
CHAPTER 5

IMPERVIOUS SURFACE AND PLANNING ANALYSIS

5.0 Introduction

Different areas of the Upper Clinton Subwatershed have been developed to different degrees. In general, the northern portion of the watershed is less developed than the southern part. A significant amount of the land that is considered developed is large-lot residential, which could be split and further developed in the future. Therefore, the watershed communities currently have an opportunity to guide future development patterns (rather than retro-fit solutions) so that water resources are protected as the land is developed.

This watershed plan looks at two ways of doing this. The first way is through an “Impervious Surface Analysis,” which uses existing land use data and community Master Plans to determine the amount of impervious surface (or surfaces that water cannot penetrate such as rooftops and pavement) within the watershed once it is fully developed as planned out by each community. The results of this analysis are provided in this chapter, and the entire report can be found in the Appendix to this document. The second way is by evaluating each community’s planning documents to determine how well they are currently protecting water resources from development pressures, and recommending possible ways they could protect these resources even more.

5.1 Impervious Surface Analysis

The Oakland County Planning and Economic Development Services (OCPEDS) Department conducted an analysis to estimate the existing and potential impervious cover in the Upper Clinton Subwatershed. Impervious Cover (IC) can be defined as having two components: “the rooftops under which we live, work, and shop, and the transport system (roads, driveways, and parking lots) that get us from place to place” (Schueler, 1994). IC impacts stream ecosystems by increasing the proportion of stormwater runoff discharged from the watershed directly to the stream as compared with the proportion that infiltrates back into the ground or is detained in wetland systems. Negative effects of increased runoff to streams include hydrologic, structural habitat, and water quality impacts. Hydrologic impacts include disruption of natural water balance, increased flood peaks, increased stormwater runoff, more frequent flooding, increased bank-full flows, and lower dry weather flow. Structural habitat impacts include stream widening and erosion, reduced fish passage, degradation of habitat structure, decreased channel stability, loss of pool-riffle structure, fragmentation of riparian tree canopy, and decreased substrate quality. Water quality impacts include increased stream temperature, pollutants, and risk of beach closure.

The Center for Watershed Protection has developed an “Impervious Cover Model” (ICM) which predicts the quality and character of a stream based on the percentage of IC in the watershed. The ICM contains three categories (Schueler, 1994): a sensitive stream, an impacted stream, and a non-supporting stream, as shown in the following table:

Table 5.1
Stream Attributes According to the IC Model (Schueler, 1994)

Sensitive Stream	Impacted Stream	Non-Supporting Stream
0-10% IC	11-25% IC	>25% IC
High quality, stable flow regime	Signs of degradation, flow regime destabilizes	Low quality; stream is essentially a conduit for conveying stormwater
Stable channels are in stable equilibrium	Altered stream geometry	Severely eroded and incised stream channel
Excellent habitat structure	Degraded physical habitat in the stream	Structure needed to sustain fish is diminished or eliminated
Excellent water quality	Water quality degraded; contact recreation becomes an issue	Water contact recreation is no longer possible
Diverse communities of both fish and aquatic insects	Many sensitive fish and aquatic insects disappearing from the stream	Stream cannot support any but the most tolerant of life forms
Do not experience frequent flooding	Flooding becomes a more serious problem	Flooding becomes a serious problem requiring drastic engineering solutions

In conducting the imperviousness analysis, OCPEDS undertook four tasks:

- 1) Catchments within the Subwatershed were delineated to provide a closer look at the impact of IC on small watershed areas.
- 2) The existing IC was estimated using Color Infrared Photography from the year 2000.
- 3) The potential future IC was estimated using community land use plans and estimated imperviousness coefficients associated with planned land uses.
- 4) An alternative potential future IC was estimated, using IC reduction factors that may be gained by implementing “Better Site Design” practices.

The results of the first task are shown in a map on the next page. This map breaks the Upper Clinton Subwatershed up into twenty-two “catchment” areas, or small sub-drainage areas.

Map 9
Upper Clinton Catchment Areas

The existing IC was estimated using a semi-automated analysis of color-infrared photography taken in 2000. This analysis resulted in an IC estimate for the subwatershed at 17%, placing it in the “Impacted” category of the ICM. The IC was unevenly distributed in the Subwatershed, tending to concentrate along the commercial corridors of Dixie Highway, M-59, and Baldwin Road, as well as along I-75. Catchments within this Subwatershed had imperviousness values as low as 10% in the less developed areas and as high as 43% in more developed areas.

The potential future IC of the Subwatershed was estimated to be 23% under conventional development techniques, keeping the watershed below the “Non-supporting” category of the ICM. The analysis demonstrated that “Better Site Design” measures could lower the potential future watershed IC to 20%, retaining the “Impacted” category of the ICM. The possible savings in impervious cover by using Better Site Design techniques for each catchment is shown in the following table:

**Table 5.2
Year 2000 and Potential Future IC Estimates of Catchments in the Upper Clinton Subwatershed**

Catchment	Acres	Year 2000 Acres Imperviousness	Potential Additional Impervious Acres (Conventional Site Design)	Potential Additional Impervious Acres (Better Site Design)	% Impervious (2000)	% Future Impervious (Conventional)	% Future Impervious (Better Site Design)	BSD Savings
Clam Lake	843	202	251	242	24	30	29	1
Clinton River Direct Drainage	6567	1576	1749	1716	24	27	26	1
Deer Lake	9317	1025	2227	1453	11	24	16	8
Eagle Lake	342	99	109	107	29	32	31	1
Flemings Lake	1730	190	327	302	11	19	17	2
Greens Lake	778	109	209	166	14	27	21	6
Huntoon Lake	709	291	303	300	41	43	42	1
I-75 Drainage	286	54	68	65	19	24	23	1
Judah Lake	3682	921	1197	1111	25	33	30	3
Lake Angelus	2439	390	477	452	16	20	19	1
Lake Goodrich	1482	563	667	647	38	45	44	1
Maceday/Lotus Lake	2974	446	525	502	15	18	17	1
Miller/Mill Lake	6375	638	813	781	10	13	12	1
Morgan Lake	1218	171	250	235	14	20	19	1
Oakhurst	655	46	59	56	7	9	9	0
Parke Lake	7634	763	1056	1001	10	14	13	1
Pleasant Lake	2619	445	594	566	17	23	22	1
Sashabaw Creek Direct Drainage	1785	268	415	387	15	23	22	1
Shell Park	729	313	343	338	43	47	46	1
Silver Lake	1197	335	370	364	28	31	30	1
Townsend Lake	2325	488	759	552	21	33	24	9
Watkins Lake	862	155	173	170	18	20	20	0

The following conclusions can be made based on this analysis:

1. Overall, the Upper Clinton Subwatershed is currently an “Impacted” stream system based on the ICM (17% IC).
2. Because of the uneven development pattern across the Subwatershed, some areas are “Sensitive” while others are “Impacted” or “Non-supporting.”
3. Potential Future IC (around 20-23%) will result in increased IC but overall the subwatershed will remain in the “Impacted” category.
4. Five catchments are classified as “Non-supporting” in 2000. Future development is projected to increase this number of catchments to 10, based on existing land use plans. “Better Site Design” measures may be able to prevent 2 catchments (Townsend Lake and Greens Lake) from progressing to the non-supporting category.
5. Eleven catchments are classified as “Impacted” in 2000. Future development is projected to increase this number to twenty-one, based on existing land use plans. “Better Site Design” measures will not prevent any of these catchments from moving into the “Impacted Category”. Oakhurst catchment is the only catchment which will remain in the “Sensitive” category.

The Center for Watershed Protection completed a review of the scientific literature pertaining to the application of the Impervious Cover Model (ICM) (*Source: Stony Creek Subwatershed Management Plan, Clinton River Watershed Council, 2003*). This review indicated that the influence of impervious cover in the 1-10% range is relatively weak when compared to other potential factors, such as percent forest cover, riparian buffer continuity, historical land use, soils, and agricultural use (CWP, 2003). The review warned that IC alone should not be used to classify and manage streams in watersheds with less than 10% impervious cover. IC seems to be a more reliable indicator of overall stream quality in watersheds that have greater than 10% IC. In addition, CWP found that a number of streams in high-IC watersheds that also had extensive streamside forest cover had unusually high-quality biological communities. In these cases, it appeared that forested stream buffers (defined as at least two-thirds of the stream network with at least 100 feet of forest width on either side of the stream) were influential in enhancing stream quality. In addition to these benefits, riparian forests shade and cool the water and aquatic habitat, reduce stormwater runoff, provide woody debris and leaf litter for instream habitat, and provide bank stability.

While the overall Upper Clinton Subwatershed’s IC is above the “Sensitive” category, some of the smaller catchment areas are not. Even though the ICM points to minimizing impervious cover through low-impact development techniques, it may be even more important to maintain existing riparian forest cover to the greatest extent possible to protect water quality over the long term.

5.2 Checklist Evaluation

To help determine how well natural resources are currently being preserved and protected throughout the subwatershed, each community's planning documents were evaluated using a checklist created by Southeast Michigan Council of Governments (SEMCOG) and Carlisle/Wortman Associates Inc. Natural feature protection was the focus of this evaluation because of the positive impact natural features, such as wetlands, woodlands, and open space have on stormwater quality and quantity. The checklist includes the following sixteen topics:

- Stormwater Management Standards
- Impervious Surface Reduction
- Land Conservation and Development Techniques
- Erosion and Sedimentation Control
- Sanitary Sewer Planning and Infrastructure
- Groundwater
- Greenways
- Habitat Preservation
- Wetland Preservation
- Woodlands Preservation
- Stream Corridors and Flood Plains
- Capital Improvement Plan
- Watershed Issues
- Public Education
- Pollution Prevention and Housekeeping Practices
- The Development Review Process

The analysis evaluated the communities' Master Plans, Recreation Master Plans, Zoning Ordinances, Engineering Standards, and any other planning document that the communities use to protect natural features. Questions about the sixteen topics above were organized into three categories: Plans and Policies; Development/Re-development Regulations; and Design Standards. While not true for the other two categories, the "Plans and Policies" questions fell within four general themes under each topic listed above:

- a) Identify the topic as an important community goal/policy,
- b) Relate preservation of natural features (specific or general) to accomplish certain outcomes (such as to "help alleviate problems associated with stormwater," or "protect the quality of air, land and water resources while accommodating development"),
- c) Relate the topic to the preservation of health, safety and welfare of residents, and
- d) Provide existing conditions information in the Master Plan regarding the topic.

The themes are identified here to give the reader a general picture of the basic ideas or information that should be included in a Master Plan regarding natural features. This information will provide a complete picture of their natural features, and why and how the community wants them preserved.

The checklist questions are worded so that they imply the desirable action. For example, the question, “Do you regulate stormwater in your community?” implies that regulating stormwater can be a good thing. The questions also provide a continuum of possibilities that a community could adopt. Not all the suggestions will fit into all communities’ existing planning approach.

Responses given to questions were “Yes,” “No,” “Yes/No,” or “N/A.” In many cases, the answers were qualified with notes in the “comments” column that explained why that response was given. This approach allows the reviewer to thoroughly evaluate how the community is addressing the question, and provides enough information to make viable recommendations to improve protection if desired.

The following provides a summary of the results for each community, and recommendations for further protective measures. The completed checklists are included in the Appendix of this document.

5.3 Planning Document Analysis

Each analysis provided below describes the strength’s of each communities’ Master Plan and Development/Re-development Regulations. It is important to acknowledge the effort that the subwatershed communities have made to protect natural features within their boundaries. Almost more importantly, though, describing what is currently being done also educates adjacent communities about programs and approaches to stormwater management that they could coordinate with to protect water resources on a subwatershed basis, rather than only in one political boundary.

City of Auburn Hills

Master Plan

The City’s Master Plan is expressed on a poster with a future Master Land Use Plan map and text describing the City’s vision for its future. The City has plans to update this document within the next few years, and could possibly change the format to allow more space for additional information about Auburn Hills. The current Plan calls for respecting natural areas in its future vision. In addition to discussing natural feature preservation in the Master Plan, the City also discusses this topic in their Recreation Master Plan, and documents created for their Phase II permit through the Rouge Watershed Project (1998). The Recreation plan describes how their existing pathway system connects natural areas together, and the City’s paths to greenways in adjacent communities. The Plan also has a goal to build on this pathway system, constructing new linear parks and trails that connect parks to neighborhoods. The Recreation Plan also provides inventories of important natural features, including wetlands and woodlands, and describes how floodplains are important for stormwater infiltration and wetlands are important for stormwater storage. An Illicit Discharge Elimination Plan was developed by the City to identify and eliminate illicit discharges to the community drainage system. It also maps the location of all drainage facilities throughout the community.

If the Master Plan were revised in a more expansive format, many of the topics in the checklist could be addressed. This format would also allow the City to extend each goal into policy statements and more specific objectives of how a goal can be reached. Suggested topics include identifying the specific natural features (wetlands, woodlands, floodplains, watershed boundaries, riparian buffers, native plants, wildlife habitat, and groundwater) as important to the community, calling for their protection, and tying them to the protection of residents' health, safety and welfare. While many provisions of the City's Zoning Ordinance require ways to protect natural features, it is important to have a policy basis in the Master Plan to ensure community regulations are defensible.

To support goals and policies about natural feature preservation, a Master Plan should inventory the community's resources (in addition to wetlands and woodlands) and identify them on a map. If summarized on a single map, the City could see where natural features overlap, and create "ecosystems," rather than isolated natural features. High quality ecosystems could then be prioritized for conservation. A conservation plan, or guidelines, could also be developed and put in the Master Plan. Wetlands could also be called for preservation on a watershed basis.

Another important idea to communicate in the Master Plan is tying natural feature preservation to stormwater infiltration and management. For instance, preserving the vegetated riparian buffers provides water quality benefits, and woodland preservation improves infiltration of stormwater. Other stormwater topics that the Master Plan could discuss are the importance of stormwater management to the City, a discussion on the quality and quantity of stormwater generated by impervious surfaces, and how stormwater management can protect the health, safety and welfare of residents. Calling for the use of Best Management Practices (BMPs), to improve infiltration and treat stormwater before it is discharged into natural water bodies are also important ideas to consider. Lastly, the Master Plan could discuss the importance of minimizing impervious surfaces, and include ways that developers could incorporate infiltration of stormwater in both new and redevelopment proposals.

Development topics could also be addressed in the Master Plan to help protect surface waters. For instance, policies on infill development or redevelopment of degraded areas could be included. Sanitary sewer planning is a particularly important topic, since 99% of the City is served by sanitary sewers. How the City proposes to maintain the system, fix problems, and replace aging or failing segments are all topics the Plan could address, as well as how these activities will be financed over time.

The pathway/trails discussion in the Recreation Master Plan could be expanded to include wildlife habitat and animal transportation corridors as important goals of the trails/pathway plan. The trails/pathway plan could also be identified in the Recreation Plan as a way of preserving natural areas. Community acquisition of open space could also include goals for nature study and wildlife habitat as well as active recreation.

Development/Redevelopment Regulations

The City's regulations currently provide a broad range of mechanisms that help protect water resources. During the development design stage, natural drainage patterns are required to be maintained and an Environmental Impact Statement is required to confirm that natural resources

are being preserved to the greatest extent possible. The City's Cluster Option, Open Space Preservation Option, and Planned Unit Development regulations provide flexible design criteria to reduce setbacks, helping to limit impervious surfaces and preserve open space. Resulting open spaces must be managed in a natural condition and protected by a conservation easement or other mechanism. Other natural feature preservation ordinances include a wetlands ordinance, which protects wetlands less than five acres and less than two acres if the wetland meets the criteria in the ordinance. The City also has a woodlands preservation ordinance, as well as a floodplain district that has specific design criteria for this sensitive area.

The City's site design criteria include regulations for stormwater systems, parking, roadways, and landscaping. The ordinance provides fully detailed design criteria for stormwater systems that require sedimentation basins for sites without detention, and maintenance requirements. It also allows developers to install permeable pavement in parking lots, and parking lot islands to break up the expanse of pavement. The parking regulations give the City flexibility in allowing less parking if warranted than the ordinance requires. This is done through land banked parking, and shared parking facilities if the hours of operation for the multiple users do not overlap. Street design is also regulated to all the minimum required widths and right-of-ways to limit clearing and grading. The City also has a list of prohibited plant species, one that could be easily updated to include exotic-invasive species. Lastly, one effort that the City has undertaken to protect water resources is an extensive program to disconnect footing drains from the sanitary system. This helps to minimize the impact stormwater has on the sanitary system, making overflows less likely.

While the City doesn't have a stormwater ordinance per se, it does have design standards for stormwater facilities. To enhance the current standards, a stormwater management ordinance could be added to communicate the desired approach to managing stormwater to developers. For instance, the ordinance could limit land grading and clearing, maintain naturally vegetated buffers adjacent to all natural features to increase infiltration, minimize impervious surfaces, encourage the use of infiltration devices, and recommend using native plant species in stormwater facilities. This ordinance could also encourage the use of Best Management Practices (BMPs) which keep stormwater above ground (rather than piped away) and prohibit direct discharge of stormwater to any natural water feature (in addition to wetlands) without pre-treatment. The ordinance could provide examples of infiltration devices, or design criteria for infiltration methods could be included in the current design standards.

The current Wetlands Ordinance requires a 25' vegetated buffer adjacent to wetlands. The ordinance could allow the size of this buffer to be increased if warranted by the conditions on the site. The buffer idea could also be extended to include buffers for streams, lakes, and ponds. For further streamside protection, development along streams could be restricted to limit degradation of water quality and alterations to the stream corridor. Where streams have floodplains, these regulations could require that flood management projects assess their impact on water quality, and that Best Management Practices be added to existing projects.

The intent of development options, such as the Planned Unit Development and Open Space Preservation Option, could be expanded to include reduction in impervious surfaces. Open space created by these provisions could be required to be consolidated with adjacent open spaces, and/or be of a minimum size or width. The City could also include provisions specifically directed at

re-development projects, such as coordinating new facilities with existing facilities and infrastructure. Infill development proposals could also be encouraged to promote conservation of existing natural features, reducing the site's environmental impact.

Miscellaneous items that could be considered relate to downspouts, groundwater, and site plan review procedures. The City has made a great effort to disconnect footing drains from the sanitary system. In the same vein, it could also prohibit connecting downspouts to the stormwater system. While Auburn Hills does not depend on groundwater for its drinking water, groundwater is connected to streams and lakes, and provides flow to these features during dry periods. The importance of groundwater could be enhanced by considering groundwater recharge areas in zoning decisions, and including additional requirements for site plan submittals in groundwater recharge areas. The information site plans provide could be improved by requiring that all natural features be shown. Currently, the City requires drainage courses and woodlands/trees. Lastly, it is a helpful practice to ensure that Best Management Practices (BMPs) be clearly labeled on site plans so that they can be easily evaluated in the field.

Brandon Township

Master Plan:

The main policy approach for Brandon Township's Master Plan (called the *Land Use Plan*) is to address natural feature preservation through an Overlay District, which provides policies for site plan review of properties within the District. While the District has supportive maps identifying the Township's various natural features, more detailed information is provided in a separate report called *The Natural Features Report*, which was recently completed. The purpose of this report is to provide the basis for a "Natural Areas Plan," to be included as a chapter in the Township's Land Use Plan. By adopting such a plan, the Township would incorporate many of the ideas listed in the checklist evaluation into their Land Use Plan. For instance, the Natural Features Report relates checklist topics to the protection of health, safety, and welfare, which is a basis in law for many environmental regulations. The ideas communicated through the checklist could also be used in development of the Natural Areas Plan. *In any event, it is important to include this information in the Land Use Plan to create a defensible position for development regulations.*

There are checklist topics that are not discussed in the Natural Features Report, but could also be added to the Land Use Plan. These topics include encouraging the use of Best Management Practices (BMPs) for stormwater management, minimizing impervious surfaces, identification and mapping of groundwater recharge areas and discussion of the importance of groundwater, categorize wetlands regarding their suitability as stormwater storage, protecting natural features on an ecosystem basis, and consideration of a capital improvement plan.

Development and re-development regulations are strong in the areas of land conservation techniques, woodlands preservation, public education, and the development review process. The cluster provisions could be fortified by requiring that open space be managed in a natural condition, and protected through permanent mechanisms such as a conservation easement.

Development/Re-Development Regulations

The main challenges for Brandon's development and re-development regulations are related to stormwater Best Management Practices (BMP's) and reducing impervious surfaces. These two topics are important for the Township to consider now because of its relatively undeveloped state. It is much more efficient and cost effective to implement stormwater BMPs and minimize impervious surfaces as a parcel is being developed, rather than try to retrofit a property with these features. A Stormwater Ordinance is one way to address these issues. These ordinances typically encourage the use of BMPs such as above ground stormwater conveyance systems, pre-treatment of stormwater before it is discharged into a wetland or other water resource, and periodic monitoring of BMPs. They also generally provide site development standards such as preserving natural drainage patterns, limiting land disturbance and grading, and encouraging the use of infiltration devices. Minimizing impervious surfaces and infiltration could also be discussed in a Stormwater Ordinance. The checklist evaluation describes many ideas to minimize impervious surfaces in regards to parking lots, streets and access ways, and lot setbacks, widths, and coverage requirements. Standards for stormwater facilities should also be developed and/or added to any existing Engineering or Design and Construction Standards.

Another challenge identified in the checklist was also mentioned in the Natural Features Report. One of the goals in the report is to develop buffer or setback regulations that maintain the native vegetation along riparian wetland systems. The report suggests 75 to 100 feet off the centerline of a creek, stream, or drain. It has been scientifically proven that the larger the vegetative buffer, the more effective it is. However, the Township could strive to meet these standards in the future, while implementing a less strenuous requirement to start with. These regulations may also be combined with development of a Greenway Plan, which could establish priority stream corridor/wetland systems for buffers and potentially non-motorized recreation as well.

The checklist evaluation also acknowledged groundwater protection as an area where Brandon could strengthen its regulations. The Township has no water supply system, and groundwater provides all the drinking water for its residents. As the Township continues to develop, groundwater recharge areas will come under increasing development pressure, potentially impacting the Township's water supply. Identification and mapping of groundwater recharge areas will provide the background needed to amend the zoning map, and improve protection of this important resource.

Lastly, it was noted that Brandon doesn't have a Wetlands Ordinance. While this type of ordinance is not the only way to protect wetlands from development, it was not evident from the plan evaluation that the Township had other measures that specifically protected wetlands. Therefore, this is a topic the Township may want to consider in future ordinance revisions.

City of the Village of Clarkston

Master Plan

The City is currently almost built out, and has significant natural features, such as the Mill Pond and Parke, Deer, and Middle Lakes, that help to define its character. The Master Plan reflects this character by discussing both “urban” and “environmental” issues. The environmental topics include land conservation, enhancing the City’s water features, the possibility of requiring an environmental impact statement for development and re-development proposals, and sanitary sewer planning. All of these topics are important considerations in regards to water quality.

The Master Plan calls for acquisition of the property at the intersection of Main Street and Waldon Road. This parcel contains the Clinton River, wetlands, and other important natural features. Because so few undeveloped parcels are left, this piece affords a rare opportunity to forever protect a stretch of the Clinton River within the City. If acquisition is not currently in the works, emphasizing this opportunity and making it a priority for the community in the Master Plan could improve the chances that the acquisition would happen. Conserving the natural features on this site would help to preserve the water quality (and many other) benefits that this parcel provides Clarkston.

Since the City is almost built-out, some of the ideas in the checklist for site design may not be applicable. However, the City will most certainly begin to receive re-development proposals. Re-development is where the City could concentrate its efforts in improving stormwater management. Important topics to discuss in the Master Plan would be goals for stormwater management (such as discussing the importance of stormwater management to protect the City’s character, as well as both the quality and quantity of stormwater exiting re-development sites), encouraging the use of stormwater Best Management Practices (BMP’s) (such as catchbasin inserts to capture sediments, automobile fluids, and trash, and underground storage of stormwater), and improved stormwater infiltration.

Because the Mill Pond and other water features are so important to the City’s character, the Master Plan could emphasize these features, and provide a strategy for improving the water quality, such as resident education about fertilizers and other landscaping chemicals, pet waste, and most importantly, vegetated buffers.

Another topic that could be strengthened in the Master Plan is the identification and mapping of the community’s groundwater recharge areas. Almost the entire community is dependent on groundwater wells for their drinking water. Therefore, proper management of recharge areas is critical to resident’s health and continued viability of wells.

Inventory and mapping of natural features provides the regulatory basis for policies in the Master Plan and prepares a defensible position for development regulations. Therefore, the Master Plan should provide inventories and maps of the following natural features: wetlands, woodlands, riparian (stream and lakeside) areas, floodplains, and watersheds. Goals for protecting these areas should be considered, as well as goals for restoring or enhancing these areas. Restoration could include removal of invasive species and sedimentation removal, and enhancement could include protective measures such as riparian buffers.

Development/Re-Development Regulations

The City has flexible provisions for both parking and setbacks through various ordinances. This is a strength of the Zoning Ordinance because these practices work to reduce impervious surface, and therefore the amount of stormwater generated by these surfaces. The parking regulations could be further strengthened by allowing small car parking, and infiltration areas within parking lot islands.

In responding to re-development and infill proposals, the City should have stormwater regulations on the books to take advantage of the new techniques and technology available to reduce the amount of stormwater, and treat the runoff before it reaches a natural waterbody. This could be accomplished through a Stormwater Ordinance that encourages the use of Best Management Practices (BMPs), and provides guidance on how to manage stormwater for the least impact on the environment. An ordinance could be enhanced through Engineering or Design and Construction Standards that provide specifics on how stormwater facilities should be constructed. Infill regulations should also address conservation of natural features to the greatest extent possible.

The current Master Plan includes goals to development regulations that protect the City's groundwater, and the City's natural features. These regulations would be built upon the inventories and policies included in the Master Plan. They should address wetlands, woodlands, and stream corridor protection. Separate ordinances could be used to accomplish this task, or a Natural Features Overlay District could be used to identify and protect specific areas that have high-priority natural features. Buffer or setback regulations would also help to preserve water resources by keeping pollutants in runoff from reaching waterbodies until it has been filtered through the buffer.

The City has some provisions regarding open space. However, they could be improved by requiring that open space be managed in a natural condition, and protected through conservation easements. There may not be many opportunities for this, but if these requirements were considered for re-development or infill proposals, application may be expanded. Natural land management could also be applied to appropriate areas of City-owned open spaces. Also, the plans for greenways within Clarkston could be expanded to include wildlife corridors (stream corridors, tree rows, natural beauty roads, utility easements) and call for natural feature protection while providing opportunities for non-motorized transportation and recreation.

Independence Township

Master Plan

Independence Township's Master Plan is composed of two documents, the Background Studies document, and the Strategic (or Master) Plan document. One main focus of these two documents is the natural environment and its preservation. The "Historic, Rural, and Open Space Preservation" chapter of the Strategic Plan recognizes the importance of natural features and open space, and has goals and strategies to preserve open space while accommodating development through alternatives to residential land development patterns. The Strategic Plan also talks about coordinating open space between residential developments, and acquiring more public parkland, as well as working with land conservancies and conservation easement.

The Strategic Plan also discusses the importance of stormwater management, connects this topic to the health, safety and welfare of residents, and has goals and policies for updating the Township's Stormwater Management Plan, and improving water quality. One such effort is the Township's plan for a regional stormwater management system that collects, stores, and discharges stormwater for 330 acres of the Township. The emphasis of this system is stormwater quality and natural feature preservation. Rather than requiring on-site stormwater detention, stormwater is directed to the regional system through storm sewers and open drains where possible. On its way to discharge points, it is filtered through a constructed six-acre wetland, which doubles as a storage area and wetland mitigation bank. To implement this program, the Township is developing a stormwater management plan for this area in addition to a plan detailing the construction of the related infrastructure.

Another chapter of the Plan discusses the important topic of sanitary sewer planning. This chapter covers both septic systems and sanitary sewer systems. The Township has developed a Sewer and Water Master Plan that relates to existing zoning. It states that higher densities should be concentrated closer to public services and utilities. It also identifies areas that are suitable for septic systems, and calls for Township-wide water quality testing program for bodies of water in areas served by septics.

The Township's Plan also discusses the importance of groundwater and calls for its protection. Further protection of groundwater is covered by the Township's Wellhead Protection Plan, which identifies areas that contribute to the community water supply, identifies sources of contamination and includes methods to cooperatively manage the area and minimize threats.

Another planning initiative the Township has undertaken is a Greenway Plan. This plan talks extensively about preserving natural greenways for habitat and natural feature protection, as well as man-made greenways for non-motorized transportation and other recreational opportunities. The Plan looks to connect natural features and community amenities within the Township, as well as to other areas.

In the Background Studies document, the Township has inventories of wetlands, woodlands, and watersheds (drainage areas). The document discusses the importance of wildlife habitat, wetlands, and watershed areas, and calls for their preservation and protection. The watershed discussion provides possible alternatives for protection, two being reduction of impervious surfaces and floodplain protection. Several environmental topics, wildlife habitat and riparian buffers, are related in the Plan to the protection of the community's health, safety and welfare, an important link to justify protective regulation. The Plan also calls for development of a River Conservation Overlay District for the Clinton River, and Sashabaw Creek and other stream resources.

In regards to stormwater, the few areas where the Township could strengthen their Strategic Plan is to connect natural feature preservation with alleviating problems with stormwater by providing infiltration and storage. More specific strategies concerning stormwater "quantity," stormwater Best Management Practices (BMPs), infiltration, and minimizing impervious surfaces would also help guide future stormwater efforts. Note that some of these topics are touched upon in the Strategic Plan and/or Greenway Plan, but discussion of them could be expanded. Other

stormwater-related topics could discuss the goal of prohibiting downspout connections to storm drains, and footing drain connections to sanitary sewers.

Other topics that could be added include a discussion about the importance of soil erosion control. The groundwater recharge areas within the Township could be identified and mapped, and then this information used in the Master Planning and Zoning process. Wetlands appropriate for stormwater storage could also be identified and mapped in the Strategic Plan, as well as policies that call for wetland protection on an ecosystem basis. The Strategic Plan could include a discussion on the importance of woodlands for residents' health, safety, and welfare, and how they contribute to stormwater attenuation. Floodplain protection could also be added in the Strategic Plan, including its importance for residents protection, and ways the Township could coordinate with other communities to control flood events. The role of native plants in natural feature preservation could also be added to the Strategic Plan's environmental goals, including their possible use in stormwater management facilities.

The Strategic Plan calls for development of several additional planning tools. All of these tools could improve the Township's current standard of protecting water quality. These tools include:

- Updating the Stormwater Management Plan,
- Developing a program to conduct Township-wide water quality monitoring of water bodies in areas that are served by septic systems, and
- Creating a River Conservation Overlay District.

Lastly, the Historic, Rural, and Open Space Preservation chapter of the Strategic Plan could be updated by adding areas identified by the Michigan Natural Features Inventory (MNFI) as environmentally significant.

Development/Re-Development Regulations

The Township's development/re-development regulations include stormwater provisions in several areas. The Drainage Management Ordinance, Environmental Performance Standards, and Development Design Standards all discuss stormwater management, including limits to grading, maintaining existing vegetation, encouraging infiltration, encouraging use of above-ground BMPs, pre-treatment of stormwater before discharge, and maintenance of BMPs over time. Other provisions under the Site Plan Review requirements also call for preservation of natural features.

The Zoning Ordinance provides for flexibility in parking requirements, and requires landscaped islands in parking lots. These islands may be used for stormwater infiltration. Other provisions that reduce impervious cover (and improve infiltration) are the flexibility in setbacks in the Cluster Ordinance and Planned Residential Development (PRD) provisions.

This document also includes erosion control standards, a Wetlands Ordinance that protects wetlands 2 acres or more in size, and watercourse protection standards. The Township also considers groundwater resources in zoning decisions, and requires that septic systems be at least 100' from a water body.

While the development/re-development regulations are comprehensive, there are some new ideas that could be considered to further strengthen natural feature, and particularly water resource,

protections. The Township does require a 25' buffer adjacent to water bodies in development review, however, it has been shown through scientific study that the larger the buffer the better. The stormwater management standards could be expanded to include a discussion about reducing impervious surfaces in development proposals. Ways this could be accomplished include opportunities for shared parking facilities, or space for compact cars in parking lots.

Provisions to require periodic monitoring of stormwater BMPs could be added to the stormwater regulations, as could requiring the use of native vegetation in above-ground stormwater facilities. The Cluster and/or PRD provisions could require that open space be consolidated with adjacent open space (if applicable), as mentioned in the Strategic Plan, and protect these open spaces with a formal mechanism, such as a conservation easement. Woodland/tree protection ordinance language, and floodplain protection language could be added and/or expanded in the Zoning Ordinance. Rather than depending on the Army Corps of Engineers standards for floodplain "flood proofing," the Township could incorporate more rigorous standards to limit development in floodplains.

City of Lake Angelus

Master Plan

The current Master Plan for Lake Angelus allots considerable space to discussing natural feature preservation. The document includes a "Conservation Plan," that is a separate chapter in their Master Plan. The plan acknowledges the importance of the community's existing natural features, including wetlands, woodlands, stream corridors, and groundwater. It provides inventories, maps them, and has policy goals for their preservation. The Conservation Plan also states that City-owned open space should be managed and maintained in a natural condition. It also calls for a "greenbelt" around the lake that is a combination of public and private properties to help maintain open space around the City and preserve its natural character. Lastly, this is one of the few plans that discusses the importance of stormwater management, and the role of natural feature preservation to properly manage storm drainage.

Several additional environmental topics could be included in the Conservation Plan such as groundwater recharge areas, flood hazard areas and watersheds. These topics would complete the environmental section of the Master Plan with inventories, maps, and preservation/conservation goals. Another important topic that the Master Plan should address is on-site sanitary disposal (OSDS) systems. The community completely relies on septic systems to treat sanitary sewerage. While currently there are no significant problems, policies focused on preventing problems should be discussed in the Plan. The City's current voluntary inspection program is a positive move, but it should be backed up by the City's position on septic maintenance, further coordination with the County Health Department, and plans for future program improvements.

The greenbelt concept discusses voluntary efforts on private property to preserve greenspace. To encourage ways of making the greenbelt a reality, the City could include in the Master Plan different potential methods of open space preservation. These could include the use of voluntary riparian buffers, or a Natural Feature Preservation Overlay District with special guidance on how property owners could improve their environmental impact on the Lake.

The Master Plan's discussion about stormwater could be expanded to include ways of reducing the amount of runoff from residential properties, such as rain gardens or other ways of increasing infiltration. Another important topic is the use of Best Management Practices (BMPs), which should be encouraged through policies in the Master Plan. This would coordinate with the City's current policy to mitigate impacts of new development on natural features. Retro-fitting BMPs into existing development or re-development proposals could also be discussed. Another related topic is striving to reduce the amount of impervious cover throughout the City. Policies to accomplish this could encourage pervious pavements for driveways, and other methods of reducing the amount of stormwater runoff.

Development/Re-Development Regulations

The approach to development/re-development regulations in Lake Angelus needs to be slightly different than in a more typical community. The purely residential nature of the City requires that improvements in development techniques need to happen one parcel at a time. Also, because of the City's built-out status, these techniques will be applied to re-development projects rather than development on raw land.

Because of the unique character of Lake Angelus, their Zoning Ordinance does not include many of the regulations mentioned in the checklist. Many simply wouldn't apply. However, an ordinance dealing with stormwater management may be tailored to fit re-development proposals. This ordinance should include Best Management Practices (BMPs) for single residential sites (lakeshore/riparian buffer, rain gardens, slope new driveways into grass, etc.), improvements to infiltration (pervious pavements, stormwater infiltration devices such as French drains, native plantings), and reduction in impervious surfaces (driveway widths, lot coverage).

Another water quality effort the City could put forth to its residents is the importance of a vegetated buffer along water resources, such as streams, wetlands and lakes. While a view of the lake is one main reason for living in Lake Angelus, low native plantings can be added along parts of the shoreline that allow both physical access and views to the lake. These vegetated buffers help to slow stormwater runoff, allowing the sediments to fall out and pollutants to be absorbed by the vegetation before the water reaches the lake. This is particularly important if adjacent lawns are fertilized or pesticides have been applied. This would be a voluntary program, but could be aided by education and other services (one-time site evaluation or design consultation) to help sell the idea.

While the City doesn't have a great deal of single-topic ordinances, it may want to consider a woodlands or tree preservation ordinance to help protect the significant trees within the City during re-development of parcels. Another topic that is not address in the Zoning Ordinance is groundwater protection regulations. Whether this ordinance is viable could be determined once the groundwater recharge information has been investigated for the Master Plan.

Orion Township

Master Plan

The Orion Township Master Plan is strong in several areas. It discusses the Township's desire to preserve natural features in parks, through new development, and to preserve the character of the Township. It also refers to its Stormwater and Erosion Control Ordinance as another way of protecting natural features. The Plan has identified high-priority natural areas, as well as inventoried and mapped Township wetlands and woodlands. Statements that recognize the importance of wetlands and woodlands, and their potential for stormwater attenuation and infiltration are also included in the Plan. Another important topic that the Plan addresses is Sanitary Sewer Planning. The Master Plan calls for development of sewer and water service area maps, and for using these maps in zoning decisions. They currently have a Sewer Map showing existing facilities, and have policies to use this information to discourage sprawl.

The Township's discussion of natural feature preservation could be enhanced by adding a discussion about the ecological importance of open space as a way to protect the health, safety, and welfare of Township residents, protect vital air, land, and water resources, buffer air and noise, etc. Other topics that could be connected to the health, safety, and welfare of residents are wildlife habitat preservation, and floodplain protection. The Plan could also recognize the importance of native vegetation and their role in ecosystem functioning, as well as the importance of stream corridors and associated riparian buffers. A specific plan to protect identified high-priority natural areas could also be included in the Master Plan (a Natural Areas Plan).

To create more policy support for the Township's Stormwater Ordinance, the Master Plan could make a stronger connection between open space preservation and alleviating problems with stormwater and improving infiltration. It could also acknowledge stormwater management as an important community goal, and include managing for stormwater "quantity" as well as "quality" (as included in the Stormwater Ordinance). Other concepts that would strengthen support for stormwater regulations include encouraging the use of Best Management Practices (BMPs), and the goal of reducing impervious surfaces.

The Sanitary Sewer Planning section of the Master Plan is thorough. However, additional discussion regarding suitable areas for septic systems, and community involvement in maintenance of these systems could be further explored.

Other important topics that should be considered for the Master Plan are groundwater, greenways, and wetlands. New ideas for groundwater protection include identifying and mapping groundwater recharge areas and adding policy statements about the importance of groundwater and calling for its protection. The greenway discussion could be enhanced by identifying natural greenways that act as transportation corridors for wildlife (such as stream corridors, tree rows, natural beauty roads, and utility corridors), and acknowledging that creating a greenway system is another way of protecting natural features. Lastly, additional information about wetlands could be added to the Master Plan. Categorizing wetlands in regards to their suitability for stormwater storage would provide the Township with important details about the level of protection needed for specific wetlands. Also, the Master Plan could call to protect wetlands within an "ecosystem" context (protecting the hydrology to the wetland, as well as

adjacent uplands that direct water to the wetland) to ensure that the wetland continues to function.

Development/Re-development Regulations

Consistent with the Master Plan, the Township's Zoning Ordinance requires developers to preserve natural features to the greatest extent possible. The community has also adopted wetlands and woodlands protection ordinances.

The Township has a Stormwater Management and Erosion Control Ordinance that meets many of the checklist criteria. This ordinance limits land grading, requires a riparian buffer strip, encourages infiltration devices, and has regulations to protect wetlands through management of stormwater quality and quantity. It requires the use of Best Management Practices (BMPs), and requires that stormwater facilities be maintained over time. The erosion control provisions of this ordinance also accomplish many of the checklist criteria; however, new State laws (effective 2000) should be incorporated into the ordinance language.

To help minimize impervious surfaces, Orion has incorporated flexibility in their parking standards, and allows smaller lot setbacks through the Cluster Ordinance. The Cluster provisions also require that any resulting open space be maintained in a natural condition, protected through a conservation easement.

Specific natural feature preservation ordinances provide significant protection for wetlands and woodlands. One small issue is that the Woodland Ordinance calls for the preservation of Norway Maples (*Acer platanoides*). However this is an exotic invasive species, and if preserved, will take over any wooded area it inhabits. Additional natural feature preservation ordinances that should be considered include language to better manage development adjacent to stream corridors, and provide floodplain protection. In addition, a groundwater protection ordinance could be built on the background information added to the Master Plan.

The Stormwater Management and Soil Erosion Control ordinance could be updated to provide guidelines on riparian buffer width. If a specific width does not provide enough flexibility, a range of widths based on the quality of the feature being buffered could be considered. The ordinance could also contain guidelines on how to reduce impervious surfaces. The soil erosion part of this ordinance could be strengthened by requiring that control measures be installed in the field before a building permit is issued. Engineering design standards for stormwater facilities would help in outlining the types of modern stormwater facilities (BMPs that minimize, pre-treat and filter stormwater) the Township is trying to encourage. Other ways of reducing the amount of stormwater is to prohibit downspout connections to storm sewers, and footing drain connections to sanitary sewers.

Miscellaneous topics include parking, sewer service areas, and native vegetation. The checklist highlighted that that Township could expand on mitigating on the impact of impervious surface by allowing a certain amount of compact car parking or stormwater infiltration areas in parking lot islands. The Master Plan calls for developing sanitary sewer and water service areas, which would help guide development decisions throughout the community. Recommendation for using native vegetation in stormwater facilities could be incorporated into any stormwater Engineering Standards, and encouraging the use of native vegetation in landscaping could be added to the

Landscaping Ordinance language in the form of guidelines. Note that the Township's list of noxious weeds lists Goldenrod (a native, and not listed in the State's Noxious Weed definition), and prohibits grasses 12" or taller. Many native grasses grow beyond this height.

City of Pontiac

Master Plan

The Master Plan reflects the urbanized nature of Pontiac. The City is almost completely built out, and has been this way for many years. Planning and development regulations will only have so much impact within this environment. However, there are certain topics the City could concentrate on to ensure that *re-development* projects work to protect water quality, and reduce stormwater runoff. In addition, the City could consider restoration projects, such as riparian buffers, that would improve both the quality of stormwater reaching waterways, and how much stormwater gets there.

Even with this urban environment, the current Master Plan states that natural areas within parks should be retained for environmental reasons and ease of maintenance. It also identifies parts of the City where additional parks are needed. Where development standards could play a major role is to help meet the Master Plan's goal of infill development, which is a high priority for the City. The City's Capital Improvements Plan (C.I.P.) also addresses stormwater. It provides design standards for stormwater and sanitary systems, and includes capital improvements for installation, maintenance, and replacement of these systems. Other programs that have a positive impact on the City's surface waters are its maintenance program for regularly cleaning out and inspecting its stormwater facilities. The City also has a landscape maintenance program, regularly sweeps the streets, evaluates the amount of deicing chemicals it uses in the winter, and provides leaf pick up during the fall.

All natural features and open space help to alleviate problems with stormwater runoff. While an extensive discussion of the City's existing natural features may not be warranted, providing an inventory of these features (such as wetlands, woodlands, native plants, wildlife habitat, water features such as lakes, ponds, rivers and streams and their watersheds, floodplains, steep slopes, and groundwater recharge areas), in the Master Plan would provide valuable information for future planning efforts, as well as for assessing the impact of infill developments or prioritizing utility maintenance projects. The discussion should also include a description of the important functions these features play (such wetland flood attenuation), and a goal to preserve them to the greatest extent possible. These features, and their preservation, should also be related to protecting the health, safety and welfare of the community.

Another way to address natural feature preservation is through a Greenway Plan, that could both create stream and river-side trails, but also protect these natural systems. Greenway plans also create an infrastructure for wildlife movement and animal access to different types of habitat. Goals of this plan could include increasing natural areas through maintenance practices (such as allowing a woodland to take over a mown area), or re-vegetate areas by planting native species along the riverfront where banks are eroding. Any new parks within the greenway system could also include small "natural" or "wooded" areas that will work to infiltrate stormwater.

Topics that an urbanized community should address in their Master Plan include stormwater management, infiltration, and impervious surface mitigation. The Master Plan could give the reader the City's approach to stormwater management, and how proper management reduces the amount of stormwater, and filters or cleans stormwater of pollutants before it reaches a natural water body. These actions help to protect the health, safety and welfare of residents. Another policy is to encourage the use of stormwater Best Management Practices (BMPs) in re-development projects to reduce and clean stormwater. Improving infiltration and reducing impervious surfaces should be other goals for an urbanized area. As properties are re-developed, infiltration facilities such as porous pavements, landscaped areas *within* parking lot pavement, landscaped greenbelts with deep rooted native plants, or vegetated riparian buffers are examples that give guidance about how to reach this goal. Green roofs are also being used more and more in industrial and commercial applications to reduce the amount of stormwater runoff.

Development/Re-development Regulations

The City currently does not have Engineering Design Standards for stormwater management systems that require pre-treatment of stormwater before it is released. These standards could also include guidelines that require limited land disturbance and grading, maintaining vegetated buffer strips adjacent to water features, encouraging impervious surfaces and use of infiltration devices. These regulations could be strengthened by requiring maintenance agreements for BMP facilities, storm water performance standards, and design guidelines for making storm water facilities more aesthetically attractive while increasing their functionality. Pontiac is probably the most densely developed community within the subwatershed. For this reason, it is also most likely to be the community with the most impervious surface. A few mechanisms that could be used to reduce imperviousness is the use of infiltration BMPs in parking lots, or allowing setbacks and lot frontages to be reduced to minimize the amount of pavement necessary in new developments. The City should also look at ways that storm water infiltration could be retrofit into urban areas, or included in re-development projects.

Another closely related subject is reducing the amount of storm water. Many communities have had success in disconnecting downspouts to storm water facilities, drastically reducing the amount of runoff that enters the system. Another consideration is that the City currently does not have a wetlands ordinance, nor does it have tools to protect riparian zones (except floodplains). Protection of these two features could be combined to improve the quality of water coming off of properties adjacent to streams and lakes. Concepts such as variable building setbacks or naturally vegetated buffers could be used among other protections. The City could also work with riparian land owners to educate them about water quality, and ways in which they can manage their property to help protect this natural asset.

Springfield Township

Master Plan

The Township has a unique approach to protecting water resources in its Master Plan. The document has a chapter called the "Natural Areas Plan" that is devoted to identifying areas that should be preserved in their natural state (high-quality areas), and areas where natural features can be integrated into development. While this is not the only place in the Master Plan where natural features are discussed, this chapter highlights environmental preservation as being a main

focus for the community. The Natural Areas Plan identifies and maps important environmental resources within the Township, including riparian systems (rivers/streams, floodplains, lakes, wetlands, and watershed boundaries), landscape fabric features (woodlands, tree rows/forest patches, and severe slopes), and MNFI (Michigan Natural Features Inventory) sites. Then the Plan goes on to provide actions that the Township can take to protect these specific ecosystems from threats identified in field inventories. The Huron, Shiawassee, and Clinton River headwaters are a focus of this Plan, and specific protective actions have been identified for each of these resources.

More general environmental preservation goals and objectives are also included in the Master Plan. The Master Plan recognizes the importance of all natural features including groundwater, wetlands, riparian corridors, woodlands, trees, tree rows, native plants, and steep slopes. The Plan calls for their preservation on an “ecosystem basis,” discussing how these features are interdependent on one another, and how preserving an ecosystem will help preserve the individual elements’ functions. The Plan also calls for preserving the “functions” of natural features by avoiding ecological fragmentation. Maintaining the diversity of habitats within the overall ecological system, and identifying and mapping groundwater recharge areas are other goals of the Master Plan.

In regards to development, the Master Plan gives guidance as to how environmental features can be preserved. It first states that density of the community’s Master Plan is based on the land’s ability to support that density. Instead of imposing a development pattern on the environment, the Township is letting the environment guide its development pattern. The Plan also talks about the importance of stormwater quality and quantity, and encourages the use of Best Management Practices (BMPs) to reduce, collect and treat stormwater. It also discusses how preserving natural features, such as woodlands and grasslands, can limit the amount of stormwater by increasing infiltration and reducing runoff. This extends to the Plan’s discussion on reducing impervious surfaces in development projects. The Plan also challenges development professionals to maintain steep slopes to reduce erosion, preserve natural drainage patterns and vegetation, and keep grading at a minimum. To avoid environmental fragmentation, the Plan talks about the importance of coordinating open spaces with each other to create larger, contiguous open areas. Conservation easements, and other preservation tools, are also discussed as options for environmental preservation.

Additional topics that the Township covers include sanitary sewer planning, greenway planning, and tree preservation. The Township has no plans to connect to a regional sanitary treatment facility. The Master Plan talks about the use of septic systems. A “greenway plan” (part of the Natural Areas Plan) identifies wildlife corridor connections, and connects natural areas to one another and the Township to other communities. A separate Pathway Plan coordinates with this plan for non-motorized human transportation opportunities. Lastly, the Tree Preservation Plan, a separate document from the Master Plan, works to protect rural character by preserving the tree-lined roads throughout the Township.

While the Township’s Master Plan covers much of the current thinking in natural feature preservation, there are a few details that could improve this document’s impact on water resource protection. Regarding stormwater topics, the Plan could specifically discuss stormwater management as an important community goal, and relate management of stormwater to the

health, safety, and welfare of its residents. Associated with this, the Plan could also have a goal or objective to reduce impervious surfaces, and reduce erosion to protect *all* water and soil resources (not just stream corridors). It could also beef up its discussion on riparian corridors by mentioning flood control, shading streams, and scenic and recreational values as other functions of healthy riparian corridors. Preservation of open space and woodlands could also be connected to stormwater infiltration, alleviating problems with too much stormwater runoff. The Plan could also consider community acquisition of additional open space. Lastly, areas suitable for septic systems could be identified and mapped (possibly in conjunction with groundwater recharge areas), and wetlands could be evaluated and mapped for their suitability as part of a stormwater management system.

Development/Re-development Regulations

The main topics addressed by the checklist are stormwater management, impervious surface mitigation, erosion control, sanitary wastes, natural feature preservation, site plan review, and construction coordination processes. Springfield has addressed each topic in their Zoning Ordinance and Engineering Design and Construction Standards.

The Township has adopted Stormwater Management/Impervious Surface Mitigation provisions within the Zoning Ordinance and has updated design standards for stormwater Best Management Practices (BMPs) that cover all the ideas expressed in the checklist. Both tools regulate stormwater using specific standards that reduce the amount of runoff and improve runoff quality. Specific standards limit grading, maintain buffer strips to improve infiltration, preserve natural drainage patterns, minimize impervious surfaces, and encourage infiltration devices. These standards also require the use of Best Management Practices (BMPs) such as above ground stormwater facilities and pre-treatment of runoff before it enters a natural water system, and require that BMPs are maintained over time. Another detail required by these standards is that native plants be considered for vegetating stormwater facilities. These species improve infiltration through their deep root systems, and help to remove pollutants from stormwater as it seeps into the ground.

Infiltration is also addressed by this ordinance. It calls to increase a site's infiltration possibilities, and limit the amount of impervious surfaces. Minimizing impervious surfaces are also handled by the Parking, Cluster, and Planned Unit Development (PUD) provisions in the Zoning Ordinance, and Private Road standards in the Engineering Design standards. The Township has included flexibility in their parking regulations to require only the amount of parking needed for a certain proposal. Some portion of parking lots are required to be planted with trees in landscaped islands. The ordinance also encourages shared parking and allows for small-car parking spaces. The Private Road provisions allow developers to build private roads in subdivisions that have smaller right-of-way and pavement widths, and steeper slopes (based on American Association of State Highway Transportation Officials (AASHTO) standards) if the goal is to preserve natural features. This allows roadways that require less grading and clearing. Other ways impervious surfaces are minimized is through the Cluster and PUD provisions. These provisions allow for relaxed setbacks and clustering of construction to reduce the amount of roadway required to serve the development. They also allow for shared driveways, and require open space that improves a site's infiltration capacity.

Other topics included in the Zoning Ordinance and Engineering Design Standards are erosion control and sanitary systems. The Design Standards require that a Soil Erosion and Sedimentation Control plan be submitted during site plan review, which is evaluated by the Drain Commissioner's Office for compliance with their rules. An additional requirement of the Zoning Ordinance is that any onsite sanitary discharge system (OSDS or septic system) be located at least 100' from any water feature.

The Township's approach to natural feature preservation ordinances is atypical in that it doesn't have an ordinance for each feature it wishes to protect (such as a Wetlands Ordinance, or Woodlands Ordinance). Instead, the environment is considered as an entire "ecosystem," understanding that each feature depends on the adjacent lands to maintain its functioning. Therefore, the Zoning Ordinance has general standards for natural feature preservation as part of its Concept Review process, as well as protective mechanisms in the Engineering Design and Construction Standards and the Stormwater ordinance. Lastly, the Township has a Resource Protection Overlay District that imparts special development requirements and standards on property that has been identified as environmentally sensitive. One feature of this District is the requirement for a field study and resulting Environmental Characterization. This report identifies where the high-quality natural features are located on the site, and directs development away from these features.

Lastly, the Township follows a comprehensive Site Plan Review process that emphasizes actions that preserve natural resources. These standards include a statement that natural features are to be preserved to the maximum extent possible. The applicant must also identify all natural features on a site plan (including native plant communities), label BMPs so that they can be reviewed against the Township's standards, and begin construction with a "pre-construction" meeting. The Township also charts the progress of construction projects to ensure they comply with the approved site plan.

The few modifications that could be considered include buffer adjustments, monitoring of BMPs, and requirements for groundwater recharge areas. The Design and Construction Standards currently require a 20' buffer adjacent to all water features. The Township does have the ability to make this buffer larger (or smaller) if they feel it is necessary. Scientific research has proven that the larger the buffer, the better it will protect a natural water feature. It is often the case that it's difficult to adjust a standard once it has been presented. Since there are no guidelines for when the buffer should be wider (or narrower), it could be argued that a larger standard would produce more consistent protection. Therefore, the buffer width suggested by the Design Standards could be gradually increased to improve the buffer's performance. The next topic, periodic monitoring of BMPs to ensure they are working, could be added as a requirement through the Master Deed and Bylaws of the Homeowner's Association to periodically monitor the system. The last topic may be able to be addressed as long as groundwater recharge data is available from Oakland County. This GIS data could be mapped, and used to guide the next Master Plan/Zoning Map update.

Waterford Township

Master Plan

The Waterford Township Master Plan is strong in several checklist areas. The Plan has a thorough discussion of the community's natural features, identifying each as important and calling for their preservation. This includes groundwater, wetlands, riparian corridors, woodlands, native vegetation, and watershed boundaries and features. Of these, they have mapped groundwater recharge areas (through the Wellhead Protection Plan), wetlands, and watershed boundaries. The Township also has a "Sensitive Natural Resource Area" map that shows the MNFI (Michigan Natural Features Inventory) areas provided by the County. The discussion on native plants encourages using these species in landscaping, and the discussion for wetland and woodland preservation talks about wildlife habitat preservation.

Open space preservation is another focus of the Master Plan. The text encourages private preservation through promoting open space developments, conservation easements, and other methods. Community acquisition of open space is covered in the "Recreation" section of the Master Plan. Another aspect talked about in the Plan is the important role open space plays in stormwater infiltration. The Plan continues its discussion on stormwater by proposing development of a Master Storm Drainage Plan to evaluate the current stormwater system, outline ways of not overtaxing this and any future systems, and discussing maintenance strategies and methods. Best Management Practices (BMPs) to reduce the quantity and improve the quality of stormwater are also discussed. All these topics are used to meet the Plan goal of managing stormwater to protect local streams.

The Master Plan also has other "plans" within it, such as a Sanitary Sewer Plan, a Greenway Plan, and a Capital Improvements Plan. A Wellhead Protection Plan also exists, and is an associated document that coordinates with the goals of the Master Plan. Sanitary sewer planning efforts have mapped the location of existing lines, which is used in the review of zoning decisions as well as a basis for determining density. Essentially, density is calculated on whether or not a sanitary line is available for hook up. The Greenway Plan provides guidance on development of the Waterford Riverwalk Pedestrian Pathway, a pathway that provides residents the opportunity to traverse the Township using non-motorized methods such as walking, biking or roller bladeing. This Plan connects the natural areas in the Township, as well as the Township to neighboring communities. The Capital Improvements Plan also contributes to water quality preservation by recommending a detailed study of stormwater drainage, including investigation of funding for implementation and maintenance of an improved stormwater system. The Wellhead Protection Plan identifies the area that contributes to the community water supply, identifies sources of potential contamination, and provides direction on how to manage the supply areas to minimize threats.

Areas where the Township's Master Plan could be augmented relate to stormwater management, impervious surfaces, and several natural feature topics. As the new thinking in stormwater management has become more main-stream, ways of managing stormwater through natural feature preservation could guide development in this positive direction. For example, the Master Plan could specifically relate stormwater management to the health, safety, and welfare of residents by describing all the positive water quality benefits that are attained through natural feature preservation. Also, natural feature preservation could be considered on an "ecosystem"

basis, rather than just working to preserve single features in isolation of their surroundings. A different approach to natural feature preservation is to have priorities for in-fill developments and re-development areas to encourage the use of sites that have already been disturbed rather than build in “green” sites. Another current stormwater-related topic is minimizing impervious surfaces. The Master Plan could state the importance of this through a goal, and provide guidance of how to reduce impervious surfaces in future developments or re-development.

The “Sensitive Natural Resource Area” map is a good start to preserving important natural areas within the Township. Currently, there is not a specific plan in place to address these sites; however, the Township does call for preservation of land through creative development techniques. A more proactive approach may be called for here through creation of a plan that prioritizes important natural areas, and sets some goals, objectives, and action items to actively preserve the remaining environmental features of the Township.

Discussions of several natural feature types could also be enhanced to improve guidance for the Township’s development regulations. The Township could meet the goal in the Master Plan to survey and map existing wetlands to determine their type and function, and develop a comprehensive wetland map that could provide more details during development reviews. The Pathway Plan could be expanded to identify potential wildlife corridors, and prioritize these areas for recreation development and preservation. A woodlands inventory could be added to the Master Plan, as well as include the importance of woodlands as stormwater infiltration areas. Riparian corridors and floodplains could be identified in the document as important natural features worthy of preservation. These linear natural features could also become part of the Pathway/Wildlife Corridor Plan.

Lastly, the Capital Improvements Plan (CIP) could be broadened to include standards for the design of stormwater and sanitary systems, and include capital planning for installation, maintenance, and replacement.

Development/Re-development Regulations

The Township has given developers many options in their Zoning Ordinance to preserve open space and natural features. Waterford has an Open Space Preservation Plan, a Subdivision Open Space Plan, a Detached Single Family Cluster Subdivision Option, and a Single Family Clustering Option. All of these options allow for clustering of residential units. The Subdivision Plan requires that for each square foot gained by a smaller lot, that area shall be dedicated to common open space. The Detached and Single Family clustering options require that land resulting from lot reductions be put into open common space that abuts the smaller lots. The Open Space option requires that resulting open space be connected with adjacent open space if feasible, and that the open space be maintained undeveloped, in a natural state. These options also help to reduce impervious surfaces by allowing smaller setbacks and lot widths, and clustered lots, which reduces the amount of necessary roadway.

Other ways the Township encourages infiltration of stormwater is through parking lot islands, and allowing leaching basins in storm sewer systems. It also has comprehensive storm water regulations that fully details design criteria for constructing these systems. Even though it is not supported in the Township’s Master Plan, infill and re-development projects are encouraged

through the development regulations, and the ordinance requires that new development coordinate with existing facilities.

Stream corridors, wetlands and woodlands have special protections. The Township requires a 25' buffer strip between a stream corridor and proposed development. Floodplains are also protected using specific building restrictions provided through the National Flood Insurance Program. The Township has also adopted a wetlands ordinance that protects wetlands less than five acres in size (the minimum protected by the State), and a woodlands ordinance that goes beyond protecting only the trees, but protects the shrub and groundlayer of a woodland as well. This ordinance also has tree replacement requirements.

The Township has a solid base of regulations to protect water resources. However, they could be updated using some of the modern ideas presented in the checklist review. Particular subjects include stormwater guidelines, site development standards, floodplain regulations, and site plan review procedures. Regarding zoning, because the Township has already mapped groundwater recharge areas, this information could be used in zoning properties. Additional protective requirements for site development could also be added to properties in the groundwater recharge area.

The stormwater ordinance could require developers to preserve the natural drainage patterns on a site as a criteria of site plan review. These regulations could also include water resource protection guidelines such as limiting the amount of grading, maintaining a *naturally vegetated* buffer, requiring the use of native plants in stormwater facilities, minimizing impervious surfaces and improving infiltration, and encouraging the use of Best Management Practices. Possible BMPs include encouraging above-ground stormwater management (vs. putting it in a pipe and directing it off site), prohibiting direct discharge into a natural water body without pre-treatment, periodic monitoring of stormwater systems, and regular maintenance activities to ensure the stormwater facilities are functioning properly. Another option is to prohibit residents from connecting down spouts to the stormwater system. The buffer strip requirement could also be increased in size, and allow for modifications if the site warrants it (wider or narrower, using a set of guidelines to determine if necessary and which way to go).

Site design options are also suggested by the checklist. It is difficult to determine the right amount of parking (not too much, not too little) when applying static parking regulations to various site plans. Adding the ability for the Planning Commission to approve less parking, if warranted by the use, could eliminate excess parking and impervious surfaces. Other ways of reducing pavement include allowing shared parking and a percentage of small parking spaces for compact cars. Another site design option would be to improve floodplain protections by requiring any development (or re-development) within the floodplain to assess the impact of the project on water quality and quantity. Finally, site plan review procedures could be modified to require developers to protect natural features to the maximum extent possible as a site design criterion. Also, the review requirements could necessitate that BMPs be clearly labeled on the plans so that they could be adequately reviewed.

White Lake Township

Master Plan

White Lake Township's Master Plan has several strengths that make it an effective tool to protect water quality. The document is strong in describing its goals for open space preservation, and how different development patterns should be matched with the land's ability to support that development. Woven throughout this Plan are references to White Lake Township's participation in the Shiawassee and Huron Headwaters Resource Preservation Project, which also details many ways that communities can preserve open space.

The Master Plan first talks about how the community itself can preserve open space and natural features by acquiring natural areas themselves, or by encouraging donation of land, conservation easements, and open space development designs. It goes on to describe other techniques as well, such as transfer of development rights, deed restrictions, open space/cluster zoning, and connecting natural areas to allow wildlife movement. It also describes the importance of working with developers in public/private partnerships to preserve open space. Another unique idea in the Plan is development of a local land conservancy to concentrate its efforts on preserving open space in the community. The Plan also suggests that the Zoning Ordinance should include incentives to encourage open space preservation and making open space a requirement of new subdivisions.

Related to this, the Master Plan has explanatory material and other goals and policies about how natural features should be preserved. The Plan states that development should be accommodated without negative impacts to the natural environment. Inventories of the community's wetland, woodland, and watershed resources are included in the Plan, along with statements that describe how the Township values these resources and sees them as important. A specific goal for water resources is that they all have a vegetated buffer zone to ameliorate the effects of development. They also relate these features (and groundwater) to protection of residents' health, safety and welfare, an important provision in the land use enabling legislation to justify development regulations for these features. Another natural feature that the Plan deems important is groundwater. The Plan protects this resource through the goal of primary and secondary containment of hazardous materials, and shows potential sources of contamination on a Wells and Aquifers vulnerability map.

Another main strength of the Master Plan is the information provided about sanitary treatment, and the goals and policies the Township has regarding this important topic. The Plan has an inventory and map of the existing sanitary system, and shows areas that are unsuitable for septic systems. The goals of the Township are to provide sanitary utilities to areas that are the most densely populated, or areas with the most sensitive natural features, such as wetlands, rivers and lakes. Another priority for sanitary systems is areas with polluting septs. The Plan also ties the location and maintenance of sanitary sewers and septic systems to the health, safety and welfare of the community.

While the Township does not have a Greenway Plan specifically, the Master Plan does call for development of a pathway system throughout the Township for non-motorized transportation. There is also a Highland Road (M-59) Corridor Plan and the Recreation Master Plan calls for development of non-motorized pathways.

While the Master Plan has many positive provisions, there are several areas where the Plan could be improved. A specific discussion about the importance of stormwater management could be added. This is particularly important since the Township has no County drains, and all stormwater drains to existing natural waterways. This discussion would include goals regarding stormwater quality and quantity, connecting stormwater management to the protection of the residents' health, safety and welfare and natural features, and encouraging the use of Best Management Practices (BMPs) to minimize, collect and treat stormwater. Related to this would be a discussion about reducing impervious surfaces in development, and preserving natural features for improved stormwater infiltration. Another topic that impacts stormwater quality is soil erosion and sedimentation control. The Master Plan should talk about how sediments are the most prevalent pollutant today, and controlling the flow of sediments into our water features can protect the health, safety and welfare of a community.

Details that could be added to the Master Plan's sanitary treatment discussion include development of a program to identify sanitary systems or septic systems that are seeping into stormwater, surface waters, or groundwater. The Plan could also map the location of groundwater recharge areas, and identify the location of community well fields in relation to groundwater resources.

The "natural area preservation" sections of the Master Plan could be augmented with a "Natural Areas Plan" that identifies and maps the Township's important natural features (such as the MNFI sites from the Headwater's Project), and discusses the important benefits they provide. This Plan could also outline how preservation of natural features such as water bodies, wetlands, floodplains, woodlands, wildlife habitat, native plant species, and naturally vegetated riparian buffers protect the health, safety, and welfare of residents. A Natural Areas Plan could also talk about natural feature preservation on an "ecosystem" basis rather than preserving each feature in isolation. This way, the Township will help preserve the functioning of these features by maintaining their relationships to adjoining landscape components. Additional topics on wetlands, such as categorizing them by their suitability for stormwater retention, could also be included.

Development/Redevelopment Regulations

As in the Master Plan, White Lake Township's development regulations pertaining to water resources are strong in several areas. The Zoning Ordinance requires that developers preserve natural drainage patterns and the Township provide many ways of doing this. Cluster provisions (Special Land Use), and an Open Space Preservation Option (by right) both allow a developer flexibility in design to cluster development so that natural areas can be preserved. These regulations require that open spaces be consolidated with adjacent natural areas, that they be preserved in natural condition, and be protected by a conservation easement. If a development is proposed of a certain intensity, the regulations require that a Community Impact Statement be submitted, which describes the existing natural features on the site and the pollutants expected to be emitted into the air and groundwater by the proposed use.

Groundwater protection standards are also a positive part of the Zoning Ordinance. These standards are part of a Wellhead Protection Overlay District. It identifies areas of critical concern for the existing community wells, and provides standards for groundwater and wellhead

protection through the site plan review process. Groundwater is also considered in determining the zoning designation of a parcel. Another water-related program that the Township participates in is the National Flood Insurance Program, which has development provisions to protect floodplains from undesirable development.

Site design criteria in the Zoning Ordinance also contributes to water resource preservation through the parking lot and roadway design standards. The parking lot standards require that trees be planted within parking lot islands, breaking up the expanse of pavement and improving the infiltration of stormwater. Some reduction in required parking is achieved through provisions that allow shared parking under certain circumstances. The Township will also allow a private roadway if the County's design standards would destroy significant natural features.

Another strong aspect of the Township's development documents are in the Township's Engineering and Design Standards, where they provide rules for designing and installing stormwater management systems. These standards provide detailed stormwater design criteria, and require that retention and detention basins are maintained. The Zoning Ordinance further prohibits any stormwater from entering surface waters without pre-treatment.

The Township's site plan review procedure also is a strength of the community's water resource protection programs. This process is tied to receiving the appropriate permits from the State and County before work begins on the site. It also requires that developers preserve natural features to the greatest extent possible, and show all natural features on a site plan.

The main items in the checklist that are not addressed in the Township's development and re-development regulations generally pertain to stormwater management, impervious surface reduction, and infiltration enhancement. Many of these ideas are relatively new, and could be incorporated into the Zoning Ordinance or Engineering Design Standards during a regular document up-date.

Additions to the stormwater management provisions could include language requiring Best Management Practices (BMPs) that reduce the amount of stormwater a development generates, and then filters any that is generated before being outlet into a natural system. Examples include above-ground facilities such as swales, manufactured wetlands (where water infiltrates into the ground, or evaporates), and retention basins. Above ground facilities allow for infiltration, where piping stormwater to one point generally does not. Additional ideas that increase infiltration through natural feature preservation include limiting land clearing and grading, minimizing impervious surfaces, and encouraging the use of infiltration devices. Requiring monitoring and regular maintenance of all stormwater facilities should also be considered.

Riparian buffer strips provide many benefits to a water-based resource, such as a wetland or stream. They slow stormwater runoff so that it can infiltrate the ground and be filtered of pollutants, rather than carry pollutants directly into the water. A buffer stabilizes the stream banks, reducing erosion from flashy stream flows. It provides shade and habitat through fallen branches and leaves for aquatic organisms. And it provides habitat for terrestrial wildlife who all need to be able to safely access a water source. Adding a buffer requirement to the development regulations would also meet a goal of the Township's Master Plan.

Other ways to reduce stormwater runoff and increase infiltration include

- Prohibiting connection of downspouts to stormwater systems
- Prohibiting connection of footing drains to sanitary systems
- Requiring a 100' setback of septic systems to any water feature
- Requiring an isolation distance between septic systems and private or community wells
- Limiting or prohibiting disturbance within a required riparian buffer
- Requiring use of native plant species in stormwater facilities to uptake and filter pollutants from stormwater
- Adopting a woodlands and/or tree preservation ordinance, which provides for significant uptake and infiltration of stormwater
- Incorporate flexibility in parking requirements, including encouraging shared parking, providing spaces for small cars, and using parking lot landscape islands as stormwater infiltration areas.

5.4 Planning Summary of the Subwatershed – Overall Challenges

Each community within the subwatershed is strong in some of the available techniques to protect water quality and water resources. However, some checklist items came forward as the most important challenges for the subwatershed overall.

Relative to the NPDES Permit, stormwater management is a main topic that most communities could concentrate more on. Most of the Master Plans evaluated do not discuss how they view stormwater, the impacts stormwater can have on natural and man-made systems, nor how they intend to improve stormwater quality or minimize its quantity. As part of this discussion, and in development standards and guidelines, a community could encourage the use of Best Management Practices (BMPs), and require that stormwater be minimized and/or treated before it is released into the environment.

Another main topic that should be considered by many of the subwatershed communities is impervious surface mitigation and infiltration enhancement. Few of the Master Plans mention the impact that impervious surfaces have on water quality, nor have ordinances to control or reduce the amount of impervious surfaces. New goals and policies should be added to Master Plans to address these concerns through specific techniques for both sites to be developed, and sites already developed. The Zoning Ordinance or Engineering Standards could be used to provide guidance on stormwater Best Management Practices for developing sites, and the community, through public education and demonstration projects, encourage existing residents to incorporate techniques into their yards, such as French drains, rain barrels, rain gardens, and similar methods.

Many areas of the subwatershed still have natural features that have not been removed by development. Where this is the case, these communities could enhance their preservation of these features, and justify this protection by linking natural feature preservation with improved stormwater infiltration. Woodlands, wetlands, and riparian buffers absorb a great deal of stormwater, recharging groundwater that feeds streams during dry periods, among many other benefits.

Because this subwatershed has a considerable amount of stream and lakefront property, community efforts should also be directed at preserving and creating riparian buffers of native vegetation along these shorelines. Goals and policies should be adopted to ensure that public riparian property is protected, and if necessary, re-vegetated as much as possible to demonstrate the water quality benefits of plants near water. Residents should be encouraged to re-vegetate their own riparian areas as well. And the Master Plan goals and zoning regulations (through Natural Feature Setbacks for example) should be used to protect existing riparian vegetation in each community.

A relatively easy but important addition to local plans and codes is encouraging the use of native plants in landscaping. This one element is an important feature of reducing the amount of stormwater (through infiltration), and providing vegetative buffers to lakes and streams. While communities cannot require the use of native vegetation, they can demonstrate the aesthetic qualities of these plants on municipal properties, and educate property owners about the benefits native plants provide.

Lastly, the communities within the subwatershed are going to become more urbanized as populations continue to shift to the north and west in Oakland County. Each community should begin to plan for in-fill development, as well as re-development of properties with stormwater quality and quantity, and natural feature preservation in mind.