

Large-Quantity Water Withdrawals & Coldwater Fisheries in Michigan: **identifying probable impacts for targeted conservation improvements**



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Introduction

The “Compact” & Michigan’s implementation of it

The Great Lakes – St. Lawrence River Basin Water Resources Compact, more often referred to as the “Great Lakes Compact”, was approved and went into effect on October 3, 2008 (Public Law 110-342, 110th Congress). This agreement of the United States, governs the conditions in which the eight Great Lakes states can accept or reject proposals for diversions of water from the Great Lakes basin. It also mandates that each of those Great Lakes states will manage and regulate new or increased water withdrawals within their jurisdictions. The State of Michigan chose to implement this requirement of the Great Lakes Compact, during the legislative process associated with passage of the Great Lakes Compact by the State of Michigan (in contrast to other states postponing fulfillment of these obligations until after they approved the Great Lakes Compact). Michigan approved the Great Lakes Compact on July 9, 2008 (MI Act 451 of 1994, Section 324.34201), and adopted its system of regulating withdrawals within the state along with it (MI Act 451 of 1994, Section 324.327). Both of these acts be found in their entirety online at [http://www.legislature.mi.gov/\(S\(zoidycrfsxllte55alrukz45\)\)/mileg.aspx?page=home](http://www.legislature.mi.gov/(S(zoidycrfsxllte55alrukz45))/mileg.aspx?page=home), the Michigan Legislature website, by searching under the MCL searches.

Large-quantity water withdrawals – new & existing

These laws now govern the regulation of new or increased “large-quantity water withdrawals” in the State of Michigan. A water withdrawal is defined as the removal of water from its source (surface or groundwater) for any purpose, other than for hydroelectric generation at sites governed by the Federal Energy Regulatory Commission. A large-quantity water withdrawal (LQWW) is defined as 1 or more cumulative total withdrawals of over 100,000 gallons of water per day (70 gallons per minute) average in any consecutive 30-day period that supply a common distribution system, or an increase of over 100,000 gallons of water per day average in any consecutive 30-day period beyond the baseline capacity of a withdrawal (baseline as established by law). The law stipulates that these types of withdrawals cannot create an “adverse resource impact” (as defined in the law). In the next section of this report, the basis for determining if an adverse resource impact is likely to occur will be summarized. However, it is important to note that LQWW’s that existed prior to this law’s enactment were “grandfathered” or held exempt from it. This means that the new legal standard of an adverse resource impact does not apply to them, but they are still governed by the reasonable use doctrine. **These grandfathered LQWW’s are the focus of this report** and the concepts surrounding their impacts and the potential for improving our coldwater fisheries by working with them to reduce their impacts will be explained further here.

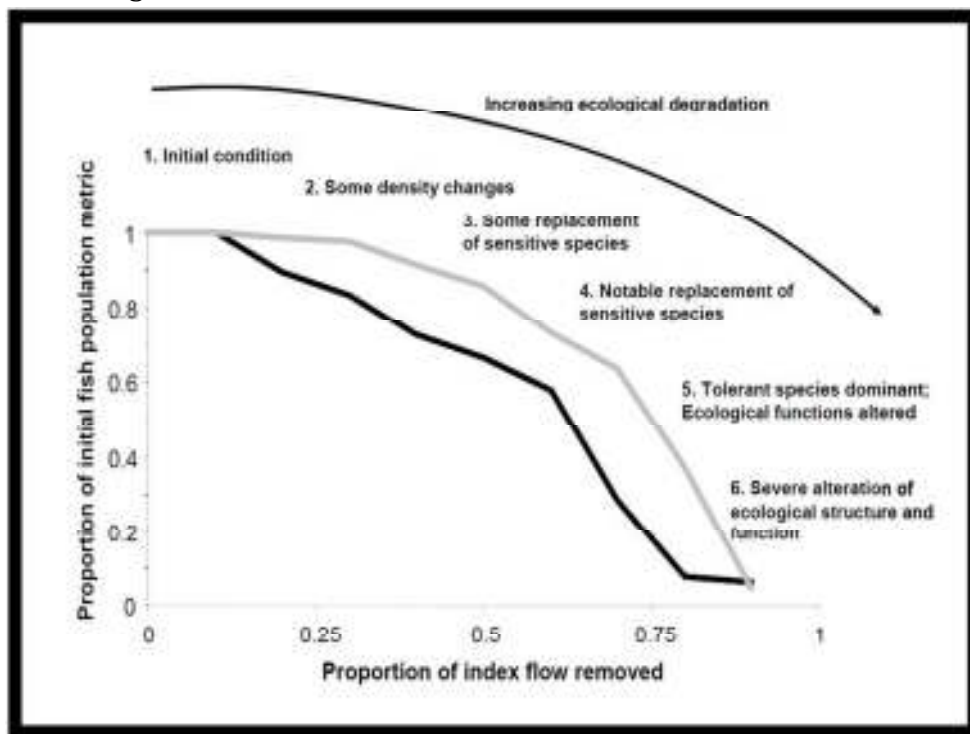
Adverse Resource Impacts and Fish Responses to Water Withdrawals

By law, new LQWW's are not allowed to create adverse resource impacts, which are defined uniquely for different categories of waterbodies. Fish communities in streams were chosen as a variable which would be responsive to water withdrawals, and could represent the overall health of a waterbody. Michigan's regulatory framework for preventing adverse resource impacts from new LQWW's relies upon the use of a "water withdrawal assessment process" (WWAP) and "water withdrawal assessment tool" (WWAT). These both rely on a set of three scientific models that simulate the ways in which a LQWW can impact the fisheries in a stream. The first model is the "withdrawal model" and predicts how much will be depleted from nearby streams from a proposed groundwater withdrawal. The second model, "streamflow model", predicts how much water is flowing in any stream during the summer low flow periods (usually July or August), this is referred to as the "index flow". The third model, the "fish impact model", predicts the level of abundance of fish species likely to be present in any stream, and predicts their likely response to a reduction in groundwater to the stream. This last model relies on information from across the state as to the sensitivity of different fish species to water temperatures and base flows in streams (the low water levels during summer where a majority of the water is from groundwater sources).

The fish impact model establishes "fish response curves", which show how increasing volumes of water withdrawals reduce the abundance of existing fish species and communities. These fish response curves are different shapes for different temperatures and sizes of streams, but in all cases, water withdrawals alter the fish communities present, and the amount of impact increases with the amount of water withdrawn. Adverse resource impacts were defined as certain amounts of change to the fish communities, along the fish response curves, for different types or categories of Michigan streams (temperature categories include cold, cold-transitional, cool and warm; size categories include streams, small rivers and large rivers). More information about these classifications of streams/rivers can be found at

www.miwwat.org/wateruse/regulations.asp (or by clicking on "Educational Resources" at www.miwwat.org).

Figure 1. A hypothetical fish response curve, indicating impact to fish communities with increasing reduction in flow level in streams.



Additional background information available

During the summer of 2009, the Michigan Environmental Council, Michigan Trout Unlimited, Tip of the Mitt Watershed Council, Sierra Club, and Clean Water Action provided numerous full-day educational workshops on this new water law framework and its implications for conservation of Michigan's aquatic resources. These workshops were produced and presented by Dr. David Lusch from Michigan State University. All of the information from these workshops was crafted into a series of separate presentations explaining all facets of this water law. These presentations, automated with voice narration, can be found at www.michigantu.org, under "Conservation" and "Water Withdrawal & Use Policy". While they are broken into 10 separate sections by topic, collectively they can provide you comprehensive information from the background of Michigan's water law to the applications of the water withdrawal assessment tool for future conservation efforts. If you lack access to these via the internet you can request a DVD copy of the complete series from Michigan Trout Unlimited, at P.O. Box 442, Dewitt, MI 48820. Conservationists planning on applying the guidance and information provided in this report are encouraged to review the complete series. All necessary background information is not covered in this report, for brevity.

The Impact of the Grandfathered LQWW's

While all LQWW's created after the passage of the in 2008 are prevented from causing adverse resource impacts, those that existed prior to the law were not held to the same standards. The fish response curves that were developed, used information about flow and water temperature in streams, collected prior to 2006. Thus, the impacts created by "grandfathered" LQWW's were built into the starting conditions of the fish impact model. However, according to those models every withdrawal impacts either the fish community present or its resilience to future impacts such as climate change. Therefore, the existing grandfathered LQWW's, while exempt from the new law, may still be impacting Michigan's stream fisheries at some level. The models were not specifically designed to quantify the exact amounts, but basic rules of the models can provide us some tools to infer which grandfathered LQWW's are having the greatest level of impact to our coldwater fisheries currently. Michigan Department of Natural Resources research report 2091, "Relationships between habitat and fish density in Michigan streams", (Zorn, Seelbach and Wiley, July 2009) contains information on the relationship between the density of different fish species with watershed size, groundwater flow and July mean temperatures. The results of that study helped form the basis for the fish model in the water withdrawal assessment tool. It provides valuable background information and tools useful for understanding and predicting the impact of existing large-quantity water withdrawals on stream fish communities, especially coldwater species such as brook and brown trout. This report can be accessed at

www.michigandnr.com/publications/pdfs/ifr/ifrlibra/research/reports/2091/rr2091.pdf.

It's also important to note though, that while these LQWW's were grandfathered exempt from the new Michigan's laws, they are not exempt from basic Michigan water law. Chief among these pertinent water laws is the Reasonable Use Doctrine, which includes a provision that permits a landowner to make use of water on, adjacent to, or under their property, so long as such use does not, among other things, unreasonably impair the quality of the water leaving their property. The public trust doctrine also offers limits to water use if they impact the public's trust to certain uses of the streams. So, while grandfathered from registration and inclusion under the 2008 law, unreasonable impacts from the uses would still be actionable. It is not the intent of this report to identify targets for future litigation, but to identify those existing LQWW's that may be causing significant impact to coldwater fisheries, so that they can be targeted by conservationist for cooperative and proactive efforts to further evaluate and potentially reduce their impacts, thus improving and protecting Michigan's coldwater fisheries.

Methods

Water temperature categories

Coldwater fisheries (i.e., trout, salmon, and steelhead) principally need cold water temperatures to exist. Each species is somewhat different in their preferences and

tolerances to water temperatures; however, generally they will be threatened when temperatures rise much above 70 degrees F for a prolonged amount of time.

The water withdrawal assessment tool models categorize all Michigan streams by size (streams, small rivers or large rivers) and by water temperature categories (cold, cold-transitional, cool or warm). Cold streams or rivers are those that have summer temperatures which are very cold and support thriving populations of coldwater fish such as trout. These streams are therefore resilient and can buffer themselves against warming trends or drought years to a large degree, but are also permitted for up to 20% reductions in median low flows levels from new LQWW's. On the other end of the spectrum, warm streams and rivers have water temperatures which normally prevent the existence of coldwater fish species in them. The exceptions to this rule would be for salmon fisheries, such as Chinook salmon – where the adults return in the fall, and juveniles migrate out of the river by the following late spring – thus avoided the warmest summer period. But by and large, these waterbodies do not offer conditions suitable for coldwater fishes.

For the purpose of identifying existing LQWW's that have the greatest potential for conservation efforts that improve coldwater fisheries, the remaining two categories of stream types offer the best targets – cold-transitional and cool waters. Cold-transitional streams and rivers are those that still offer water temperatures in the summer that are adequately cold for coldwater fishes, but which cannot withstand any significant reduction in low flows levels without resulting warmer water temperatures that would collapse the existing coldwater fish populations. These cold-transitional streams and rivers are “right on the edge” of being lost to coldwater fisheries. Cool streams and rivers are those that “have already been pushed just past the edge” for coldwater fisheries. The water temperatures in these streams are cold enough for some limited coldwater fish to survive, but not for populations of them to thrive sustainably (without human intervention through “stocking” of hatchery fish). Water temperatures in July-August in these streams average in the mid to high 70's (F), and possess smallmouth bass, northern pike, white suckers, and other “coolwater species” predominately.

It is possible that existing LQWW's might be significantly impairing some cold or warm streams and rivers. However, cold streams and rivers still have some resilience left to them, and warm streams and rivers are severely too warm for coldwater fishes, therefore the potential for meaningful improvements to either of these stream categories is lower than for cold-transitional or cool waters. Therefore, in identifying top priority targets of conservation efforts aimed at existing LQWW and improving coldwater fisheries, only those falling in watersheds defined as cold-transitional or cool were focused on for this report. They offer our best opportunity to either protect a fragile fishery or to restore an impaired one.

Cold Transitional and cool water rivers and streams were determined based on the Department of Natural Resources and Environment's Revision8 linework and catchment data file which was used in the Water Withdrawal Assessment Tool. This file was acquired

from the Michigan Department of Natural Resources and Environment. Cold transitional and cool waters of all sizes were selected out based on river type from the Revision8 linework table for surface and groundwater.

Characteristics of the Existing Water Use

Size and Timing of the withdrawal

Size of the water withdrawal will relate to the potential impact it causes in the watershed it's located within, the larger the water use, the larger the impact. So, LQWW's with greater capacity to withdraw, or greater water usage, will in theory have greater impacts than LQWW's with lesser withdrawal rates, all other factors held constant. In theory, even small domestic water withdrawals could impact rivers and streams, especially cumulatively. However, in this analysis with the objective of identifying existing LQWW's with the greatest potential for conservation effort improvements to coldwater fisheries, we constrained the analysis to include only those withdrawals meeting the threshold definition for "large-quantity" as defined by law (100,000 gallons per day).

The frequency of the water withdrawal is another factor that can influence the impact it will have on the fish community in its watershed. Some LQWW's are continuous – withdrawing the same amounts of water throughout the year (e.g., industrial, water bottling, municipal uses). These uses will be drawing from the aquifer repeatedly throughout the year, and can have the greatest impacts. The current assessment tool models rely upon the impact of withdrawals on summer time low flows and warm water temperatures. However, research has also shown that stream fishes can be very sensitive to flow level fluctuations in the winter period – a mechanism not included in the current assessment tool models. Therefore, a continuous LQWW should be assumed to have greater impacts than a "seasonal" one of the same size. Seasonal uses (agriculture, irrigation – including non-agricultural irrigation such as golf courses), will have less impact than a year round withdrawal of the same size. However, because these seasonal LQWW most often occur during the summer low flow periods, the impact they can cause can be severe, especially for coldwater fishes.

For this analysis, wells were selected from "Wells Complete Database" downloaded from the Center for Geographic Information's Data Library. From the Wells Complete Databases wells of interest, Irrigation and Industrial wells, were selected based on the type of well. Once the irrigation and industrial wells were separated out, they were further thinned by the definition of large capacity withdrawals. The threshold for large capacity withdrawals is 70gal/min, also equal to 100,00gal/day.

Where – watershed size and distance from stream

The type of watershed the withdrawal is located in, can determine the level of impact the withdrawal will have on the fish community in the watershed. Smaller watersheds with smaller streams will be more sensitive to reduction in water. For example, reducing the

low flow of a stream by 2 cubic feet per second (cfs) will have varying impacts on stream/river segments with low flows of 5 cfs, 50 cfs and 500 cfs.

According to the hydrologic models used in the assessment tool, the further a withdrawal well is from a stream, the less impact it will have on reducing the flow of the stream. Therefore, a withdrawal directly from the surface waters of a stream will have the most impact to flow reduction (1:1 ratio of water withdrawn to flow reduced instream). Wells occurring further from the surface waters of a stream will have diminished impacts on reducing the flow of it (e.g., a well 2 miles away might have a 2:1 ratio of water withdrawn to flow reduced instream). Therefore, in this analysis we examined distance of a LQWW from a stream as a primary variable of interest, assuming that those closer to streams could have higher probability of impacts to it. We specifically looked at distances of <0.10 miles, <1.0 miles, and >1.0 miles from a stream.

Results

There are a total of 392 large-quantity water withdrawal wells located in cold-transitional or cool streams, small rivers and large rivers. The average capacity for these wells is 506,000 gallons per day, with a range of 100,800 gpd to a high just over 14 million gpd. The volumes provided are well capacities, not water use reports, meaning they represent the potential of the wells to withdraw, not the amounts which are actually withdrawn. The reason for this is that all wells drilled are required to report on the well depth, location and the capacity for withdrawal. However, the actual amount of water used, while reported, is protected from public information for many types of uses (e.g. agriculture). Since wells are seldom built with capacities far beyond the actual needs, the relative size of capacities reported here should provide useful information as to the relative impacts of these wells and potential for conservation measures with them.

Of the 392 wells, 168 are located within 1 mile of a cold-transitional or cool stream or river; while 21 are located within 0.10 miles of a cold-transitional or cool stream or river. By and large the density of LQWW's is highest in southern Michigan and diminishes northerly through Michigan (Figures 2-6).

A total of 60 counties have LQWW's on cold-transitional or cool streams or rivers, and 13 counties have 10 or more. Kent, Berrien, Montcalm, Oakland, Allegan, Ottawa, Van Buren, Ingham, Emmet, Kalamazoo, Gratiot, Calhoun, and Wayne counties all have 10 or more LQWW's. Kent County has the most numerous water withdrawals from cold-transitional or cool waters with 31 total LQWW's, 19 of which are located 1 mile or less from the cold-transitional or cool streams or rivers. However, Montcalm County might be

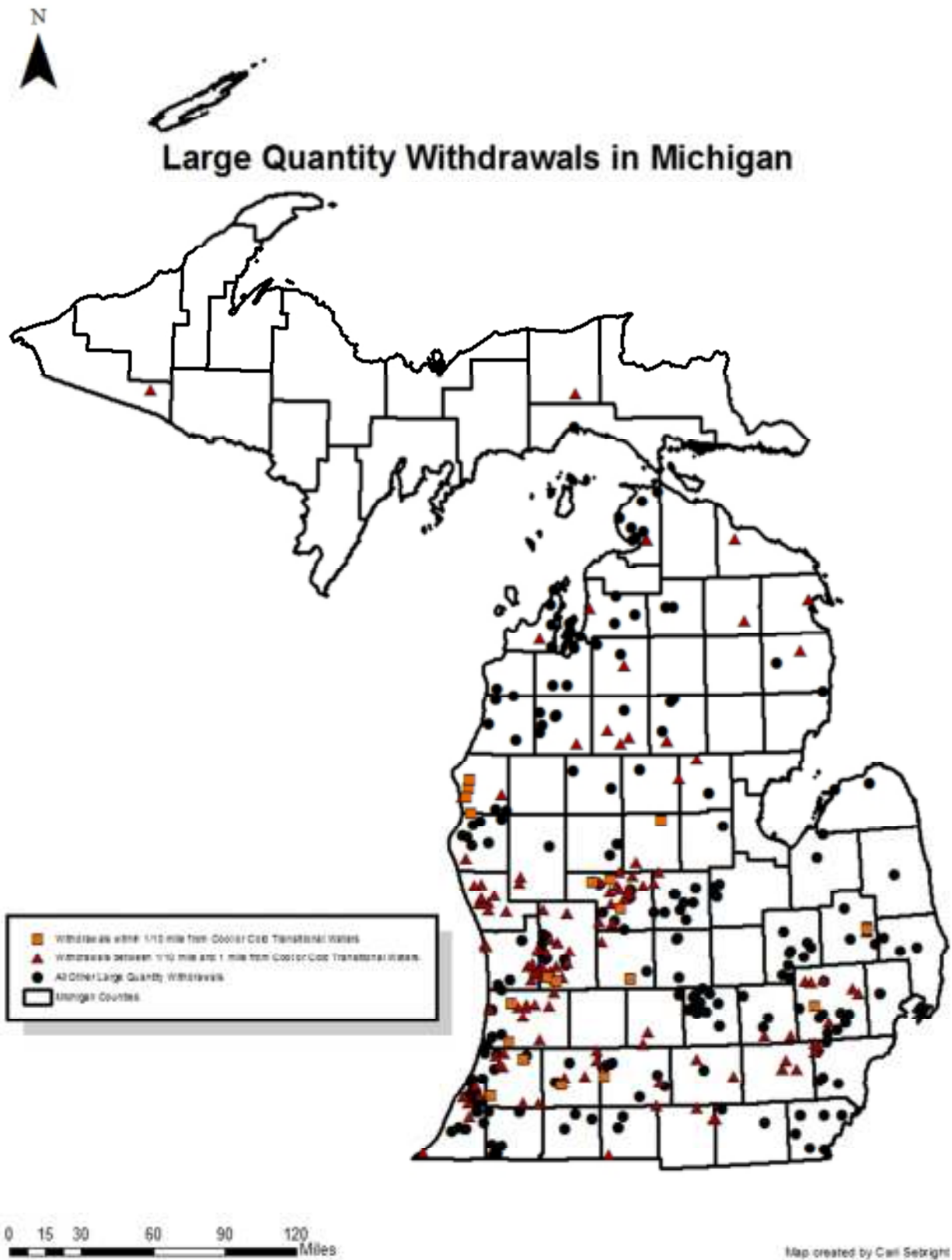


Table 1. Number of large-quantity water withdrawals by county, located on cold-transitional or cool streams or rivers, along with the number by distance from the water.

County	Total	< 1 mile	< .1 mile		County	Total	< 1 mile	< .1 mile
Kent	31	19	2		Lenawee	4	2	0
Berrien	31	10	0		Branch	4	1	0
Montcalm	24	17	3		Mecosta	4	1	0
Oakland	18	8	1		Manistee	4	0	0
Allegan	16	11	2		Saginaw	4	0	0
Ottawa	16	12	0		Gladwin	3	3	0
Van Buren	14	10	2		Jackson	3	2	0
Ingham	13	0	0		Newaygo	3	2	0
Emmet	12	5	0		Alcona	3	1	0
Kalamazoo	11	6	1		Kalkaska	3	1	0
Gratiot	11	2	0		Clinton	3	0	0
Calhoun	10	3	1		St. Clair	3	0	0
Wayne	10	5	0		St. Joseph	3	0	0
Muskegon	9	9	0		Tuscola	3	0	0
Genesee	9	0	0		Isabella	2	2	1
Mason	8	6	4		Alpena	2	2	0
Oceana	8	1	0		Benzie	2	0	0
Cass	8	0	0		Huron	2	0	0
Monroe	8	0	0		Macomb	2	0	0
Grand Traverse	7	0	0		Osceola	2	0	0
Lapeer	6	3	2		Otsego	2	0	0
Wexford	6	1	0		Gogebic	1	1	0
Livingston	5	2	0		Hillsdale	1	1	0
Roscommon	5	2	0		Luce	1	1	0
Antrim	5	1	0		Montmorency	1	1	0
Leelanau	5	1	0		Presque Isle	1	1	0
Ionia	4	2	2		Clare	1	0	0
Washtenaw	4	4	0		Mackinac	1	0	0
Eaton	4	3	0		Midland	1	0	0
Missaukee	4	3	0		Sanilac	1	0	0

the most severely impacted by LQWW, with 14 wells located within 1 mile of a stream, with greater than 400,000 gallons per day capacity (average capacity of the LQWW's in that county, on cold-transitional or cool streams or rivers is approximately 1.5 million gallons per day).

Applications

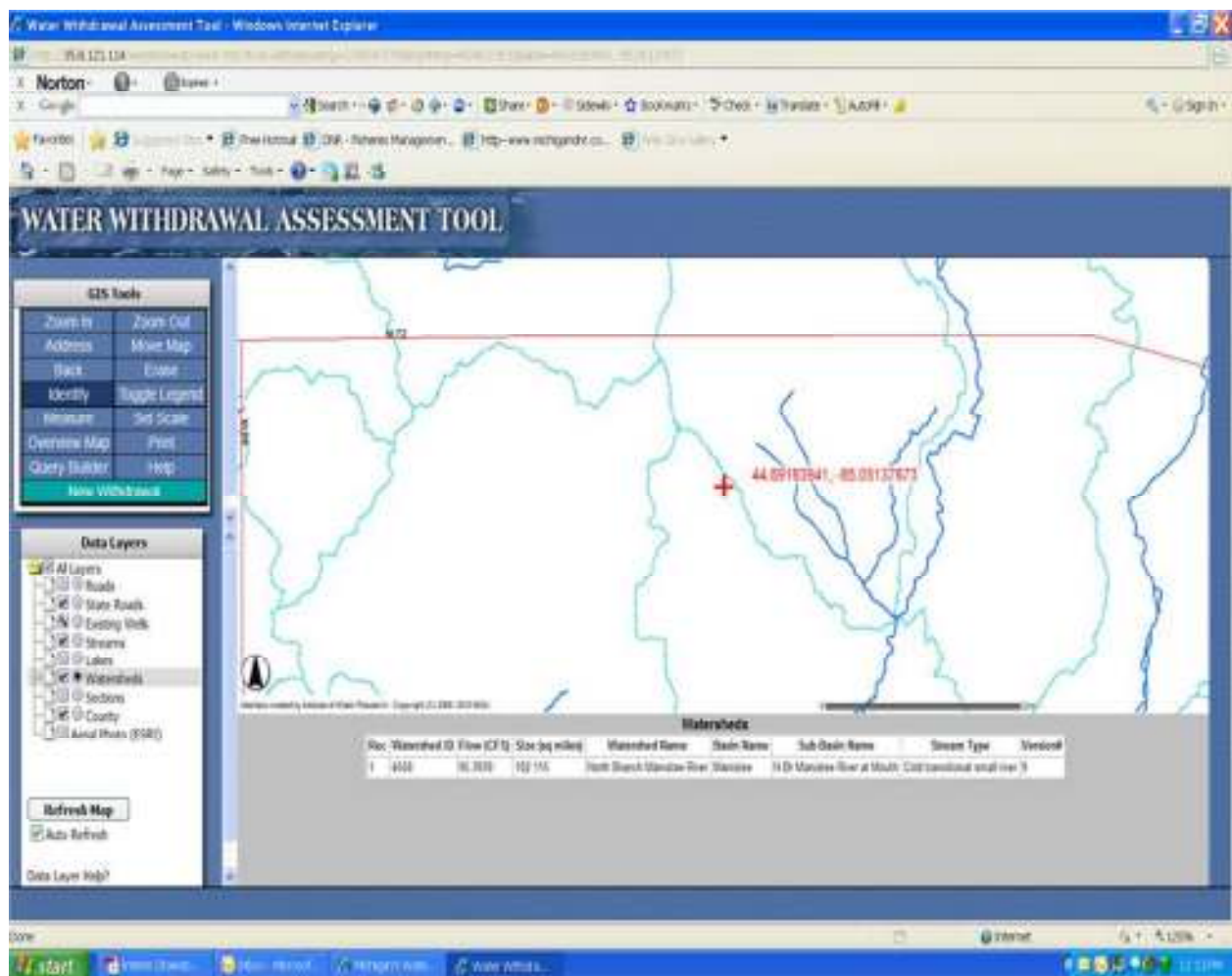
Tables are provided that list all of the LQWW wells, arranged by county. In order to understand more thoroughly assess the potential impacts from each, it will be useful to:

- 1) Consider the volume of the well pump capacity. The larger the volume, the larger the potential for it to create greater impacts. However, the importance of well capacity is also relative to the size of the watershed. Larger streams and rivers can withstand larger volumes of water withdrawal, and small waterbodies can withstand less.
- 2) Consider the distance of the well away from the actual stream. Those located further away will in theory have somewhat less direct impact on the stream.
- 3) Consider the actual watershed that the withdrawal is located in. This can be discovered by utilizing the Michigan Water Withdrawal Assessment Tool at www.miwwat.org. This website will allow a user to enter the latitude and longitude coordinates of a well (provided in the tables in this report), and then have the name of the actual watershed, temperature classification, predicted baseflow of the stream, and other useful information identified). This information can then also be discussed with your local MDNRE fisheries biologist who might be able to provide more data on the current fish community in the stream, and assess the potential for improvement in it with improvements in low flow or water temperatures.
- 4) Explore or assess the feasibility of alterations to the existing LQWW. This will be discussed more in the next section. However, using the MI WWAT website, will allow you to explore whether moving the well further away from a stream, drilling it deeper, or altering the frequency of use might likely alleviate impacts it's having.

An example to illustrate use of this information

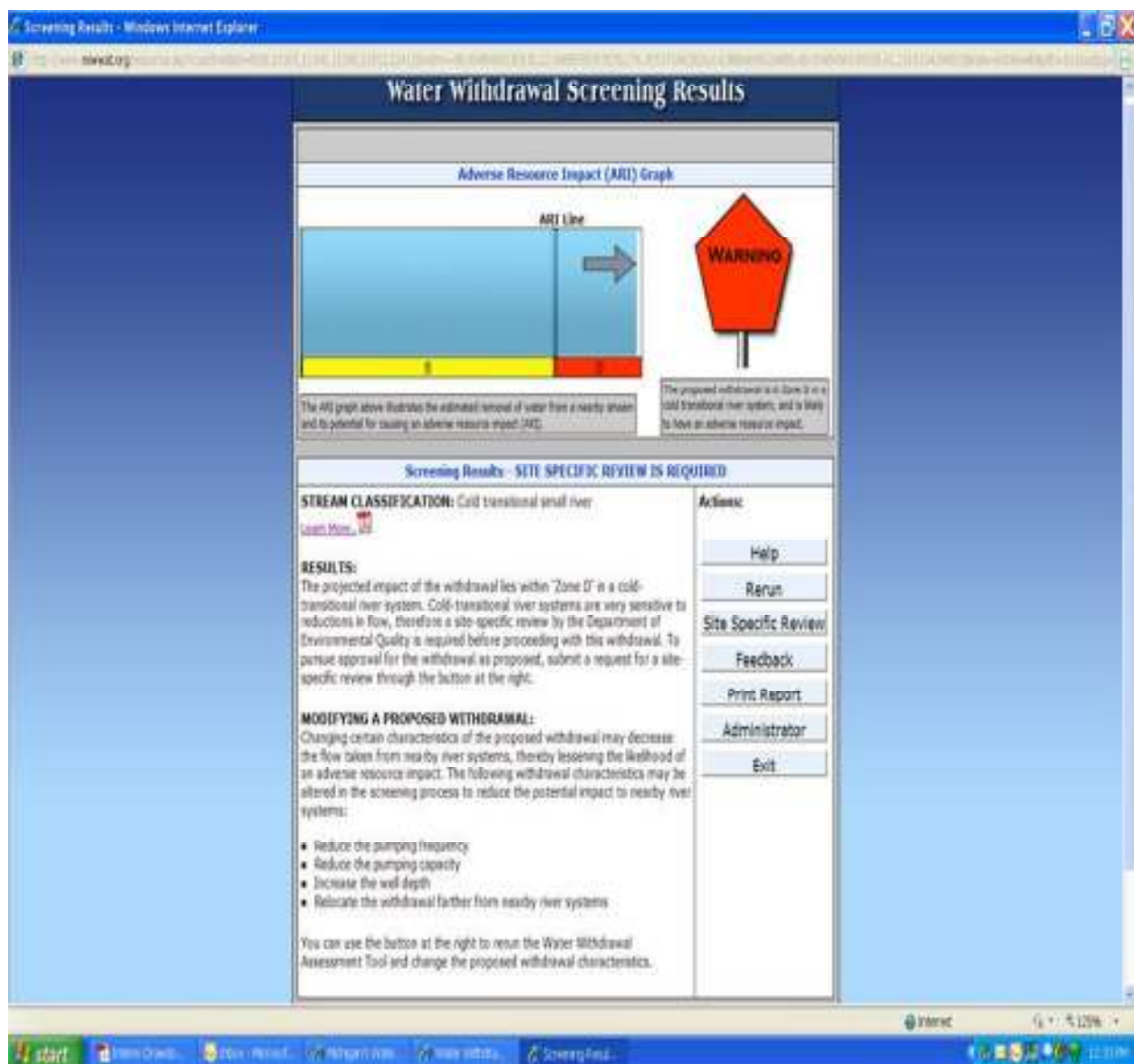
The following is provided as an example. For Kalkaska county, there are three LQWW's listed as located in cold-transitional or cool watersheds. Of the three, only one is located within 1 mile of a stream. This LQWW also possesses a large volume capacity, at 864,000 gallons per day. Combined, these attributes would primarily identify it as possibly having a high level of potential for impact. When the water withdrawal assessment tool is used to investigate this specific withdrawal in more detail, the following is discovered.

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	TOWNSHIP	DEPTH (ft)	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Kalkaska	122,400	EDWARD SCHULTZ	Clearwater	83	09/15/01	44.81829466	-85.28289203		
Kalkaska	864,000	EXCELSIOR TEN C/O CALVIN ADKIN	Excelsior	248	09/20/91	44.75770898	-85.07647807		
Kalkaska	864,000	DONALD COTTON	Excelsior	106		44.69183941	-85.05137873		X



The LQWW well is located in the watershed of the North Branch Manistee River, which is predicted to have a median baseflow of 95 cubic feet per second, flows into the Manistee River, and is classified as a cold-transitional small river. A discussion with the local DNRE fish manager would reveal that this stream is home to both brown and brook trout, is

temperature challenged in different parts, and several small dam removals projects are underway in this watershed to help alleviate warm water temperatures and blocked fish passage. Next, in order to assess the possible level of impact from this with existing LQWW, you could simulate a request for a new LQWW using the exact same location, depth of the well, and pump capacity that is reported for the existing well. The results in this case would return that if this existing well was proposed today, it would be rejected from automatic approval, as the models would predict that this well, if proposed today, would create an unallowable level damage and result in an adverse resource impact. Not only this, but as the screen image below shows, it would be predicted to far exceed the level of adverse resource impact (see location of arrow symbol relative to the boundary line between zones B and D (yellow and red)).



This is useful in indicating that if this well is operated continuously at its full capacity, that it's likely having some significant impact on the stream currently.

Using the model, (under "rerun"), you could then begin to alter some of the variables of the well to understand the stream's possible reaction to alterations of it, or possible responses to conservation measures targeted at it.

ENTER WITHDRAWAL INFORMATION

Pumping Source and Frequency

Withdrawal Source:

Surface Water (from stream) Ground Water Shallow Pond

Pumping Frequency: Continuous Intermittent

Pumping Parameters

Pumping Capacity (GPM): 300

Lat/Long from Map: -44.891835, -85.051379

Well Depth (FT): 101-125

Aquifer Type: Bedrock Gravel

Current State of Location

- Depth to Bedrock (FT): 433
- Average Well Depth (FT): 500
- Percent Wells in Gravel: 100
- Percent Wells in Bedrock: 0

Intermittent Pumping Schedule

Pumping Hours/Day: 12 Pumpog Days/Week: 6

Months Pumping: Jan Feb Mar Apr May Jun Jul

(Hold Ctrl to select multiple months)

Run Model

No information will be transmitted to the DNR until a Registration Form or Site Specific Review Request Form has been filed out and submitted. You will have the opportunity to ID out and submit the appropriate form after running the WRAI model.

In this particular case, altering the depth of the well (making it deeper) would not result in a lessening of the impact. Altering the capacity of the well would be more responsive, but still not highly responsive (66% reduction would be needed for the level of impact to move from red to yellow zone on the screen image). Using the online model, you can also see that this well, while close to the stream, is about as far away from it as it could be, without leaving the watershed. The nearby adjacent watersheds are also classified as cold-transitional and are smaller streams with less predicted flow, preventing them from being better alternative locations. Just under 2 miles to the north, it would be possible to be in the watershed of a cold stream (part of the Boardman river watershed). A quick simulation of applying for this size well in that watershed also results in a significant adverse resource impact. So in this case, altering the location of the well would not appear to be a viable

option for reducing its impact. Altering the nature of the frequency of the withdrawal (from continuous to intermittent) would result in the most responsive reductions in likely impact levels.

As demonstrated, using the information in this report, along with some experimentation using the water withdrawal assessment tool, we discovered that this existing LQWW is likely to be causing some possibly significant level of impact to this cold-transitional trout fishery. It was also discovered that efforts to deepen the well, lower its capacity, or move it further away from the stream would not be highly productive at minimizing its impacts. The tool did indicate however, the frequency and of the withdrawals is an important and responsive variable in this case. Since the information contained about the well in this report, or available at www.miwwat.org does not provide the actual history of real water use for the well, but rather the maximum capacity of the well to withdraw, the next most important step in this example, would be to acquire this information. Water use reports for select well types are available from the DNRE. However, following this example, it might also be appropriate to contact the owner (name and address provided), to discuss the water use at his well.

In contacting well owners in this regard, it's important to remember that while they are not permitted to cause an unreasonable impact to water quality leaving their property, they are also not held to the same standards that new withdrawals are held to through use of the water withdrawal assessment tool. While the information in this report and available through use of the assessment tool provide useful indications of the impact of existing LQWW's, actually documenting the real world impact from existing wells would require significant cost and difficulty, and legal recourse would be expensive and uncertain (as "reasonable" is a relative term). Therefore, it is the intent of this report, to encourage productive and cooperative discussions between large quantity water users and aquatic conservationists, not antagonism. Following along with our example, we would recommend contacting the well owner and asking to discuss his well with him. We would indicate our intent to improve coldwater fisheries, indicate the significance of the fishery and watershed their well is located in, and indicate that our efforts so far has identified that their well could be impacting the trout fishery, but without knowing the actual water use of the well, it's not possible to be sure. The discussion with him would then revolve around understanding the actual water use at the well, and then using the assessment tool again to attempt to understand whether impacts are likely or not. If so, then discussions could revolve around whether and how the impact could be alleviated through cooperative efforts.

Cooperative Efforts

We've already mentioned several of the ways in which the impacts of current wells might be alleviated. In some cases digging wells deeper might help lessen the impact to stream flow. While this is true in general, consulting a well driller, geologist, and/or hydrologist would be strongly recommended. Different parts of the state have different groundwater sources at different depths. Consultation with a professional knowledgeable about Michigan's aquifers would be required to proceed with this potential activity. The cost associated with this activity, would of course include the cost of professional consultation and drilling.

Altering the location of the wells can be an important tool for minimizing impacts. Perhaps the most pertinent example of this would be the case of direct surface withdrawals. These are believed to be the most damaging type of water withdrawal. Surface water withdrawals or shallow groundwater wells located close to streams could be discontinued and replaced by deeper groundwater wells located as far as feasible from the streams. Cost associated with this type of effort would include cost of well drilling, and possibly easements or pipelines to locate wells away from streams and then deliver the water to where it is needed for use.

Alterations to the amount of water use and/or the timing of it is the last major category of potential conservation measures, and is perhaps the most diverse with potential means for conservation efforts. Coldwater fisheries can be impacted by water withdrawals in many ways. Reductions in groundwater to stream flow can raise temperatures, especially during the warmest summer months, thus making the stream unsuitable for their survival. This means is perhaps the most likely and direct, and is the mechanism that the current Michigan water withdrawal assessment tool models rely upon. However, trout can also be impacted directly and indirectly by the flow levels. Flow levels over the course of the year, called flow regime, help to determine the physical nature of the stream and the trout habitat. Reducing flows can change the shape of streams, reduce water depths in critical areas, lead to sediment deposition, influence survival of juvenile fish, and flow levels in the winter months while not well understood, appear critical to the survival of trout. The following are a few possible examples of possible conservation efforts which might help alleviate the impact of water withdrawals. It is not a complete list, and creativity is encouraged in developing new methods for use in the future.

Since one of the most direct and severe impacts of water withdrawals on coldwater fisheries is the lowering of groundwater flow into the stream during the warmest summer months, thus increasing water temperature, one possible solution could be to construct water storage tanks. Water could then be withdrawn and put into storage during periods

of high groundwater recharge, such as during spring floods. This water could then be used, if needed, during the months of July and August when the streamflows are at critical lows.

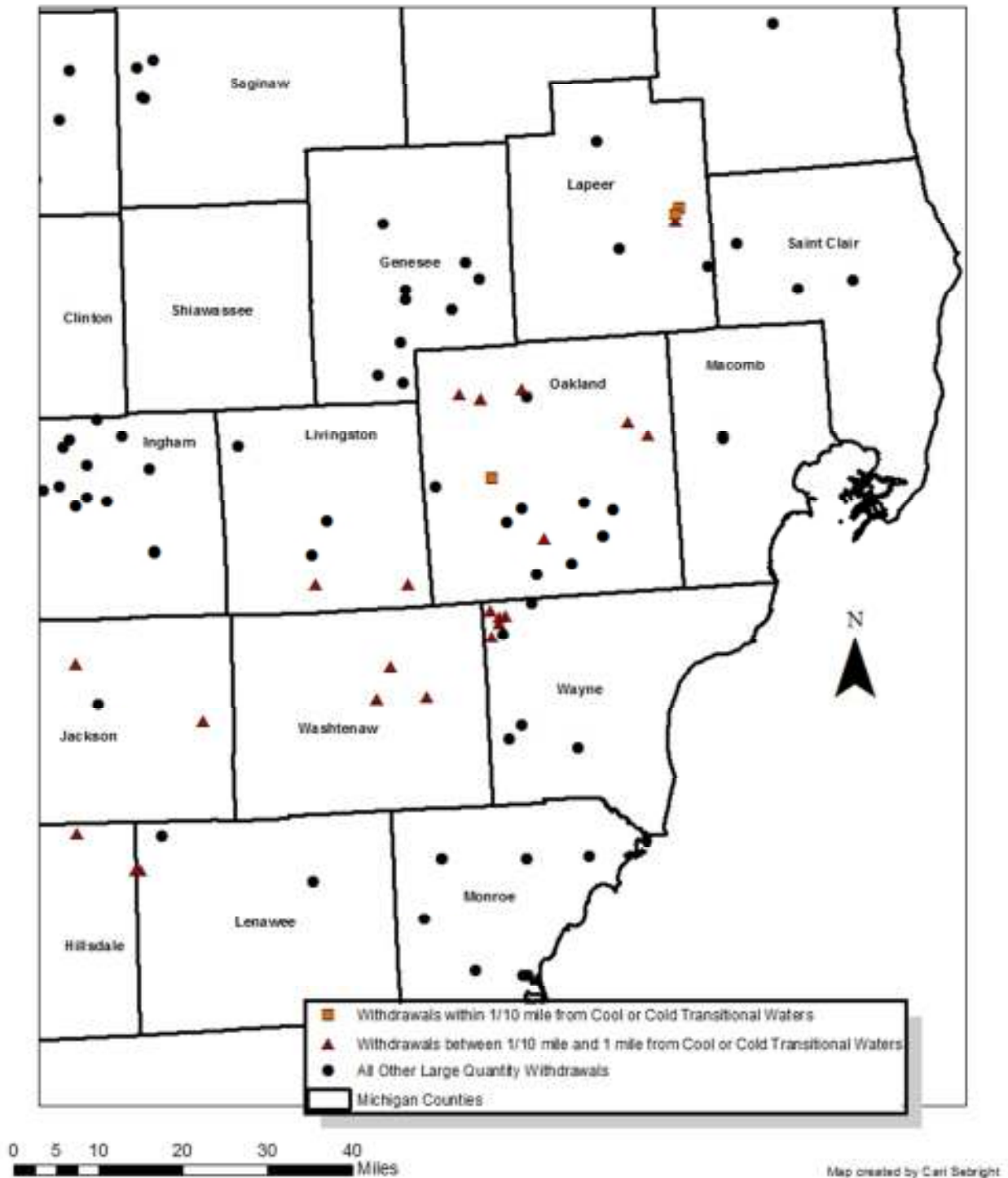
Also, to minimize the impact during these warmest of months, it might be feasible to help cooperatively fund efficiency measures that would reduce the amount of water expended on the target use. For example, if the use is to irrigate crops, certain technologies such as drip irrigation, which results in less evaporative loss, might reduce water use and thus reduce impact to the source stream. Many water user industries have developed guidelines on preferred conservation measures for water use. While these might be preferred, economics might prevent some users from employing them. If an effort to cooperatively fund their installation was accounted for, it might make it feasible.

One more untested, but possible option to alleviate impacts of withdrawals during warm summer months, might be to directly discharge some volume of cold groundwater directly from a well, into a surface water during periods of critically high water temperatures (for example, whenever temperatures exceed 74 degrees F). It might be possible under this scenario, for some streams, that an overall net positive impact to coldwater fisheries could result, such as when temperature is a more limiting factor for the fish community than actual flow levels. For example, cool small rivers could be ideal for this because the size of the stream is sufficiently large for significant water withdrawals to occur, but water temperatures might be just slightly too warm for coldwater fisheries to survive through the warmest periods of the summer.

These are but a few basic examples to that hold possibility in reducing the current impact to our coldwater fisheries from existing large quantity water withdrawals. We are at a point where many of these basic techniques have not been employed and evaluated before. It is hoped that serious improvements to our fisheries might be gained by beginning to cooperatively enact some of these measures in the coming years. Further into the future, water resources stand to become more limited, and these tensions will foster greater creativity over ways in which people can use the water they need, while maintain aquatic natural resources in the conditions that we need them to remain in. Thank you for reviewing the information in this report and for considering using it to help improve and restore some of Michigan's coldwater fisheries that need restoration or protection from future degradation. If you need support in your efforts towards these ends, please contact Michigan Trout Unlimited at www.michigantu.org.

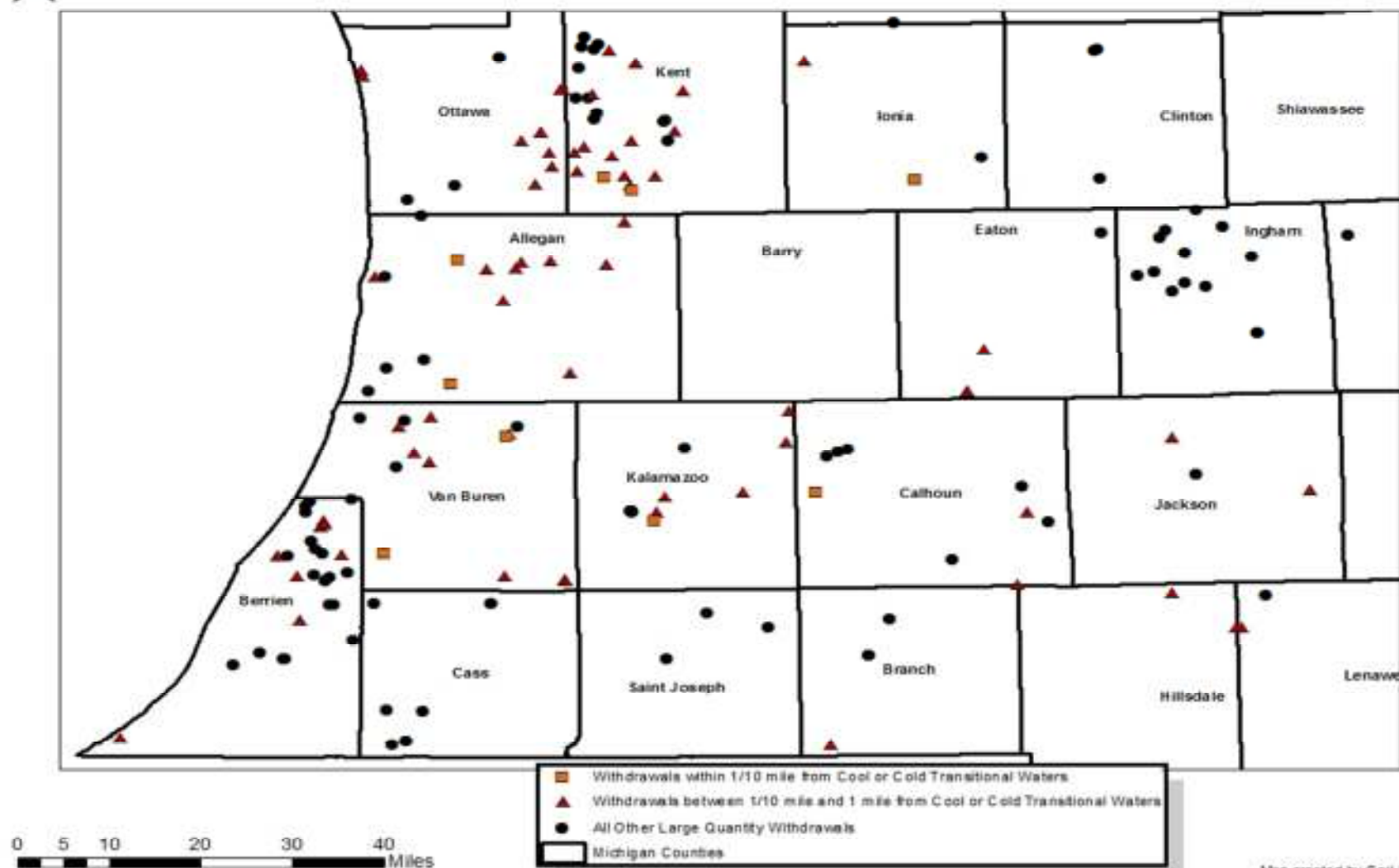
Appendices

Large Quantity Withdrawals in Southeast Michigan





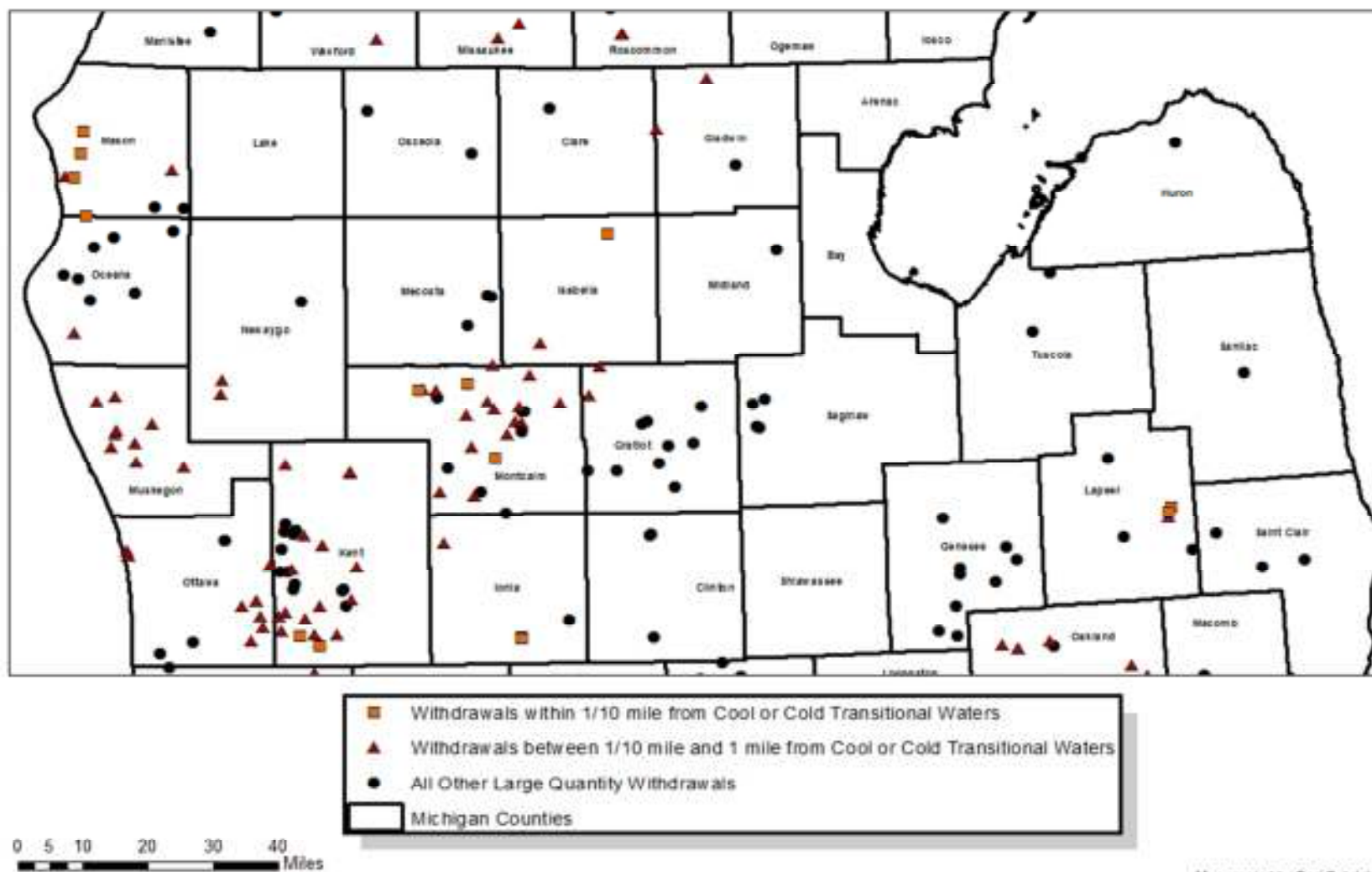
Large Quantity Withdrawals in Southwest Michigan



Map created by Carl Sebright

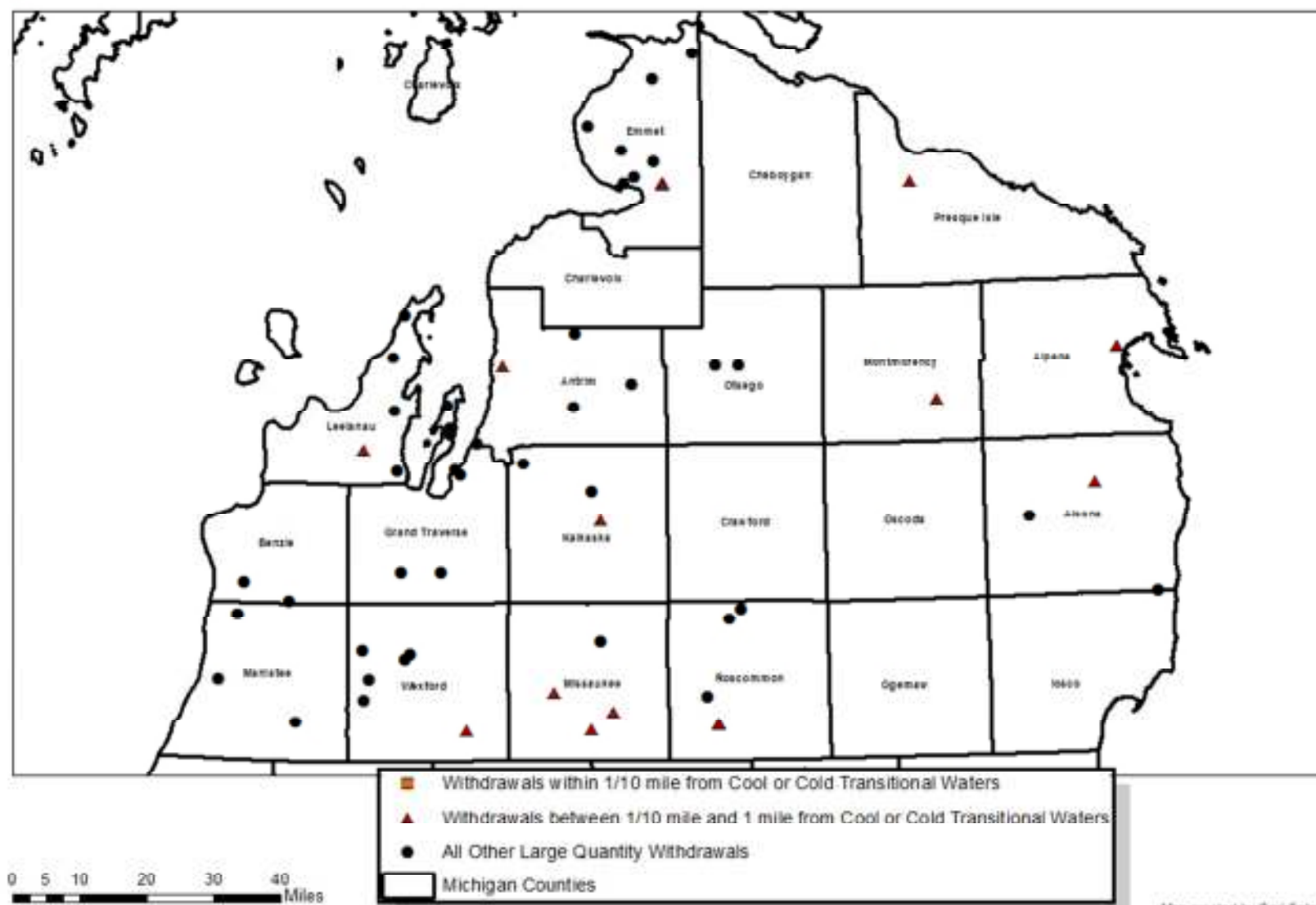


Large Quantity Withdrawals in Mid-Michigan



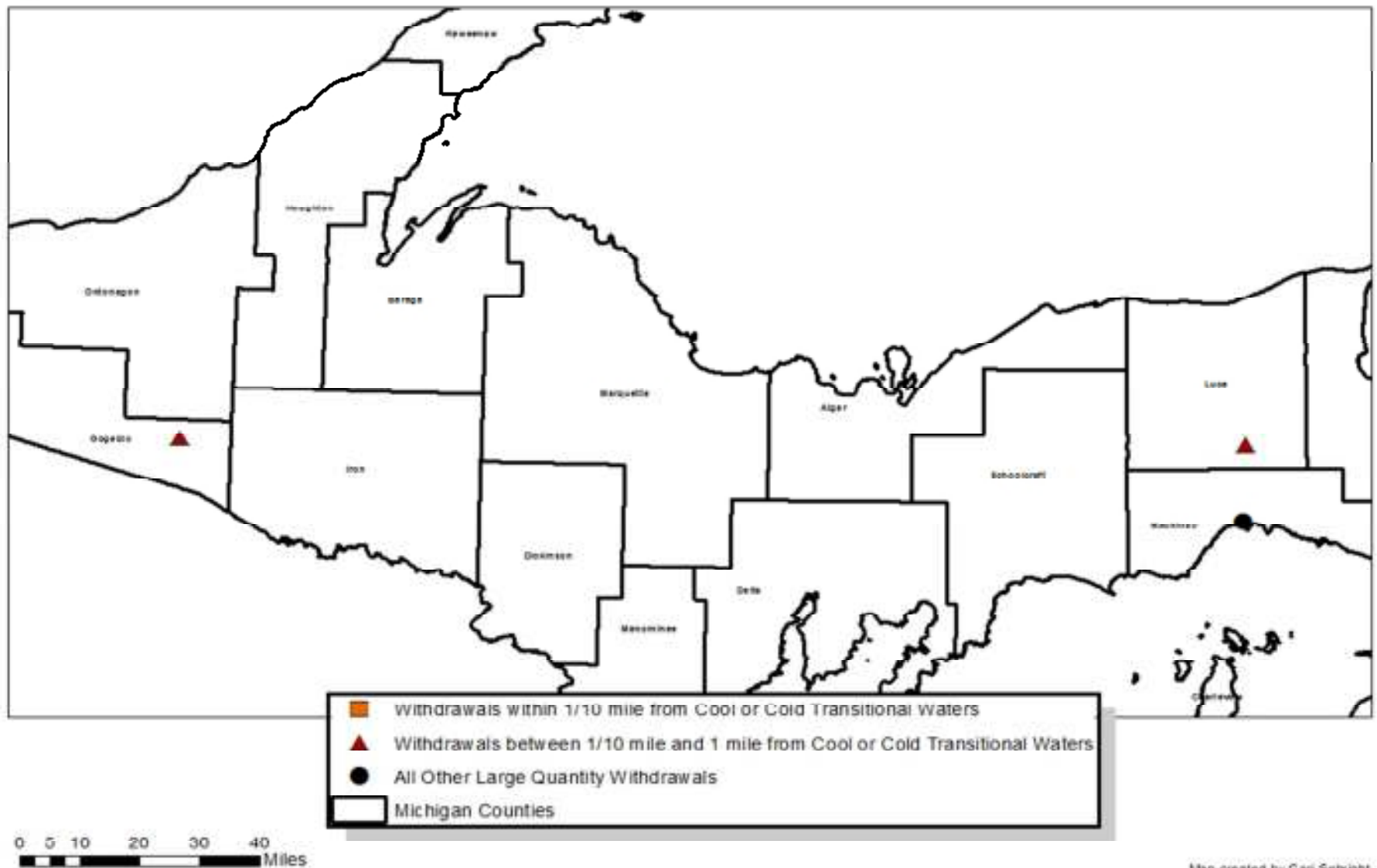


Large Quantity Withdrawals in Northern LP Michigan





Large Quantity Withdrawals in the UP of Michigan



Appendix 6. Table of large quantity water withdrawals on cold-transitional or cool streams and rivers in Michigan and their distance from the actual surface waters of the streams.

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Alcona	576,000	LAKEWOOD SHORES GOLF COURSE	7751 CEDAR LAKE ROAD	Greenbush	68	IRRI	07/19/00	44.51290068	83.37074245		
Alcona	115,200	GOODLAND TRUCKING	5552 GROSSE POINT ROAD	Mitchell	222	IRRI	08/17/00	44.68457129	83.75249195		
Alcona	122,400	TIMBER CREEK RESORT	575 NEMODE RD	Hawes	176	IRRI	12/11/90	44.75601398	83.55110904		X
Allegan	1,152,000	Sandy Pines Campground	2745 136th Street	Salem	250	IRRI	02/11/00	42.68131809	85.81693201		X
Allegan	360,000	GORTSEMA GREENHOUSES	1138 146TH	Leighton	380	IRRI	01/13/00	42.75360373	85.65839014		X
Allegan	936,000	Diamond Springs Golf Course	34th St.	Monterey	185	IRRI	06/23/00	42.68018403	85.88009811		X
Allegan	936,000	Diamond Springs Golf Course	3400 34th St.	Monterey	185	IRRI	06/23/00	42.66870676	85.89164064		X
Allegan	792,000	ROSEBAY NURSERY	OLD ALLEGAN ROAD	Saugatuck	127	IRRI	08/18/00	42.65375654	86.19248255		X
Allegan	432,000	Cornerstone Ag.		Lee	100	IRRI	04/16/01	42.45565386	86.03159221	X	X
Allegan	460,800	Walters Gardens	4115 134th Ave.	Overisel	75	IRRI	03/25/02	42.66617619	85.95279463		X
Allegan	504,000	ROSEDAY NURSERY	6394 OLD ALLEGAN RD	Saugatuck	119	IRRI	08/15/02	42.65256213	86.17263488		
Allegan	115,200	SCOTT SLENK	38TH ST	Heath	154	IRRI	07/13/02	42.60910334	85.91879238		X
Allegan	720,000	BITTERSWEET RESORT	600 RIVER ROAD	Otsego	59	IRRI	11/04/02	42.47417952	85.77573161		X
Allegan	180,000	HAMILTON COMM SCH	3640 48TH STREET	Fillmore	139	IRRI	04/03/03	42.68451759	86.01578125	X	X
Allegan	144,000	KEVIN DYKSTRA	1556 136TH AVE	Hopkins	90	IRRI	07/30/03	42.67468148	85.69681799		X
Allegan	144,000	BOB LEVINE	1113 56TH	Lee	77	IRRI	11/20/03	42.49972027	86.08940687		
Allegan	180,000	CITY OF HOLLAND		Fillmore	164	IRRI	04/15/92	42.76621400	86.09475069		
Allegan	122,400	Allen Overhiser	6405 109th Ave	Casco	126	IRRI	06/03/04	42.48373400	86.16895800		
Allegan	122,400	Adkins Blue Ribbon	103rd & 68th	Casco	144	IRRI	09/27/04	42.44089800	86.20713300		

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Alpena	360,000	ALPENA PUBLIC SCHOOLS	3303 S 3RD AVE	Alpena	702	IRRI	07/21/03	45.05452300	83.46970000		X
Alpena	360,000	Alpena Public Schools	3303S. 3rd. Ave.	Alpena	702	IRRI	07/21/03	45.05452300	83.46970000		X
Antrim	100,800	LOREA HUGHES	1168 M-66 SOUTH	Echo	104	IRRI	07/19/01	45.10507404	85.11971057		
Antrim	324,000	A- GA-MING GOLF CLUB	11301 Barnes Rd	Torch Lake	244	IRRI	05/13/03	45.03463496	85.34123582		X
Antrim	216,000	ALTONEN ORCHARDS	11595 S US 31	Elk Rapids	128	IRRI	04/23/04	44.86352538	85.42399735		
Antrim	1,483,200	KITCHEN FARMS		Star	211	IRRI	04/16/81	44.99306700	84.95012200		
Antrim	1,296,000	GO FORWARD OPERATIONS	SHANTY CREEK RD	Custer	288	IRRI	08/10/04	44.94213200	85.12705100		
Benzie	1,044,000	CRYSTAL MOUNTAIN RESORT	12500 CRYSTAL MOUNTAIN RESORT	Weldon	130	IRRI	10/13/00	44.51732046	85.99257102		
Benzie	144,000	GORDON SAUER	5414 MICK RD	Joyfield	215	IRRI	09/18/03	44.56039428	86.13117132		
Berrien	201,600	John DenHann & Son Inc.	6327 Clymer Road	Coloma	162	IRRI	08/04/97	42.22598551	86.34020917		
Berrien	324,000	Wayne Hosbein	2846 Boyer Road	Coloma	207	IRRI	06/02/00	42.16335741	86.32970806		
Berrien	201,600	Rodney Winkel	8110 North Branch Road	Bainbridge	157	IRRI	06/07/00	42.13740742	86.26183286		X
Berrien	201,600	Kurt Weber	6439 North Branch Road	Bainbridge	182	IRRI	05/29/01	42.13787862	86.30341956		
Berrien	201,600	John DenHaan & Sons	5161 Taube Road	Hagar	148	IRRI	05/24/01	42.23653251	86.33147517		
Berrien	144,000	IRV EBERHART	1885 MORGAN RD.	Bainbridge	236	IRRI	07/24/00	42.08870403	86.29968920		
Berrien	115,200	James Culby	1280 Hillendale Road	Benton	153	IRRI	08/18/89	42.09637371	86.35884826		X
Berrien	324,000	Jeanne Tompkins Page	6933 Naomi Road	Pipestone	109	IRRI	06/14/93	42.04309922	86.28973915		
Berrien	201,600	Robert Sommerfeldt	1093 North Benton Center Road	Benton	62	IRRI	08/02/83	42.13394571	86.37863956		
Berrien	489,600	DeGroot Inc.	P.O. Box 934	Coloma	98	IRRI	04/09/98	42.20005307	86.30113369		X
Berrien	1,008,000	MATT STEFFEN		Coloma	100	INDUS	07/07/66	42.18861039	86.30755190		X

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Berrien	1,008,000	MATT STEFFEY		Coloma	100	INDUS	07/07/66	42.18857439	86.30735568		X
Berrien	489,600	DeGroot Inc.	Paw Paw Lake Road, P.O. Box 934	Coloma	98	IRRI	04/09/98	42.19429053	86.30017789		X
Berrien	201,600	Frederic Grootendorst	2450 Red Arrow Hwy.	Benton	150	IRRI	04/07/89	42.13438951	86.39844546		X
Berrien	115,200	Frederic Grootendorst	2450 Red Arrow Highway	Benton	153	IRRI	12/21/93	42.13438951	86.39844546		X
Berrien	122,400	TWIXWOOD NURSERY	BAST SHAWNEE ROAD	Oronoko	96	IRRI	05/30/01	41.94327515	86.38584028		
Berrien	129,600	EISEN FARMS	7077 NORTH WATERVLIET ROAD	Watervliet	72	IRRI	06/18/01	42.23951492	86.24307257		
Berrien	324,000	Twixwood Nursery/Mike Edelbach	6945 East Napier	Bainbridge	220	IRRI	07/02/02	42.09392822	86.28933896		
Berrien	115,200	John Calsbeek	5737 Clymer Road	Coloma	187	IRRI	09/08/03	42.21513301	86.34013037		
Berrien	201,600	Dan & Kristina Peek	7108 N. Watervliet Road	Watervliet	104	IRRI	11/12/03	42.24003382	86.24307747		
Berrien	122,400	TWIXWOOD NURSERY		Oronoko	97	IRRI	05/24/04	41.94258700	86.38422472		
Berrien	864,000	CURTIS TIDEY	9082 LAKE RD	Berrien	160	IRRI	06/08/04	41.97827800	86.23795800		
Berrien	100,800	NEW BUFFALO AREA SCHOOLS	1112 EAST CLAY STREET	New Buffalo	108	IRRI	09/19/04	41.79519000	86.72974000		X
Branch	1,440,000	DALE MALLOW		Noble	63	IRRI		41.77971233	85.22582222		X
Branch	1,152,000	LEROY MEYER		Batavia	48	IRRI	03/29/85	41.94534120	85.14521415		
Branch	1,152,000	LEROY MYER		Batavia	48	IRRI	03/29/85	41.94506785	85.14606818		
Branch	1,584,000	C & K FARMS		Union	83	IRRI	03/15/78	42.01443336	85.09904711		
Calhoun	129,600	LAKEVIEW HIGH SCHOOL	300 S. 28TH ST	Battle Creek	110	IRRI	01/29/01	42.31835126	85.22920865		
Calhoun	129,600	CHARLIE MORSE	12300 BETZ RD	Battle Creek	156	IRRI	05/15/03	42.25100056	85.25254928	X	X
Calhoun	720,000	ROCK-TENN CO	126 PARISH ST	Battle Creek	102	IRRI	08/19/03	42.32574446	85.20390189		
Calhoun	720,000	ROCK-TENN	126 PARISH	Battle Creek	102	INDUS	09/25/03	42.32574446	85.20390189		

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Calhoun	216,000	Cello-Foil Products, Inc.	155 Brook Street	Bedford	135	INDUS	06/10/80	42.33102400	- 85.18431700		
Calhoun	1,728,000	Starr Commonwealth Schools		Sheridan	230	IRRI	06/28/84	42.25804743	- 84.81471115		
Calhoun	864,000	Lloyd Spencer	9307 25.5-Mile	Albion	122	IRRI	07/23/97	42.21058608	- 84.80270105		X
Calhoun	1,728,000	Marion Miller	27601 H Drive South	Albion	267	IRRI	01/14/77	42.19167740	- 84.75759656		
Calhoun	864,000	Ted Landis	1050 South County Line Road	Homer	200	IRRI	02/03/75	42.07461256	- 84.82523871		X
Calhoun	792,000	Don Brewer		Tekonsha	70	IRRI	07/07/80	42.12347613	- 84.96320768		
Cass	1,152,000	AGGREGATE INDUSTRIES INC.	ANDERSON ROAD	Milton	69	IRRI	05/08/00	41.78971784	- 86.12734966		
Cass	2,160,000	AGGREGATE INDUSTRIES INC.	ANDERSON ROAD	Milton	140	IRRI	05/08/00	41.78931348	- 86.12744743		
Cass	122,400	NICK NICKERSON	65650 DAILEY RD.	Jefferson	87	IRRI	04/27/00	41.84468329	- 86.09139001		
Cass	288,000	HAROLD CHOATE	2885 US 12	Milton	113	IRRI	08/01/03	41.78337510	- 86.15528450		
Cass	115,200	JAMES ELLIS ELEMENTARY	2740 MANNIX RD	Howard	60	IRRI	09/10/03	41.84771525	- 86.16739175		
Cass	2,160,000	HERMAN CROSSEY		Volinia	109	IRRI	06/20/97	42.04663215	- 85.94529586		
Cass	2,160,000	HERMAN CROSBY		Volinia	109	IRRI	06/20/97	42.04617192	- 85.94526829		
Cass	1,152,000	PHIL CRAWFORD	FIELD LANE	Silver Creek	165	IRRI	05/28/04	42.04635825	- 86.19612558		
Clare	108,000	Gary Campbell	5400 North Jackson Avenue	Greenwood	140	IRRI	09/22/02	44.06607034	- 84.92851328		
Clinton	576,000	AGRO-CULTURE LIQUID FERTILIZER		Essex	400	IRRI	08/26/00	43.06580145	- 84.64080035		
Clinton	576,000	Agro-Culture Liquid Fertilizer	5788 W. Lowe Rd.	Essex	420	IRRI	02/26/02	43.06812980	- 84.63630526		
Clinton	100,800	PAUL FELZKE	5601 WEST HERBISON	Watertown	180	IRRI	01/06/04	42.82768100	- 84.63342200		
Eaton	144,000	CHESTER BINKOWSKI	5839 S STINE	Carmel	140	IRRI	07/31/77	42.51198651	- 84.89003003		X

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Eaton	331,200	AUTO OWNER INS./GORDON MILLER	5820 W ST. JOE HWY	Delta	300	IRRI	05/31/00	42.72656863	84.63341228	-	
Eaton	129,600	OLIVET COLLEGE	9049 S. MARSHALL RD.	Walton	142	IRRI	04/13/01	42.43659251	84.92608310	-	X
Eaton	129,600	OLIVET COLLEGE	9049 S. MARSHALL RD.	Walton	142	IRRI	04/12/01	42.43644570	84.92623587	-	X
Emmet	684,000	Fairways Development North	1875 Clubhouse Drive	Pleasant View	427	IRRI	05/26/00	45.47975431	84.87348327	-	
Emmet	1,440,000	ODEN STATE FISH HATCHERY	8258 S AYR RD	Littlefield	300	IRRI	10/02/01	45.43258243	84.84604402	-	X
Emmet	1,440,000	ODEN STATE FISH HATCHERY	8258 S AYR RD	Littlefield	300	IRRI	10/03/01	45.43305700	84.84937532	-	X
Emmet	1,440,000	ODEN STATE FISH HATCHERY	8258 S AYR RD	Littlefield	300	IRRI	10/02/01	45.43210420	84.84600154	-	X
Emmet	1,440,000	ODEN STATE FISH HATCHERY	8258 S.AYR RD	Littlefield	300	IRRI	10/01/01	45.43224175	84.84871322	-	X
Emmet	1,440,000	ODEN STATE FISH HATCHERY	8258 S AYR RD	Littlefield	289	IRRI	10/04/01	45.43174357	84.84668748	-	X
Emmet	108,000	LITZENBURGER LANDSCAPING	7132 HEDRICK	Little Traverse	300	IRRI	08/25/03	45.44765008	84.93539706	-	
Emmet	288,000	WEQUETONSING GOLF CLUB	M-119	Little Traverse	255	IRRI	06/30/90	45.43412611	84.96428488	-	
Emmet	108,000	CLIFF MATTHEWS		Pleasant View	458	IRRI	11/30/95	45.50627420	84.97464749	-	
Emmet	194,400	GOOD HART FARMS L.C.	ROBINSON RD	Readmond	1018	IRRI	05/29/69	45.56108366	85.07386305	-	
Emmet	684,000	THE MACKINAW CLUB	MACKINAW HIGHWAY	Carp Lake	315	IRRI	08/12/96	45.71871212	84.74986431	-	
Emmet	576,000	LENNARD FARMS	1820 GARBER RD	Bliss	330	IRRI	05/26/92	45.66479544	84.87489431	-	
Genesee	115,200	THE ELDON AUKER ASSOC	BELSAY ROAD	Grand Blanc	300	IRRI	10/20/00	42.93950320	83.59775114	-	
Genesee	14,398,560	Ricky Grant	6058 North Jennings Road	Mount Morris	260	IRRI	07/12/01	43.09070847	83.75309750	-	
Genesee	144,000	AGE INC	2305 N LONG LAKE RD	Fenton	110	IRRI	01/02/01	42.81584913	83.71853943	-	
Genesee	100,800	TREADWELL GOLF ASSOC	8475 ATHERTON ROAD	Davison	260	IRRI	07/21/01	42.99124781	83.53189247	-	

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Genesee	144,000	WOJO GREENHOUSE	7360 E COURT STREET	Davison	285	IRRI	04/15/02	43.01924545	- 83.56483624		
Genesee	100,800	KIRK FRID	2232 BALDWIN ROAD	Mundy	91	IRRI	08/01/03	42.88546353	- 83.71929925		
Genesee	288,000	CARMAN AINSWORTH MIDDLE SCHOOL	1409 W. MAPLE	Mundy	253	IRRI	10/17/03	42.95931863	- 83.70734475		
Genesee	115,200	SWARTZ CREEK GOLF COURSE	1902 HAMMERBERG	Flint	200	IRRI	05/22/98	42.97455908	- 83.70496371		
Genesee	432,000	SPRING MEADOWS COUNTRY CLUB	1129 RIPLEY RD	Fenton	265	IRRI	01/31/05	42.82894000	- 83.77528000		
Gladwin	146,880	JUDY AND MIKE JANICE	224 EAST HIGHWOOD	Hay	42	IRRI	09/25/02	43.92827972	- 84.35724890		
Gladwin	554,400	Sugar Springs POA	5477 Worthington Court	Butman	191	IRRI	03/27/04	44.13122100	- 84.44407600		X
Gladwin	122,400	JAMES J. WATSON	5848 W. EAGLESON RD	Sage	96	IRRI	04/21/83	44.01810632	- 84.60092575		X
Gogebic	302,400	LAC VIEUX DESERT		Watersmeet	59	IRRI	07/16/97	46.28297951	- 89.16708113		X
Grand Traverse	288,000	Lochenheath	4448 Maitland Rd.	Acme	163	IRRI	09/27/99	44.80560628	- 85.48898469		
Grand Traverse	115,200	DANIEL WEBER/JOHN URKA	M-37 SOUTH	Mayfield	66	IRRI	04/26/00	44.57942740	- 85.65466162		
Grand Traverse	115,200	Bob Garvey	7490 Lautner Rd.	Acme	125	IRRI	10/03/00	44.79404105	- 85.47406507		
Grand Traverse	129,600	WALTER BRYN	3309 BLUE WATER ROAD	Peninsula	284	IRRI	08/17/01	44.88382694	- 85.50429940		
Grand Traverse	216,000	DEAN JOHNSON	14388 CENTER RD	Peninsula	260	IRRI	06/15/02	44.89907493	- 85.50443000		
Grand Traverse	115,200	KINGLEY SCHOOL	7475 KINGSLEY ROAD	Paradise	195	IRRI	11/07/02	44.57771800	- 85.53356800		
Grand Traverse	226,080	LEONARD LIGON	3150 OLD MISSION ROAD	Peninsula	189	IRRI	05/28/03	44.94903398	- 85.50974005		
Gratiot	115,200	INTERSTATE HIGHWAY CORP.	US 27 @ M-57	Washington	500	IRRI	06/15/00	43.17702872	- 84.56226710		
Gratiot	2,160,000	V&G Farms	Jackson Road	Seville	153	IRRI	04/26/01	43.39349758	- 84.82090371		X
Gratiot	144,000	BUTCH LOOMIS	11696 N. WARNER	Seville	78	IRRI	01/09/02	43.46210743	- 84.78388664		X

COUNTY	PMP_CPCITY (gal/day)	OWNER_NAME	ADDRESS	TOWNSHIP	DEPTH (ft)	TYPE	DATE	LATITUDE	LONGITUDE	<0.1 mile	<1 mile
Gratiot	324,000	Jack Bertuleit	4992 East Fillmore Road	North Star	175	IRRI	05/09/88	43.27972942	84.50424212	-	
Gratiot	138,240	Lowell Cook	6941 West Hayes Road	New Haven	108	IRRI	06/29/71	43.21937700	84.73685500	-	
Gratiot	1,080,000	John Van Page	Van Buren Road	Lafayette	225	IRRI	05/16/80	43.36527347	84.47912764	-	
Gratiot	648,000	Robert Davis		New Haven	127	IRRI		43.22057202	84.82714118	-	
Gratiot	216,000	Ray Frieke		Newark	110	IRRI	10/21/98	43.23487917	84.60987288	-	
Gratiot	108,000	North American Drilling Co.		North Star	523	INDUS	05/24/74	43.27460926	84.57882488	-	
Gratiot	576,000	MIKE CHAFFIN		Arcada	180	IRRI	10/18/98	43.33240516	84.64549538	-	
Gratiot	144,000	JERRY CLARK		Arcada	182	IRRI		43.32616667	84.65970752	-	
Hillsdale	576,000	STANSLEY GROUP	US 12	Moscow	200	IRRI	09/13/03	42.05519459	84.49589557	-	X
Huron	324,000	FRED & DEB GOTTSCHAULK	5538 N. VAN DYKE	Dwight	260	IRRI	04/11/00	43.95451607	83.00570360	-	
Huron	115,200	HIDDEN HARBOUR GOLF COURSE	7521 PORT AUSTIN RD	Caseville	240	IRRI	07/25/01	43.92573429	83.29664689	-	
Ingham	115,200	ADAM'S CUSTOM LANDSCAPING	1736 WILLIAMSTON	Ingham	100	IRRI	03/30/00	42.53570868	84.30278635	-	
Ingham	115,200	ADAM'S CUSTOM LANDSCAPING	1736 WILLIAMSTON RD.	Ingham	100	IRRI		42.53553488	84.30396984	-	
Ingham	144,000	DISCOUNT TREE'S	1632 HAGADORN RD	Alaiedon	158	IRRI	05/18/98	42.63113999	84.45670890	-	
Ingham	100,800	STEVE LOTT	1683 LAMB RD.	Alaiedon	200	IRRI	04/13/92	42.62465908	84.41065558	-	
Ingham	115,200	JOHN BONDARENKO	CRICKET RIDGE	Delhi	200	IRRI	08/01/97	42.65169736	84.52057482	-	
Ingham	324,000	DON FRANCIS	2530 GUNN RD	Delhi	250	IRRI	06/20/96	42.64518619	84.55848288	-	
Ingham	122,400	BIRD BLUEBERRY PLANTATION		Meridian	377	IRRI	06/18/88	42.73409717	84.37323478	-	
Ingham	122,400	OKEMOS PUBLIC SCHOOLS	HULETT ROAD	Meridian	200	IRRI	10/10/95	42.68745353	84.45486210	-	
Ingham	108,000	J. CARTER CO	KALAMAZOO ST	Lansing	280	IRRI	05/11/99	42.72918685	84.49652790	-	

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Ingham	115,200	JERRY GRANGER	MT HOPE RD	Lansing	295	IRRI		42.71643831	84.50918389		
Ingham	180,000	LAND EQUITIES NILSON BLDRS	M-78	Meridian	360	IRRI	05/24/00	42.76553765	84.42941502		
Ingham	108,000	rick cortis	3219 zimmer rd.	Wheatfield	180	IRRI	05/13/02	42.67733170	84.31226212		
Ingham	115,200	ZELINSKI BUILDERS	1211 N. COLLEDE RD	Delhi	200	IRRI	11/15/01	42.61735919	84.48479674		
Ionia	936,000	R&R RECREATION CO., LLC	4424 WHITES BRIDGE ROAD	Otisco	189	IRRI	09/29/99	43.05336391	85.26686795		X
Ionia	112,320	PORTLAND CONCRETE	9600 LOOKINGGLASS	Portland	350	IRRI	04/04/96	42.87161800	84.88821900		
Ionia	1,332,000	DEBRUYN PRODUCE		Sebewa	389	IRRI	07/02/88	42.83082822	85.03329528	X	X
Ionia	1,440,000	DEBRUYN PRODUCE		Sebewa	290	IRRI		42.82979773	85.03202582	X	X
Isabella	648,000	GALLER FARMS	4850 STEVENSON LAKE	Vernon	130	IRRI	06/30/03	43.77090809	84.75364162	X	X
Isabella	1,440,000	LEWIS MAIN		Fremont	170	IRRI	05/03/04	43.52006351	84.96536046		X
Jackson	115,200	VISTA GRANDE VILLA	2251 SPRINGPORT RD	Blackman	122	IRRI	02/13/02	42.27654020	84.44137489		
Jackson	540,000	JULE SWARTZ AND SONS EXC	7855 DIXON RD	Tompkins	560	IRRI	09/20/01	42.34564140	84.48979066		X
Jackson	129,600	GRASS LAKE COMM SCHOOLS	GRASS LAKE RD	Grass Lake	200	IRRI	05/13/02	42.24235415	84.19857059		X
Kalamazoo	180,000	SANDERSON & DEHAAN	5082 LOVERS LANE	Portage	116	IRRI	07/30/97	42.24322505	85.57504388		X
Kalamazoo	144,000	MIDWEST REALITY GROUP	1350 CENTRE WEST	Portage	68	IRRI	06/23/00	42.20097764	85.59947582	X	X
Kalamazoo	108,000	KAL. CHRISTIAN SCHOOL	5055 QUEEN VICTORIA LANE	Kalamazoo	86	IRRI	12/17/99	42.21852425	85.64905538		
Kalamazoo	216,000	LAND & CO.	G AVE.	Cooper	90	IRRI	10/13/01	42.33396217	85.53263844		
Kalamazoo	324,000	SCHUG FARMS		Charleston	158	IRRI	06/12/02	42.25178895	85.40652602		X
Kalamazoo	1,296,000	STAFFORD FARMS	9593 NORTH 48TH STREET	Ross	270	IRRI	09/15/02	42.40121997	85.30819081		X

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Kalamazoo	129,600	RDI DEV CO		Portage	93	IRRI	05/27/03	42.21687530	- 85.64570766		
Kalamazoo	129,600	RDI DEV CO		Portage	88	IRRI	05/27/03	42.21643499	- 85.64655524		
Kalamazoo	129,600	RDI Development Company		Portage	80	IRRI	09/12/03	42.21632156	- 85.64581056		
Kalamazoo	324,000	VA NATIONAL CEMETARY		Ross	109	IRRI	10/11/96	42.34469783	- 85.31330910		X
Kalamazoo	720,000	CITY OF PORTAGE DEPT COMMUNITY	280 ROMENCE RD	Portage	115	IRRI	05/25/01	42.21576874	- 85.59260954		X
Kalkaska	122,400	EDWARD SCHULTZ		Clearwater	83	IRRI	09/15/01	44.81829466	- 85.28289203		
Kalkaska	864,000	EXCELSIOR TEN C/O CALVIN ADKIN	HAGNI RD	Excelsior	248	IRRI	09/20/91	44.75770898	- 85.07647807		
Kalkaska	864,000	DONALD COTTON		Excelsior	106	IRRI		44.69183941	- 85.05137873		X
Kent	319,680	BOB WEAVER	2943 68TH STREET	Gaines	40	IRRI	12/11/99	42.84124225	- 85.59158246		X
Kent	201,600	Chase Orchards	3020 9-Mile Road	Alpine	103	IRRI	05/18/00	43.09890441	- 85.74356516		
Kent	115,200	CEDAR SPRINGS PUBLIC SCHOOLS	204 E MUSKEGON ST.	Nelson	107	IRRI	08/14/00	43.21993775	- 85.54610556		X
Kent	115,200	CEDAR SPRINGS PUBLIC SCHOOLS	204 E. MUSKEGON ST.	Nelson	88	IRRI	08/20/00	43.22007056	- 85.54601347		X
Kent	144,000	TRINITY DEVELOPMENT		Grand Rapids	145	IRRI	07/31/00	42.99383920	- 85.72538549		X
Kent	201,600	ED & DON RASCH FARM	4010 HENDERSHOT	Alpine	111	IRRI	06/30/00	43.04084926	- 85.75502277		
Kent	108,000	SCHEPERS' LAWN SPRINKLING	3741 64TH ST.	Byron	158	IRRI	04/20/01	42.84850758	- 85.75792131		X
Kent	144,000	QUAIL CREST CONDOS	2233 TEAL COUT	Cascade	57	IRRI	04/25/00	42.92369384	- 85.54750873		X
Kent	172,800	PORTER HILLS- COOK VALLEY ESTAT	1093 EAST PARIS	Grand Rapids	135	IRRI	04/21/00	42.94467301	- 85.57006467		
Kent	144,000	GRAND RAPIDS ELKS LODGE #48	2715 LEONARD STREET NW	Grand Rapids	95	IRRI	08/25/02	42.98621807	- 85.73560701		
Kent	331,200	FOREST HILLS PUBLIC SCHOOLS	3801 LEONARD STREET NE	Grand Rapids	216	IRRI	10/09/02	42.98681287	- 85.76118506		

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Kent	288,000	OTTAWA AGGREGATES	4640 COIT	Plainfield	59	IRRI	12/07/02	43.05025897	- 85.63225172		X
Kent	216,000	OTTAWA AGGREGATES	4640 COIT	Plainfield	57	IRRI	11/30/02	43.05025966	- 85.63245252		X
Kent	108,000	WILLIAM J. FETTIS & MIKE RAU	4180 44TH ST., S.W.	Wyoming	200	IRRI	05/14/03	42.88464864	- 85.76618953		X
Kent	576,000	LAND & COMPANY	6791 BURLINGAME	Byron	192	IRRI	07/30/03	42.83743284	- 85.70321533	X	X
Kent	648,000	JAMES HILL	6159 PEACH RIDGE AVE NW	Alpine	225	IRRI	06/14/03	43.08227261	- 85.74846039		
Kent	100,800	EVERETTS LANDSCAPE MAN INC	7884 EASTERN SE	Gaines	130	IRRI	07/15/03	42.82287984	- 85.64417430		X
Kent	144,000	MICHIGAN CHRISTIAN HOMES	800 EASTERN AVENUE SE	Gaines	112	IRRI	09/30/03	42.81385543	- 85.64347402	X	X
Kent	288,000	PORTER HILLS RETIREMENT COM	1049 E PARIS AVE	Grand Rapids	111	IRRI	10/08/03	42.94194768	- 85.57300481		
Kent	122,400	DAN SCHIMMEL	2228 BUTTERWORTH, S.W.	Walker	69	INDUS	02/23/04	42.94626300	- 85.72281600		
Kent	108,000	FOREST HILLS SCHOOLS	5800 KNAPP ST.	Ada	72	IRRI	03/16/04	42.99819507	- 85.52886884		X
Kent	194,400	THOME ORCHARDS	2137 7 MILE RD	Alpine	177	IRRI	03/23/04	43.07626687	- 85.72241848		
Kent	360,000	PINE REST CHRISTIAN HOSPITAL	300 68TH ST., S.E.	Gaines	260	IRRI	06/03/04	42.84072500	- 85.65701300		X
Kent	921,600	ALPINE GOLF CLUB	6320 ALPINE AVENUE NW	Alpine	70	IRRI		43.07373481	- 85.68856448		X
Kent	115,200	SPLASH IRRIGATION		Paris	96	IRRI	08/17/99	42.90744868	- 85.56343594		
Kent	180,000	PERSONVOGT COMPANY	1024 KEN-O- SHA INDUSTRIAL DR	Grand Rapids	295	IRRI	05/06/92	42.90727937	- 85.64035737		X
Kent	115,200	WHISPERING SPRINGS CONDOS	CALVIN CT SW	Wyoming	225	IRRI	11/09/89	42.89524965	- 85.74471857		X
Kent	1,008,000	L. E. Kaufman Golf Course	4807 Clyde Park SW	Wyoming	305	IRRI	06/25/04	42.87880100	- 85.68433700		X

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Kent	1,800,000	SITE DEVELOPERS LLC	223 COVELL AVE., S.W.	Walker	156	IRRI	07/28/04	42.95828200	85.71692400	-	
Kent	108,000	ED & DON RASCH FARMS	15217 COALTER AVE	Tyrone	98	IRRI	06/30/04	43.24085487	85.74268563	-	X
Kent	460,800	BERNARD J. THOME	6701 BRISTON AVE	Alpine	84	IRRI	08/15/04	43.08493850	85.71147558	-	
Lapeer	129,600	OLDANI LANDSCAPE & NURSERIES	2666 TOZER RD	North Branch	270	IRRI	05/20/00	43.22088578	83.24875126	-	
Lapeer	115,200	ETTEMA BROTHERS PACKAGING	7402 SHAW RD.	Goodland	137	IRRI	06/21/98	43.10210817	83.06211935	-	X
Lapeer	432,000	Imlay City Concrete	7015 Enterprise Dr.	Burnside	500	INDUS	12/18/02	43.00000000	83.00000000	-	
Lapeer	115,200	Dan Mulligan	150 N. Force Rd.	Attica	200	IRRI	08/09/03	43.03432825	83.20582976	-	
Lapeer	115,200	JOHN BARRETT	2040 SHAW ROAD	Goodland	220	IRRI	07/16/74	43.09134299	83.07040330	-	X
Lapeer	100,800	VAN DYKE FARMS		Goodland	48	IRRI	07/18/02	43.07923774	83.06949309	-	X
Leelanau	417,600	BAHLE FARMS	2685 S. KOHLER RD.	Bingham	285	IRRI	06/18/98	44.93856425	85.67100081	-	
Leelanau	208,800	STEVANT & ELMER KALCHIK		Leelanau	233	IRRI	07/03/98	45.05419575	85.67513192	-	
Leelanau	115,200	ART MCMANUS	E. GARTHE ROAD	Leelanau	78	IRRI	05/10/00	45.14514815	85.64113575	-	
Leelanau	108,000	DAVID STANTON	9100 S LAKE SHORE RD	Solon	227	IRRI	07/02/02	44.85309518	85.76755256	-	X
Leelanau	108,000	John Gallagher	9300 E. Breithaupt Road	Elmwood	210	IRRI	02/26/04	44.80441100	85.66401300	-	
Lenawee	288,000	Tony Solitro/Silver Lk Golf Co	15649 U.S. 12	Woodstock	135	IRRI	04/04/00	42.04933992	84.29949569	-	
Lenawee	720,000	JIM MICKEL		Woodstock	130	IRRI	05/23/77	41.99017338	84.34973322	-	X
Lenawee	432,000	JIM MICKEL		Woodstock	110	IRRI	06/19/77	41.98916698	84.36200816	-	X
Lenawee	115,200	TEC. AREA LITTLE LEAGUE	MITCHELL PARK	Raisin	97	IRRI	10/06/04	41.96371365	83.95568591	-	
Livingston	720,000	Moose Ridge	9179 Silverside	Green Oak	129	IRRI	09/10/99	42.46887423	83.71776201	-	X

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Livingston	115,200	NORTHLAND SOD FARMS	60 RUSH LK RD	Putnam	83	IRRI	05/19/01	42.47180772	83.93367521		X
Livingston	144,000	LYLE YOUNG	9395 SHERWOOD RD	Conway	220	IRRI	07/22/02	42.71425236	84.10322246		
Livingston	100,800	KRISTINY CUSTOM HOMES	2400 CHILSON MEADOWS	Genoa	70	IRRI	06/26/02	42.58102139	83.90161749		
Livingston	259,200	HOWELL NATURE CENTRE	1005 TRIANGLE LAKE	Marion	227	IRRI	05/20/04	42.52448800	83.94061100		
Luce	864,000	WAYNE LENNARD & SONS, INC.		Pentland	262	IRRI	06/28/75	46.30592121	85.45156040		X
Mackinac	216,000	HIAWATHA SPIRITS CLUB		Garfield	167	IRRI	08/20/80	46.10677354	85.46146891		
Macomb	331,200	RANDAZZO HURSERY		Shelby	56	IRRI	09/02/00	42.70247653	82.97776772		
Macomb	331,200	RANDAZZO NURSERY		Shelby	56	IRRI	09/02/00	42.70647141	82.97941520		
Manistee	720,000	HEATHLAND GOLD COURSE	6444 FARR ROAD	Manistee	211	IRRI	07/13/00	44.34467908	86.20599994		
Manistee	288,000	Ronald Webber	678 Seaman Rd.	Norman	85	IRRI	08/05/03	44.25187073	85.97384864		
Manistee	216,000	CHESTNUT HILL GROVE CO.	7700 GLOVERS LAKE RD	Pleasanton	140	IRRI	07/09/03	44.48901503	86.14765163		
Manistee	216,000	CHESTNUT HILL GOLF COURSE	7700 GLOVERS LAKE	Pleasanton	106	IRRI	08/10/98	44.48923618	86.14760070		
Mason	864,000	WCOC	5080 Sippy RD	Logan	134	IRRI	11/20/99	43.83935115	86.14264420		
Mason	144,000	LISTER FARMS		Pere Marquette	165	IRRI	05/28/00	43.96613338	86.37011030	X	X
Mason	576,000	GREG GREGWER	2902 WASHINGTON	Riverton	123	IRRI	09/10/01	43.81885182	86.35228778	X	X
Mason	144,000	STAN PETERSON	25745 BENEDICT RD	Pere Marquette	122	IRRI	10/20/01	43.91169053	86.38958972	X	X
Mason	1,440,000	JORGENSEN PROPERTIES	6888 MASTEN RD	Logan	336	IRRI	10/11/01	43.83822534	86.05129872		
Mason	324,000	JAMES NICKERSON	N VICTORY CORNERS RD	Victory	169	IRRI	08/15/02	44.01848855	86.36386543	X	X
Mason	144,000	OTTO PETERSON	BRUNSON	Pere Marquette	180	IRRI	09/05/01	43.91335558	86.41893963		X
Mason	374,400	BAROTHY LODGE	7478 EAST BAROTHY ROAD	Branch	173	IRRI	09/19/02	43.92781508	86.08932065		X

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Mecosta	360,000	John Orr		Wheatland	247	IRRI	04/12/01	43.56242246	-		
Mecosta	129,600	LEE CARTE	1528 11 MILE RD	Wheatland	216	IRRI	04/18/02	43.63148868	-		
Mecosta	1,872,000	RIVER RIDGE FAMRS	N COUNTY LINE RD	Millbrook	300	IRRI	06/06/02	43.46747271	-		X
Mecosta	129,600	LEE CARTE	1528 11 MILE ROAD	Wheatland	220	IRRI	07/18/02	43.62824003	-		
Midland	1,153,440	Brian Wilson		Larkin	429	IRRI	06/17/99	43.72872213	-		
Missaukee	100,800	Keith Davenport	1799 S. Call Rd.	Reeder	150	IRRI	02/15/02	44.31254627	-		X
Missaukee	115,200	CHARLIE HELSEL		Norwich	102	IRRI	05/07/02	44.42499281	-		
Missaukee	604,800	CHAD OUTMAN		Aetna	143	IRRI	05/19/99	44.26810910	-		X
Missaukee	115,200	BENJAMIN BOWMASTER III	S. KOOPMAN RD	Clam Union	72	IRRI	06/25/99	44.23167600	-		X
Monroe	115,200	RODNEY GRODI	2917 ERIE	Erie	120	IRRI	02/23/00	41.79422513	-		
Monroe	115,200	JIM BRUCE	17655 ALBAIN	Summerfield	375	IRRI	09/08/99	41.89500229	-		
Monroe	576,000	RAISIN RIVER GOLF CLUB	1500 NORTH DIXIE HWY	Frenchtown	270	IRRI	07/20/00	41.99374945	-		
Monroe	288,000	Blair's Live Fish Company	3371 East Erie Road	Erie	220	IRRI	01/24/97	41.79400722	-		
Monroe	648,000	Mark Brant	4929 Bluebush	Raisinville	405	IRRI	02/14/02	41.99155066	-		
Monroe	648,000	HOLCIM	15215 DAY	Dundee	360	IRRI	01/30/03	41.99731653	-		
Monroe	648,000	HOLCIM	15215 DAY	Dundee	360	IRRI	01/31/03	41.99731653	-		
Monroe	115,200	Jeff Zink	10445 Jackman	Bedford	122	IRRI	08/05/03	41.80523264	-		
Montcalm	1,440,000	LEONARD KOUTZ	KLEES RD	Day	220	IRRI	02/22/02	43.30731315	-		X
Montcalm	864,000	V&G FARMS	LAKE MONTCALM RD	Richland	154	IRRI	06/11/02	43.37948839	-		X
Montcalm	115,200	ELAINE MUILERXBURG	PAKES RD	Sidney	84	IRRI	07/29/02	43.27868892	-		X
Montcalm	1,728,000	GREG MCCARTHY		Home	176	IRRI	05/08/03	43.44379264	-		X

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Montcalm	540,000	STEVE COMDEN		Douglass	138	IRRI	07/01/03	43.35167067	- 85.19511592		X
Montcalm	504,000	KORSON TREE FARMS	1429 SIDNEY RD	Sidney	207	IRRI	11/17/03	43.25000727	- 85.10612197	X	X
Montcalm	288,000	HICKORY HILLS GOLF COURCE	11877 S. SHERIDAN RD	Bushnell	144	IRRI	09/18/03	43.12211789	- 85.07472257		
Montcalm	1,152,000	MR. HOWARD JORGENSEN	1340 NEFF RD.	Day	180	IRRI	07/16/79	43.31193200	- 85.02456000		
Montcalm	1,440,000	PETERSEN FARMS	4457 GREENVILLE ROAD	Montcalm	124	IRRI	06/15/90	43.22901700	- 85.25232400		
Montcalm	1,440,000	MR. DAVID BAILEY		Day	200	IRRI	04/17/81	43.37174875	- 85.03441279		X
Montcalm	1,440,000	SACKETT RANCH	2736 NEFF ROAD	Day	110	IRRI	03/30/78	43.33196800	- 85.02449800		X
Montcalm	1,008,000	VACHEL PERKINS		Douglass	135	IRRI		43.36571995	- 85.10946357		X
Montcalm	468,000	PAUL MAIN		Belvidere	94	IRRI	06/28/85	43.42380617	- 85.18871381	X	X
Montcalm	14,398,560	NORMAN CROOKS		Belvidere	126	IRRI	06/15/90	43.38327482	- 85.12922770		X
Montcalm	1,872,000	CARR FARMS		Cato	165	IRRI	05/10/89	43.40932791	- 85.28355418		X
Montcalm	1,584,000	ARTHUR BERHENWALD & SONS		Cato	110	IRRI		43.39215271	- 85.28181467		
Montcalm	684,000	KEN RADER		Winfield	97	IRRI	05/10/82	43.41068244	- 85.33745055	X	X
Montcalm	1,440,000	JACK PAULSON		Winfield	131	IRRI	03/31/89	43.41391083	- 85.32574174		X
Montcalm	1,440,000	EINER THORLUND	5774 W. FENWICK	Fairplain	230	IRRI	04/17/04	43.16233862	- 85.17379596		X
Montcalm	115,200	HATHAWAY PROPERTIES		Eureka	285	IRRI	06/24/04	43.17284431	- 85.27737992		X
Montcalm	1,296,000	RICHARD NAUTS		Day	136	IRRI	05/15/79	43.35782200	- 85.01499700		
Montcalm	864,000	LAVERNE HANSEN		Day	157	IRRI		43.35988700	- 85.02319500		
Montcalm	1,080,000	MR. VACH PERKINS	WYMAN RD	Day	217	IRRI	05/21/84	43.33636600	- 85.04364900		X
Montcalm	360,000	CURT & HERB LOWEKE	8298 GROW RD	Fairplain	167	IRRI	07/05/83	43.17329600	- 85.15284300		

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Montmorency	129,600	LIMBERLOST FARMS	18565 DEFORGE DR.	Avery	197	IRRI	06/24/01	44.94819403	84.02173081		X
Muskegon	462,240	EUGENE WERNSTROM	1991 REIGLER	Muskegon	36	IRRI	06/27/00	43.29022552	86.20152026		X
Muskegon	223,200	AL SORRELL	1505 HAVENGA	Laketon	31	IRRI	08/30/00	43.27973882	86.27427186		X
Muskegon	144,000	BARYS FLOWERS SHOP	3000 WHITEHALL RD	Dalton	49	IRRI	04/26/01	43.31088272	86.26154426		X
Muskegon	216,000	BAKER COLLEGE	1903 MARQUETTE	Muskegon	64	IRRI	05/10/01	43.24512752	86.19618085		X
Muskegon	144,000	Muskegon City Road Commission	7700 E. Apple Ave.	Egelston	45	IRRI	05/10/00	43.23512193	86.05439556		X
Muskegon	115,200	DALTON TWP GOVERNMENT	BEAGLE FIELD	Dalton	49	IRRI	05/10/01	43.31758920	86.25640843		X
Muskegon	100,800	BRUCE ESSAY	735 W. CRYSTAL LAKE	Blue Lake	79	IRRI	06/30/03	43.39778558	86.26230656		X
Muskegon	576,000	STONE GATE GOLF CLUB	4465 AUSTIN RD	Cedar Creek	214	IRRI	06/19/03	43.33258208	86.14835721		X
Muskegon	172,800	WHITEHALL SCHOOLS	3100 WHITE LAKE DRIVE	Whitehall	110	IRRI	09/26/03	43.38486231	86.31893927		X
Newaygo	122,400	JOHN FRENS	5390 WEST 64TH STREET	Sheridan	216	IRRI	04/23/03	43.43528521	85.93476781		X
Newaygo	144,000	LEONARD JR. VINING	4301 VAN BUREN	Wilcox	135	IRRI	09/17/03	43.61908854	85.69339609		
Newaygo	576,000	KARNEMAATS L.L.C.	8287 SOUTH WARNER	Sheridan	71	IRRI	08/14/03	43.40385667	85.93969366		X
Oakland	216,000	TURTLE LAKE DEVELOPMENT	2500 TURTLE	Bloomfield	124	IRRI	05/31/01	42.60128287	83.30504778		
Oakland	144,000	JERRY FORSTER	10065 ALLEN ROAD	Independence	187	IRRI	04/19/00	42.78496976	83.43140750		
Oakland	864,000	OAKLAND HILLS COUNTRY CLYUB	LASHER	Bloomfield	204	IRRI	02/24/00	42.54204913	83.26461452		
Oakland	864,000	OAKLAND HILLS COUNTRY CLUB	LASHER ROAD	Bloomfield	190	IRRI	03/24/00	42.54204913	83.26461452		
Oakland	115,200	JACK SHADER	3050 REECE ROAD	Brandon	150	IRRI	09/01/98	42.79840377	83.44206430		X
Oakland	108,000	STRAWBERRY LANE APT	27466 MIDDLEBELT	Farmington	126	IRRI	06/14/01	42.49605468	83.33934198		
Oakland	172,800	GEORGE W. AUCH	6161 E. HOLLY RD	Holly	279	IRRI	06/15/98	42.79321773	83.58605925		X

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Oakland	141,120	ANGLIN COMPANY		Commerce	80	IRRI	06/28/00	42.59258944	- 83.44939828		
Oakland	576,000	BLFD OPEN HUNT	405 E. LONG LAKE	Bloomfield	127	IRRI	10/15/01	42.58583798	- 83.23996331		
Oakland	504,000	TH GARRISON CO	8393 E HOLLY RD	Springfield	241	IRRI	08/23/01	42.78317713	- 83.53839791		X
Oakland	223,200	JEWISH COMMUNITY CENTER	6600 W. MAPLE RD.	West Bloomfield	184	IRRI	08/28/01	42.54200247	- 83.40097997		X
Oakland	115,200	GOLF COURCE DEVELOPMENT	4161 ADAMS ROAD	Oakland	170	IRRI	02/27/01	42.73676197	- 83.19696126		X
Oakland	504,000	THE GARRISON CO	8393 E HOLLY RD	Springfield	241	IRRI	08/09/01	42.78321015	- 83.53813334		X
Oakland	345,600	WOODBIDGE LAKE ASSOC.		Commerce	132	IRRI	01/14/03	42.57123038	- 83.48460325		
Oakland	504,000	F & H HOLDINGS		Farmington	191	IRRI	08/12/02	42.47949480	- 83.42115548		
Oakland	100,800	DYNAMIC POUND WALLS	781 SUNSET	White Lake	110	IRRI	08/30/02	42.64868224	- 83.51788509	X	X
Oakland	201,600	J R THOMAS	5941 SOUTHGATE RD	Oakland	163	IRRI	09/10/02	42.71178625	- 83.15110121		X
Oakland	576,000	PRESTWICK VILLAGE GOLF	2015 W HIGHLAND RD	Highland	112	IRRI	03/08/02	42.63610258	- 83.64863470		
Oceana	122,400	JUDITH BURMEISTER	68TH AVE	Grant	63	IRRI	05/10/00	43.54832972	- 86.38825136		X
Oceana	360,000	FENTON RECIEVING & TRUCKING	5655 W. 5TH ST	Golden	240	IRRI	05/30/00	43.68093097	- 86.41957777		
Oceana	272,160	PHIL JONASSEN	7619 E. JEFFERSON RD	Colfax	240	IRRI	06/18/01	43.78600764	- 86.08715548		
Oceana	576,000	Paul Oomen	7035 N. 120th Ave.	Crystal	140	IRRI	06/30/01	43.77100107	- 86.26710963		
Oceana	122,400	OOMEN BROTHERS, INC.	2157 E. JACKSON RD.	Crystal	144	IRRI	09/11/01	43.74607311	- 86.32955197		
Oceana	115,200	DeRuiter Farms	3884 W. Taylor Rd.	Hart	99	IRRI	06/10/02	43.67455743	- 86.37476613		
Oceana	576,000	KARL PETERSON	1104 S. 88TH AVE	Shelby	229	IRRI	06/18/03	43.62440545	- 86.33817390		
Oceana	393,120	PETERSON FARMS INC	3104 WEST BASELINE ROAD	Hart	360	IRRI	03/12/04	43.64257800	- 86.20062100		
Osceola	100,800	PINE RIVER AREA SCHOOLS	17445 PINE RIVER ROAD	Leroy	212	IRRI	07/11/02	44.06455780	- 85.48787286		

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Osceola	763,200	L.L. AND MARCIA BELL		Sylvan	175	IRRI	02/17/05	43.96238000	85.16870200		
Otsego	115,200	KASPER INDUSTRIES INC	356 EXPRESSWAY COURT	Livingston	145	IRRI	08/07/00	45.03202062	84.69318994		
Otsego	115,200	WM & LINDA MUZYL	418 GOSLOW RD	Livingston	184	IRRI	11/10/04	45.03072800	84.62624800		
Ottawa	115,200	Dutton Park	Howard	Holland	49	IRRI	02/01/00	42.79644200	86.12425020		
Ottawa	122,400	ZEELAND SCHOOL CREEKSIDE	100TH ST	Holland	135	IRRI	03/15/00	42.82372005	86.02396024		
Ottawa	144,000	HUDSONVILLE SCHOOLS	2745 RILEY	Jamestown	280	IRRI	04/20/99	42.82575452	85.84895942		X
Ottawa	216,000	LINCOLN NURSURIES	0-142 LINCOLN NW	Tallmadge	98	IRRI	06/27/00	43.00129112	85.78780024		X
Ottawa	1,152,000	LINCOLN NURSERIES	0-142 LINCOLN STREET	Tallmadge	135	IRRI	08/21/00	43.00303165	85.79352850		X
Ottawa	144,000	COOPERSVILLE PUBLIC SCHOOLS	190 EAST STREET	Polkton	300	IRRI	07/11/00	43.06246011	85.92733874		
Ottawa	144,000	COOPERSVILLE PUBLIC SCHOOLS	190 EAST STREET	Polkton	310	IRRI	07/05/00	43.06246011	85.92733874		
Ottawa	108,000	Schepers Lawn Sprinkling	1415 44th St. SW	Georgetown	17	IRRI	10/15/01	42.88579684	85.82016755		X
Ottawa	324,000	AJAX PAVING INDUSTRIES	5111 12TH AVE	Georgetown	403	INDUS	07/16/02	42.85794874	85.81171143		X
Ottawa	144,000	STANDARD SAND	14201 LAKESHORE	Grand Haven	50	IRRI	07/01/02	43.02656916	86.22056772		X
Ottawa	144,000	STANDARD SAND	14201 LAKESHORE DRIVE	Grand Haven	50	IRRI	07/02/02	43.02663544	86.22074946		X
Ottawa	144,000	HUDSONVILLE MIDDLE SCHOOL	3835 BALDWIN ST	Georgetown	220	IRRI	06/28/02	42.90737608	85.87830178		X
Ottawa	288,000	JENISON HIGH SCHOOL	2140 BAUER RD.	Georgetown	220	IRRI	05/22/03	42.92166174	85.83528323		X
Ottawa	288,000	JENISON HIGH SCHOOL	2140 BAUER RD	Georgetown	220	IRRI	05/20/03	42.92166174	85.83528323		X
Ottawa	122,400	GRAND HAVEN HIDEAWAY	14868 LAKESHORE DR.	Grand Haven	40	IRRI	07/30/03	43.03811502	86.22520904		X
Ottawa	144,000	STANDARD SAND	14201 LAKESHORE DR	Grand Haven	50	IRRI	11/12/02	43.02675700	86.22069400		X
Presque Isle	576,000	Viginia Schaedig	3361 N. Ocqueoc Rd	Ocqueoc	153	IRRI	08/07/03	45.42847822	84.08800137		X

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Roscommon	115,200	ROBERT T FRYE	9435 NORTH CUT ROAD	Gerrish	147	IRRI	10/20/00	44.47185347	84.66415667		
Roscommon	100,800	HENMAR LLC MARIE PINCH	7108 S. RESERVE RD	Lyon	171	IRRI	08/09/01	44.23990200	84.70048400		X
Roscommon	100,800	HENMARR LLC	7108 S RESERVE RD	Lyon	171	IRRI	08/09/01	44.23906500	84.70046000		X
Roscommon	288,000	YE OLDE COUNTRY CLUB	904 WEST SUNSET DRIVE	Gerrish	130	IRRI	05/06/02	44.49376415	84.63095183		
Roscommon	396,000	Pine View Golf Course	4761 West Houghton Lake Drive	Roscommon	180	IRRI	09/28/02	44.29879007	84.73473597		
Saginaw	1,728,000	THE CURCH OF LATTER DAY SAINTS	SWAN CREEK RD	Fremont	270	IRRI	12/10/99	43.37964869	84.28394055		
Saginaw	1,440,000	THE CUHRUCH OF LATTER DAY SAIN	MERRILL RD	Lakefield	560	IRRI	12/10/99	43.36817395	84.32200735		
Saginaw	1,584,000	WALTHER FARMS	CHAPIN RD	Lakefield	370	IRRI	03/31/99	43.31250307	84.30437044		
Saginaw	1,008,000	WALTHER FARMS	CHAPIN RD	Lakefield	350	IRRI	03/17/99	43.31565275	84.30998577		
Sanilac	129,600	SAUDOSKY SCHOOLS		Watertown	120	IRRI	07/23/01	43.41072582	82.82550045		
St. Clair	100,800	James Theisen Inc.	11757 Hill RD	Riley	89	IRRI	08/12/99	42.95523202	82.79240532		
St. Clair	144,000	Holly Meadows Golf Course	4855 Capac	Mussey	210	IRRI	08/07/01	43.03707634	82.92941107		
St. Clair	144,000	WHITE OAKS GOLF COURSE	8480 SPARLING RD.	Wales	89	IRRI	09/06/02	42.96772858	82.66337256		
St. Joseph	374,400	DENNIS DECKER	COVEY RD.	Leonidas	97	IRRI	05/30/00	41.99963949	85.35721827		
St. Joseph	720,000	JOE SCHMITT	23953 PORTAGE LAKE ROAD	Mendon	120	IRRI	03/10/00	42.02792822	85.48783539		
St. Joseph	468,000	Levine Fricke (LFR)	19684 South River Road	Lockport	85	IRRI	06/12/01	41.94091650	85.57363634		
Tuscola	115,200	Mantey Brothers		Almer	315	IRRI	04/24/02	43.52351557	83.46221855		
Tuscola	122,400	DAVID STERLING		Columbia	240	IRRI	07/08/86	43.65922017	83.40411378		
Tuscola	115,200	BARRY STING		Columbia	240	IRRI	07/08/86	43.65912925	83.40339830		

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Van Buren	1,224,000	Elwyn Shugars	Sec. 26 Porter Twp.	Porter	103	IRRI	02/28/00	42.09123767	- 85.78795258		X
Van Buren	1,224,000	ELWYN SHUGARS		Porter	103	IRRI	02/28/00	42.08751780	- 85.78535149		X
Van Buren	108,000	MICHAEL CHARBONEAU	64683 77TH AVENUE	Keeler	160	IRRI	04/25/00	42.13912957	- 86.17352755	X	X
Van Buren	122,400	D&J BLUEBERRY	0962 60 ST	Geneva	77	IRRI	06/05/99	42.38600627	- 86.12968590		
Van Buren	172,800	RUSSELL SULLINS		Bangor	65	IRRI	10/21/99	42.32670723	- 86.10963228		X
Van Buren	122,400	Ted Stocchiero	54584 M-43	Arlington	140	IRRI	04/18/00	42.30935361	- 86.07657899		X
Van Buren	122,400	WILLIAM HURLEY	35176 MILL LAKE ROAD	Bloomingtondale	109	IRRI	06/27/00	42.37499272	- 85.88925618		
Van Buren	115,200	BROOKSIDE FARM		Bloomingtondale	73	IRRI	06/29/00	42.35864701	- 85.91198326	X	X
Van Buren	864,000	HODGEMAN BLUEBERRY FARM	6336 COUNTY ROAD 215	Columbia	70	IRRI	04/16/97	42.39288201	- 86.07367106		X
Van Buren	122,400	Mike Packard	69792 8th Avenue	Geneva	120	IRRI	01/01/00	42.38956415	- 86.22456791		
Van Buren	144,000	DEYOUNG CELERY	39993 88TH ST	Decatur	101	IRRI	07/31/01	42.09807626	- 85.91700281		X
Van Buren	122,400	TOMMIE GARDNER	32744 62ND ST	Bangor	68	IRRI	07/15/02	42.30008393	- 86.14768005		
Van Buren	115,200	BROOKSIDE FARM	37347 CR 388	Bloomingtondale	66	IRRI	07/09/03	42.36122070	- 85.90820394		X
Van Buren	122,400	JEFF PRIMMER	61159 CR 384	Geneva	88	IRRI	08/11/04	42.37510779	- 86.14074540		X
Washtenaw	324,000	BARTON HILLS CO CLUB	STEIN RD	Ann Arbor	238	IRRI	07/23/02	42.32848171	- 83.76513884		X
Washtenaw	115,200	EDWARD C. LEVY CO.	3305 WEST LIBERTY	Scio	172	IRRI	03/19/03	42.27358593	- 83.79767430		X
Washtenaw	115,200	EDWARD C. LEVY CO.	3305 WEST LIBERTY	Scio	173	IRRI	03/18/03	42.27358593	- 83.79767430		X
Washtenaw	144,000	CONCORDIA COLLEGE	4090 GEDDES	Ann Arbor	97	IRRI	12/17/03	42.27467200	- 83.68222100		X
Wayne	129,600	NORTHVILLE PARKS	15801 BECK ROAD	Northville	138	IRRI	02/09/00	42.39734478	- 83.51044076		X
Wayne	144,000	JONNA CONST CO	19500 HAGGERTY	Livonia	66	IRRI	11/20/98	42.43066515	- 83.43336245		

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Wayne	201,600	OCCIDENTAL DEV LTD		Van Buren	185	IRRI	08/05/91	42.22079925	- 83.46537986		
Wayne	115,200	WILSON NURSERY	45700 SIX MILE	Northville	140	IRRI	08/02/99	42.41009661	- 83.49650835		X
Wayne	489,600	Stonewater LLC	Ridge Road	Northville	250	IRRI	10/22/99	42.41887939	- 83.53081695		X
Wayne	144,000	NORTHRIDGE CHURCH		Northville	93	IRRI	08/20/01	42.37495819	- 83.52935971		X
Wayne	504,000	HRON SOD FARMS	30877 PENNSYLVANIA	Huron	160	IRRI	05/21/97	42.17935214	- 83.33765991		
Wayne	175,680	DALLAS OSWALT	13441 GLENVIEW DR.	Plymouth	230	IRRI	11/04/03	42.37759603	- 83.50130194		
Wayne	115,200	BELLEVILLE HIGH SCHOOL	555 WEST COLUMBIA	Van Buren	157	IRRI	06/24/04	42.19797400	- 83.49507500		
Wayne	864,000	TOLL BROTHERS		Northville	114	IRRI	05/15/00	42.40845000	- 83.51036000		X
Wexford	122,400	JEFF K MCNITT	3201 W 18 1/2 RD	Antioch	193	IRRI	04/15/02	44.38838904	- 85.64376786		
Wexford	122,400	RONALD L COCHRANE	4170 N 5 1/2 RD	Springville	148	IRRI	05/21/02	44.41011782	- 85.77033560		
Wexford	216,000	CADILLAC COUNTRY CLUB	5510 EAST M- 55	Cherry Grove	85	IRRI		44.23163026	- 85.46032800		X
Wexford	122,400	WADE SHERBURNE		Antioch	128	IRRI	07/09/04	44.40129505	- 85.62939764		
Wexford	172,800	MICHAEL MACEACHERN	9287 WEST 30.5 ROAD	Slagle	77	IRRI	04/08/99	44.29929300	- 85.76687000		
Wexford	136,800	FRED ABRAHAM		Springville	72	IRRI	05/05/71	44.34150000	- 85.75491300		