Land Protection Priorities in the Macatawa Watershed

Part 2 - Farmland

Prepared for the

Macatawa Area Coordinating Council

By

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February 1, 2010

1. INTRODUCTION

1.1 The Macatawa Watershed

The Macatawa River watershed drains an area of 175 square miles in southern Ottawa and northern Allegan Counties in southwestern Michigan. The river and its tributaries flow into Lake Macatawa, an 1808 acre, 5 mile long body of water which empties into Lake Michigan through a short channel. Pine Creek drains the northwestern part of the watershed directly into Lake Macatawa.

The watershed encompasses the cities of Holland and Zeeland and most of the townships of Park, Holland and Zeeland as well as parts of Port Sheldon, Olive, Blendon, Georgetown and Jamestown townships in Ottawa County and parts of Manlius, Overisel, Fillmore and Laketown townships in Allegan County.

The region is relatively flat with a maximum elevation above Lake Michigan of approximately 35 meters. The land has been extensively drained for agriculture and almost 50% of the watershed is characterized as prime farmland soil by the U. S. Department of Agriculture with another 25% classed as farmland of local importance.

1.2 Farmland Protection

Agriculture was the main reason for the settlement of the Macatawa River watershed and it remains its most important industry. However, suburbanization and industrial sprawl are rapidly consuming the historically and financially valuable farmland on which the regions success is based. Farmland protection has now become an important concern of local citizens, but resources are limited and there are so many factors involved that it is not easy to determine which farmland to protect. This project is an attempt to develop a tool which will assist community members in deciding where to invest their scarce land protection resources. It is important to note that the goal is to assess protection potential rather than the inherent quality of the farmland, although the two are, of course, closely related.

A GIS model tries to represent a natural system in digital form. To the extent the criteria that determine protection potential can be digitized the model can be used to predict which farmland units will have the highest protection priority. Some protection criteria cannot be digitized or can be digitized only imperfectly so the model has its limitations but a GIS analysis provides a powerful means of visualizing conditions on the ground and revealing geographical patterns which may not otherwise be obvious. A discussion of the considerations involved in choosing and quantifying criteria for farmland protection is contained in Appendix I of this manual.

1.3 Protection Criteria

Stakeholders have already invested a great deal of time and effort in developing a list of factors which can be used to determine which farmland to protect. Criteria used for this project are the result of those efforts and were chosen from three main sources:

- The Michigan Agricultural Preservation Fund Grant Qualification Criteria.

- The Allegan County Farmland Preservation Board Purchase of Development Rights Scoring System.
- The Ottawa County Purchase of Development Rights Scoring System Criteria.

The original datasets used to quantify the criteria are described in the appendices. Much of the original data was extensively modified as described in Section 2 - Data Preparation.

The unit of comparison used in this study is the survey quarter-quarter section. (See Appendix A for a discussion of comparison units and why it was impossible to compare 'farms' directly). Each quarter-quarter section or part quarter-quarter section was assigned a protection score based on the value of each of the criteria used in assessing protection potential. Protection priority was determined by summing the criteria scores and comparing the totals for each quarter-quarter section.

The following is an overview of the criteria used:

Agricultural Soil Quality. Soil quality is the most important factor cited in most farmland protection scoring systems. Fortunately, an excellent digital soil quality dataset is freely available from the Natural Resources Conservation Service of the United States Department of Agriculture. The Soil Survey data shows the spatial extent of soil types in each Michigan County. Reports can be created listing the soil types considered prime farmland, prime farmland if drained and farmland of local importance. MAPF qualification criteria include only prime farmland but most county criteria also assign value to farmland of local importance so both classes are considered in this study.

Farmland Area. Preserving large blocks of farmland is a high priority in all scoring systems. The amount of farmland in each comparison unit (quarter-quarter section) can be calculated from the Land Use/Land Cover dataset for the Macatawa Watershed created by the Michigan Department of Environmental Quality. Forty acres is often considered a minimum size for funding.

Proximity to Other Farmland. Stakeholders generally consider "islands" of farmland surrounded by different land uses to have lower priority for preservation than farms surrounded by other farms. The percentage of agricultural land within one mile of each comparison unit was calculated for this study and higher values assigned to higher percentages.

Proximity to Protected Land. Farms adjacent to other types of protected land (parks, preserves, environmental easements) are under less development pressure than those next to developed lands. Protected areas can be identified from county property parcel datasets and higher preservation values are assigned to quarter-quarter sections closer to these areas.

Type of Agricultural Production. Distinguishing crop types by remote sensing (aerial imagery) is an inexact science. Fortunately the most valuable specialty crops in the study area (bush and tree fruits) can be identified with a fair degree of accuracy. The DEQ landcover dataset mentioned above, with some revisions, was used to assign extra protection value to quarter-quarter sections containing specialty crops.

Water Accessibility. The presence of streams, drains or ponds is cited as a valuable characteristic in all county scoring systems. Digital hydro data is available through the Michigan Geographic Framework and was used to determine whether the comparison unit has direct access to surface water. Hydro values were based on the class (stream, drain or pond) of feature in each quarter-quarter section. Scores were weighted to reflect the relative values of each class as indicated in the sources listed above.

Road Frontage. Some county systems assign higher value to farms with public road frontage. Digital road datasets are available through the Michigan Geographic Framework and were used to calculate the number of miles of road in each comparison unit.

Proximity to Community Services/Development Pressure. These are complex criteria which are difficult to evaluate due to sometimes conflicting effects on protection priority. If farmland is close to development it might be necessary to move quickly to save it. On the other hand, it will probably be more difficult and expensive to protect. When a community invests in expensive utilities and other urban services it may expect higher tax returns from adjacent land than farmland can provide. On balance, protecting farmland close to services may not be practical so this model assigns lower priority to such properties. For this purpose a one-quarter mile buffer layer was created around heavily developed areas in the watershed. (The buffered area included but was not restricted to the cities of Holland and Zeeland). Farmland quarter-quarter section units within the buffered area were assigned negative protection value.

1.4 Methodology Outline

The procedure for creating the model comprised the following steps:

- Creation of a survey quarter-quarter section ESRI file geodatabase feature class to serve as a base or framework for the model.
- Creation and/or modification of a geodatabase feature class representing each of the protection criteria.
- Establishment of a numerical attribute (area, length, percentage, index or nominal value, etc.) which best represents the contribution each criterion makes to the quality of the farmland.
- Addition of the attribute values for each of the criteria to the framework feature class (model) attribute table.
- Classification (if necessary) of each criterion attribute.
- Weighting (scoring) of each criterion attribute for each quarter-quarter section.
- Computation of a total protection score for each quarter-quarter section by the addition of the scores for each criterion.
- Testing of outcomes against aerial imagery, parcel data and other digital resources as well as by ground-truthing.
- Ranking and symbolization of the outcome for display in a map.

2. DATA PREPARATION

2.1 Watershed Boundary

<u>Data Source</u>
Macc_Watershed.shp.
Dataset provided by the Macatawa Area Coordinating Council.

<u>Processing</u>
Macc_Watershed.shp reprojected from:
NAD_1983_Michigan_GeoRef_Meters
to:
NAD_1983_Hotine_Oblique_Mercator_Azimuth_Natural_Origin.

Dataset imported into ESRI file geodatabase as:
MAG.gdb/MAG_WS_Bound.

2.2 Survey Quarter-Quarter Section Base Feature Class

<u>Data Source</u>
ottawa_quarter_quarter_sections.shp
and
allegan_quarter_quarter_sections.shp
Development of these datasets was initiated by the Michigan Department of Natural Resources (MDNR), Forest Management Division; Further processing, cleaning and maintenance of the data is the responsibility of the Center for Geographic Information (CGI), Michigan Department of Information Technology (MDIT).
Data downloaded from the Michigan Geographic Data Library.
(www.mcgi.state.mi.us/mgdl/)

<u>Processing</u>
Select by location from *allegan_quarter_quarter_sections.shp* and *ottawa_quarter_quarter_sections.shp* features which intersect *MAG.gdb/MAG_WS_Bound*.

Merge (Data Management Tools>General>Merge) selected features.

Clip (Analysis Tools>Extract>Clip) merged dataset with *MAG.gdb/MAG_WS_Bound*.
The resulting dataset has 2950 features (Quarter-quarter sections).

Delete fields AREA and PERIMETER from attribute table. (They refer to the un-clipped features. New areas and perimeters are given by Shape_Area and Shape_Length).

Delete features less than 1 acre (52 features). 2898 remain. (The deleted polygons are slivers along the edges of the boundary).

Add field:
MAC_ID (short integer).

Populate field with sequential values 1 to 2898.

Save dataset as: *MAG.gdb/MAG_QQ*.

Add field:
MAC_Acres (double)
Populate field using Calculate Geometry.

2.3 Land Cover/Land Use
Data Source
Original Dataset: *lu2005.shp* developed by the Michigan Department of Environmental Quality and obtained from the Macatawa Area Coordinating Council. (Total acres = 111677).

In preparing data for the farmland priority model extensive revisions were made to polygons classified as farmland in the Michigan DEQ *lu2005.shp* dataset. Changes were made by comparison to 1998 and 2005 aerial imagery and ground-truthing. Revisions included reclassification and splitting of some polygons. No polygons were re-drawn. During the revision process some farmland areas were reclassified to other cover types and some non-farmland areas were reclassified as farmland. The new classification system is described in Appendix B.

Processing
Define projection as:
NAD_1983_Hotine_Oblique_Mercator_Azimuth_Natural_Origin.prj

Save dataset as MAG.gdb/MAG_Cover.

Edit features as described above.

Add Fields:
M_Class (text, 5).
M_Type (text, 12).
M_Acres (double).
M_AgClass (text, 5)
M_AgType (text, 15)

Use Calculate Geometry to populate M_Acres field.

Use Field Calculator to populate M_Class, M_Type, M_AgClass and M_AgType fields with appropriate Class symbol and type designation (see: Appendix B).
Note: there are two classes of agricultural land in M_Class (M2 and M29) but agricultural land is further broken down into 4 classes in M_AgClass (M21, M22, M24, M29).

Select by Attributes from *MAG.gdb/MAG_Cover* features where M_Class = M2 or M_Class = M29 (includes all agricultural use). Export selected features to:

MAG.gdb/MAG_CoverAg.

Select by Attributes from *MAG.gdb/MAG_Cover* features where M_AgClass = M22 (specialty crops). Export selected features to:
MAG.gdb/MAG_CoverSpC.

2.4 Soil Quality

<u>Data Source</u>

Allegan County Soil Survey Data (Survey Area Version 8; Tabular Data Version 7; Spatial Data Version 5; (SSURGOV2.1, MD 2.2.3)
and
Ottawa County Soil Survey Data (Survey Area Version 4; Tabular Data Version 4; Spatial Data Version 2; (SSURGOV2.1, MD 2.2.2):

The data is provided in the form of shapefiles (*soilmu_a_mi005.shp* and *soilmu_a_mi139.shp*) which show the spatial extent of soil types in the respective counties. In addition, a set of tabular data which contains attribute information for the soil types is provided, as well as a Microsoft Access template database (*soildb_MI_2002.mdb*). The tabular data can be imported into the Access template and reports created.
Note: PDF versions of reports listing soil types are located in the RelatedDocs folder on the DVD accompanying this model.

All original data was created by United States Department of Agriculture, Natural Resources Conservation Service and downloaded from the Soil Data Mart. (http://soildatamart.nrcs.usda.gov/).

<u>Processing</u>

soilmu_a_mi005.shp and *soilmu_a_mi139.shp* reprojected from:
NAD_1983_Michigan_GeoRef_Meters
to:
NAD_1983_Hotine_Oblique_Mercator_Azimuth_Natural_Origin.

Select by Location features from *soilmu_a_mi005.shp* and *soilmu_a_mi139* that intersect *MAG.gdb/MAG_WS_Bound* and output selected data as:
MAG.gdb/MSoil005 and
MAG.gdb/MSoil139.

Note: These datasets were not clipped to the watershed boundary before processing in order to avoid creating slivers along the clip line. A clipped version was also created for use in mapping.

Select by Attributes from *MAG.gdb/MSoil005* features where MUSYM field attribute equals one of the Map Symbols listed in the Prime and Other Important Farmlands report for Allegan County as ‘All areas are prime farmland’. Export selected features to:
MAG.gdb/MSoil005_prime.

Select by Attributes from *MAG.gdb/MSoil005* features where MUSYM field attribute equals one of the Map Symbols listed in the Prime and Other Important Farmlands report for Allegan County as ‘Prime farmland if drained’. Export selected features to: *MAG.gdb/MSoil005_drained*.

Select by Attributes from *MAG.gdb/MSoil139* features where MUSYM field attribute equals one of the Map Symbols listed in the Prime and Other Important Farmlands report for Ottawa County as ‘All areas are prime farmland’. Export selected features to: *MAG.gdb/MSoil139_prime*.

Select by Attributes from *MAG.gdb/MSoil139* features where MUSYM field attribute equals one of the Map Symbols listed in the Prime and Other Important Farmlands report for Ottawa County as ‘Prime farmland if drained’. Export selected features to: *MAG.gdb/MSoil139_drained*.

Merge (Data Management Tools>General>Merge) *MAG.gdb/MSoil005_prime*, *MAG.gdb/MSoil005_drained*, *MAG.gdb/MSoil139_prime* and *MAG.gdb/MSoil139_drained*.
Output: *MAG.gdb/MAG_SoilPrime*. (Note: 47% of watershed is prime farmland soil).

Select by Attributes from *MAG.gdb/MSoil005* features where MUSYM field attribute equals one of the Map Symbols listed in the Prime and Other Important Farmlands report for Allegan County as ‘Farmland of local importance’. Export selected features to: *MAG.gdb/MSoil005_local*.

Select by Attributes from *MAG.gdb/Msoil139* features where MUSYM field attribute equals one of the Map Symbols listed in the Prime and Other Important Farmlands report for Ottawa County as ‘Farmland of local importance’. Export selected features to: *MAG.gdb/Msoil139_local*.

Merge (Data Management Tools>General>Merge): *MAG.gdb/MSoil005_local* and *MAG.gdb/MSoil139_local*.
Output: *MAG.gdb/MAG_SoilLocal*. (Note: 24% of watershed is farmland of local importance).

2.5 Protected Areas

Protected Parcels are property parcels which currently (2009) have some degree of protection from development through their designation as parks, preserves or nature areas or due to the presence of a conservation easement. A few parcels of undeveloped public land (state, county or municipal) are also included.

Protected Areas are protected parcels or groups of protected parcels. Generally, parcels in a protected area will have the same owner but there are some exceptions such as Holland's Outdoor Discovery Center. Also, parcels in a protected area are usually contiguous but not always (Holland City Greenway parcels, Greenway Partnership parcels).

The Macatawa Greenway is a projected natural corridor running along the Macatawa River from downtown Holland to Zeeland Township. Current components of the Greenway comprise both public and private lands. The project is administered by the The Outdoor Discovery Center - Macatawa Greenway Partnership (ODC-MGP), a nonprofit environmental education and conservation organization. Some components of the Greenway are named parks or preserves and are listed as such under AreaName in the datasets attribute table - otherwise they are listed as 'Macatawa Greenway'.

<u>Processing</u>
Create new polygon feature class MAG.gdb/MAG_Protect.

Add Fields:
AreaName (text, 35)
Location (text, 15)
AcresMAC (double)
Parcels (short integer)
OwnerType (text, 10)
Owner1 (text, 35)
Owner2 (text, 35)
Owner3 (text, 35)
Status (text, 5)
NotesMAC (text, 25)

Append (Data Management Tools>General>Append) protected parcel features from county property parcel layers to MAG.gdb/MAG_Protect (Schema Type = NO TEST).

Merge (Edit>Merge) parcels where there is more than one property parcel in a protected area (see above).

Populate attribute fields of MAG.gdb/MAG_Protect with information from Appendix D.

Select by Location from *MAG.gdb/MAG_QQ_Ag* (QQs containing at least one acre of farmland. See Section 3.4, below) features which intersect *MAG.gdb/MAG_Protect*.

Export selected features to new feature class:
MAG.gdb/MAG_ProxPro.

By reference to *MAG.gdb/MAG_CoverAg*, delete features from *MAG.gdb/MAG_ProxPro* which have only non-Agricultural land in contact with protected land from *MAG.gdb/MAG_Protect*.

To *MAG.gdb/MAG_ProxPro* add field:
MPxP (short integer).

By inspection, populate the MPxP field of the features in *MAG.gdb/MAG_ProxPro* with one of 2 values:
'1' for QQs with farmland which shares a border equal to or greater than 500 ft with protected features from *MAG.gdb/MAG_Protect*.
'2' for QQs with farmland which shares a border less than 500 ft with protected features from *MAG.gdb/MAG_Protect*.

Select by Location from *MAG.gdb/MAG_QQ_Ag* features which are within 0.5 miles of features in *MAG.gdb/MAG_Protect*.

Export selected features to new feature class:
MAG.gdb/MAG_ProxPro2.

To *MAG.gdb/MAG_ProxPro2* add field:
MPxP (short integer).

Populate the MPxP field of all features in *MAG.gdb/MAG_ProxPro2* with:
'3' for QQs with farmland that is within 0.5 mile of protected features from *MAG.gdb/MAG_Protect*.

2.6 Roads

Data Source

Allegan Transport Framework: *allroads_005v8a.shp*
Ottawa Transport Framework: *allroads_139v8a.shp*

These datasets are maintained and distributed by the Michigan Center for Geographic Information and were downloaded from the Michigan Geographic Data Library.

Processing

Data Management Tools>General>Merge *allroads_005v8a.shp* and *allroads_139v8a.shp*. Save as:
MAG.gdb/Allroads.

Select by Location from *MAG.gdb/Allroads* features that are within *MAG.gdb/MAG_WS_Bound*. Export selected data to:
MAG.gdb/MAG_Roads.

Select by Attributes from *MAG.gdb/MAG_Roads* features where FCC = A11, A12, A21, A31 or A32. Export selected features to:
MAG.gdb/MAG_RoadsM.
Note: Framework Classification Codes are described in a PDF document located in the OriginalData folder on the DVD accompanying this model).

Delete features representing dual-carriageway roads (all A11 and A12 and most A21 features) and replace with screen digitized single line features.

2.7 Hydro

Data Source

Ottawa Hydro Framework: *hydro_139v8a.shp*.
Allegan Hydro Framework: *hydro_005v8a.shp*.

These datasets are maintained and distributed by the Michigan Center for Geographic Information and were downloaded from the Michigan Geographic Data Library.

Processing

Select by Location from *hydro_139v8a.shp* and *hydro_005v8a.shp* features that are within *MAG.gdb/MAG_WS_Bound* . Export selected data to *MAG.gdb/Hydro_Ottawa* and *MAG.gdb/Hydro_Allegan*.

Merge (Data Management Tools>General>Merge): *MAG.gdb/Hydro_Ottawa* and *MAG.gdb/Hydro_Allegan*. Output:
MAG.gdb/MAG_Hydro.

Edit features in *MAG.gdb/MAG_Hydro* to conform more closely to 2005 and 1998 DOQ aerial imagery. DRGs, DEMs and ground-truthing consulted to improve accuracy.

Note: The following two steps were carried out by reference to 1998 and 2005 aerial imagery (DOQs) and Mi DEQ Land Use/Land Cover dataset (*lu2005.shp*).

Remove lake features (FCC = H21) where lake shorelines within a quarter-quarter section are completely developed (built up).

Digitize unrecorded lakes and ponds greater than 5000m^2. Mark FCC = H21 and ver = “jdf”. (85 new features created. 127 total H21 features).

Change FCC class of Lake Macatawa mouth features from H32 (two-bank stream) to H21 (lake shoreline).

2.8 Proximity to Serviced Areas

Data Source

A polygon feature class representing heavily developed residential and commercial property areas was screen digitized based on property parcel datasets and DOQ aerial imagery. (Property Parcel datasets were created by Ottawa and Allegan counties and obtained from the Macatawa Area Coordinating Council. DOQ aerial imagery for 1998 and 2005 was downloaded from the Michigan Geographic Data Library.).

Output: *MAG.gdb/MAG_Service*.

3. MODEL CREATION

3.1 Data Sources

Watershed boundary: *MAG.gdb/MAG_WS_Bound*. (Data Preparation 2.1).
Survey quarter-quarter sections: *MAG.gdb/MAG_QQ*. (Data Preparation 2.2).
Land Cover/Use: *MAG.gdb/MAG_Cover*. (Data Preparation 2.3).
Soil Quality: *MAG.gdb/MAG_SoilPrime* and *MAG.gdb/MAG_SoilLocal*. (Data Preparation 2.4).
Farmland Area: *MAG.gdb/MAG_CoverAg*. (Data Preparation 2.3).
Specialty Crops: *MAG.gdb/MAG_CoverSpC*. (Data Preparation 2.3).
Proximity to protected land: *MAG.gdb/MAG_Protect*, *MAG.gdb/MAG_ProxPro* and *MAG.gdb/MAG_ProxPro2*. (Data Preparation 2.5).
Proximity to other farmland: *MAG.gdb/MAG_CoverAg*. (Data Preparation 2.3).
Roads: *MAG.gdb/MAG_Roads* and *MAG.gdb/MAG_RoadsM*. (Data Preparation 2.6).
Hydro: *MAG.gdb/MAG_Hydro*. (Data Preparation 2.7).
Proximity to built-up areas: *MAG.gdb/MAG_Service*. (Data Preparation 2.8)

3.2 Model Framework

Delete all fields from *MAG.gdb/MAG_QQ* except:
OBJECTID
Shape
COUNTY
TOWN
GEO_ID
MAC_ID
MAC_Acres

Save result as:
MAG.gdb/MAG_Model.

To *MAG.gdb/MAG_Model* add fields:
MAC_BL (text, 5).
MAC_AG (text, 3).

Select by inspection quarter-quarter sections from *MAG.gdb/MAG_Model* with no unbuilt parcel greater than 5 acres. Populate MAC_BL field for selected features with “B”. (312 features).

Select by inspection quarter-quarter sections from *MAG.gdb/MAG_Model* consisting entirely of water (in Lake Macatawa). Populate MAC_BL field for selected features with “L”. (21 features).

All other quarter-quarter sections designated ‘S’ in MAC_BL field.

3.3 Soil Quality

To *MAG.gdb/MAG_Model* add fields:

MSoP (double).
MSoL (double).

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* and MAG.*gdb/MAG_SoilPrime*. (No FID).
Output: *MAG.gdb/Intersect_Prime*.

Summarize on *MAG.gdb/Intersect_Prime* field MAC_ID for field Shape_Area (Sum).
Output table: *MAG.gdb/Sum_Prime*.

Join table *MAG.gdb/Sum_Prime* to *MAG.gdb/MAG_Model* based on field MAC_ID.

Use Field Calculator to populate model MSoP field [MAG_Model.MSoP] with percentage of prime soil cover in each QQ section using expression:
([Sum_Prime.Sum_Shape_Area] / [MAG_Model.Shape_Area]) *100.
The first variable is the area of prime soil in the QQ section and the second variable is the area of the QQ.

Remove Join.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* and MAG.*gdb/MAG_SoilLocal*. (No FID).
Output: *MAG.gdb/Intersect_Local*.

Summarize on *MAG.gdb/Intersect_Local* field MAC_ID for field Shape_Area (Sum).
Output table: *MAG.gdb/Sum_Local*.

Join table *MAG.gdb/Sum_Local* to *MAG.gdb/MAG_Model* based on field MAC_ID.

Use Field Calculator to populate model MSoL field [MAG_Model.MSoL] with percentage of prime soil cover in each QQ section using expression:
([Sum_Local.Sum_Shape_Area] / [MAG_Model.Shape_Area]) *100

Remove Join.

3.4 Farmland Area

To *MAG.gdb/MAG_Model* add field:
MAg (double).

Merge (Edit) features in *MAG.gdb/MAG_CoverAg*. Output: *MAG.gdb/MAG_CoverAg_Merge*.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* with *MAG.gdb/MAG_CoverAg_Merge* (No FID).
Output: *MAG.gdb/Intersect_CoverAg*.

Use Calculate Geometry to populate MAC_Acres field in *MAG.gdb/Intersect_CoverAg*.

Join *MAG.gdb/Intersect_CoverAg* to *MAG.gdb/MAG_Model* based on field MAC_ID.

Use Field Calculator to populate model MAg field with acreage from
MAG.gdb/Intersect_CoverAg MAC_Acres field.
(MAG_Model.MAg = [Intersect_CoverAg.MAC_Acres]).

Remove Join.

Select from *MAG.gdb/MAG_Model* where field MAg =>1 (quarter-quarter sections having more than one acre of agricultural land). 1924 features.

Use Field Calculator to populate *MAG.gdb/MAG_Model* MAC_AG field for selected features with "Ag".

Export selected features to:
MAG.gdb/MAG_QQ_Ag.

Switch selection in *MAG.gdb/MAG_Model* and populate MAC_AG field for remaining features with "No".

3.5 Specialty Crops

To *MAG.gdb/MAG_Model* add field:
MSC (double).

Merge (Edit) features in *MAG.gdb/MAG_CoverSpC*. Output:
MAG.gdb/MAG_CoverSpC_Merge.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* with
MAG.gdb/MAG_CoverSpC_Merge (NO FID; Output Type = INPUT).
Output: *MAG.gdb/Intersect_CoverSpC*.

Use Calculate Geometry to populate MAC_Acres field in *MAG.gdb/Intersect_CoverSpC*.

Join *MAG.gdb/Intersect_CoverSpC* to *MAG.gdb/MAG_Model* based on field MAC_ID.

Use Field Calculator to populate model MSC field with acreage from
MAG.gdb/Intersect_CoverSpC MAC_Acres field.
(MAG_Model.MSC = [Intersect_CoverSpC.MAC_Acres]).

Remove Join.

3.6 Proximity to Protected Land

To *MAG.gdb/MAG_Model* add field:
MPxP (integer).

Join *MAG.gdb/MAG_Model* and *MAG.gdb/MAG_ProxPro* using MAC_ID as join field.

Join *MAG.gdb/MAG_Model* and *MAG.gdb/MAG_ProxPro2* using MAC_ID as join field.

Select by Attributes from *MAG.gdb/MAG_Model* where MAG_ProxPro.MPxP >0.

Using Field Calculator, populate *MAG.gdb/MAG_Model* MPxP field of selected features with values from *MAG.gdb/MAG_ProxPro* MPxP field.

Select by Attributes from *MAG.gdb/MAG_Model* where"MAG_ProxPro.MPxP" IS NULL AND MAG_ProxPro2.MPxP >0

Using Field Calculator, populate *MAG.gdb/MAG_Model* MPxP field of selected features with values from *MAG.gdb/MAG_ProxPro2* MPxP field.

Note: Features which are directly adjacent to protected areas are also within one-half mile. The above procedure insures they get the higher value.

Remove Joins.

3.7 Proximity to Farmland

To *MAG.gdb/MAG_Model* add field:
MPxF (double).

Buffer (Analysis Tools>Proximity>Buffer) (Side Type FULL; Dissolve Type NONE) features in *MAG.gdb/MAG_QQ_Ag* (see Section 3.4) by 0.9 mile.
Output: *MAG.gdb/MAG_QQ_Mile*.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_QQ_Mile* and *MAG.gdb/MAG_CoverAg_Merge* (see Section 3.4).
Output: *Intersect.gdb/Ag_Mile_Intersect*.

(Note: the resulting Ag_Mile_Intersect dataset is so large that the process requires a great deal of computer memory to complete. It may be necessary to split the input quarter-quarter section dataset and carry out the intersection in two parts. This will depend on the amount of memory available. Also, the product of this operation is saved in a separate geodatabase (*Intersect.gdb*) to make copying and backing up the main Model geodatabase easier).

Summarize features in *Intersect.gdb/Ag_Mile_Intersect* for Shape_Area (Sum).
Output table: *MAG.gdb/Sum_ProxAg*.

Join table *MAG.gdb/Sum_ProxAg* to *MAG.gdb/MAG_Model* based on field MAC_ID.

Join *MAG.gdb/MAG_QQ_Mile* to *MAG.gdb/MAG_Model* based on field MAC_ID.

Select from *MAG.gdb/MAG_Model* where *MAG.gdb/Sum_ProxAg* field Sum_ProxAg.Sum_Shape_Area > 0.

Use Field Calculator to populate MPxF field of selected features of *MAG.gdb/MAG_Model* with percentage of area within a one-mile radius of each agricultural quarter-quarter section which is active agricultural land. Use expression:
([Sum_ProxAg.Sum_Shape_Area] / [MAG_QQ_Mile.Shape_Area])*100
Note: The first variable is the area of Ag land within each one-mile buffer zone and the second variable is the total area of the buffer zone.

Switch Selection and populate MPxF field of remaining features with ‘0’.

3.8 Roads
To *MAG.gdb/MAG_Model* add field:
MRd (double).

Merge (Edit) features in *MAG.gdb/MAG_RoadsM*. Delete all fields except OBJECTID, Shape, LENGTH and Shape_Length. Save new feature class as *MAG.gdb/MAG_RoadsM_Merge*.

Use Calculate Geometry to populate LENGTH field with length in miles.

Buffer (Analysis Tools>Proximity>Buffer) features in *MAG.gdb/MAG_Model* by a distance of 15 meters (Dissolve Type: None). Output: *MAG.gdb/MAG_Model_Buf15*.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model_Buf15* with *MAG.gdb/MAG_RoadsM_Merge* (No FID).
Output: *MAG.gdb/Intersect_Road_Buf*.

Use Calculate Geometry to populate LENGTH field with length in miles.

Summarize features in *MAG.gdb/Intersect_Road_Buf* for LENGTH (Sum).
Output table: *MAG.gdb/Sum_Roads*.

Join table *MAG.gdb/Sum_Roads* with *MAG.gdb/MAG_Model* based on field MAC_ID.

Populate *MAG.gdb/MAG_Model* field MRd with mile values in *MAG.gdb/Sum_Roads* Sum_LENGTH field.

Remove Join.

3.9 Hydro
To *MAG.gdb/MAG_Model* add field:
MHyd (text, 3).

Export feature class *MAG.gdb/MAG_Hydro* to:
MAG.gdb/MAG_Hydro_Merge.

Delete all two-banked streams (H32) and replace with a single screen digitized H31 feature.

Edit/Merge all features where FCC = H31, H32 or H33 into a single feature where FCC = H3.

Edit/Merge all features where FCC = H41 into a single feature where FCC = H4.

Edit/Merge all features where FCC = H21 and lake => 3 acres (by comparison with MAG.gdb/MAG_H2_Poly) into a single feature where FCC = H2.

Delete features where FCC = H21 and lake area < 3 acres.

Select from *MAG.gdb/MAG_Hydro_Merge* where FCC = H2. Export selected feature to:
MAG.gdb/MAG_H2_Merge.

Repeat previous step for FCC= H4 and FCC = H3.
Output:
MAG.gdb/MAG_H4_Merge.
MAG.gdb/MAG_H3_Merge.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* with
MAG.gdb/MAG_H2_Merge (No FID).
Output: *MAG.gdb/Intersect_H2*.

Join *MAG.gdb/MAG_Model* with *MAG.gdb/Intersect_H2* based on field MAC_ID.

Use Field Calculator to populate MHyd field in *MAG.gdb/MAG_Model* with value in FCC field of Intersect_H2 (‘H2’).

Remove Join.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* with
MAG.gdb/MAG_H4_Merge (No FID).
Output: *MAG.gdb/Intersect_H4*.

Join *MAG.gdb/MAG_Model* with *MAG.gdb/Intersect_H4* based on field MAC_ID.

Select by Attributes features where:
Intersect_H4.FCC = 'H4' AND Intersect_H4.Shape_Length >=10

Use Field Calculator to populate MHyd field in *MAG.gdb/MAG_Model* with value in Intersect_H4.FCC field of selected features (‘H4’).

Remove Join.

Intersect (Analysis Tools>Overlay>Intersect) *MAG.gdb/MAG_Model* with *MAG.gdb/MAG_H3_Merge* (No FID).
Output: *MAG.gdb/Intersect_H3*.

Join *MAG.gdb/MAG_Model* with *MAG.gdb/Intersect_H3* based on field MAC_ID.

Select by Attributes features where:
Intersect_H3.FCC = 'H3' AND Intersect_H3.Shape_Length >=10.

Add to selection 5 QQs within 15 m along a length of H3 feature (by observation).

Use Field Calculator to populate MHyd field in *MAG.gdb/MAG_Model* with value in Intersect_H3.FCC field of selected features (‘H3’).

Note: Fields must be populated in the order H2, H4, H3 because some quarter-quarter sections have more than one class of hydro feature and H3 features are more valuable than H4 which are more valuable than H2.

3.10 Proximity to Services

To *MAG.gdb/MAG_Model* add field:
MSrv (text, 3).

Buffer (Analysis Tools>Proximity>Buffer) features in *MAG.gdb/MAG_Service* by a distance of 0.25 miles (Dissolve Type: All). Output: *MAG.gdb/MAG_Service_Buf*.

Select by Location from *MAG.gdb/MAG_Model* features which have their centroid in *MAG.gdb/MAG_Service_Buf*. (322 features).

Populate MSrv field of selected features in *MAG.gdb/MAG_Model* with “yes”.

Switch selection and populate MSrv field for remaining features with “no”.

4. MODEL SCORING

4.1 Scoring Considerations

The model cannot represent all the criteria used to measure protection potential in any particular stakeholder scoring system (see Appendix I). Instead, the scores computed here are meant to reflect the relative value of the comparison units (survey quarter-quarter sections) based on the criteria actually used.

There are no 'right' scores for each of the criteria just as there are no 'right' total scores for each of the quarter-quarter sections. The computer cannot decide what weights to assign to each of the criteria because the criteria are of different types: percentage area of prime soil vs. miles of road frontage, for example. Humans must decide the comparative value of prime soil vs. road frontage. The machine merely crunches the numbers and adds them up. The beauty of the computer model is that the weights can be changed and the model re-run to produce different outcomes. This is vital because in the end the rankings must reflect real-world conditions on the ground as well as the actual preferences of the stakeholders.

In practice a number of factors were taken into account when assigning weights:

- The relative importance given to the criteria in the scoring systems from which they were chosen (see section 1.3). For example, soil quality is assigned almost double the value of any other factor in most systems.
- The need to separate the comparison units numerically so they can be effectively ranked. If too many units get the same score the prioritization is less useful.
- The need to ensure that slight differences in the value of a criterion do not result in large differences in score. A unit which has 69.9% of a given value should not score significantly less than a unit which has 70% of the value.
- The limitations of the technology. Some criteria may be represented more accurately than others and that should be reflected in the scores.

4.2 Classification and Weighting

<u>Processing</u>

To *MAG.gdb/MAG_Model* add fields:
MSoP_PS (short integer)
MSoL_PS (short integer)
MAg_PS (short integer)
MSC_PS (short integer)
MPxP_PS (short integer)
MPxF_PS (short integer)
MRd_PS (short integer)
MHyd_PS (short integer)
MSrv_PS (short integer)
MAEAP_PS (short integer)
PA116_PS (short integer)
Total_PS (short integer)

Save *MAG.gdb/MAG_Model* as:
MAG.gdb/MAG_Model_F.

Classify protection criteria fields (MSoP to MSrv) and apply protection scores (MSoP_PS to MSrv_PS) based on values in the Protection Criteria Classification and Weighting Worksheet on the following pages.

Calculate the Total Protection Score for each quarter-quarter section by the adding the scores for each of the criteria (MSoP_PS to MSrv_PS).

4.3 Protection Criteria Classification and Weighting Worksheet.

Criterion	Field	Classification	QQs	Fw1		
Percent of q-q with	**MSoP**	< 1%	310	**0**		
prime farmland soil.		=> 1 - < 10	62	**1**		
(Section 3.3)		=> 10 - < 20	84	**2**		
		=> 20 - < 30	60	**4**		
		=> 30 - < 40	78	**6**		
		=> 40 - < 50	87	**8**		
		=> 50 - < 60	99	**10**		
		=> 60 - < 70	109	**12**		
		=> 70 - < 80	167	**14**		
		=> 80 - < 90	168	**16**		
		=> 90	700	**18**		
			1924			
Percent of q-q with	**MSoL**	< 1%	705	**0**		
soil of local importance.		=> 1 - < 10	300	**1**		
(Section 3.3)		=> 10 - < 20	189	**2**		
		=> 20 - < 30	149	**4**		
		=> 30 - < 40	112	**6**		
		=> 40 - < 50	83	**8**		
		=> 50 - < 60	89	**10**		
		=> 60 - < 70	71	**12**		
		=> 70 - < 80	68	**14**		
		=> 80 - < 90	56	**16**		
		=> 90	102	**18**		
			1924			
Acres of q-q in	**MAg**	< 20 ac	514	**0**		
agricultural use.		=> 20 - < 30	344	**3**		
(Section 3.4)		=> 30 - <= 39	498	**7**		
		> 39 ac	568	**10**		
			1924			
Acres of q-q in specialty	**MSC**	< 1 ac	1817	**0**		
crops.		=> 1 - < 10	39	**4**		
(Section 3.5)		=> 10 - < 20	23	**6**		
		=> 20 - < 30	26	**8**		
		=> 30 ac	19	**10**		
			1924			
Index of proximity to	**MPxP**	further than 0.5 mi	1476	**0**		
protected land.		within 0.5 mile	342	**3**		
(Sections 2.5 and 3.6)		shared border (< 500')	35	**8**		
		shared border (=>500')	71	**10**		
			1924			
Percent of land within one	**MPxF**	< 25%	161	**0**		
mile of q-q that is in		=> 25 - < 50	481	**2**		
agricultural use.		=> 50 - < 75	791	**4**		
(Section 3.7)		=> 75%	491	**6**		
			1924			

Miles of roads within	**MRd**	0 mi	209	**0**		
each q-q.		> 0 - < 0.25	114	**1**		
(Section 3.8)		=> 0.25 - < 0.5	874	**2**		
		=> 0.5 - < 0.75	667	**3**		
		=> 0.75 mi	60	**4**		
			1924			
Presence of at least 10m	**MHyd**	none	931	**0**		
of hydro class within		H2 (pond)	6	**1**		
each q-q.		H4 (drain)	715	**2**		
(Section 3.9)		H3 (river)	272	**4**		
			1924			
Center of q-q is within	**MSrv**	yes	322	**- 5**		
serviced area buffer zone.		no	1602	**0**		
(Section 3.10)			1924			

Total Agriculture QQs = 1924, F = classification version, QQs = # of QQs in class, Fw1 = protection scores for classification F. (Fw1 is also the version number for this model outcome).

5. SYMBOLOGY

The scoring system used above ranked the 1924 survey quarter-quarter sections in the Macatawa watershed with at least one acre of farmland on a scale of -2 to 49. The beauty of a GIS analysis is that the results can be represented geographically in a map. However, a map having 49 different colors would be very confusing. The manner in which data is represented in a map is referred to as *symbology*. There is no one correct way to symbolize a given dataset. The mapmaker chooses classes, colors and labels which illustrate broad patterns in the data at small scales and more detailed information at larger scales.

The maps used in this document to represent the model outcome re-classify the 49 actual classes to 3, with Class 1 comprising approximately the top 10% (9.5%) of quarter-quarter sections, Class 2 comprising approximately the next 30% (31.3%) and Class 3 comprising approximately the bottom 60% (59.2%). The classes are based to some extent on natural breaks occurring in the data but they are essentially arbitrary. The highest ranking units in Class 2 are very close to the lowest ranking units in Class 1. The purpose of this symbology is to draw attention to areas of relatively high protection value rather than to provide information about particular quarter-quarter sections. Note also that heavily built-up (MAC_BL = B) and water (MAC_BL = L) units were excluded from the map symbology (although they were scored).

The most useful application of the model would be in a GIS where the model layer can be overlaid by a property parcel dataset so individual farm owners in areas of high protection potential can be identified. For that purpose the symbology could be adjusted to make it more effective. For example, each quarter-quarter section could be labeled with its protection score (Total_PS).

It should be kept in mind that the Macatawa watershed is characterized by the high overall quality of its farmland. The model does not attempt to distinguish good from bad farmland but rather to identify the areas of good farmland which have the highest protection potential. Thus farmland in Class 3 should not be considered of poor quality compared to farmland in other areas of the state.

See Appendix G for instructions on how to change map symbology.

6. CONCLUSIONS

The model described in this manual attempts to identify areas of the Macatawa watershed that have a high potential for farmland preservation. The bases for the model are the PDR scoring systems developed by the state and county bodies tasked to protect farmland from development. Because of the lack of a spatial dataset representing individual farms in the watershed and the difficulty of creating digital layers for some of the criteria the model cannot determine whether any particular area of farmland should or should not be preserved. Final decisions about which farms to protect must wait until individual farmers submit applications in which the geographical limits of the farms to be considered are accurately defined. However, the model can be useful in highlighting areas where qualified farms are likely to be found.

Despite some limitations the model has a number of major advantages:

- It enables the analyst to compare large numbers of units using exactly the same criteria for each one.
- The results are transparent in the sense that users can see exactly what factors went into creating the final unit rankings.
- The model can be easily re-run with different weighting given to criteria if outcomes fail to reflect conditions on the ground or the protection priorities of the stake holders.
- Characteristics which are not easy to observe or measure (e.g. prime soil types) can easily be compared by the computer.
- The model has high predictive value. When used with a property parcel layer the model can identify prospective farm owners who might be encouraged to apply for PDR funding. Furthermore it identifies areas of high protection potential which may help to inform zoning and other resource management decisions.
- Model outcomes can be displayed in geographical maps which the computer can create in seconds and change as often as necessary.

Although the model resulted in the assignment of a protection score to each of the survey quarter-quarter section comparison units in the study area it is important to note that there is no single correct outcome for the priority modeling process. Classification and weighting of the values representing each of the criteria is a matter of judgment. It reflects the modeler's best assessment of the relative importance of each criterion and of the quality of the data used to represent it. As far as possible the results must be tested against real world conditions to determine their accuracy and reliability. In short, the model is not meant to produce an ideal protection priority ranking but rather to be a flexible tool which can assist decision makers in applying real-world priorities to land conservation decisions.

Appendix A - Choosing Base Units When Prioritizing Farmland for Protection

Farms

There is no spatial dataset representing individual *farms* and it would be very difficult to create one. A list of farmers and a property parcel dataset combined with an accurate land cover layer and/or current aerial imagery would be required to create such a layer. It would necessitate screen or tablet digitizing every farm individually and would be a painstaking and expensive undertaking. The difficulty of obtaining even a good *farmland* layer (see below) gives some indication of the problems that would be involved.

Property Parcels

Property parcel layers can now be purchased for most counties and they have the benefit of identifying individual owners but farmland may make up only part of a property parcel or may extend over more than one parcel. An individual may own farmland on parcels that are not contiguous. A farmer may have parcels listed under different names. Another problem with property parcel data is that the digitization quality is variable. The purposes for which counties use the data may not require high accuracy and data integrity but analysis in a GIS is not so tolerant. Because standards and methods are different from county to county it may be particularly difficult to reconcile parcel data if a study area crosses county lines as in the Macatawa watershed. A further problem is that parcels differ in size so when prioritizing them a choice must always be made between average values and absolute values. Would you assign the higher rank to a 10 acre parcel which is 50% farmland or to a 100 acre parcel which is 10% farmland?

Farmland Units

Farmland units would be polygons representing blocks of contiguous farmland. No such layer is currently available at a level of resolution suitable for this analysis. A farmland layer could be created by screen or tablet digitizing from orthorectified aerial imagery. This can be quite accurate but is very time-consuming and demanding work and may be impractical for large areas. The DEQ land use/cover layer for the Macatawa watershed could serve as the basis for such a layer but to be effective it would have to further sub-divided by barriers, whether natural (streams) or man-made (roads over a certain width). Alternatively, it might be useful to sub-divide the farmland polygons by quarter-quarter section lines. This might result in a useful base unit because it would tend to conform to property ownership but it would also be expensive.

Survey Quarter-Quarter Sections

In a quarter-quarter section grid each cell is approximately 40 acres - though a few may be much smaller, especially if clipped to a natural boundary such as a watershed. An advantage of quarter-quarter sections is that they often correspond with property parcel boundaries (boundaries are based on section lines) - especially if the parcels are large. Also, 40 acres is close to the lower limit of accuracy for the best available land cover data. A quarter-quarter section dataset is available from the Michigan Geographic Data Library for every county in the state and using these base units would allow easy comparisons between counties or watersheds.

Appendix B - Land Cover Classes

M_ Class

Class	Type	Acres	Description
M1	Developed	31847	Built up, roads
M19	Recreation	1693	Golf, playground, vacant lot, lawn, etc.
M2	Agriculture	53356	Farmland
M29	Ag Structure	1294	Farmhouses, barns, greenhouses, silos, etc.
M31	Open	4272	Herbaceous open land (meadow, overgrown farmland)
M32	Shrubland	2958	Shrubland, some emergent trees.
M4	Forest	12213	Mature forest
M429	Plantation	119	Christmas trees, pine plantation, etc.
M5	Water	2450	Open water (lakes, large two-bank rivers)
M53	Reservoir	274	Recent, manmade lake/pond, recreational, development.
M6	Wetland	893	Wetland (open or emergent)
M7	Bare	318	Sand, open pit, etc.

M_ AgClass

Class	Type	Acres	Description
M21	Cropland	50902	Row crops, small grains.
M22	Orchard	1855	Tree and bush fruits, ornamentals.
M24	Pasture	598	Permanent pasture
M29	Structure	1294	Farmhouses, barns, greenhouses, silos, etc.

The original Land Cover/Use dataset used in this study was developed by the Michigan Department of Environmental Quality, Land and Water Management Division, Hydrologic Studies Unit and obtained from the Macatawa Area Coordinating Council.

In preparing data for the Farmland Priority Model extensive revisions were made to polygons classified as farmland in the Michigan DEQ *lu2005.shp* dataset. Changes were made by comparison to 1998 and 2005 aerial imagery and ground-truthing. Revisions included reclassification and splitting of some polygons. No polygons were re-drawn. During the revision process some farmland areas were reclassified to other cover types and some non-farmland areas were reclassified as farmland.

New class designations (see tables) used in the MAC study were chosen to reflect those used in the original dataset and also in the Michigan Land Cover/Use Classification System - 2000, which was originally developed by the Michigan Land Use Classification and Referencing Committee and is published by the Michigan Department of Natural Resources.

Appendix C - Soil Quality

The original data for this characteristic was developed by the United States Department of Agriculture, Natural Resources Conservation Service and was obtained from the Soil Data Mart (http://soildatamart.nrcs.usda.gov/).

The data is provided in the form of shapefiles (*soilmu_a_mi005.shp* and *soilmu_a_mi139.shp*) which show the spatial extent of soil types in Allegan County and Ottawa County respectively. In addition, a set of tabular data which contains attribute information about the soil types is provided, as well as a Microsoft Access template database (*soildb_MI_2002.mdb*). The tabular data can be imported into the Access template and reports created.

Versions used in this study:
Allegan County Soil Survey Data (Survey Area Version 8; Tabular Data Version 7; Spatial Data Version 5; (SSURGOV2.1, MD 2.2.3)
and
Ottawa County Soil Survey Data (Survey Area Version 4; Tabular Data Version 4; Spatial Data Version 2; (SSURGOV2.1, MD 2.2.2).

Reports were created using the Access template database and the tabular information to obtain a list of the Map Symbols for prime farmland, farmland if drained and farmland of local importance in the respective counties. The symbols were used to identify these classes of features in the spatial dataset.
(PDF copies of the reports are located in the RelatedDocs folder on the DVD accompanying this manual).

Appendix D - Protected Areas

	Owner/ Easement Holder	Protected Area Name	Size (ac)	Location
1	Land Conservancy of West Michigan	Kuker-VanTil Nature Preserve	45	Park Twp
2		Dune Pines Nature Presrve	13	Laketown Twp
3		Castle Park Reserve	5	Laketown Twp
4		Muzzy Conservation Easement	10	Laketown Twp
5	Michigan Department of Natural Resources	Holland State Park	142	Park Twp
6		Olive Twp State Game Area	245	Olive Twp
7		Blendon Twp State Game Area	40	Blendon Twp
8		unknown	8	Park Twp
9	Hope College	Hope College Nature Preserve	55	Laketown Twp
10	Ottawa County	Upper Macatawa Conservation Area	612	Zeeland Twp
11		12 Park Parcels	58	Park Twp
12		Riley Trails	300	Park Twp
13		Albert C. Keppel Forest Preserve	40	Park Twp
14		Tunnel Park	17	Park Twp
15		Macatawa Greenway	10	Holland Twp
16		unknown	40	Holland Twp
17	Macatawa Greenway Partnership	Macatawa Greenway	65	Holland, Zeeland
18		MG - Buursma Easement	3	Holland Twp
19		MG - Ridge Point Easement	150	Holland Twp
20		MG - Cruiser Easement	21	Holland Twp
21		MG - Dirkse Easement	12	Holland Twp
22	Wildlife Unlimited	Outdoor Discovery Center	100	Fillmore Twp
22	ODC of Wildlife	Outdoor Discovery Center	1	Fillmore Twp
22	ODC Friends	Outdoor Discovery Center	5	Fillmore Twp
23	Park Township	Ransom St. Park	20	Park Twp
24		Pine Creek Trail	37	Park Twp
25		Winstrom Park/Preserve	72	Park Twp
26		Cooper-Van Wieren	66	Park Twp
27		Wendt Fitness Park	17	Park Twp
28		unknown	14	Park Twp
29	Holland Township	Dunton Park	21	Holland Twp
30		Quincy Park	133	Holland Twp
31		Helder Park	159	Holland Twp
32		Macatawa Greenway	19	Holland Twp
33	Zeeland Township	VanZoeren Woods	34	Zeeland Twp
34		Drenthe Grove Park	20	Zeeland Twp
35	Fillmore Township	proposed	20	Fillmore Twp
36		unknown	6	Fillmore Twp

37	Laketown Township	Sanctuary Woods	40	Laketown Twp
38		Wolters Woods	34	Laketown Twp
39		The Huyser Farm	102	Laketown Twp
40		Fairview Nature Park	87	Laketown Twp
41		Kelly Lake	10	Laketown Twp
42		Gilligan Lake	13	Laketown Twp
43	Overisel Township	unknown	50	Overisel Twp
44	City of Holland	Degraff Nature Center	18	Holland City
45		Van Raalte Farm	160	Holland City
46		Windmill Island	70	Holland City
47		Window on the Waterfront	40	Holland City
48		Macatawa Greenway	17	Holland City
49		Macatawa Greenway	55	Holland Twp
50		unknown	8	Holland City
51		Paw Paw Recreation Preserve	48	Holland City
52		Kollen Park	19	Holland City
53		Lakeview Park	3	Holland City
54		Prospect Park	7	Holland City
55		VanBragt Park	4	Holland City
56	City of Zeeland	Huizenga Park	23	Zeeland City

Protected Parcels are property parcels which currently (2009) have some degree of protection from development through their designation as parks, preserves or nature areas or due to the presence of a conservation easement. Parks which have extensive recreational facilities (playgrounds, ballfields, tennis courts, campgrounds etc.) are generally not included unless they have significant areas (>5 acres) of undeveloped forest, wetland or meadow.

Protected Areas are protected parcels or groups of protected parcels. Generally, parcels in a protected area will have the same owner but there are some exceptions such as Holland’s Outdoor Discovery Center. Also, parcels in a protected area are usually contiguous but not always (Holland City Greenway parcels, Greenway Partnership parcels).

The **Macatawa Greenway** is a projected natural corridor running along the Macatawa River from downtown Holland to Zeeland Township. Current components of the Greenway comprise both public and private lands. The project is administered by the The Outdoor Discovery Center - Macatawa Greenway Partnership (ODC-MGP), a nonprofit environmental education and conservation organization. Some components of the Greenway are named parks or preserves and are listed as such in the above table - otherwise they are listed as ‘Macatawa Greenway’.

Protected areas were identified on property parcel datasets by referring to the websites of state, county and local government institutions and land conservation organizations in the watershed.

Appendix E - Fields in the Model Dataset Attribute Table

Field	Data Type	Values
OBJECTID		Database unique identifier. Maintained by ArcGIS.
Shape		Feature type. Maintained by ArcGIS.
COUNTY	text, 2	County code (from original q-q dataset).
TOWN	text, 3	Township code. (from original q-q dataset).
GEO_ID	text, 12	Town, range, section, quarter and quarter-quarter section. (from original q-q dataset).
MAC_ID	integer	Project unique identifier
MAC_BL	text, 3	Totally built-up or totally water q-q. (see 3.#)
MAC_AG	text, 3	q-q with at least one acre of agricultural land (M2 or M29).
MAC_Acres	double	(acres) Calculate Geometry (from Shape_Area).
MSoP	double	% of q-q with prime farmland soil or prime farmland if drained.
MSoL	double	% of q-q with farmland soil of local importance.
MAg	double	Acres of q-q in agricultural use. (M_Class = M2 or M29).
MSC	double	Acres of q-q in specialty crops (M_AgClass = M22).
MPxP	integer	Index of adjacency of q-q farmland to already protected land . (see 2.5).
MPxF	double	% of agricultural land within 1 mile of q-q.
MRd	double	Miles of road in q-q. (see 2.6)
MHyd	text, 3	Class of hydro features (river, drain or lake > 3 acres) in q-q. (see 2.7)
MSrv	text, 3	Center of q-q within serviced area buffer.
MAEAP	text, 5	MAEAP certified farms in q-q.
PA116	text, 5	PA116 enrolled farms in q-q.
****_PS*	integer	A separate protection score field for each of the above criteria fields.
Total_PS	integer	Sum of '***_PS' fields
Shape_Length	double	(m) Automatically computed for each feature. Maintained by ArcGIS.
Shape_Area	double	(m^2) Automatically computed for each feature. Maintained by ArcGIS.

Appendix F - Protection Criteria Classification and Weighting Worksheet.

Criterion	Field	Classification	QQs	Fw1		
Percent of q-q with	**MSoP**	< 1%	310	**0**		
prime farmland soil.		=> 1 - < 10	62	**1**		
(Section 3.3)		=> 10 - < 20	84	**2**		
		=> 20 - < 30	60	**4**		
		=> 30 - < 40	78	**6**		
		=> 40 - < 50	87	**8**		
		=> 50 - < 60	99	**10**		
		=> 60 - < 70	109	**12**		
		=> 70 - < 80	167	**14**		
		=> 80 - < 90	168	**16**		
		=> 90	700	**18**		
			1924			
Percent of q-q with	**MSoL**	< 1%	705	**0**		
soil of local importance.		=> 1 - < 10	300	**1**		
(Section 3.3)		=> 10 - < 20	189	**2**		
		=> 20 - < 30	149	**4**		
		=> 30 - < 40	112	**6**		
		=> 40 - < 50	83	**8**		
		=> 50 - < 60	89	**10**		
		=> 60 - < 70	71	**12**		
		=> 70 - < 80	68	**14**		
		=> 80 - < 90	56	**16**		
		=> 90	102	**18**		
			1924			
Acres of q-q in	**MAg**	< 20 ac	514	**0**		
agricultural use.		=> 20 - < 30	344	**3**		
(Section 3.4)		=> 30 - <= 39	498	**7**		
		> 39 ac	568	**10**		
			1924			
Acres of q-q in specialty	**MSC**	< 1 ac	1817	**0**		
crops.		=> 1 - < 10	39	**4**		
(Section 3.5)		=> 10 - < 20	23	**6**		
		=> 20 - < 30	26	**8**		
		=> 30 ac	19	**10**		
			1924			
Index of proximity to	**MPxP**	further than 0.5 mi	1476	**0**		
protected land.		within 0.5 mile	342	**3**		
(Sections 2.5 and 3.6)		shared border (< 500')	35	**8**		
		shared border (=>500')	71	**10**		
			1924			
Percent of land within one	**MPxF**	< 25%	161	**0**		
mile of q-q that is in		=> 25 - < 50	481	**2**		
agricultural use.		=> 50 - < 75	791	**4**		
(Section 3.7)		=> 75%	491	**6**		
			1924			

Miles of roads within	**MRd**	0 mi	209	**0**		
each q-q.		> 0 - < 0.25	114	**1**		
(Section 3.8)		=> 0.25 - < 0.5	874	**2**		
		=> 0.5 - < 0.75	667	**3**		
		=> 0.75 mi	60	**4**		
			1924			
Presence of at least 10m	**MHyd**	none	931	**0**		
of hydro class within		H2 (pond)	6	**1**		
each q-q.		H4 (drain)	715	**2**		
(Section 3.9)		H3 (river)	272	**4**		
			1924			
Center of q-q is within	**MSrv**	yes	322	**- 5**		
serviced area buffer zone.		no	1602	**0**		
			1924			

Total Agriculture QQs = 1924, F = classification version, QQs = # of QQs in class, Fw1 = protection scores for classification F. (Fw1 is also the version number for this model outcome).

Changing Scores

Scores in the worksheet can be changed by changing the values in the *_PS fields in the model (see Appendix E and Section 4). For example, the procedure for changing the score for q-qs within the serviced zone from -5 to -4 is as follows:

Start by saving *MAG.gdb\MAG_Model_F* with a new name (MAG_Model_F2). You might want to create a new file geodatabase (MAG2.gdb) and export Model_F to it, changing the name in the process.

In ArcMap, open the attribute table of *MAG.gdb\MAG_Model_F2*. (Rt-click on the layer name in the Table of Contents and choose Open Attribute Table).

From the Menu bar choose Selection>Select by Attributes>Select from MAG_Model_F2 where “MSrv_PS” = -5
Click OK.
Now the appropriate features are selected in the attribute table. Click the Show Selected button at the bottom to see them.

Scroll over to the MSrv_PS column. Rt-click on the header and choose Field Calculator.

Type -4 in the big box. Click OK and the -5 values will change to -4. Note that this applies to selected features only.

VBA expressions (*.cal) can be used to simplify changing scores for attributes. Click the Advanced box in the Field Calculator and browse to the Expressions folder.

Appendix G – Map Symbology

Symbology determines how the model outcomes will be displayed in a map.

The symbology for a feature class (dataset) is saved in a map (.mxd) document or a layer file (.lyr) – but not with the shapefile or geodatabase feature class that contains the map layer's data.

A particular dataset can be symbolized in many different ways for *any of its attributes* and each way can be saved in the same map or a different map or as a different layer file. **The data remains the same, only the appearance changes**.

The following is the procedure for symbolizing the model used in this study based on its Total_PS attribute:

Right-click the model layer name in the ArcMap Table of Contents and choose Properties and then the Symbology tab.

In the left pane choose View: Quantities > Graduated Colors.

For Fields choose TOTAL_PS.

Click the Classify button. Set Classes (in the upper left) to 3 (or however many you want). The Natural Breaks method tries to find breaks in the data corresponding to the number of classes you choose. If you want to set your own breaks set Method to Manual.

Set the Break Values to correspond to the number of units you want in each class. Click on each break value to show the number of elements in each class (at the bottom of the window). This should correspond to the number of quarter-quarter sections (QQs) for each class in the Worksheet.

Experiment with number and size of classes until you find a symbology which represents the data in the simplest and most useful way possible. When you have chosen the class breaks click OK.

Now you can change the colors using the Color Ramp or individually, by rt-clicking on each class symbol.

Appendix H – Problems Encountered in Creating the Model

There are a number of problems that may result in iterations of the model which do not produce acceptable results. Some problems are inherent in the design of the model or in the nature of the data used. Others are the result of the way the data is classified and weighted.

Problems inherent in the model design include:

- Farms cannot be compared directly because no digital farm base layer is available.
- Some useful criteria (e.g. MAEAP participation, PA116 enrollment) are not available in a form that can be used by the GIS.
- Quarter-quarter section units in the base layer are not all the same size. The large majority are approximately 40 acres but some quarter-quarter sections along county and watershed borders are considerably smaller. The value of these small quarter-quarter sections may tend to be overestimated.

Problems inherent in the data include:

- Inaccurate data. Remote sensing is not able to distinguish land cover types with perfect accuracy; e.g. when imagery is obtained during dry periods, unforested wetland may be confused with farmland. Roads may not align perfectly with Quarter-quarter section boundaries.
- Changes in conditions (e.g. land cover) since the latest available digital data was created.

Finally, different systems of classifying the data and weighting the classes will give different outcomes. Outcomes should be tested against aerial imagery, parcel data and other digital resources and by ground truthing wherever possible.

Appendix I -

Farmland Protection Modeling in Southwest Michigan

(Paper prepared for the Southwest Michigan Land Conservancy, Kalamazoo, Michigan)

Introduction

GIS priority modeling is a useful tool for land protection specialists. The Southwest Michigan Land Conservancy has successfully used GIS modeling to prioritize the ecological and recreational value of land in various watersheds in their service area. Recently, SWMLC has investigated the possibilities of prioritizing farmland for protection using the same techniques. The following is a discussion of the data required for the creation of a GIS farmland model.

Priority Units

Before considering the protection criteria to be used the modeler must determine what spatial units to prioritize. It may seem obvious that for farmland protection the spatial units should be farms but there is no spatial layer representing individual farms in Michigan. Creating a *farm* layer would require a *farmland* layer (see Base Layer, below) and the appropriate county property parcel data. Contiguous areas of farmland under the same ownership could be digitized and it would then be possible to compare and rank such ‘farms’. It should be noted however that farmers may consider only part of their farms for protection and funding programs may allow farmers to include non-contiguous farmland as part of a single application.

Without a farm layer it is impossible to create a model using a scoring system that corresponds exactly with any of the scoring systems used by county or state agencies to prioritize individual farms. However, using other types of priority units it should be possible to identify areas where high quality farms are located. Several alternative types of priority units are available including natural units (blocks of farmland), property parcels, or grids of various kinds (e.g. survey quarter-quarter sections). See Appendix for further discussion of priority units.

It should also be noted that some protection criteria can *only* be applied to specific farms (enrollment or certification criteria) while others can be applied to farmland blocks or quarter-quarter sections (agricultural productivity, development pressure, etc.).

Base Layer

No matter what priority units are employed the first requirement for the creation of the model is a digital layer representing *farmland* in the study area. Two freely available datasets purport to distinguish farmland from other types of land cover:

- IFMAP: Integrated Forest Monitoring, Assessment and Prescription System. 1997 – 2000 (ifmap_lp_landcover.img).
- CDL: Cropland Data Layer. USDA 2008 (cdl_awifs_r_mi_2008.tif.).

After careful comparison with 1998 and 2005 DOQ imagery of the study area it was concluded that neither layer was able to identify farmland with sufficient accuracy to serve as a basis for prioritizing farmland of a minimum size of 40 acres *even if no*

distinctions between crop types were considered. Our conclusion is that in order to successfully create a farmland prioritization model an unclassified farmland layer would have to be created or at least the IFMAP or CDL layer would have to be heavily edited to conform to the DOQ aerial imagery.
Note that both datasets are rasters with 30 meter resolution. Pre-processing can improve their quality (by generalization and filtering) but this requires a specialized extension (Spatial Analyst, if using ArcGIS). Otherwise the raster data can be converted to vector format for editing and analysis.

Protection Criteria
Wilderness is characterized by a wide diversity of plant and animal life in a more or less self-sustaining ecosystem. Criteria for determining high priority natural areas tend to be ecological and to some extent esthetic. Farmland is quite different. It is, by definition a monoculture and requires extensive management (planting, harvesting, fertilizing, etc.) to maintain. The criteria used to identify farmland for protection are very different and often mutually exclusive from those used to identify high quality wilderness.

Land protection almost always incurs a cost so financial and political considerations cannot be neglected when determining what farmland should be protected. The Michigan Farmland and Open Space Preservation Program includes several methods of preserving farmland, including the Purchase of Development Rights. By the terms of the act authorizing the PDR program (Natural Resources and Environmental Protection Act - Act 451 of 1994) local authorities (counties) must first approve or reject applications for PDR before they are submitted to the State for final approval. Each county is free to establish its own criteria (within the definitions of farmland established by the Act). The county standards vary in the criteria included and in their relative value but they encompass a variety of factors considered important by a range of stake-holders including farmers, administrators, politicians and the general public. Criteria considered in this paper will be drawn from those included in the Allegan (A), Ottawa (O) and Van Buren (VB) Counties PDR application scoring systems as well as the Michigan Agricultural Preservation Fund (MAPF) Qualification Procedure and Criteria scoring system.

Whatever criteria are chosen, each one must be expressed in digital form and ultimately georeferenced in some way for use in a GIS. To some extent this drives the choice of criteria and may preclude the use of some criteria altogether. Ideally, the necessary digital data can be obtained from other sources but in practice publicly available data may need to be modified or new datasets created by the modeler. The following discussion will consider the availability, quality and appropriateness of digital data required to construct a GIS farmland protection priority model for southwest Michigan.

Crop Type
Distinguishing crop types is an important part of all the county scoring systems considered (but not of the MAPF scoring system). In spite of its more recent date and much greater number of crop type classes, the 2008 Cropland Data Layer was unable to consistently distinguish crop types over the small areas (minimum 40 acres) required for an effective priority model. The CDL was particularly poor at identifying the woody

crops (orchards, grapes, blueberries) which are a significant specialty crop in southwest Michigan. IFMAP was more successful in identifying woody crops even though slightly less accurate in discriminating farmland in general.

Our conclusion is that it might be possible, using IFMAP, CDL and observation of DOQ aerial imagery to classify crop types into three or four broad classes (e.g. woody crops, row crops, and pasture) but that the process would require heavy editing and extensive ground-truthing.

Agricultural Productivity

All scoring systems place a priority on productive farmland as defined by the USDA Soil Conservation Service Soil Survey. Some systems mention only prime and unique soil types (MAPF, A) and some also mention soil types of local significance (VB, O). There are actually no unique soil types listed for any of the three counties. USDA Soil Survey Data is available by county in the form of a shapefile (*soilmu_a_mi###.shp*). Prime, unique and locally important soil types are listed in the Access database *soildb_MI_2002.mdb*.

Proximity to Protected Land

This criterion is mentioned by all authorities cited. Two types of protected land are generally distinguished: protected farmland and other protected (conservation) land.

Enrollment in a Michigan Farmland and Open Space Preservation Program Farmland Development Rights Agreement (PA116) is sometimes taken as a measure of protected status, though this protection is not permanent. More problematic is that there is no spatial dataset showing PA116 enrolled farms. Legal descriptions of PA116 farms are available but to be useful in a model they would have to be individually digitized. (The Black River watershed, for example, contains approximately 180 PA116 farms and digitizing all of them from legal descriptions would be very time-consuming). Farmland protected under any other program (Local Open Space Easement, Designated Open Space Easement) would likewise have to be digitized by the modeler (if legal descriptions were available) to create a spatial dataset.

The general location of protected conservation land in the study area can be obtained from appropriate government agencies, land trusts and non-profit conservation organizations although this requires considerable research, especially to establish the level of protection afforded. In order to convert this information into a spatial data layer a *property parcel dataset for the appropriate county is required*. The protected parcels can then be identified by inspection and exported to a protected land layer. This process is easier than that described in the previous paragraph because protection is afforded and recorded by property parcel and not by farmland parcel. It should be noted that the Conservation and Recreation Lands (CARL) layer produced by Ducks Unlimited is of some use in identifying recreation areas (golf courses, etc.) but cannot be relied upon to identify protected conservation areas, especially at the property parcel level.

There is also a question of what constitutes proximity or contiguity. In some county scoring systems a minimum length of shared boundary is required for maximum points while points are also awarded for the presence of protected farmland which is not contiguous but is within a specified distance (VB). In other cases a farm must be "adjacent" to protected land to receive maximum points (A). Sometimes the terms "near" or "adjacent" are used without specifying their exact meaning. The modeler is left to devise a way to quantify this characteristic.

Proximity to Non-protected Farmland
Ottawa County awards points to: "Amount of land in the surrounding area in agricultural use" in addition to points awarded to *protected* surrounding farmland. Other authorities refer only to protected surrounding farmland - although in some cases (MAPF) the wording is somewhat ambiguous. Again in this case some measure of proximity would have to be devised by the modeler.

Size of Farm
If no farm layer is available this criterion cannot be applied directly. An alternative would be to assign value to blocks of contiguous farmland without regard to ownership (see Base Units, above).
Because property boundaries often correspond to survey section (or part section) lines it might be useful to divide the base farmland layer (see above) into quarter-quarter section blocks. If this were done the largest farmland block would be 40 acres. This would be particularly useful if quarter-quarter sections were the priority units employed. For example, the previous criterion (Proximity to Non-protected farmland) could be characterized by determining the percentage of farmland in adjacent quarter-quarter sections. (Whether adjacent q-q sections were part of the same farm would have to be determined by inspection using a property parcel layer).

Hydro
All three counties assign value to proximity to water, either as part of a larger category (Unique Physical Characteristics, A) or a separate category. Points awarded if "adjacent" to river, stream or lake (A) or "frontage" on a stream (no mention of lake) with size of stream characterized by the amount of land drained by the stream (O, VB). MAPF does not mention hydro.
A county hydro framework dataset is available from MIGDL. Drainage areas would have to be computed from watershed layers available from MIGDL. This calculation might be difficult for smaller streams.

Road Frontage
Allegan County does not mention road frontage in its scoring system. Van Buren County mentions it as a discretionary criterion with low positive value assigned to parcels with "proximity to and/or frontage on a major thoroughfare" but also uses it as an indicator of development pressure with values awarded depending on length of road frontage and additional points assigned for proximity to freeway interchanges. Ottawa County gives higher priority to "lands along public roads".
A county transport framework dataset is available from MIGDL.

Development Pressure
This criterion is not mentioned by Ottawa County, is mentioned as a priority in the introduction to the Allegan county scoring system but is not actually scored and is scored based on the number of well permits issued and also by amount of residential construction in the Van Buren county system.
As an alternative to well permits and residential construction it would be possible to use the Purdue University ILWIMI Land Transfer Model to predict development pressure.

MAEAP Enrollment
The Michigan Agricultural Environmental Assurance Program certifies farms that engage in environmentally sound practices. All authorities except Van Buren County specifically mention MAEAP enrollment. Van Buren awards discretionary points to farms which follow Generally Accepted Agricultural and Management Practices (GAAMPs). MAEAP procedures are based on GAAMPs.
There is no spatial data available for this criterion. Values might be assigned by comparing a list of enrolled farm owners with the property parcel dataset for the appropriate location. This would depend on the amount and type of information available from MAEAP. (MAEAP Verifier: Josh Appleby, applebyj@michigan.gov).

PA116 Enrollment
In addition to being useful for defining protected farmland (See "Proximity to Protected Land" above), PA116 enrollment is itself worth points in all 3 county scoring systems, though it is considered discretionary (VB) or of secondary importance (O) in some. It is not mentioned in MAPF.
As mentioned under "Proximity to Protected Land" a spatial dataset of PA116 farms could be digitized from their legal descriptions. As an alternative, SWMLC staff attempted to create a PA116 data layer by comparing property parcel data with the names of listed owners of PA116 farms. Because of the nature of the property parcel data (see Appendix) and the lack of information provided with the owner database this was not successful.

Conservation Plan
All authorities award scores to farms having a *current* conservation plan on file with the USDA-Natural Resources Conservation Service. In Michigan the NRCS sponsors the Environmental Quality Incentives Program, 2009. Further research would be required to determine what other conservation plans are certified by the NRCS.
It is unlikely that spatial data is available for this criterion. Values might be assigned by comparing a list of enrolled farm owners with the property parcel dataset for the appropriate location but this would depend on the amount and type of information available from the NRCS.

NOP Certification
The USDA- National Organic Program regulates the standards for any farm, wild crop harvesting, or handling operation that wants to sell an agricultural product as organically produced. NOP certification is considered of primary importance in the Ottawa county

scoring system but is not mentioned by other authorities. See Conservation Plan, above, for suggestions on creating a spatial layer for this data.

Zoning
Allegan County awards points for the number of acres of the farm in zoned agricultural use areas. Other authorities do not mention zoning. This criterion could be applied to farmland blocks or quarter-quarter sections if a digital zoning layer was available from the appropriate county. (The Southwest Michigan Commission may be developing such a layer for its service area).

Public Access
Van Buren county awards points for farms enrolled in a state or locally recognized public access program (MiDNR HAP, etc.). Other authorities do not mention public access. See Conservation Plan, above, for suggestions on creating a spatial layer for this data.

Unique Historical Characteristics
Van Buren and Ottawa counties award points to Centennial Farms and/or farms with other designated historical or archeological features. See Conservation Plan, above, for suggestions on creating a spatial layer for this type of data.

Preservation Commitment
This criterion is mentioned only by MAPF and Van Buren County. MAPF awards points to farms in local communities which have a dedicated funding source for farmland preservation (millage, user fees, etc.). Extra points are added if a priority map has been created. Van Buren County considers this among several criteria for which discretionary points may be awarded.
This criterion would be relatively easy to score because any farm (farmland, q-q section) lying within the qualifying local community (township, county) would be awarded points.

Matching Funds
Funds committed to a specific farm from any source including community funding (as above), federal grants, contributions from the farm owner, etc. would qualify. MAPF awards points only for matching funds greater than 25% of total. Counties award points based on a sliding scale. Landowners can agree to accept an offer less than the purchase value of the development rights and have the remaining portion of the rights' value considered as matching funds.
This would be difficult to include in the model because funding commitments might not be publicly announced until an application is made.

Unique Environmental/Physical Characteristics
All three counties have a provision for awarding points for scenic views or vistas or other unspecified unique physical characteristics. Hydro features may be included in this category (A) as well as frontage on major thoroughfares (VB). Esthetic characteristics such as scenic views would be very difficult to model. Hydro and road frontage are discussed in an earlier section.

Conservation Values Other than Farmland
Van Buren County awards points for "…significant natural resource features including natural water bodies and water courses, sand dunes, wildlife habitat, wetlands and other open space." This criterion would have to be scored based on inspection of aerial imagery.

MAPF-Specific Criteria
The Michigan Agricultural Preservation Fund is designed to assist local units of government and not farmers directly. Its scoring system lists a number of criteria (in addition to Preservation Commitment and Matching Funds, see above) which reflect the degree of commitment of local communities to the farmland preservation process. These include:

- Intergovernmental Cooperation
- Local Planning Training
- Local Capacity to Execute
- Local Agricultural Planning
- Agricultural Economic Development Plan

These criteria are generally quite complex and it would probably require assistance from MAPF as well as local government authorities to characterize these criteria in such a way that they could be used in a model.

Conclusion
It should be clear from the above discussion that it would be prohibitively difficult and time consuming to create a model which could score individual farms on the basis of any of the scoring systems considered or indeed of any useful subset of the many criteria employed. Such a model would have to apply values for each criterion to each farm in the study area. With adequate resources an individual 'farm' data layer could be created but there is no way to anticipate which part of their farmland the owner might consider for protection. Final decisions on which farms are eligible for protection have to be made on as individual basis after the farm has been submitted for consideration.

However, a GIS model can play a useful role in prioritizing *farmland* in a study area. Such a model could rank farmland blocks (either naturally occurring or divided into quarter-quarter section units) or survey quarter-quarter sections. Criteria used could approximate as closely as practicable those discussed above with an emphasis on the characteristics considered most important by the state and county agencies involved. We have seen from the discussion of individual criteria that very few of them are represented by georeferenced spatial data. Thus the effectiveness of this type of priority model would be determined by the time and resources available to the modeler for the creation of new datasets.

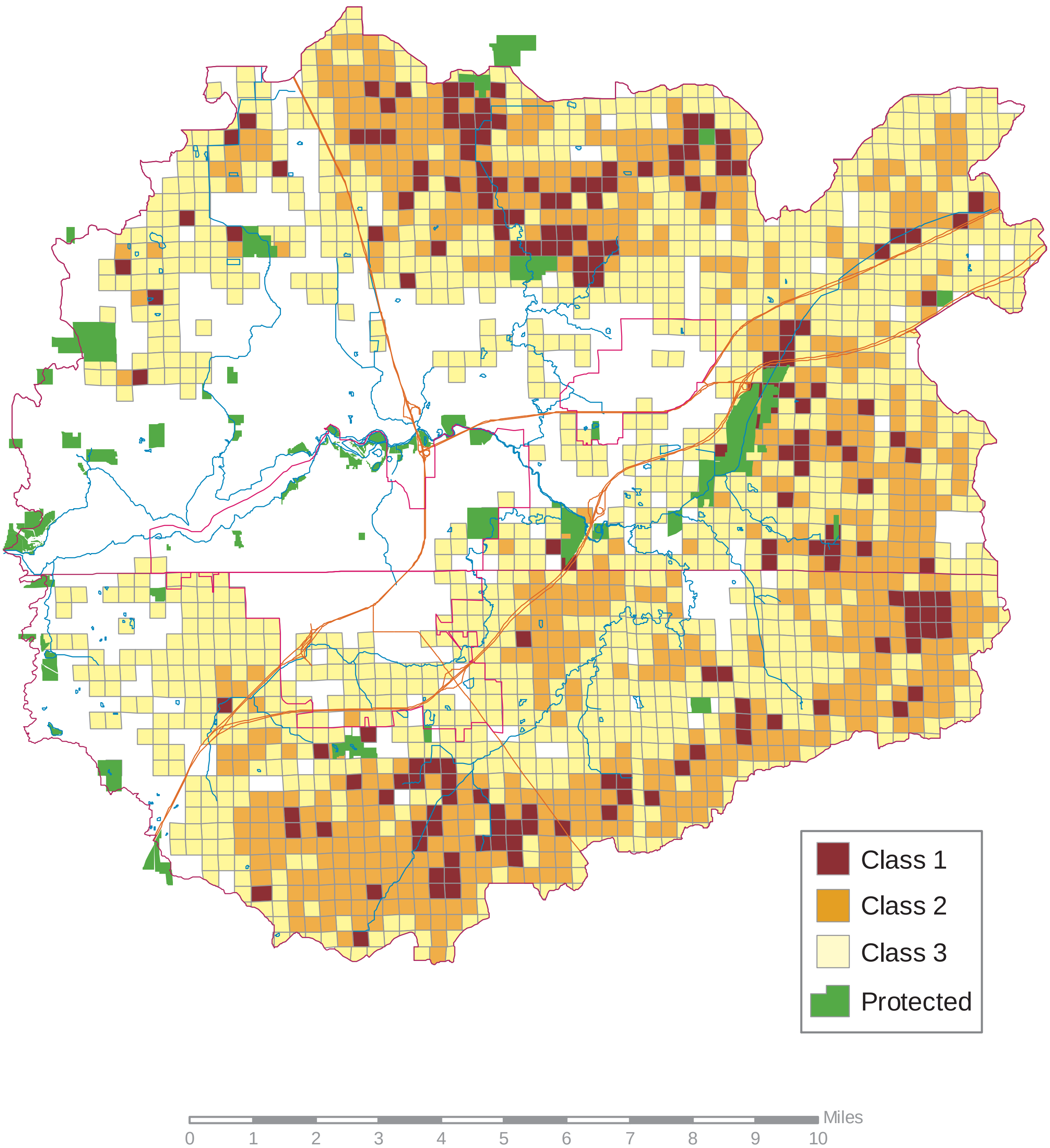
It should be noted that although this farmland priority model would score the base units used (farmland, quarter-quarter sections, etc.) the actual scores would not correspond to the scores in any other scoring system. *The final product would not be a score but a priority ranking based solely on the criteria used.*

The value of prioritizing farmland in this way is that it would be a useful predictor of the areas that might contain individual farms worth protecting. The farms themselves could then be identified by overlaying a property parcel layer over the farmland priority model.

Macatawa Watershed

Farmland Protection Priority by Quarter-Quarter Section

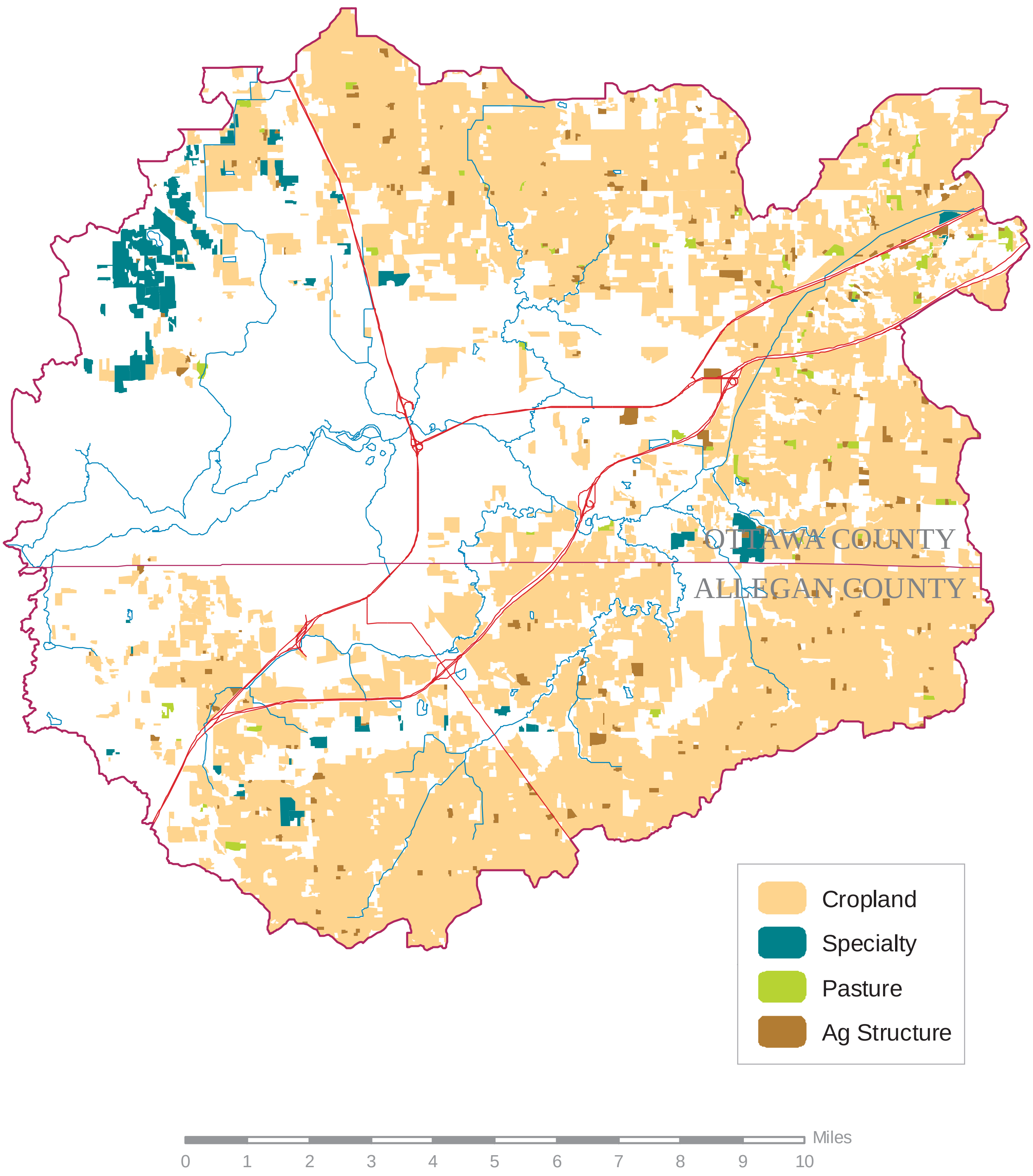
Version Fw1



Macatawa Area Coordinating Council

Fw1 - 01/31/10

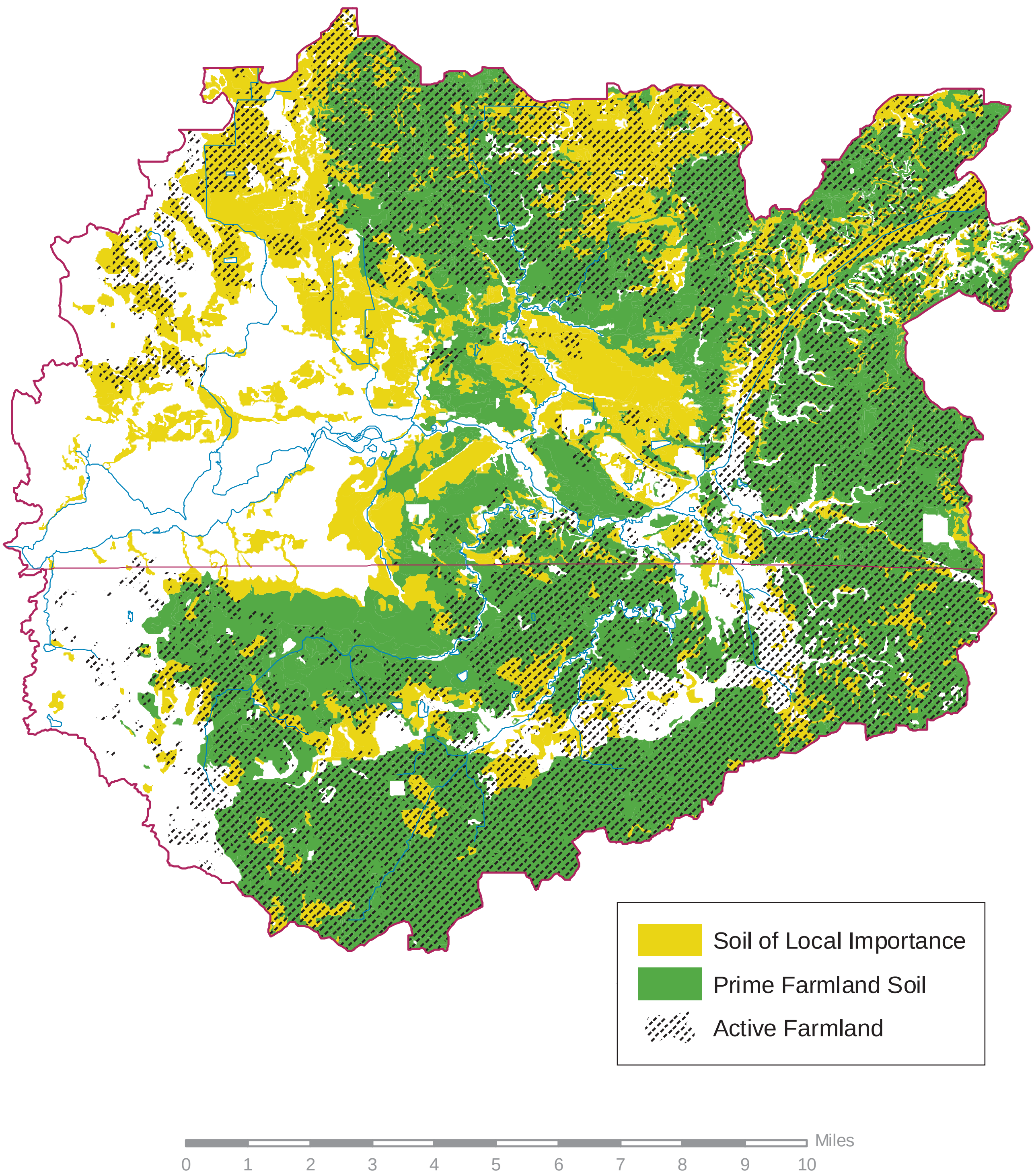
Macatawa Watershed
Agricultural Land Use/Cover



Macatawa Area Coordinating Council

02/01/10

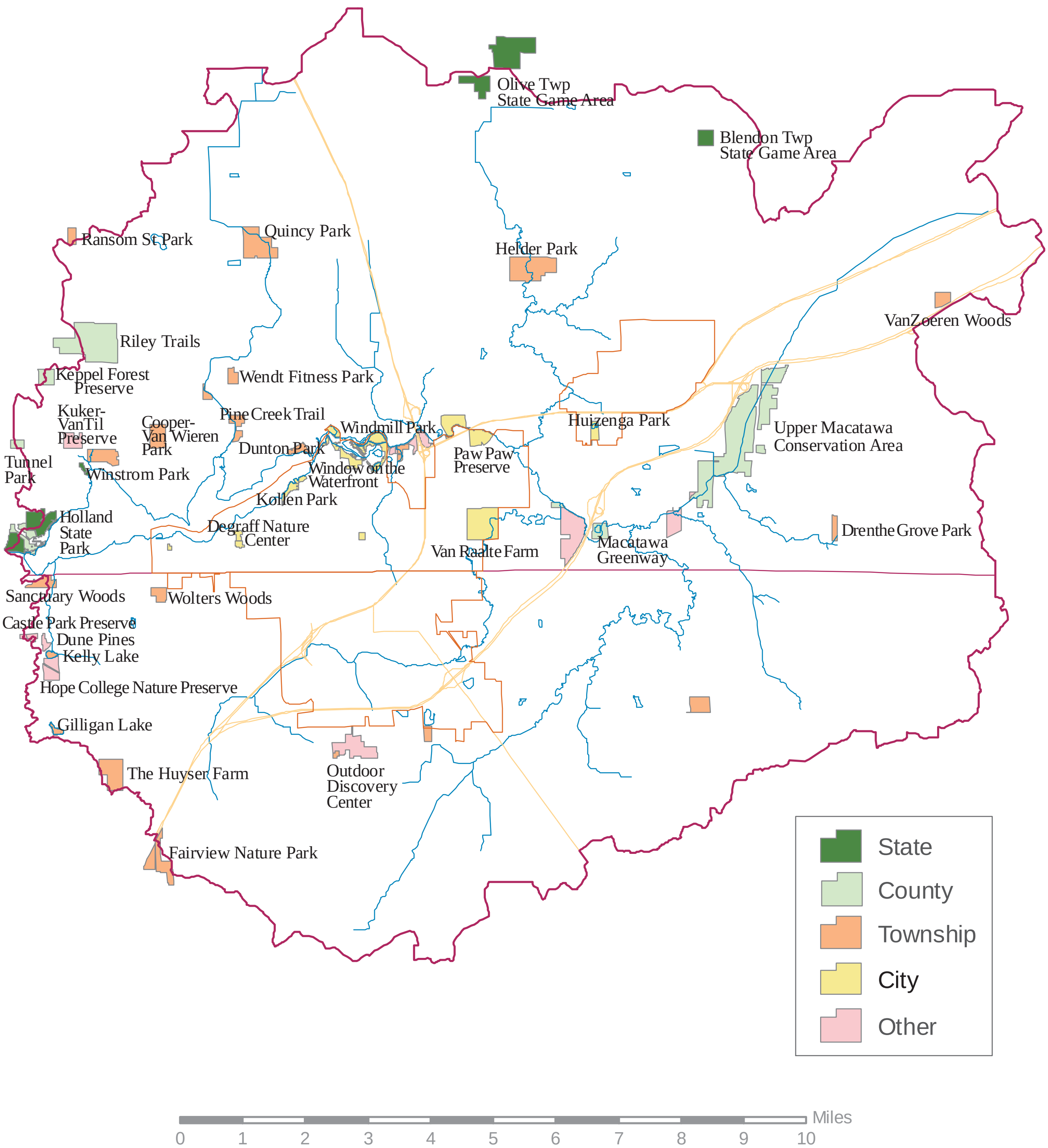
Macatawa Watershed
Prime and Other Important Farmland Soil



Macatawa Area Coordinating Council

01/31/10

Macatawa Watershed
Protected Areas



Macatawa Area Coordinating Council

01/31/10

Macatawa Watershed
Political Divisions