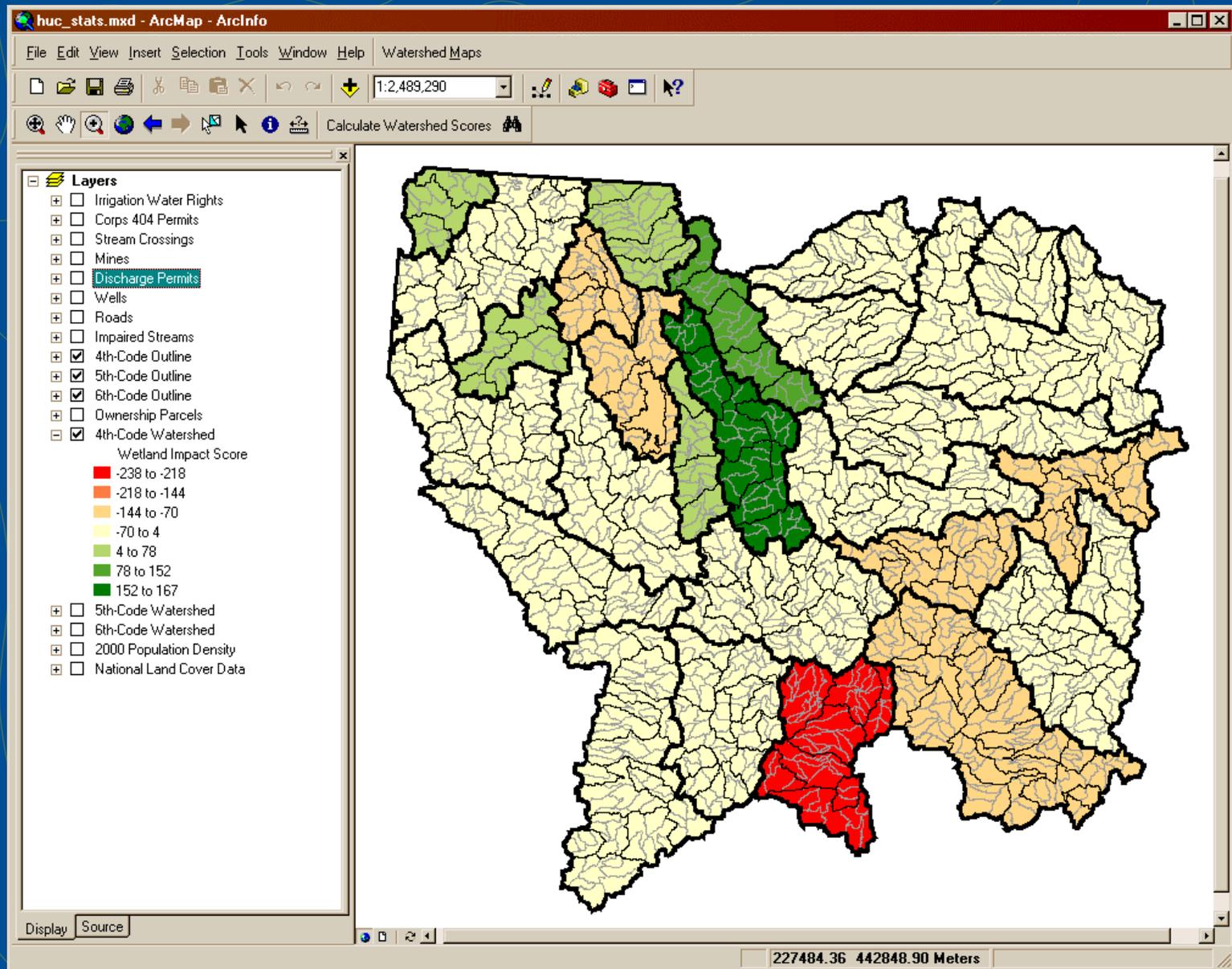
# View Watershed Scores – 6<sup>th</sup> Code



# View Watershed Scores – 5<sup>th</sup> Code



# View Watershed Scores – 4<sup>th</sup> Code



# Assign New Weights to Phenomena

**Watershed Scores**

Enter a value between -10 and +10 to weight the relative positive or negative impact of each factor on the wetland score.

Blue numbers are the Statewide value for each factor

General		National Land Cover Data	
Corps 404 Permits	<input type="text" value="-5"/> 7.23	Barren	<input type="text" value="0"/> 1.15
Stream Crossings	<input type="text" value="-4"/> 7.06	Commercial	<input type="text" value="-3"/> 0.13
Federal Land	<input type="text" value="4"/> 28.9	Crops	<input type="text" value="-3"/> 18.6
FWS Easements	<input type="text" value="0"/> 0.17	Forest	<input type="text" value="5"/> 22.6
Mines	<input type="text" value="-7"/> 5.09	Grassland	<input type="text" value="3"/> 44.7
Discharge Permits	<input type="text" value="-5"/> 0.46	Water	<input type="text" value="1"/> 1.05
Population	<input type="text" value="-5"/> 6.14	Mines	<input type="text" value="-4"/> 2.80
Roads	<input type="text" value="-6"/> 1.09	Orchards	<input type="text" value="0"/> 0.00006
303d Listed Streams	<input type="text" value="-4"/> 98.7	Pasture	<input type="text" value="-1"/> 2.34
Wells	<input type="text" value="-5"/> 1.27	Low-Dens Residential	<input type="text" value="-2"/> 0.080
Wilderness	<input type="text" value="8"/> 3.70	Hi-Dens Residential	<input type="text" value="0"/> 0.002
Irrigation Water Rights	<input type="text" value="-5"/> 0.45	Shrubs	<input type="text" value="1"/> 8.77
		Snow	<input type="text" value="1"/> 0.048
		Wetlands	<input type="text" value="0"/> 0.005

Parcel Agriculture Data		Parcel Information	
Hay	<input type="text" value="-2"/> 0.92	Avg Parcel Size, Acres	<input type="text" value="0"/> 208
Continuous Cropping	<input type="text" value="0"/> 0.086	Parcels w/ Living Units	<input type="text" value="0"/> 35.8
Fallow Crops	<input type="text" value="-4"/> 13.1	Parcels < 20 Acres	<input type="text" value="0"/> 52.0
Grazing	<input type="text" value="-5"/> 38.0		
Irrigated	<input type="text" value="-5"/> 1.84		
Timber	<input type="text" value="3"/> 5.43		

Calculations Remaining: 0

**Watershed Scores**

Enter a value between -10 and +10 to weight the relative positive or negative impact of each factor on the wetland score.

Blue numbers are the Statewide value for each factor

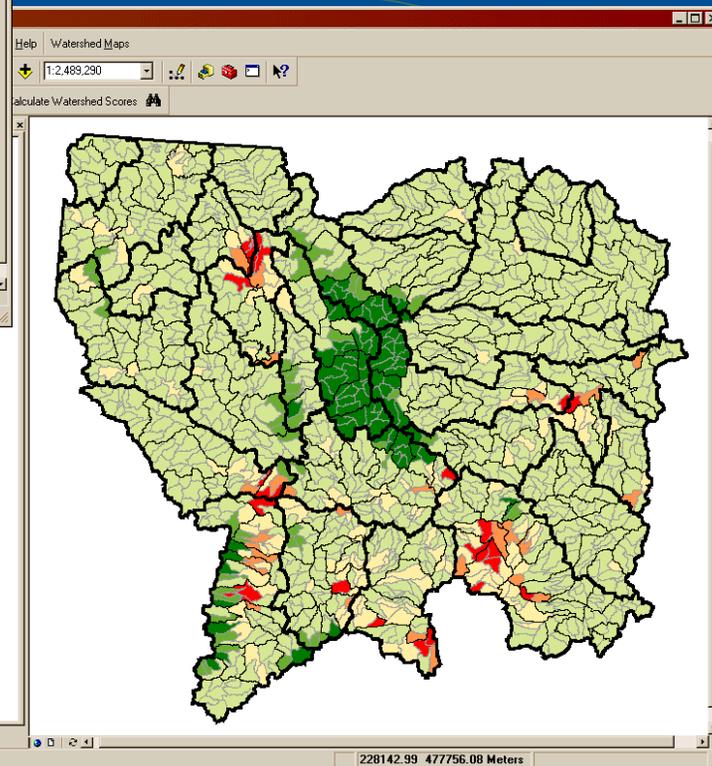
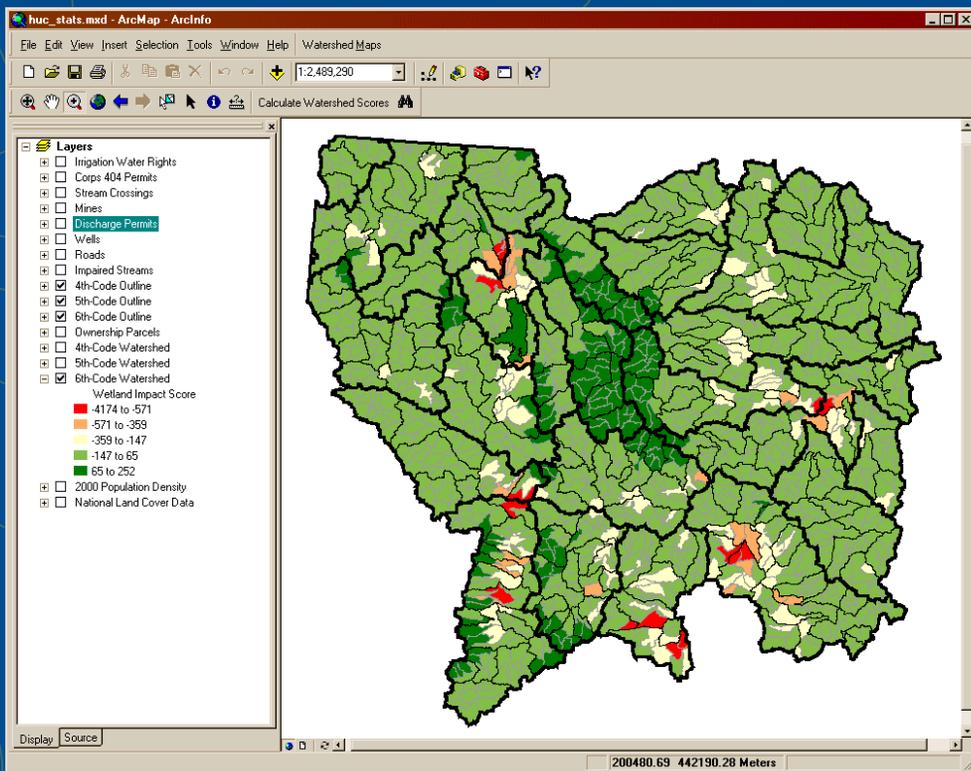
General		National Land Cover Data	
Corps 404 Permits	<input type="text" value="-5"/> 7.23	Barren	<input type="text" value="0"/> 1.15
Stream Crossings	<input type="text" value="-4"/> 7.06	Commercial	<input type="text" value="0"/> 0.13
Federal Land	<input type="text" value="0"/> 28.9	Crops	<input type="text" value="0"/> 18.6
FWS Easements	<input type="text" value="0"/> 0.17	Forest	<input type="text" value="0"/> 22.6
Mines	<input type="text" value="-7"/> 5.09	Grassland	<input type="text" value="0"/> 44.7
Discharge Permits	<input type="text" value="-5"/> 0.46	Water	<input type="text" value="0"/> 1.05
Population	<input type="text" value="-5"/> 6.14	Mines	<input type="text" value="0"/> 2.80
Roads	<input type="text" value="-6"/> 1.09	Orchards	<input type="text" value="0"/> 0.00006
303d Listed Streams	<input type="text" value="-4"/> 98.7	Pasture	<input type="text" value="0"/> 2.34
Wells	<input type="text" value="-5"/> 1.27	Low-Dens Residential	<input type="text" value="0"/> 0.080
Wilderness	<input type="text" value="10"/> 3.70	Hi-Dens Residential	<input type="text" value="0"/> 0.002
Irrigation Water Rights	<input type="text" value="-5"/> 0.45	Shrubs	<input type="text" value="0"/> 8.77
		Snow	<input type="text" value="0"/> 0.048
		Wetlands	<input type="text" value="0"/> 0.005

Parcel Agriculture Data		Parcel Information	
Hay	<input type="text" value="0"/> 0.92	Avg Parcel Size, Acres	<input type="text" value="0"/> 208
Continuous Cropping	<input type="text" value="0"/> 0.086	Parcels w/ Living Units	<input type="text" value="0"/> 35.8
Fallow Crops	<input type="text" value="0"/> 13.1	Parcels < 20 Acres	<input type="text" value="0"/> 52.0
Grazing	<input type="text" value="0"/> 38.0		
Irrigated	<input type="text" value="0"/> 1.84		
Timber	<input type="text" value="0"/> 5.43		

Calculations Remaining: 0

# View New Watershed Scores



# Watershed Database

**Attributes of 6th-Code Watershed**

HU_12_NAME	SCORE	ACRES	HU_8_NAME	HU_10_NAME	S303D	S303D_S
Lower Nyack Creek	32.80	22349.735	Middle Fork Flathead River	Harrison Lake	0	0
Upper Willow Creek	-125.11	33417.960	Cut Bank Creek	Willow Creek	0	0
Upper Good Creek	8.50	18915.741	Stillwater River	Good Creek	0	0

**Attributes of 6th-Code Watershed**

HU_12_NAME	SCORE	CORPS	CORPS_S	FED	FED_S	FWS	FWS_S	WILD	WILD_S	MINES
Lower Nyack Creek	32.80	0.00	0	100.000000	13.8313	0	0	0	0	
Upper Willow Creek	-125.11	44.05	-30.4706	0.000000	0	0.228	0	0	0	3.8
Upper Good Creek	8.50	3.38	-2.3405	96.918120	13.405	0	0	0	0	
Lower Lake Creek	-92.90	32.35	-22.375	45.457720	6.2874	0	0	14.77212	31.9225	29.8
Whitefish Lake	-100.72	63.59	-43.9897	15.953910	2.2066	0	0	0	0	
Mission Lake	-6.06	0.00	0	0.000000	0	0	0	0	0	
South Callahan Creek	31.90	0.00	0	99.999920	13.8312	0	0	0	0	
Lower Eagle Creek	-86.84	11.61	-8.0295	2.132361	0.2949	0	0	0	0	
Middle Fork Flathead River-Deer Li	74.83	16.14	-11.167	95.188360	13.1657	0	0	44.74963	96.7037	

Record: 1 Show: All Selected Records (0 out of 1402 Selected.) Options

**Attributes of 6th-Code Watershed**

HU_12_NAME	SCORE	MINES	MINES_S	CROSS	CROSS_S	PCS	PCS_S	LCH20	LCH20_S
Lower Nyack Creek	32.80	0	0	0	0	0	0	0.33534	0.3188
Upper Willow Creek	-125.11	3.83	-5.2655	7.852	-4.4494	0	0	1.59120	1.5126
Upper Good Creek	8.50	0	0	11.842	-6.7103	0	0	0.00118	0.0011
Lower Lake Creek	-92.90	29.86	-41.0449	11.694	-6.6265	0	0	0.77727	0.7389
Whitefish Lake	-100.72	0	0	7.481	-4.2393	0	0	20.20496	19.2062
Mission Lake	-6.06	0	0	6.998	-3.9654	0	0	6.58852	6.2629
South Callahan Creek	31.90	0	0	0	0	0	0	0.27769	0.2640
Lower Eagle Creek	-86.84	0	0	3.869	-2.1925	0	0	0.71729	0.6818
Middle Fork Flathead River-Deer Li	74.83	0	0	4.125	-2.3377	1.79	-19.3785	1.72027	1.6352

Record: 1 Show: All Selected Records (0 out of 1402 Selected.) Options

# Watershed Database

Attributes of 6th-Code Watershed

HU_12_NAME	SCORE	LCGRASS	LCGRASS_S	LCPASTUR	LCPASTUR_S	LCCROPS	LCCROPS_S	LCWE
Lower Nyack Creek	32.80	2.027	0.1361	0	0	0	0	0.78
Upper Willow Creek	-125.11	89.662	6.0189	3.65357	-1.5614	0.00266	-0.0004	1.92
Upper Good Creek	8.50	0.200	0.0134	0	0	0	0	0.01

Attributes of 6th-Code Watershed

HU_12_NAME	SCORE	WELLS	WELLS_S	PDENS	PDENS_S	ROADS	ROADS_S	AGCROP	AGCROP_S
Lower Nyack Creek	32.80	0	0	0.100000	-0.0814	0	0	0.000000	
Upper Willow Creek	-125.11	1.685	-6.6351	56.01984	-45.6113	2.13666	-11.8156	0.000000	
Upper Good Creek	8.50	0.068	-0.2664	0.144215	-0.1174	2.88257	-15.9405	0.000000	
Lower Lake Creek	-92.90	5.474	-21.5505	15.35205	-12.4996	2.29556	-12.6943	0.000000	
Whitefish Lake	-100.72	6.509	-25.6251	76.92969	-62.6361	3.39667	-18.7834	0.000000	
Mission Lake	-6.06	0	0	0.356182	-0.2900	1.36489	-7.5478	0.000000	
South Callahan Creek	31.90	0	0	0.071624	-0.0583	0.53019	-2.9319	0.000000	
Lower Eagle Creek	-86.84	0.329	-1.2948	0.965243	-0.7859	1.77253	-9.802	0.000000	
Middle Fork Flathead River-Deer Li	74.83	0.466	-1.8360	2.98911	-2.4337	0.84839	-4.6916	0.000000	

Record: 1 Show: All Selected Records (0 out of 1402 Selected.) Options

Attributes of 6th-Code Watershed

HU_12_NAME	SCORE	CADAVGSZ	CADAVGSZ_S	CADSUBDV	CADSUBDV_S	WR_IRR	WR_IRR_S
Lower Nyack Creek	32.80	564.73	0	0.0000	0	0.000000	0
Upper Willow Creek	-125.11	57.85	0	0.7336	0	0.010084	-0.1128
Upper Good Creek	8.50	487.06	0	0.5258	0	0.000423	-0.0047
Lower Lake Creek	-92.90	0.00	0	0.0000	0	0.019256	-0.2153
Whitefish Lake	-100.72	5.76	0	0.9613	0	0.007510	-0.0840
Mission Lake	-6.06	255.52	0	0.0306	0	0.000000	0
South Callahan Creek	31.90	0.00	0	0.0000	0	0.000000	0
Lower Eagle Creek	-86.84	180.00	0	0.3445	0	0.015477	-0.1731
Middle Fork Flathead River-Deer Li	74.83	85.93	0	0.7657	0	0.005801	-0.0649

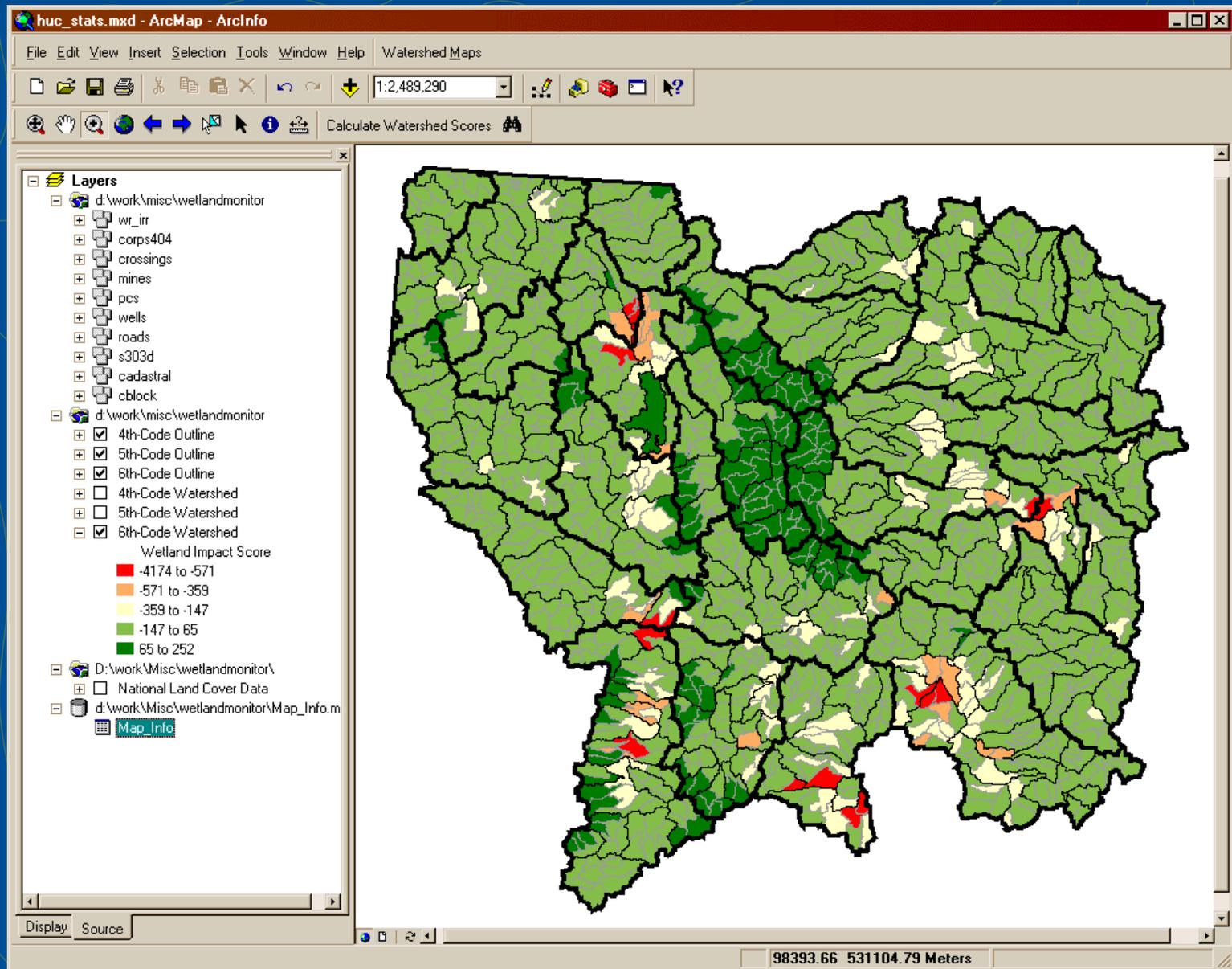
Record: 1 Show: All Selected Records (0 out of 1402 Selected.) Options

# Map Tools

The screenshot displays the ArcMap interface with the following components:

- Title Bar:** huc\_stats.mxd - ArcMap - ArcInfo
- Menu Bar:** File, Edit, View, Insert, Selection, Tools, Window, Help
- Toolbars:** Standard toolbar and a 'Calculate' button.
- Layers Panel:**
  - Layers list:
    - Irrigation Water Rights
    - Corps 404 Permits
    - Stream Crossings
    - Mines
    - Discharge Permits
    - Wells
    - Roads
    - Impaired Streams
    - 4th-Code Outline
    - 5th-Code Outline
    - 6th-Code Outline
    - Ownership Parcels
    - 4th-Code Watershed
    - 5th-Code Watershed
    - 6th-Code Watershed
  - Legend for 6th-Code Watershed:
    - Persons/Sq Mile
    - 0 (White)
    - 0-0.5 (Yellow)
    - 0.5-2 (Orange)
    - 2-20 (Red)
    - 20-50 (Pink)
    - 50-200 (Purple)
    - 200-1700 (Dark Purple)
  - 2000 Population Density
  - National Land Cover Data
- Watershed Maps Dropdown:**
  - 6th-Code
    - General (Selected)
    - Land Cover
    - Parcel Agriculture
    - Parcel Information
    - Watershed Scores
  - 5th-Code
  - 4th-Code
- General Sub-menu:**
  - Corps 404 Permits / 100 sq miles
  - Road/Stream Crossings / 10 sq miles
  - Percent Federal Land
  - Percent Fish and Wildlife Service
  - Mines / 100 sq miles
  - Discharge Permits / 100 sq miles
  - Population / sq mile (Selected)
  - Road miles / sq mile
  - Listed Streams, meters / sq mile
  - Wells / sq mile
  - Percent Wilderness
  - Percent with Irrigation Water Rights
- Status Bar:** Runs a macro titled: Project.Watershed.PDENS12 | 127373.21 557449.83 Meters

# Database with Summary of Phenomena



# Database with Summary of Phenomena

FieldName	Title	StateMean	Weight	Break1	Label1
S303D	Streams on 303D List,meters/Sq Mile	98.74	-4	200	3-200
CORPS	Corps 404 Permits/100 Sq Miles	7.228	-5	12	0-12
FED	Percent Federal Land	28.92	4	10	0-10
FWS	Percent Fish & Wildlife Service Easements	0.171	0	2	0-2
WILD	Percent Wilderness	3.702	8	2	0-2
MINES	Mines/100 sq miles	5.092	-7	10	0-10
CROSS	Stream Crossings/10 sq miles	7.059	-4	5	0-5
PCS	Discharge Permits/100 sq miles	0.4628	-5	4	0-4
LCH20	Percent Surface Water	1.052	1	2	0-2
LCSNOW	Percent Snow	0.04803	1	0.02	0-0.02
LCRES1	Percent Urban Low-Density Residential	0.07996	-2	0.1	0-0.1
LCRES2	Percent Urban High-Density Residential	0.002741	0	0.02	0-0.02
LCCOMM	Percent Commercial & Transportation	0.1299	-3	0.1	0-0.1
LCBARREN	Percent Barren	1.15	0	1	0-1
LCMINE	Percent Mines	0.02799	-4	0.1	0-0.1
LCFOREST	Percent Forest	22.64	5	10	0-10
LCSHRUB	Percent Shrubs	8.771	1	5	0-5
LCORCHRD	Percent Orchards	0.000059	0	0.001	0-0.001
LCGRASS	Percent Grassland	44.69	3	15	5-15
LCPASTUR	Percent Pasture	2.34	-1	2.5	0-2.5
LCCROPS	Percent Crops	18.57	-3	10	0-10
LCWET	Percent Wetland	0.005049	0	0.25	0-0.25
WELLS	Wells/Sq Mile	1.27	-5	1	0-1
PDENS	Persons/Sq Mile	6.141	-5	0.5	0-0.5
ROADS	Road Miles/Sq Mile	1.085	-6	0.75	0-0.75
AGCROP	Percent Cropped Continuously	0.000859	0	0.001	0-0.1
AGFALLOW	Percent Fallow Cropping	0.1306	-4	0.1	0-10
AGIRRIG	Percent Irrigated	0.01845	-5	0.05	0-5
AGGRAZE	Percent Grazing	0.3802	-5	0.15	0-15
AGHAY	Percent Hay	0.009234	-2	0.002	0-0.2
AGTIMBR	Percent Timber	0.05431	3	0.15	0-15
CADLIVNG	Parcels with Living Units	0.3576	0	0.05	0-5%
CADAVGSZ	Average Parcel Size,Acres	208.1	0	20	0-20
CADSUBDV	Parcels < 20 acres,Percent	0.52	0	0.1	0-10
WR_IRR	Percent with Irrigation Water Rights	0.4471	-5	0.02	0-2

Record: 35 Show: All Selected Records (0 out of 35 Selected.) Options