THE ROUGE RIVER PROJECT
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Rouge River National Wet Weather Demonstration Project

Wayne County, Michigan

TASK PRODUCT MEMORANDUM

Drain Information System Pilot Project

RPO-WMGT-TPM60.00

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Drain Information System
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Watershed Management Work Plan No. WMOG6.4, Task No. 1

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Rouge River National Wet Weather Demonstration Project

MISSION STATEMENT

The mission of the Rouge River National Wet Weather Demonstration Project is to demonstrate effective solutions to water quality problems facing an urban watershed highly impacted by wet weather and develop potential solutions and implement projects which will lead to the restoration of water quality in the Rouge River. The project will address both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downstream water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state and local environmental laws which protect human health and the environment.

This will be accomplish through the development, implementation and financial integration of technical, social and institutional frameworks leading to cost-efficient and innovative watershed-based solutions to wet weather problems. This watershed-based national demonstration project will provide other municipalities across the nation facing similar problems with guidance and potentially effective solutions.

PREFACE

The Rouge River, historically a source of pollution to the Great Lakes, is being restored. Wayne County's Rouge River National Wet Weather Demonstration Project (Rouge Project) was initiated in 1992 to lead the restoration effort. The Rouge River Remedial Action Plan (RAP) of 1985 was the foundation for the Rouge Project.

The Rouge Project was established under an initial grant from the United States Environmental Protection Agency. This grant enabled Wayne County to initiate a comprehensive watershed-wide approach to address combined sewer overflows (CSO), stormwater management, and other point and nonpoint source controls.

Subsequent grants have provided the framework for the progression and implementation of Rouge Project goals. Wayne County and the other two counties and 48 communities of the Rouge watershed continue to implement projects to restore water quality and ecosystem health in the Rouge River. The Rouge Project is addressing both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downstream water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state, and local environmental laws which protect human health and the environment.

This mission is being accomplished through the development, implementation, and financial integration of technical, social, and institutional frameworks leading to cost-efficient and innovative watershed-based solutions to wet weather problems. There are over two hundred restoration projects underway or completed by communities and agencies in the Rouge. This watershed-based national demonstration project provides other municipalities across the nation facing similar problems with guidance and potentially effective solutions.

The Rouge Project continues to build on lessons learned from earlier efforts and focuses on further integration of the goals of the overall mission. To this end, current work concentrates on the following key project areas:

Watershed Management. Activities in this area include the following: a holistic watershed approach for the development, evaluation and implementation of wet weather and stormwater management alternatives; ongoing efforts to monitor ongoing ecosystem health; analysis of data and presentation recommendations; and development of watershed management tools such as geographic information systems (GIS).

Stormwater and Nonpoint Source Pollution Control. This area provides for watershed-based wetweather management in concert with enhanced efforts to establish institutional partnerships. Numerous pilot stormwater and watershed management projects are being undertaken in partnership with Rouge communities. The Michigan Voluntary Storm Water General Permit is an example of an innovative watershed based regulatory tool used by the Rouge communities. Additional efforts include the enhancement of wetlands and restoration of riparian habitats.

CSO Construction Coordination. This area is evaluating the performance of numerous CSO control demonstration projects established and built during 1994 to 1997. The evaluation of various technologies and operation practices will provide technical data for a basis of design for Phase 2 and Phase 3 CSO facilities in the Rouge watershed and for use by others nationally.

Public Involvement and Information. This area leads the effort to reach and involve stakeholders, institutions, and regulatory agencies, thus fostering a renewed understanding and continued commitment to reducing pollution. The transfer of watershed management approaches to others regionally and nationally is also a key component of the Rouge Project. Major tools include the website (rougeriver.com), information workshops in the watershed and coordination of public education activities by communities and public agencies of the Rouge.

Additional information on the Rouge River Project is available from many sources, including the Wayne County Department of Environment (WCDOE) (888) 223-2363, the Rouge Program Office (RPO) (313) 961-0700, and the Rouge Project website ("http:/ www.rougeriver.com").

ABSTRACT

The Wayne County Department of Environment, Division of Public Works (DPW) is improving and modernizing its information systems for County Drains. This work includes the conversion of information from paper maps and legal descriptions to a computer-based geographic information system (GIS). Ultimately, the GIS will provide three benefits for the County:

- improved record-keeping for maintenance and engineering staff responsible for County Drains;
- improved service to residents and businesses served by the County Drains; and
- improved ability to perform environmental management and reporting under the Michigan Storm Water General Permit (MIG610000) and future federal storm water regulations.

This task product memorandum describes the inventory of information available for developing the Wayne County Drain GIS. The inventory includes a County-wide review of available digital data, paper maps and drainage districts and a more detailed review of parcel boundary data within one community – Westland.

This memorandum also describes the end products of this project such as the preliminary Drain Information System (DIS) pilot project file developed in ArcVIEW™ that includes the location and extent of approximately 375 unique County Drains. Within the detailed pilot area of Westland, more complete information is presented for the drain network and for parcels within the drainage districts. The DIS pilot was developed using the State of Michigan MIRIS base map currently used by the Rouge Project. All data necessary to view the DIS pilot were provided to DPW.

Recommendations were developed for implementing a full-scale DIS based on the pilot results. These recommendations include: 1) perform quality control steps and reconcile discrepancies within existing information; 2) establish the full-scale DIS on the new Wayne County digital ortho-photo base map currently under development; and 3) incorporate new digitized data with parcels that the County is developing under another project.

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1.0 INTRODUCTION. This memorandum describes the work completed for Rouge Work Plan No. WMOG6.4 Task 1 - subtasks A through D "Drain Information System Watershed Management." The term "Drain" refers to the open channels, ditches, and storm sewers that Wayne County owns and maintains on behalf of statutory assessment districts in the County established under the Michigan Drain Code (Act 40 of 1956, MCL 280.1 et seq., as amended). Generally, a "Drain" is a system of storm water facilities within a subwatershed. The annual cost of maintenance and the cost of any improvements to the Drain is assessed to the properties within the assessment district.

The work described in this report is a pilot effort in converting Drain records to a new geographic information system (GIS) structure. The new GIS structure is compatible with the County-wide parcel mapping project, and it will assist the County in managing its Drains to meet the current requirements of the State of Michigan Storm Water General Permit Michigan and future federal stormwater regulations. This work converted the County Drain map data into digital format, and in the process verified and updated data. This work helps to maintain the Rouge project GIS information for future years by making the data useful for other purposes. The process was logically divided into two major components. The first component consisted of creating the digital data and performing all logical corrections and the second component consisted of verification by field staff and others and then making the corresponding corrections. This document details the work completed to date and includes a summary of remaining work needed to complete the Wayne County Drain Information System (DIS).

A complete list of acronyms used in this report is presented in Appendix A.

2.0 DESCRIPTION OF WORK EFFORTS.

2.1 SUBTASK A - GEOGRAPHIC DATA INVENTORY AND AUTOMATION. This work effort involved collecting and reviewing available data. Meetings were held with the County staff and a list of known data sources was assembled. The data inventory established for this project is shown in *Table 2.1*. Some additional Wayne County Rouge Program Office (RPO) data has been used in this project on an as-needed basis. These data sets are the standard RPO data sets distributed on CD-ROM and include such data as the watershed, subwatershed and subarea boundaries, road features, and administrative boundaries.

Table 2.1 - Geographic Data Inventory

	Initial data	Conversion/Update	Final data
Theme	**format**	**Methods**	**format**
Drain district boundaries	paper maps	manual drawing	p o l y g o n / r region
Drain district description start	paper maps, 1/4 section maps	manual drawing	point
Drain courses	Paper, 1:24k	Scan/heads-up trace	line
County Drains (derived from MIRIS)	MIRIS	manually tag, split, edit	line
Community Data (Example)			
Westland parcels	shape file	convert to Nad83	polygon
Westland storm pipes	shape file	convert to Nad83	line
Westland storm structures	shape file	convert to Nad83	point
Westland Drains	shape file	convert to Nad83	line
Westland road ROW dimensions	shape file	convert to Nad83	annotation
Westland railroad ROW	shape file	convert to Nad83	line, annotation
Westland road names	shape file	convert to Nad83	annotation
Westland Rivers	shape file	convert to Nad83	line
Westland section lines	shape file	convert to Nad83	line
Westland storm pipes	shape file	convert to Nad83	line
Westland storm structures	shape file	convert to Nad83	point
Wayne County Drain assessment info for parcels	ascii file	database load	dbase file
Wayne County Drain district database	ascii file	database load	dbase file
RPO Watershed boundary	Nad27	convert to Nad83	
RPO Watershed subareas	Nad27	convert to Nad83	

While the creation of *Table 2.1* was central to Subtask A, creation of the data layers that it describes are the central focus of one or another of the other Subtasks. Reference will be made to this table as necessary when each subtask is described below. Additionally, the project directory structure was established and this structure is also presented below.

2.1.1 Directory Structure. The directory structure as defined for the Drain Information System is shown below. The software environment is ArcView™ 3.0, which is based on a single project file organization. The ArcView™ project files contain references to all the spatial and attribute data files that are used in that project. It is beneficial from a development and implementation perspective to have all files referenced in a project file located in a single directory branch. This improves portability, backup and other aspects.

C:\PROJECT\DIS	**(Note: project file will be portable to network drive)**
\APP	**ArcView™ project files, referred to as applications**
\DOC	**project documentation**
\DRAWING	**Cad Drawings, [AutoCad™ or Microstation]**
\IMAGE	**aerial and other imagery**
\THEME	
\ADMIN	**Standard RPO political boundaries**
\ASSMNT	**files related to the Drain assessment process**
\DATABASE	
\DRAIN	**All spatial data files generated by the DIS (Drain Information System)**
\WAYN83	**A/I coverage of MIRIS basemap. MIRIS basemap consists of numerous numbered layers corresponding to most standard features on the USGS 1:24,000 topographic quadrangle maps.**
\HYDRO	**Standard RPO hydrologic features**
\SEWER	
Contract.shp	**Point features serving as index to Wayne County Sewer construction contracts.**
Drains.shp	**Drain locations**
Meter.shp	**Sanitary Sewer Meter locations**
Struct.shp	**Key sanitary sewer infrastructure locations such as treatment plants and pumpstations**
Swrmain.shp	**Wayne County Sanitary Sewer mains**

2.2 SUBTASK B - DIGITIZE MAP DATA. This subtask describing digitizing map data refers to two different data layers. This section describes the capture of the "drain assessment districts" and then describes the County Drain layer.

2.2.1 Drain Assessment Districts. This task was intended to create a digital version of the County Drain district boundaries. The community chosen for this initial effort was the City of Westland. This choice was based on several factors including:

- location (Westland is entirely within the Rouge Watershed)
- responsibility for County Drain maintenance has been retained by the County
- limited drain district GIS work had been initiated
- numerous RPO data sets were available for this area, and
- the community already had a digital parcel base map.

Once the area had been defined, Wayne County staff provided a complete set of the County Drain Quarter-Section maps for each of the seven Drain districts selected. These are the maps the County staff use to show the district boundaries. These maps also contain parcel boundary lines as reference. In most instances, the parcel boundaries form the edge of the drain districts themselves.

In general, the digitizing process followed for this task consisted of drawing the drain district boundaries in AutoCad™ using parcel lines as a reference. The completed drawing is shown in *Figure 2-1*. A point feature with the alphanumeric County Drain identifier was added and features were also created indicating the start point of textual drain description. The software used for this task was AutoCad™ Release 13, although almost any modern version of AutoCad™ would be sufficient to perform this task. The detailed version of the procedures are provided below. Along with a comprehensive description of the database structure that has been established.

2.2.2 Drain Assessment District Digitizing Process. Data sources required for this effort are:

- County Drain Quarter Section maps
- County Drain descriptions
- Digital parcel basemap (in AutoCad™ format)

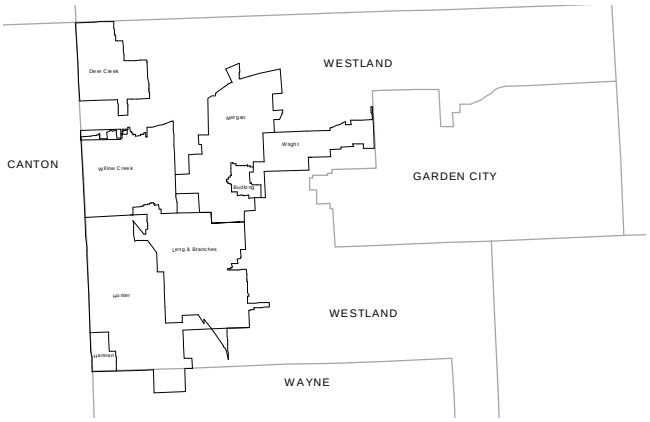

Figure 2-1 - Completed Drain District Drawing

The process begins with the preparation of an AutoCad™ drawing of the parcels by the technician. AutoCad™ layers for this task are shown in *Table 2.2*.

TABLE 2.2
AutoCad™ LAYERS

LAYER NAME	LAYER DESCRIPTION
Co_drn_bnd	Drain district boundaries
Co_drn_jur_bnd	Lines where drain district crosses political jurisdiction
Co_drn_name	County Drain name text
Drn_strt_pnt	County Drain description starting point (text)
Error	Areas where maps disagree with adjacent maps or descriptions
Parcel	Parcel lines
Sections	Section lines and numbers

The precise symbology of the layers is not critical so long as they are different enough from one another to enable a technician to readily perform the work.

The technician selects a set of the Quarter Section maps for any given Drain. Beginning with the first Quarter Section map, the technician must find the corresponding feature in the AutoCad™ drawing. The last two layers in the *Table 2.2* are reference layers that facilitate orienting the technician to the paper maps. Once located, the technician begins entering lines into AutoCad™ by "snapping" to existing lines on the parcel layer. Care should be taken to ensure that lines are always snapped to ensure network connectivity. Where a boundary coincides with a Right of Way (ROW) centerline, the centerline can be determined by drawing "construction" lines across the ROW and then snapping the drain district line to the midpoints of the construction line. This is important since the source of the parcel lines were scanned-and-traced digital data and the ROWs are not likely to be exactly sized. Because of this, offsetting lines a precise distance from one edge (such as 30 feet for a 60 foot ROW) will not provide the actual midpoint between the two ROW edges. However, when district lines run parallel to parcel lines but across parcels, the AutoCad™ command **offset** may be used. Some of the distances between parcel lines and district boundaries have been written on the maps. For those that have been omitted, the drain description must be read to determine the correct distance. AutoCad™ allows keying in distances when entering lines, a very helpful tool when trying to construct lines accurately.

The drain line is entered onto the **co_drn_bnd** or the **co_drn_jur_bnd** layers depending on their status. If implementing this system on a large scale, the **co_drn_jur_bnd** layer may not be necessary. This layer was created because the drain districts overlap municipal boundaries and adequate parcel data did not exist to allow for complete drawing of the drain district. This layer, however, may still be desirable in the future because Inter-County Drains may present a similar challenge. The layering is not critical when moved to a GIS. Two layers are easily combined and the 'layer' attribute of the line may be maintained or discarded as desired.
The drain district maps are handled as individual sets for each district. Any map sheet that has multiple districts within will be found in each corresponding set of district maps. During the drawing of the drain districts from the paper maps, it was discovered that these maps did not always agree on common boundary between districts. In some cases the legal description could clarify the discrepancy, or the discrepancy only affected a ROW area and was deemed insignificant. In cases where the discrepancy was significant and not resolvable by staff, polygon shapes were drawn on the **error** layer so that these could be easily identified for County review.

The start point of the drain district textual (or legal) description is found on the map. A text feature should be snapped to the corresponding node on the map on the **drn_str_pnt** layer. The size of this text is specified at 50 feet, but the size is not critical as it is easily changed and primarily provides a point feature for future GIS application. The text feature will consist of the corresponding County Drain district identifier (e.g. L012).

The Drain District name will be entered on the **co_drn_name** layer. The text is sized at 250 feet, a practical size for this drawing.

2.2.3 Drain District Layer Issues. The process of digitizing the drainage districts demonstrated an interesting aspect which had not been previously known to the RPO GIS staff. This issue does not directly affect this process of digitizing as it was performed but may affect the approach used in the future. The issue is that Drain assessment districts are sometimes 'nested' which indicates that a small drain district may geographically fall within a larger district. The area within the smaller district is considered to be in both districts. The smaller district is effectively a subset of the larger district. This means that the district names and boundaries as shown in the AutoCad™ Drawing may be misleading, and in the GIS environment, at least, a different data structure must be implemented. Due to this nesting, the GIS must contain a slightly more complex region topology than the standard polygon topology. Therefore, it may be beneficial in future efforts that the data be directly digitized using a GIS environment such as ESRI's ArcEdit™.

Another important aspect is that symbolizing these nested districts can be a challenge even within the GIS. The advisable approach is to anticipate that the districts will have to be filled with vector hatching. The complexity is that a 'district order' attribute may need to be established. For example: any district that has does not fall within a larger district gets a value of (1). If a district falls within a district of order (1) then it is assigned (2). If a district falls within a (2) so that is also falls within a (1) then it gets order (3). Then, the order attribute would be used for determining symbology. In this way, conflicts in symbology could be prevented. While this was not necessary for the scale of this project, eventually capturing and mapping of the 600 or so drain districts throughout the County may demand this sort of organization.

2.2.4 County Drain Layer Digitizing Process. The second set of features that required digitizing for this work plan were the County Drains themselves. The most suitable source data had to be determined and acquired. It was known that Wayne County possesses drain maps at three different scales. The largest scale is the Quarter Section maps (about 1:12,000 scale) that are used to provide detailed drain district delineation in reference to parcels (those used in the digitizing described above). However, in many cases, these maps do not actually show the position and extent of the drain within that district. The second are the township scale maps that represent the drains and natural drainage within approximately a township size area at about 1:24,000 scale. The third and smallest scale maps consists of a two-map set showing one half of the County on a 24 x 36 inch sheet of paper (about 1:42,000). This last map appears to be something of an index map related to the set of Township scale maps, however, there are many apparent discrepancies between the two sets of maps.

It was decided that the township level of map representation of the drains were detailed enough and yet few enough in number to be converted to digital form within the current budget. Since these maps did not have coordinate information and did not contain features with which to establish coordinates, we looked to an existing source of digital drain data that might be updated by adding desired attributes. The two readily available sources of digital drain data consisted of the EPA Reach file and the MIRIS drainage features. After consideration of the issue of scale, it was decided to use MIRIS as the base set of water features. Since the RPO data had not converted this data set from NAD27 to NAD83, one of the first steps was to project this coverage. This was necessary to have the data align with parcels and other data sources.

Initially, there was an attempt to manually or visually identify the drains in MIRIS with the drains on the County paper maps. It was quickly discovered that there were substantial differences between the data sources that made this process difficult so an alternative approach was pursued. This alternative approach consisted of scanning the Township scale drain maps and using Arc/Info to rectify the images to create one seamless raster image of the mapped area within Wayne County. This raster image

(wayndrn.tif) is provided on CD with the GIS data. This image was also cut into tiles to increase efficiency for use on lower powered computers and networks. The process is described in Appendix A.

The seamless raster image of the drain maps was registered to the Michigan State Plane, South Zone, NAD83 coordinate system by using the political boundary corners on the maps as referenced to the corresponding corners in MIRIS data. The completed, registered raster drain map image provided a back drop for heads-up digitizing. The MIRIS features were placed on top of the raster image and identified which MIRIS drain corresponded to which drains on the County maps and documented the also identify differences between the two sources.

The following general guidelines were developed for this editing process:

- MIRIS drain feature positions were not moved;
- MIRIS drain features were split where drain maps indicated a change in status;
- Additional drain and natural watercourse features were drawn where indicated on the raster image; and
- Drain features were tagged with a County Drain code such as 'A001' or 'ndrn' for natural watercourses.

Drain tile areas were traced as polygons in a separate file (**DRN_POL.SHP**). These were also coded with the County Drain code where available. Once the graphic drain editing and tagging was completed, comparisons were performed to match the spatial data and attributes to the drain database provided by the County. Discrepancies were listed and provided to the County along with check plots. The County marked up the check plots and edits. It is believed that the drain attributes are as complete as possible based on the resources and knowledge of staff currently involved, but significant discrepancies still remain.

The next major effort to improve this data will require generation of large scale check maps (about 1:24,000 scale) on a community basis and significant interaction between the County field staff, GIS staff and local community representatives. The expectation is that the County field staff and local representatives will be able to add substantial knowledge to the editing of the drain maps. A prototype of this large scale map has been produced and provided to County Staff. The drain data file is shown in the table below:

```
        Structure for table:    DRAINSC.DBF
          Number of data records: 4289

     Field  Field Name  Type       Width    Dec
 1   FNODE_      Numeric       11
 2   TNODE_      Numeric       11
 3   LPOLY_      Numeric       11
 4   RPOLY_      Numeric       11
 5   LENGTH      Numeric       18       5
 6   DRAINSC_    Numeric       11
 7   DRAINSC_ID  Numeric       11
 8   DRAIN_NAME  Character     30
 9   DRAIN_NUM   Character      5
10   ED_DESCRIP  Character     25
11   DRN_STATUS  Character      3
12   NOTES       Character     50
        ** Total **                     198
```

Many of the fields in this data structure are Arc/Info generated. The remaining fields are populated as follows:

FIELD	**COUNT**	**DESCRIPTION**
drain_name		Populated automatically via a table join with the **DRAINTBL.DBF** file provided by the County. The key field for that link is drain_num.
drain_num	399	unique drain IDs such as A001, A002.
	2091	ndrn indicating this is not a County Drain
	253	"na" the status as County Drain or not County Drain is undetermined.
ed_descrip	1848	MIRIS Source of lines was MIRIS digital file
	2395	WC 24k drain map line was traced from scan of drain map
drain_status	1954	Yes Indicates the line segment is a County Drain
	2091	No Indicates the line is not a County Drain
	253	"na" Indicates that the drain status is unknown

A second basic data file was necessary to represent 'tile' areas since drain tile areas are also described as County Drains in some cases. The file **drain_pol** describes these areas and the structure is as follows.

```
Structure for table: drn_pol.dbf
Number of data records: 61

 Field  Field Name  Type       Width    Dec

1  ID          Numeric        8
2  DRAIN_NUM   Character      4
3  NOTES       Character     50
      ** Total **                    63
```

The contents of the tile polygon attribute table are limited to the following:

FIELD	COUNT	DETAIL
drain_num	55	unique drain Ids such as A001, A002.
	7	"n/a" indicating that name of drain could not be found in County attribute table

The primary source of attribute data for the County Drain features was an Microsoft Access™ database. This was loaded into a dBase format with the structure as follows:

```
Structure for table:    DRAINTBL.DBF
  Number of data records: 589

Field  Field Name  Type       Width    Dec    Index    Collate
       1  DNAME       Character     50
       2  DRAINCODE   Character     12
       3  GLNBR       Numeric        8
       4  WONBR       Numeric        8
       5  CHAP        Character      6
       6  LENGTH      Numeric       17     14
       7  COMMUNITY   Character     24
       8  CONSOLIDAT  Character     16
       9  QC_MATCH    Character      2
             ** Total **                  144
```

The primary key is assumed to be the ***draincode*** field, however, there is one duplicate ***draincode*** value, F027, which occurs twice. The records for F027 have different drain names and different lengths.

FIELD	COUNT	DESCRIPTION
dname	554 13 3	unique values drain_names occur twice each drain names occur three times each
drain_code	588 F027	unique values occurs twice but has different drain length and other chapter
QC_match	384 43 11 151	D match drain line in **DRAINSC.SHP** T match tile polygon in **DRN_POL** B match in both line and polygon attribute table na no matches to any spatial data features

The ***QC_match*** field was added to the database and populated to record the comparison between the **DRAINTBL** file and the two spatial data files (i.e., the drain lines **DRAINSC** and polygon tile areas **DRN_POL**). Matches indicate only that the number occurs in both the **DRAINTBL** file and one or both of the spatial files. This database comparison could not verify that the attributes on the spatial data are attached to the correct features. Further processing can be performed in the GIS that can aid in this verification by calculating a total length by ***draincode*** to compare against the values in the **DRAINTBL** file and thus screen for gross errors. Also, drains of the same code must be in close proximity and this may be screened as well. This screening, however, was not able to be incorporated into the work-to-date due to staff time constraints. A list of all non-matching drain codes is presented in Appendix B.

2.3 SUBTASK C - SECURE PARCEL DATA. The parcel data consisted of two parts. The first part was the spatial data composed primarily of the parcel boundaries, and the second part was the drain assessment attribute data related to the parcels.

The spatial parcel data needed for this project have been created and are maintained in a digital form by some of the communities within the Rouge Watershed. As stated earlier, the community that was chosen for this project was the City of Westland. Westland has developed a set of GIS data layers which include the critical parcel boundaries with polygon topology and the parcel identifier attached. While additional attribute data are linked to the parcels via the parcel identifier for day-to-day use at the community, these attributes were not essential for the task at hand and were not

acquired. The spatial data itself were incorporated into the standard project directory structure and ArcView™ project files. The data existed in several formats at the City-ArcView™ shapefile, Arc/Info coverages and AutoCad™ drawings. For this project, the ArcView™ shapefile format was obtained.

The drain assessment attribute data related to the parcels is maintained by Wayne County on their mainframe system entitled ILIS — Integrated Land Information System. These data are keyed on the same parcel identifier that the City uses to label the parcel polygons. Wayne County staff are able to export selected data from the ILIS system to an ASCII format that is suitable for import into an attribute file within ArcView™. Initially, the data for the seven County Drain districts that were chosen for digitization and provided by County Staff. Since parcel data were available for the whole City of Westland, it was decided to obtain the Drain Assessment attribute data for all of the City. The processing and linking of these files is described in the next section.

2.4 SUBTASK D - LINK ATTRIBUTE INFORMATION TO MAP FEATURES.

The acquisition of the existing drain assessment attribute information was described in the Section 2.3 above. Once these data were received, they needed only a moderate amount of processing to incorporate them into the Drain Information System. A sample of the format of the received data is shown below:

```
82MW23 ,56035040001013,   .740,    .205,       ,C
82MW23 ,56035040001317,  1.500,    .395     C  ,C
82MW23 ,56035040001318,   .750,    .208,       ,C
82MW23 ,56035040014003,  4.230,   1.092,       ,C
82MW23 ,56035040018004,  3.970,   1.025,       ,C
82MW23 ,56035040018005,  3.730,    .965,       ,C
82MW23 ,56035040019001,   .642,    .181,    J  ,R
82MW23 ,56035040019002,   .963,    .261,       ,R
```

The above sample represents certain fields of the ILIS database for the Wright Drain. The drain is identified by the first column, part of that code is W23. This translates to the W023 that is used elsewhere in the project for the unique drain identifier. The second column in the database is the parcel identifier or Sidwell number. The third column is the acreage of the parcel. The fourth column is the 'reduced acreage.' The fifth column is only sparsely populated and indicates the 'exempt code' such as local or federal government owned. The sixth column contains values of "C" or "R" indicating that the parcel is under commercial or residential use, respectively.

The processing necessary for this file consists of loading the ASCII file into a word processing program or text editor. The user must insert a row at the top of the file indicating the names of the corresponding columns below. In the example above, six entries would be needed and these would be separated by commas. The example below illustrates the necessary format (note: the following table is not justified so as to best illustrate the actual file format):

```
Drain,  Parcel ID, Acreage, RFactor, Excode, Use
82MW23 ,56035040001013,   .740,   .205,    ,C
82MW23 ,56035040001317,   1.500, .395,  C,C
82MW23 ,56035040001318,    .750,  .208,    ,C
82MW23 ,56035040014003,   4.230, 1.092,  ,C
82MW23 ,56035040018004,   3.970, 1.025,  ,C
2MW23  ,56035040018005,   3.730,  .965,  ,C
82MW23 ,56035040019001,    .642,   .181,  J,R
82MW23 ,56035040019002,    .963,   .261,    ,R
```

Once the field names are entered into this row, the file was saved again as an ASCII text file. ArcView™ was then used to convert this text file to a dBase format database table by using the ADD button in the ArcView™ project window. From the project window the user can select the ASCII text file and load this into the ArcView™ project. While in this format, the file can be linked to an appropriate source in ArcView™ for maximum flexibility.

The next step was to select file/export from the project window GUI pull-down menus. From this dialog box the 'text' table was saved into a dBase format, and load the new dBase file back into this ArcView™ project via the table project window and TABLE ADD button. Once the dBase table is loaded back into ArcView™, the data can be analyzed and linked plus perform individual or bulk edits, as necessary. For this project it was necessary to edit the Sidwell numbers in the county file by adding a new column and converting the county Sidwell numbers into the format maintained by the City of Westland. The city uses a format that looks like the following:

```
001 99 0030 000
001 99 0031 000
001 99 0033 000
001 99 0034 000
001 99 0035 000
001 99 0036 000
001 99 0037 000
```

This format was used because it matches the City's assessment database. At first glance the numbers above may appear to be entirely different. In actuality there are only three differences in this format. The first is that the County's ILIS system maintains the "56" value at the front of the number. This is the community ID and is therefore necessary for the County's use because they maintain data for many communities, but it is not needed in the City's systems since it is always the same. The second difference is that the City of Westland has inserted spaces to separate the various components of the Sidwell number. In some systems hyphens are used for separators. In some systems no separators are stored in the database but these are inserted on output screens and printouts for user convenience. The third difference is potentially significant. Due to the spaces in the format that the City of Westland has chosen, this field must be defined as a character or string field. The County's data may be stored as a numeric field, however, since there is likely a community with a leading zero ID then almost certainly the data are stored as string as well. The significance here is primarily that the two fields must be of the same data type for relates to be performed successfully in most database systems.

It was a simple task to use the table/field/calculate tool in ArcView™ to convert the County number to the Westland format. By copying this format into an additional column, the necessary key filed was provided for database relates, and both formats are readily available to the user who may be more comfortable or familiar with one or another.

Once the County Drain assessment attribute data were loaded into the table as described above, a few summary statistics were generated to illustrate at least one potentially significant issue affecting the integration of these data with a GIS. The issue was described earlier that the County Drain Districts may 'nest' within one another such that a parcel can be considered to be in two or more districts at one time. This is further complicated by the scenario where a district line runs through a parcel. By reviewing the data file provided by the county it appears that ILIS maintains multiple assessment records for each parcel where necessary. The ramifications of this are simply that a one-to-many relationship must be handled through the GIS and in some cases the assessment records will refer to the whole parcel and other times just to part.

The data for the City of Westland show the following characteristics:

- There were 25,402 records exported from ILIS.
- 18,899 unique Sidwell numbers occur in this file
- The following table shows how many times the unique Sidwell numbers occur.

Sidwell numbers	Occurrences
13045	1
5236	2
601	3
16	4
1	18

2.5 RECOMMENDED DATA STRUCTURE. During the course of working with the Drain Assessment attribute data, substantial consideration was made regarding the optimum data structure that may be implemented. It would appear that the Arc/Info "region" feature type may be the most appropriate method for maintaining drain districts in the GIS. Regions are a complex form of polygon topology which allows for overlapping polygons of just the nature that occurs in the drain districts. The implementation of regions, however, complicates the conversion process somewhat since subsequent editing may be required in Arc/Info to construct the regions. Some experimentation was performed in this regard and it was determined that regions can be easily generated from the AutoCad™ source data with minor editing in the GIS environment. If regions are deemed the optimum structure then the AutoCad™ procedures may need to be modified or future updates may be better performed directly in a program that supports regions such as Arc/Info.

Another aspect of the structure of the current data as it stands is related to difficulties symbolizing the assessment attributes. Because the attributes represent a many to one relationship to the parcels, showing those attributes on the map can be problematic. Currently the recommended solution is to make use of hatched patterns in ArcView™. If the background color of the fill is set to transparent then different hatches (or attributes) may be stacked up within the same polygon and be interpreted. This is only useful for 2-3 attributes before it becomes difficult for human interpretation and is more subject to problems with scale, (i.e. solid patterns in polygons can be depicted clearing at smaller scales than hatch patterns). Also, on a technical note, currently the default fill patterns in ArcView™ do not appear to work properly with transparent background on HP plotters. The recommendation is to simply load the fill pallette **CARTO.AVP**. This loads in a set of vector fill patterns including hatch patterns that work as expected.

3.0 CONCLUSION. The methods used to capture the County Drains and natural watercourses in this pilot project ultimately was quite efficient for the work that was accomplished. ESRI's ArcView™ 3.1 program seems to be a sufficient platform for accessing and editing the Drain information. Certain tradeoffs were made by locating the County Drains at a coarser scale than that used for the districts. However, the primary reason for this approach was that the drains for the entire county could be tagged in a very short time.

While there has been difficulty in finding a resolution to the remaining 151 records in the County **DRAINTBL** file that were not found on the map, discrepancies were anticipated and resolving those discrepancies was expected to be challenging. The resolution of these discrepancies will require substantial cooperation between County field management, field staff and local municipal staff working with the large scale (about 1:12,000) Drain maps that this project can now produce.

To date, there has not been an opportunity to present the large scale drain map prototype to the County field staff or community representatives for review. This task will require much more effort than originally anticipated, especially in regards to staff time required to facilitate the transfer and presentation of the maps. Also, attributes such as whether a drain is enclosed or not, or under whose jurisdiction the drain falls must be enumerated and participants will need to be educated on the procedures needed to clearly mark-up the maps with their edits. This process will take some substantial time in order to work with the numerous communities that can provide the detail.

This task is critical to establishing an accurate, detailed Drain network data set. This Drain network is important managing the impacts of engineering projects that may affect those drains, recording and directing citizen complaints or reports and community staff observations in the field. The complete Drain network also would be useful in terms of providing detail for emergency response such as illustrating potential sources for a toxic spill.

Another portion of the Drain Information System work plan that has not been completed is the finalizing and installation of an ArcView™ project file on Wayne County staff computers. While the project file is essentially complete, the County Drain assessment staff have not yet received the necessary GIS computer hardware. A preliminary delivery of the ArcView™ Project file was delivered but could not be installed due to insufficient disk space on the designated County computer. The data are too complex to be effectively used directly from a CDROM drive.

A work plan will be provided that encompasses these two tasks along with additional tasks that were identified in the course of the project. These tasks include items that had not been included in the original work effort but which were discovered by

project staff and were deemed of significant value to include in any future, related work.

Additional tasks that were identified in the course of this project include:

- **Enhancements to the ArcView™ project file to facilitate mapping specific drains** - ArcView™ scripting could facilitate generating maps for specific drains. Several maps of specific Drains were produced for County staff during the course of this project. While this was a simple task for skilled ArcView™ users, the potentially infrequent need for these maps will make the task intimidating for the likely end users. Also, some temporary files, view and layouts must be created. A substantial amount of this can be easily scripted to improve this process.

- **Construct Drain Index Map** - An Index Map should be developed which will allow users to rapidly find any drain within the county via the common letter/number row/column style of locator map. A scheme would also need to be developed to easily update this map in the future since changes in the drains are certain to occur as the data discrepancies are resolved.

- **Other map layouts** - The delivered ArcView™ project file should have several predefined layouts for standard maps. While there is a prototype within the current working project file for various maps, changes in layout, format, scaling, and labeling will undoubtedly occur once field staff and other end users begin using the maps and the digital data in ArcView™ or ArcExplorer.

- **Topologically clean MIRIS data** - The MIRIS data were found to contain substantial topological errors. That is, drainage features cross watershed boundaries where they should not, there are gaps between some drain segments and so forth. Arc/Info can be used to correct some of these errors and manual editing may be required to correct others.

- **The project should be ported to ArcExplorer** - While the County and many of the potential Community users of the Drain Information System already have the ArcView™ software, there may well be many users that do not or do not have access to an ArcView™ system. It is believed that a substantial amount of the use for these data will be purely for viewing mode. ArcExplorer is a free geographic data viewer from ESRI that would facilitate wide access to these data, and these data should be easily loaded into ArcExplorer.

APPENDIX A

APPENDIX A

List of Acronyms used in this report

AutoCad Computer Aided Drawing program developed by AutoDesk. Commonly used in engineering and automated mapping work.

DIS Drain Information System**. LAKJDLKASJ**

ESRI Environmental Systems Research Institute. The developer of the ArcView GIS software that was used for this project, based in Redlands, CA.

GIS Geographic Information System. A computer program or set of programs designed for the purpose of store, manipulating and retrieving information about entities including their locational attributes.

MIRIS Michigan Resource Information System. This was a group in place at the Michigan Department of Natural Resources for many years that established a set of digital files for the State of Michigan. These files, were derived from 1:24,000 scale United Stated Geological Survey quadrangle maps. The date of the data varies between about 1975 and 1983. It is not certain if any of the digital data from MIRIS was updated beyond that point. The Michigan Information Center has generally taken over the responsibility of maintenance and distribution of these data.

NAD83 North American Datum, 1983. System defined by the United Stated Geological Survey describing the basis of various coordinate systems. In the case of this report the coordinate system is further defined as Michigan State Plane, South Zone with maps units of U.S. Survey Feet.

ROW Right of Way. The region of land falling outside of that designated as private or publicly owned parcels. It is the area in which public roads typically travel, however, it should not be confused with the actual edge of pavement. In modern developed areas such as single family home subdivisions, the ROW often falls approximately one foot behind the back edge of the sidewalk.

RPO Wayne County Rouge Program Office. This is the office consisting of Wayne County staff along with contractors that was established to administer the Rouge River National Wet Weather Demonstration Project.

APPENDIX B

APPENDIX B

Procedures to register scanned maps to NAD83

- Obtain 256 gray scale image in TIFF format from scanning vendor

- Subset the corresponding community boundary into its own coverage in the Michigan State Plane NAD83 coordinate system

- Use ARC **REGISTER** command
  strive for RMS errors as low as possible
  for this project RMS ranged from 3.5 to about 60.

– Use **RECTIFY** command to transform the image using the saved registration information from the previous step

- Convert image to grid using ARC command **IMAGEGRID**

- Use GRID command **SELECTPOLYGON** to clip grid to the area desired

- Use ARC command **GRIDINSERT** to merge grids together to form a master grid

- Repeat the above steps until all maps have been processed

- Use **GRIDIMAGE** to create a TIFF file from the master grid

APPENDIX C

APPENDIX C

Table listing all records in the County draintbl file that were not identified on the County Drain maps.

DRAINCODE	DNAME
A002	ALEXANDER
A008	ASH
A022	A. P. PNEUMATIC/ELEVATOR
B050	BROWN - HURON/ROMULUS
B061	BONDIE
B083	BAKER BR.-SEXTON KILFOIL
B088	BENNETT
B090	BLACK MARSH
B092	BEVINS
B094	BELL CR.MIDDL.OF ROUGE
B096	BLACK MARSH, SEC.I
B098	BLUE DRAIN(REDFORD) 54177/820
B099	BLUE DRAIN EX. & BR.
B100	BRODY ARM OF SEXTON KILFOIL
B101	BRADNER IMPROVEMENTS
B102	BROWNTOWN CONS NO.#1
B104	BIG SWAN CREEK CONSOLIDATED
B105	BRADSHAW CONSOLIDATED
C006	CARR-KILLIAN(INTER-County
C033	COON MARSH
C061	CENTRALIA
C063	CARTER
C065	CARSONTOWN, NO.1 ARM OF

C066	CONNER CREEK IMPROVEMENTS
D012	DIX HORGER
D027	DUDLEY
D028	DETROIT DRAIN NO.1 & BRANCHES
D029	DEER CREEK IMPROVEMENTS
D030	DESBROW CONSOLIDATED
E008	ELWELL BRANCH OF HEAD
E018	ENGEL
E019	ELBA ISLAND SANITARY
E021	ECORSE CREEK POLL ABATE DR. #1
E022	ECORSE CREEK POOL ABATE DR.#3
F014	FREEMAN
F016	FIVE ELMS
F020	FOX SANITARY
F024	FOX CREEK
F025	FORD-VICTOR RELIEF
F026	FARMINGTON ROAD STORM RELIEF
F027	FARMINGTON RELIEF EXT.#1
F027	FARMINGTON ROAD STORM RELIEF
F028	FOX CREEK ENCLOSURE
G004	GEE
G007	GIRARD
G041	GORDIONIER
G051	GILL DRAIN
G056	GRS ILE SANITARY INT.& TX PLANT
G057	GIRARD, SEC. I
G061	GRS ILE SANITARY INT.& DR BRNCHES
G062	GRS ILE SANITARY DRAIN #1
G063	GRS ILE SAN INT & TX PLANT IMP
H001	HALE TILE

H033	HUSTON
H041	HAWKINS BR. OF
H053	HAL (INTER-County)
H054	HUNTINGTON RELIEF
H055	HICKORY ISLAND SANITARY
H056	HORGER ARM PUMP. STA.
H057	HUNTER LENG & BRANCHES
H058	HAMTRAMCK SEWER SYSTEM IMP
H059	HOLLAND RELIEF DR# 1 & BRANCHES
J011	JOHN THEIS (?) SAN. JAMES DRAIN
K006	KOCH
K017	KIRK LATERAL OF RED RUN
L006	LATERAL 94 OF DIST. 2 TILE
L008	LATHERS & SOUTH BRANCH
L009	LE BLANC TILE
L018	LIVONIA
L055	LAT. 2 OF ROBERTS SAN. EXT. OF
L068	LATERAL NO. 2 OF #1 ARM-LeBLANC
L080	LIVONIA NO. 12
L090	LIVONIA NO. 21
L096	LIVONIA DRAIN NO. 11 EXTENSIONS
L098	LIVONIA NO. 27 & BRANCHES
L106	LIVONIA NO. 12 BRANCHES
L107	LIVONIA NO. 19 EXTENSION
L108	LIVONIA NO. 13 EXT. & BRANCHES
L109	LIVONIA NO. 16 EXT. & BRANCHES
L117	LIVONIA NO. 36
L118	LIVONIA NO. 37
L119	LIVONIA NO. 38
L120	LIVONIA NO. 10 EXT. & BRCHS

L121	LIVONIA NO. 39 & BRANCHES
L122	LIVONIA NO. 42
L123	LIVONIA NO. 41
L124	LIVONIA NO. 43 & EXTENSIONS
L125	LIVONIA NO. 44
L126	LIVONIA NO. 45
L127	LIVONIA NO. 46
L128	LIVONIA NO. 47
L129	LIVONIA NO. 48
L130	LIVONIA NO. 49
M008	MCKINNEY TILE
M015	MARTIN
M019	MELDRUM
M020	MELDRUM N. BRANCH
M024	MILK RIVER (INTER-County)
M032	MONROE/WAYNE CNTY LINE (I-C)
M034	MOORE BRANCH OF BARLOW
M061	MARY ST. BRANCH OF SNOW
M080	MICHAELSON
M081	MONTEREY-CALIFORNIA RELIEF
M082	MONROE ST. STORM - BASIN
M083	MID-TOWN
M084	MELDRUM
O010	OAKVIEW
P002	PALMER ACRES
P003	PATTENGILL
P020	POST & BRANCH
P025	POLK STORM WATER
P053	PLYMOUTH DRAIN # 1 EXT. OF BR# 1
P099	PLAT REVIEW

R042	ROSSOW BRANCH OF
R045	ROMULUS-HURON RELIEF DRAIN
R046	RANDOLPH STREET (INTER-County)
R047	ROUGE RIVER CORPS PROJ. - SEC. A
R048	ROUGE RIVER (INTER-County)
R049	REDFORD SANITARY IMPROVEMENTS
R050	REDFORD CONSOLIDATED
S008	SHERBEN
S024	SNOW TILE
S029	STEVENS
S032	STEWART
S064	SHOTWELL LATERAL SANITARY
S067	SCHOMBERG
S069	HURON VALLEY WASTE WATER CTRL
S078	SECTION TWENTY SEVEN
S082	SOUTHGATE-WYANDOTTE RELIEF
S083	SWAN ISLAND SANITARY
S084	SEXTON KILFOIL
S085	SUMPTER TWP SAN. DRAIN IMP.
S098	SUSPENDED OVERHEAD
S099	SUSPENDED OVERHEAD
T005	THORNTON
T025	TAYLOR STORM # 2
T028	THOMAS
T029	TONQUISH CREEK BRANCH # 1
T030	TONQUISH CREEK DRAIN #1
T032	TAYLOR DRAINS PROJ.
V009	VERNIER
W003	WALLACE
W004	WALLACE

W008	WASHTENAW / WAYNE (I-C)
W009	WAYNE CTY. DIST. NO. 5
W033	WOLF TILE
W047	WILKIE
W051	WILKIE LATERAL # 4 OF
W052	WILKIE LATERAL # 5 OF
W053	WESTLAND CONS. DRAIN # 1
2W054	WESTLAND CONS. DRAIN # 2