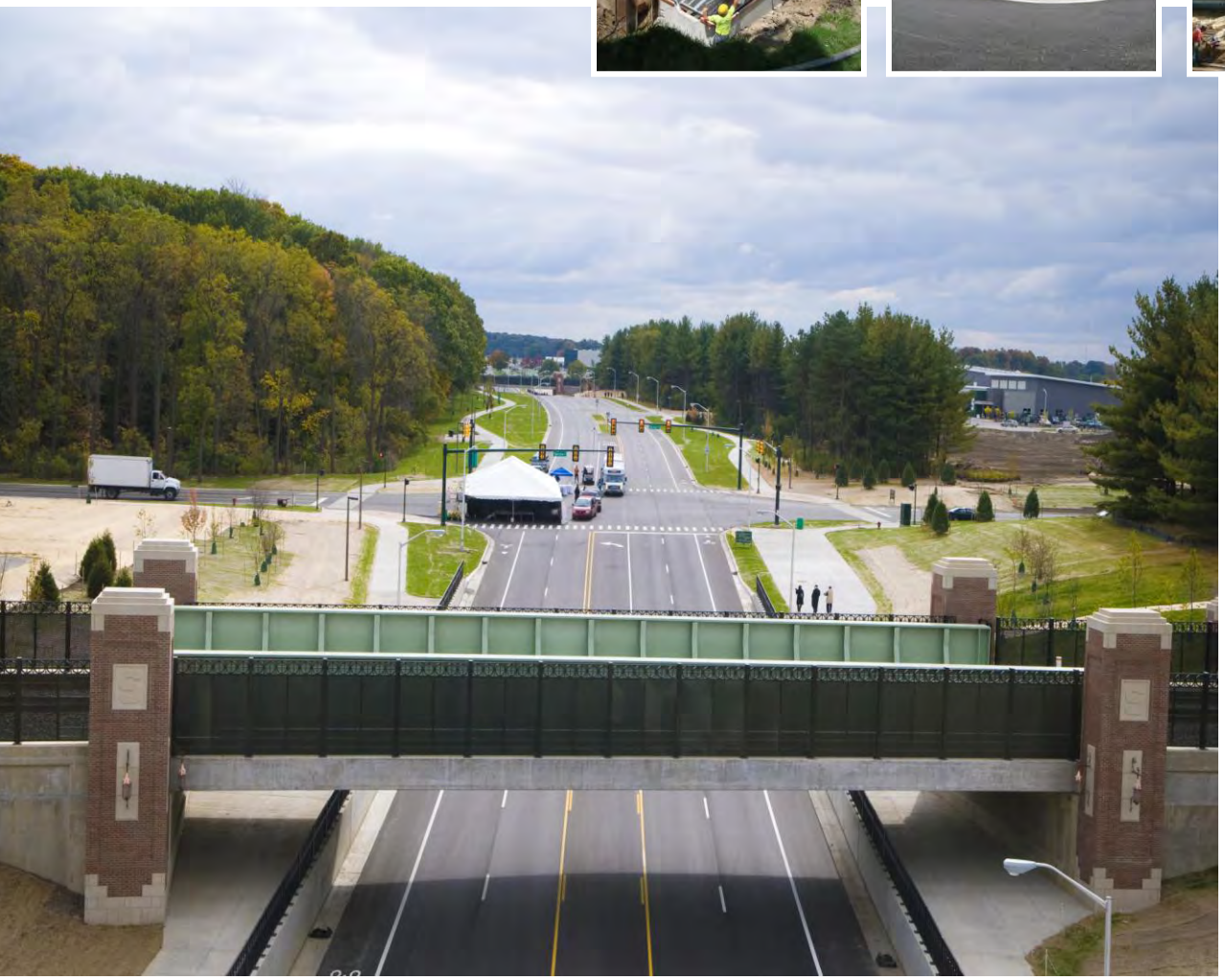
Facilities & Infrastructure Report 2010

Office of the Vice President for Finance & Operations
February 2010



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Executive Summary

The Michigan State University main campus covers 5,200 acres and includes 553 buildings, 18 miles of roads and 54 lane miles. The number of buildings has decreased over the past few years due to the demolition of some buildings in Spartan Village. The number of lane miles has increased primarily because Farm Lane changed from two lanes to five lanes as a result of the underpass project.

This report is the annual Infrastructure Report which includes the Property Report and Environmental Stewardship recommendations and progress to date with these initiatives. As with the university budget, the resources available to repair and maintain the campus buildings, roads, utilities, parking lots, and sidewalks have been severely decreased. Steam tunnel repairs are a major piece of the repairs needed for the campus.

Even with the economic impact, the campus still continues to build new space, renovate space, maintain and repair facilities based on risk-related priorities, and conserve the university's resources through the environmental stewardship initiatives.

As we look at the near term future, it is highly likely the university will see increased regulatory requirements particularly relating to the power plant emissions. In addition, the university will need to focus on the management of the steam and electrical demands in order to delay the expansion of the power plant as long as possible. The delayed Just-in-Time needs accumulate at a very high level and balancing the 'wait on the return of the endowments' versus the need to repair is a constant process.

The management of the construction projects is improving and unused funds for projects are being returned at a faster rate to the units that funded the project.

This report is a snapshot in time and focuses on the priorities for the university at this time. The university continues to monitor the constant need for refinement and improvement in the work that is done.

Thanks to the dedicated staff for their work and commitment to making the university a better place.

Fred L. Poston
Vice President for Finance and Operations and Treasurer

JUST-IN-TIME

Summary

The Just-In-Time (JIT) facilities evaluation process requires a comprehensive review of all campus infrastructure components in order to determine their condition, estimate their failure date, and schedule necessary repairs. The industry-predicted life cycle of infrastructure systems (average number of years before a replacement is normally needed) is used as the starting point for projecting the timing of required work. This method is commonly referred to as deferred maintenance. This number is adjusted to account for actual university experience with the life cycles of essential components. Observations are made in the field during preventive maintenance and testing of building system components. This refined process of JIT information is collected in a database and used to predict annual maintenance and replacement costs for the next 20 years.

The intent of the JIT approach is to predict when critical infrastructure components are approaching failure. This allows the university to allocate resources closer to when repairs are needed. Accurate assessments of future JIT needs make it possible to coordinate JIT projects with other construction and renovation projects. These opportunities diminish, however, when available funding falls short of what is needed. The advantage of this planning approach is that campus disruptions and multiple repairs at the same location are minimized and project costs are often reduced. This process also provides the opportunity for greater flexibility in managing the funding of these projects. When the JIT process was developed in 2000-01, Michigan State University (MSU) had an estimated deferred maintenance backlog of approximately $360 million for general fund infrastructure work. As JIT implementation progressed, the $360 million backlog figure was reevaluated through MSU field observations and integrated into the projections for future infrastructure needs. The result was a 20-year projection of JIT needs. The JIT process tracks facility needs in three time scales: 1) zero to five years, 2) five to ten years, and 3) ten to twenty years. Needs for the first five years are determined by an analysis based primarily on field inspections. Projections for the five to ten year period are determined by industry life cycles adjusted for MSU experience. The remaining ten-year forecast is determined by industry life cycle alone.

Analysis

The general fund 20-year JIT forecast identifies $567 million of work that must be performed in order to preserve the safety and reliability of the university infrastructure. This is more than last year’s forecast of $560 million, primarily because of data refinements. Figure 1 shows JIT needs for the next 20 fiscal years.

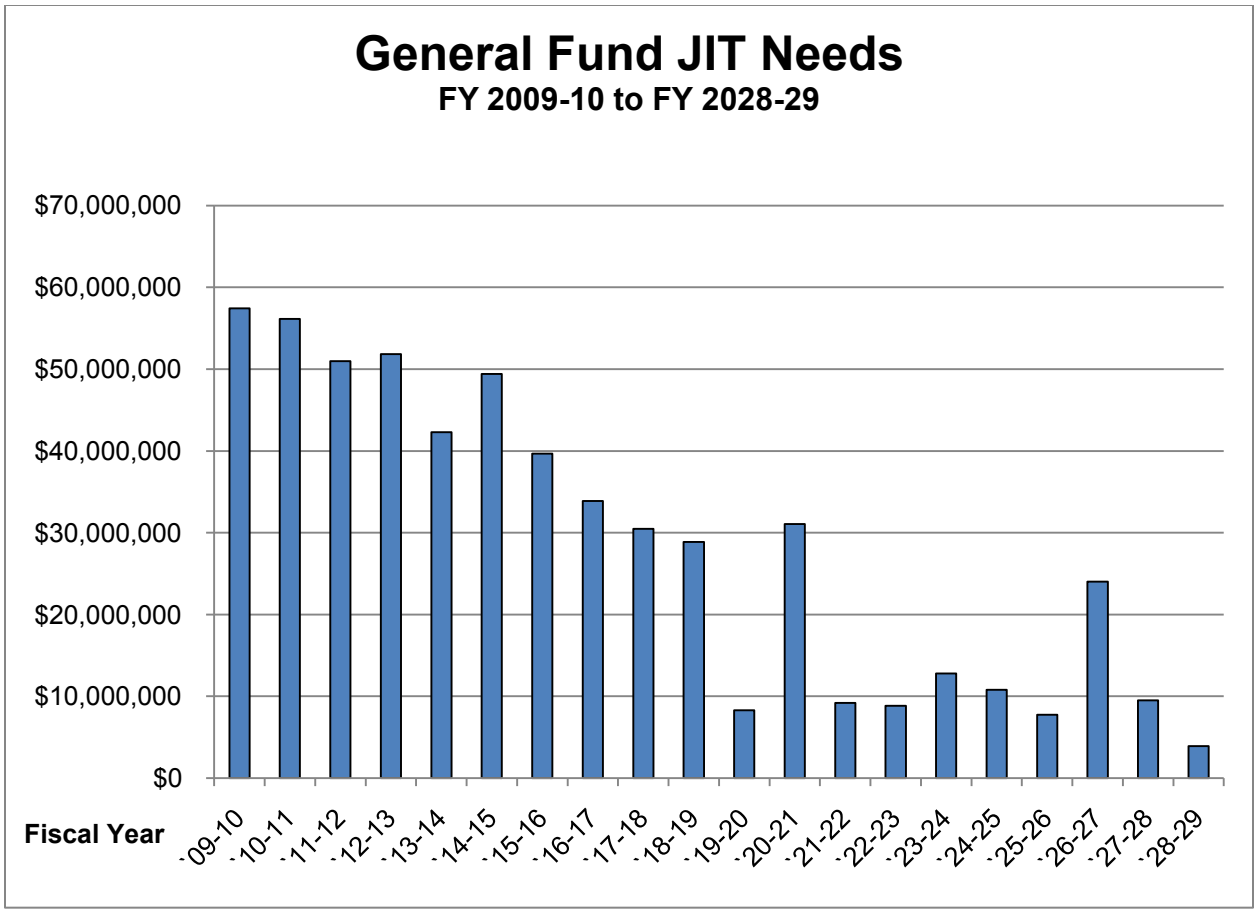


Figure 1. *Annual general fund JIT needs for the next 20 fiscal years*.

With the annual funding need ranging between $30 and $60 million, the next 10 fiscal years are a concern. These substantial targets will be difficult to realize. Maintaining the key components of MSU's campus infrastructure system, while operating near failure, will be a challenge. JIT funding needs after 2019-20 are considerably less and it may be possible to commence with catching up on work that was carried forward from prior years. However, projected costs may increase as the data for outlying years is refined.

Four categories comprise the JIT infrastructure needs for the general fund facilities: buildings, utility distribution systems, power and water systems, and roads. Figure 2 shows the next 10 years of JIT needs sorted by category.

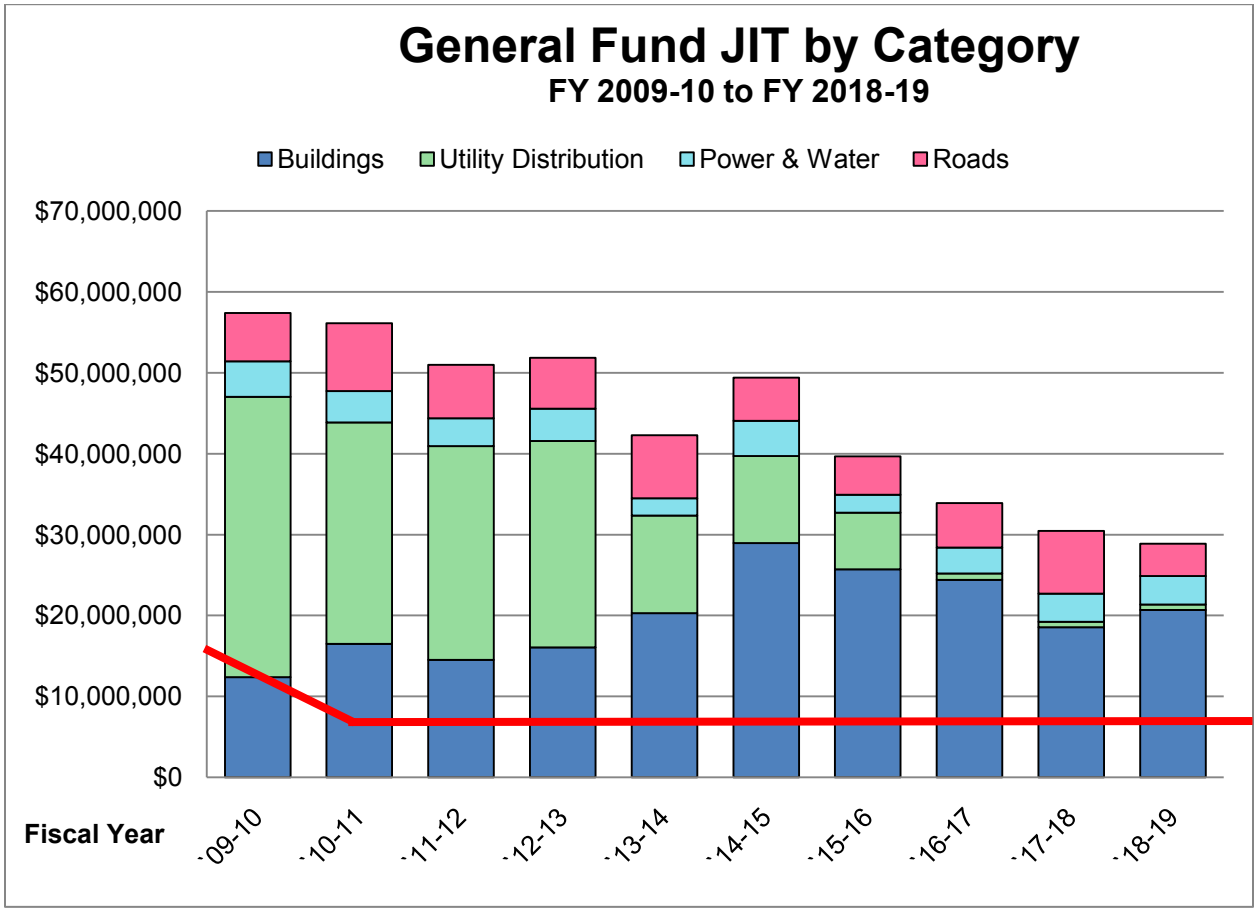


Figure 2. *Annual general fund JIT needs from fiscal years 2010 through 2019 for buildings, utility distribution, power and water, and roads. The red line shows the anticipated average of funds available for JIT.*

The 10-year general fund outlook of JIT needs incorporates information obtained through field inspections, which provides a more precise analysis. The data can reveal trends developing within each category. Figure 2 shows that funding requirements for power and water and roads are more stable while building and utility distribution needs fluctuate. During this time, many of the building systems and campus utilities constructed in the 1950s and 60s will reach the end of their adjusted life cycles. Based on past experience, it is projected that a significant number will need major maintenance or replacement within this 10-year period.

Buildings

The largest percentage of JIT needs for the next 10 years is in the buildings category, which consists of three components: 1) the building envelope, 2) building systems, and 3) interior finishes.

Emphasis has been placed on building envelope projects as the highest priority, in order to preserve the protective barriers which shield the elements. Examples of these projects include roofs, exterior masonry, windows, and doors.

High priority is given to building systems projects, which include heating, ventilating and air conditioning (HVAC) systems, building electrical systems, elevators, and plumbing. If left unaddressed, building system failures will result in significant interruptions to the operation of a particular facility. In fiscal year 2009-10, 26% of JIT needs are for building envelope projects, while 40% is related to building systems.

The interior finishes component includes floors, walls, interior doors, toilet partitions, and ceilings and it is given the lowest funding priority. In fiscal year 2009-10, however, it is projected that 34% of JIT needs for buildings will be related to interior finish projects. When funding for JIT is limited, only interior projects that could result in safety hazards, if neglected, are considered. If not addressed, the appearance of older campus buildings will further decline.

Utility Distribution

Significant attention has been given to the JIT category of utility distribution system, which includes both steam and electrical distribution to the campus. Figure 3 shows an example of a direct buried steam line. Over the past five years, substantial progress has been made in upgrading the reliability of the campus steam distribution system through the JIT program. The quantity of direct buried steam piping has been reduced from 7.4 miles to 4.06 miles and replaced with tunnels. Figure 4 shows an example of how steam tunnels are constructed. This is the most short-lived and problem prone part of the system.

Figure 3. *Direct buried steam line.*

Figure 4. *Steam tunnel under construction.*

A study, recently completed by FTC&H Engineers, reveals that substantial work is required on the North Campus steam tunnels, most of which are 90 to 100 years old (Figure 5). The study suggests implementing $50 million of work over the next five years.

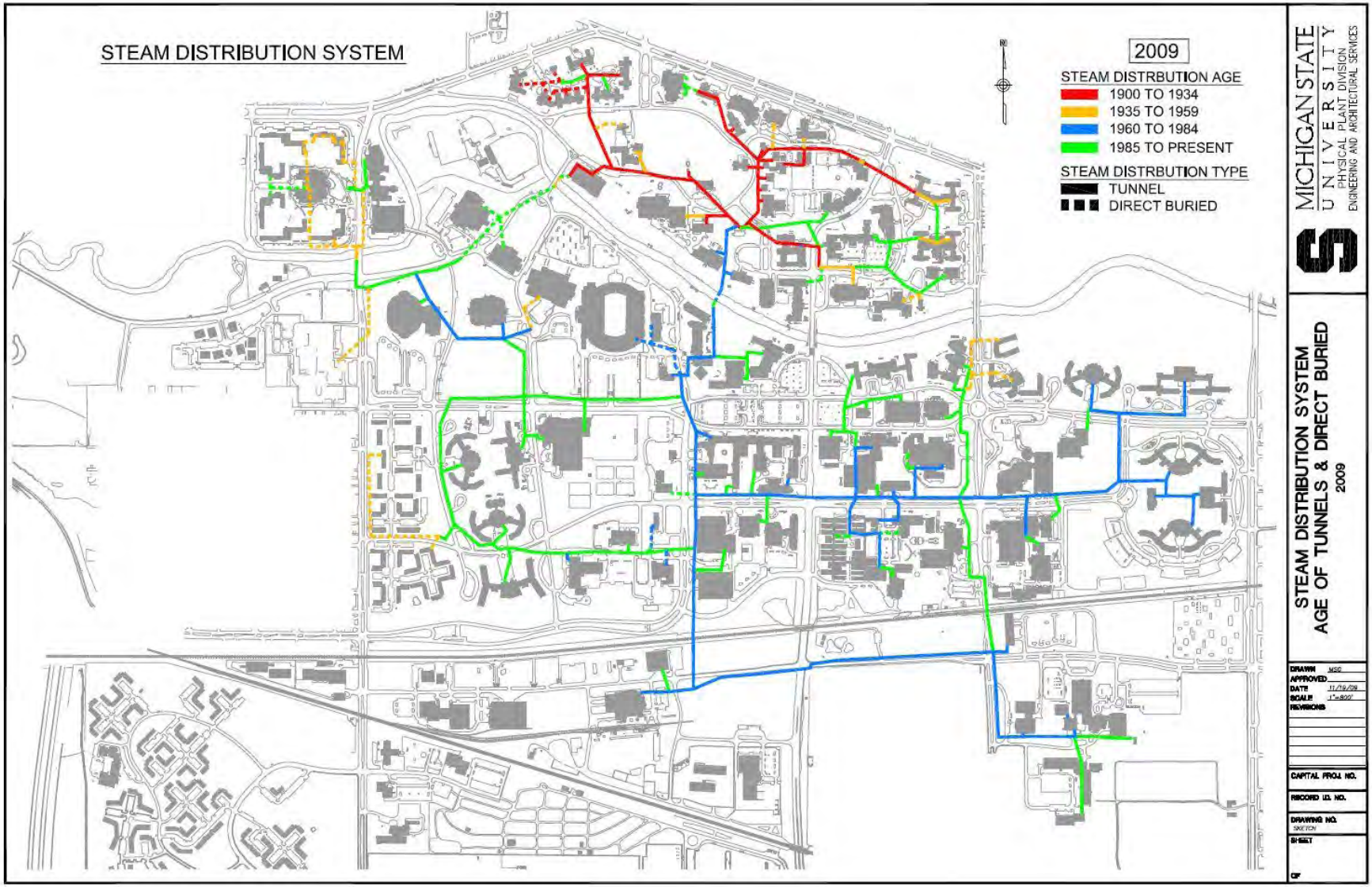


Figure 5. *Steam distribution system.*

The most pressing issue is the structural integrity of the steam tunnels. As illustrated in Figure 6, several sections of the tunnel are exhibiting severe structural failures. A 250-foot section of the tunnel under Circle Drive, near the library, was recently filled with pea stone to prevent its collapse because JIT funds are not available for permanent repair.

The study recommends increasing the size of some high pressure steam lines to accommodate future loads consistent with the Vision 20/20 Master Plan and converting the remaining buildings connected to the old, low pressure steam system to high pressure steam. This would eliminate future maintenance on two miles of low pressure steam piping and associated valves, expansion joints, and steam traps.

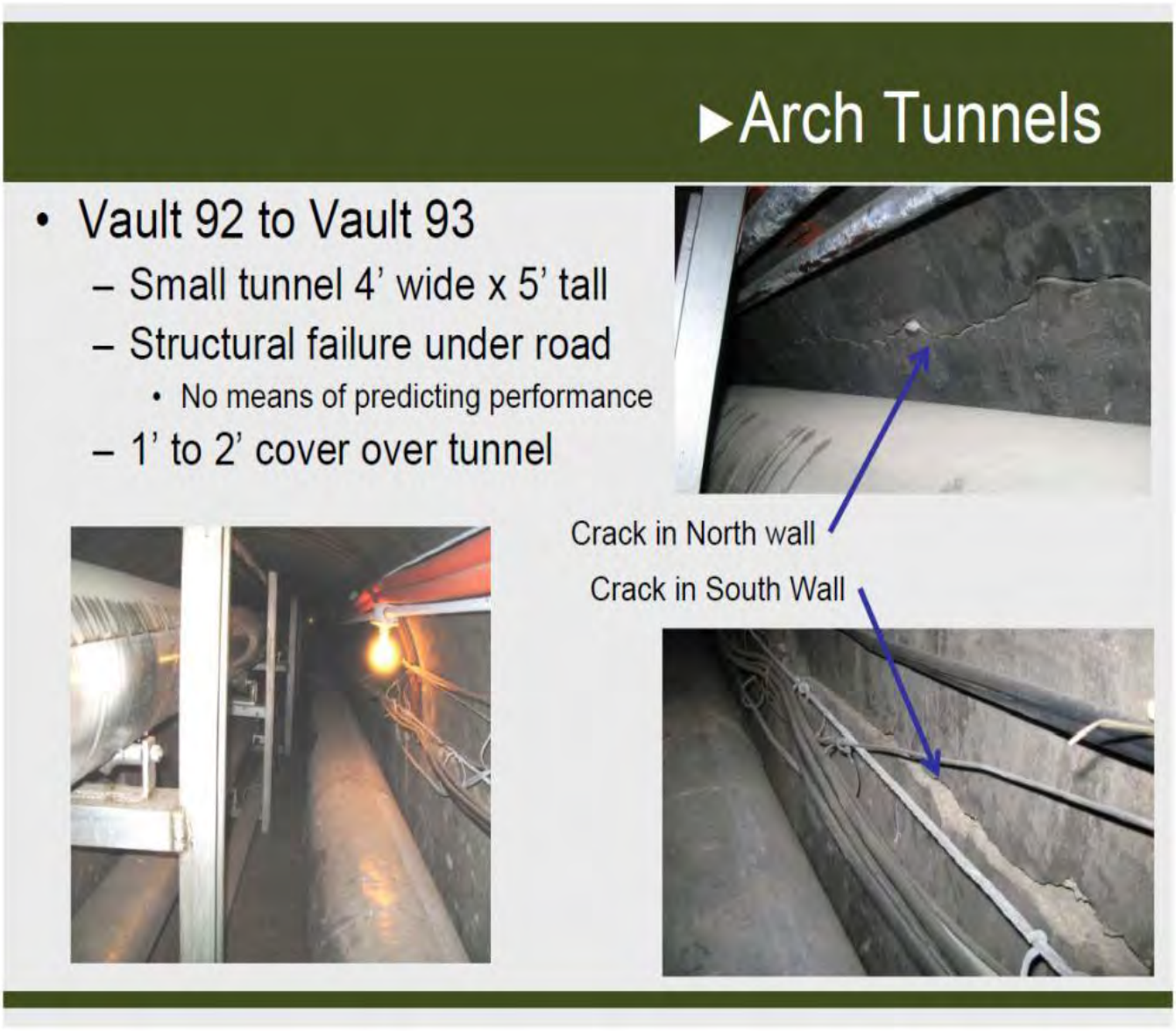


Figure 6. *Steam tunnel under Circle Drive.*

Figure 7 is a map of the campus electrical distribution system. Seven campus buildings remain on the old 4,160 volt system (Landon, Williams, Yakeley, Gilchrist, Wills House, Music/Music Practice, and I.M. Sports Circle.) Most of the electrical substations in these buildings and the distribution cables that feed them are over 60 years old; more than 10 years past their expected life span.

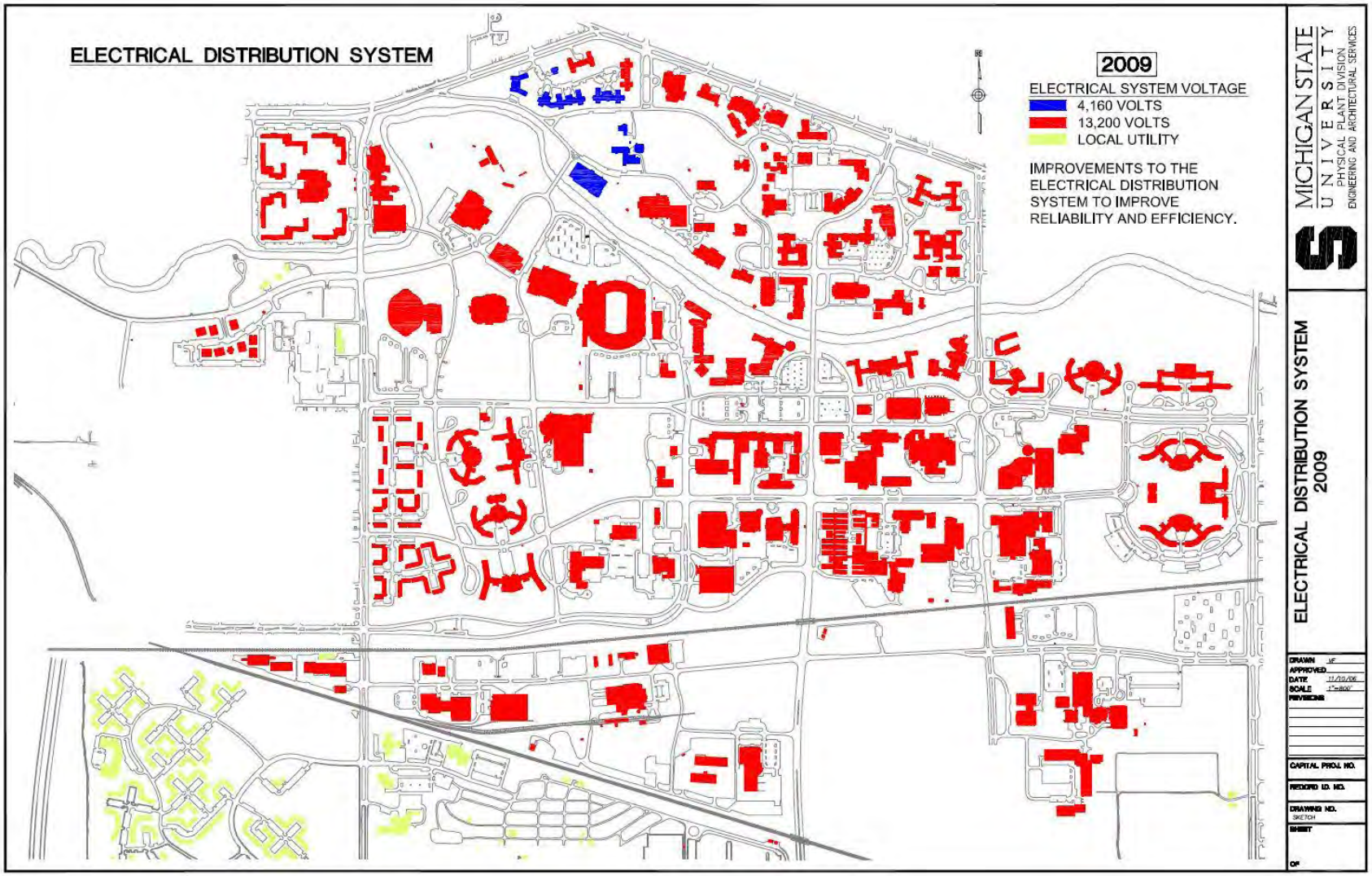


Figure 7. *Electrical distribution system.*

It will require five million dollars to replace the substations and extend the 13,200 volt electrical distribution system to these buildings. Funding is not currently available causing this work to be deferred until at least fiscal year 2013 or later.

Failure of certain components in the system would result in the loss of power to one or more of these buildings for several days, while emergency repairs are implemented. The university has sufficient generators to power two or three buildings, but not all of them. It would take approximately one day to connect generators to a building. A failure in the North Campus substation could cause a power outage to all buildings served by the 4,160 volt system and could take several days to repair.

Power and Water

The JIT power and water category remains stable over the next 10 years, averaging between $2 and $4 million per year during this period. Examples of power and water JIT projects include work on turbines, generators, and wells.

Roads

A significant number of JIT road projects have been completed in recent years. Remaining project work will continue as funding is available. Roads which have previously been reconstructed to current standards can usually be maintained by milling off the top layer of asphalt and recapping the surface with a new layer. As a result, the JIT need for campus roads is projected to remain more stable until outlying years and will become contingent upon future assessments of pavement condition due to winter weather.

Cumulative Impact

Figure 8 shows the cumulative impact of JIT needs for the next 20 fiscal years. The annual funding need quickly compounds to a point where it reaches an unattainable level and such deferments increase the risk of infrastructure failure on each delayed project.

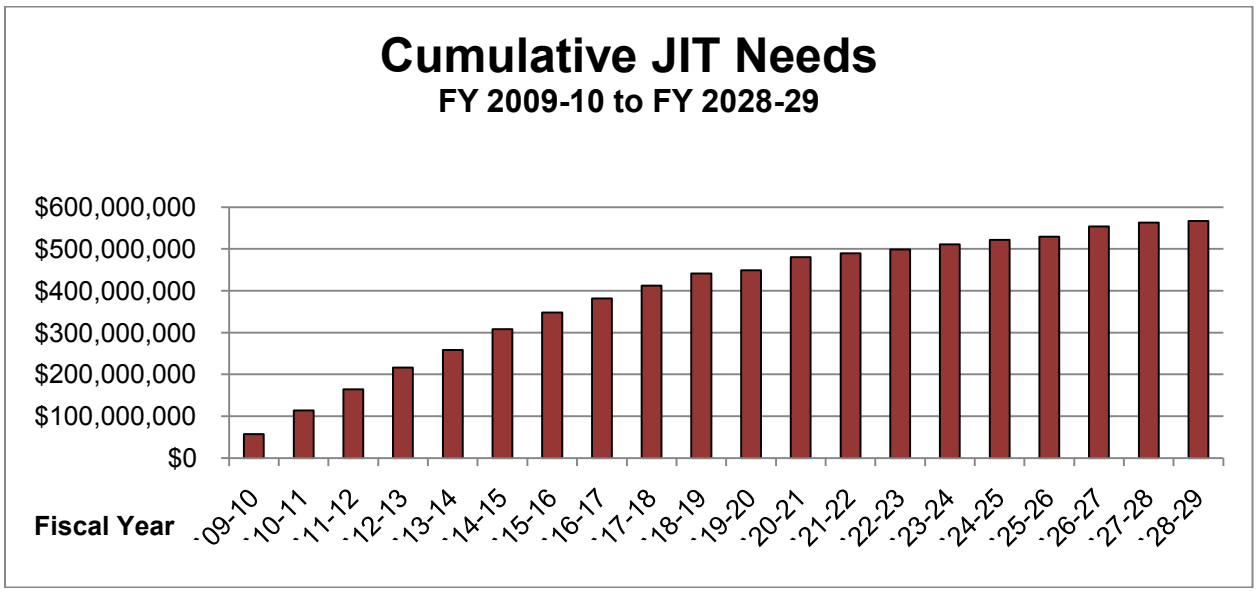


Figure 8. *The cumulative growth of general fund JIT needs for the next 20 fiscal years.*

If JIT funding was not provided for the next 20 years, the cumulative cost for deferred projects would escalate to $567 million by 2028-29. There is a critical concern for JIT funding needs occurring between fiscal years 2009-10 and 2018-19. During these years, the components of many buildings and systems which were constructed in the 1950s and 60s will reach the end of their adjusted life cycle. From 2019-20 through 2028-29, there is a much more gradual increase in JIT needs as the backlog of major maintenance challenges is addressed. It is possible, however, that these amounts may increase as more field observations are performed through time.

Risk Management Approach

Securing adequate funding for each year's identified needs is critical to the management of the JIT program. Recently, it was expected that endowment funds would provide between $20 and $30 million a year to address JIT needs for the next 10 fiscal years. The downturned economy and resulting loss of investment income has reduced that amount to just $5.8 million in 2009-2010 with no endowment funds available for the remaining 10 fiscal years. As a result, many infrastructure projects must be deferred to later years. Consequently, the JIT projects list was reviewed to prioritize possible failures in terms of areas at most risk to the university, should they fail before being repaired. For example, with less funding, it would be a higher priority to fund a steam or utility project because failure in those areas would impact multiple buildings. Figure 9 reflects this new approach in managing JIT for the next 10 fiscal years.

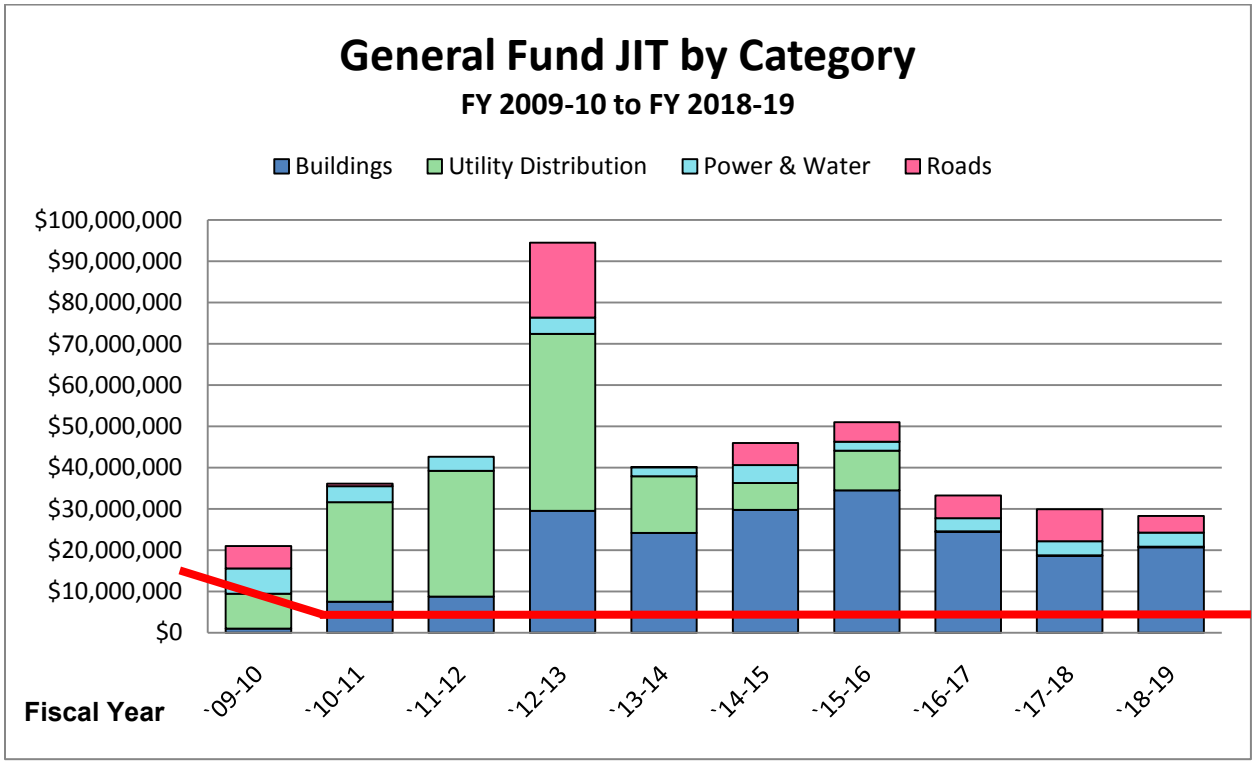


Figure 9. *Annual general fund JIT needs from fiscal years 2010 through 2019 for buildings, utility distribution, power and water, and roads accounting for the loss of projected funds for the next three fiscal years. The red line shows the current average of funds available for JIT without endowment funding.*

The large increase in JIT needs, starting in fiscal year 2013, is precipitated by the deferral of JIT work from fiscal years 2009-10 through 2011-12. Since the average annual funding

Physical Plant has to address JIT with is approximately nine million dollars, only the highest risk needs are now included for 2009 through 2012 (Figure 9). Given that it is not feasible to complete all of the deferred work in one year, it has been spread out from 2013 through 2016, with 2012-13 seeing the largest increase. Projects delayed from 2009-10 through 2011-12 include $36 million in building projects, $25 million in utility projects, and $11 million in road repairs.

JIT Future Directions

The summary of JIT requirements shows the financial challenges facing the university infrastructure. Although many infrastructure systems continue to operate, the likelihood of a disruptive failure grows yearly due to their age and deteriorating condition. If an adequate and consistent source of funding cannot be established, the university runs the risk of multiple failures within the various infrastructure systems.

There are major challenges facing the university when addressing JIT in the years ahead:

- Investment portfolio performance threatens to reduce resources for JIT, delaying a significant number of projects to future years. This will have a negative impact on the effectiveness and safety of an already aging campus infrastructure system.

- Replacement criteria for JIT for windows, chillers, and other energy saving projects may be revised due to the impact on reducing energy demand.

- Campus pathways, parking ramps, and parking lots continue to be evaluated for JIT needs so funding will be required for these areas as well. The concern is that more work will have to be done with fewer resources.

A benefit to addressing JIT needs is that many of the “Just-in-Time” projects include the added advantage of energy savings when completed. Projects such as window replacements, roof replacements, exterior door replacements, chiller replacements, and air handler replacements will generally improve energy conservation by maintaining an air-tight building envelope, increasing insulation, or installing up-to-date equipment that will operate more efficiently.

CONSTRUCTION

Summary

Adequate facilities are vital for Michigan State University (MSU) to perform its missions of education, research, and outreach. The university continues to invest heavily in design and construction projects. The current economic climate may cause this volume to decrease after fiscal year 2010-11, but there are a number of projects that will keep construction volume high for the near term.

MSU's construction performance and delivery of projects has improved in many areas. Ninety percent of substantial completion dates during fiscal year 2008-09 were met, and 95% of closed projects were within budget. During the past four years, the university has improved in meeting final completion dates. More feedback is being given to contractors to facilitate process improvements and better overall performance.

Projects are tracked through the Facilities Asset Management Information System (FAMIS) and Skire project management software to provide timely and accurate project information, and to report on project performance as a whole. Data provides an opportunity to analyze strengths and weaknesses in the delivery and management of construction projects and then improve upon processes. As the projects continue to increase in volume and complexity, MSU is examining processes and implementing improvements in project management to engage designers, contractors, and the campus community.

Analysis

Annual Construction Report

The annual construction report reviews completed projects as part of a required reporting process for MSU's Board of Trustees. This report is included in Appendix A and lists 59 major and minor capital projects with a total value of $206 million which were closed in fiscal year 2008-09. These projects were completed on average 3.6% under budget. Quarterly reports for active projects are also sent to the Board of Trustees.

Construction and Design Volume

Figure 1 details construction payments over the past six fiscal years. During fiscal year 2008-09, payments to contractors totaled approximately $112 million; an increase from 2007-08, but consistent with fiscal year 2006-07.

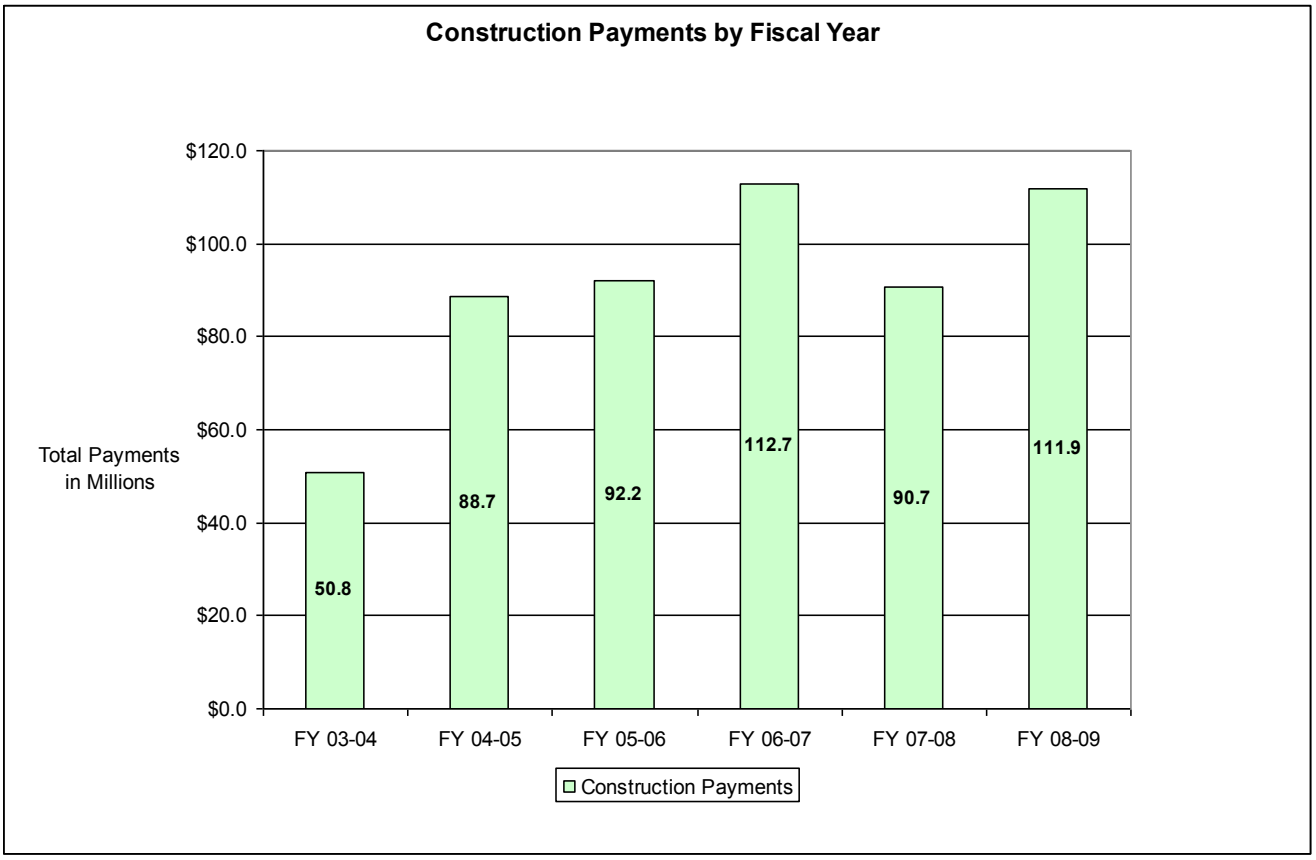


Figure 1. *Construction payments by fiscal year.*

It should be noted that five projects accounted for nearly $56 million in payments. They included the Secchia Center, the Wharton Center Addition, Mary Mayo Hall Renovations, the MSU Surplus Store and Recycling Center, and the Cyclotron Office Addition I and High Bay Addition.

Figure 2 details design payments over the past six fiscal years. Design payments decreased by 21% over the past year, but remain consistent with the three-year average. Nearly one-third of these payments were made for the Secchia Center, Brody Hall Renovations, the Cyclotron Office Addition I and High Bay Addition, and various Just-In-Time (JIT) projects.

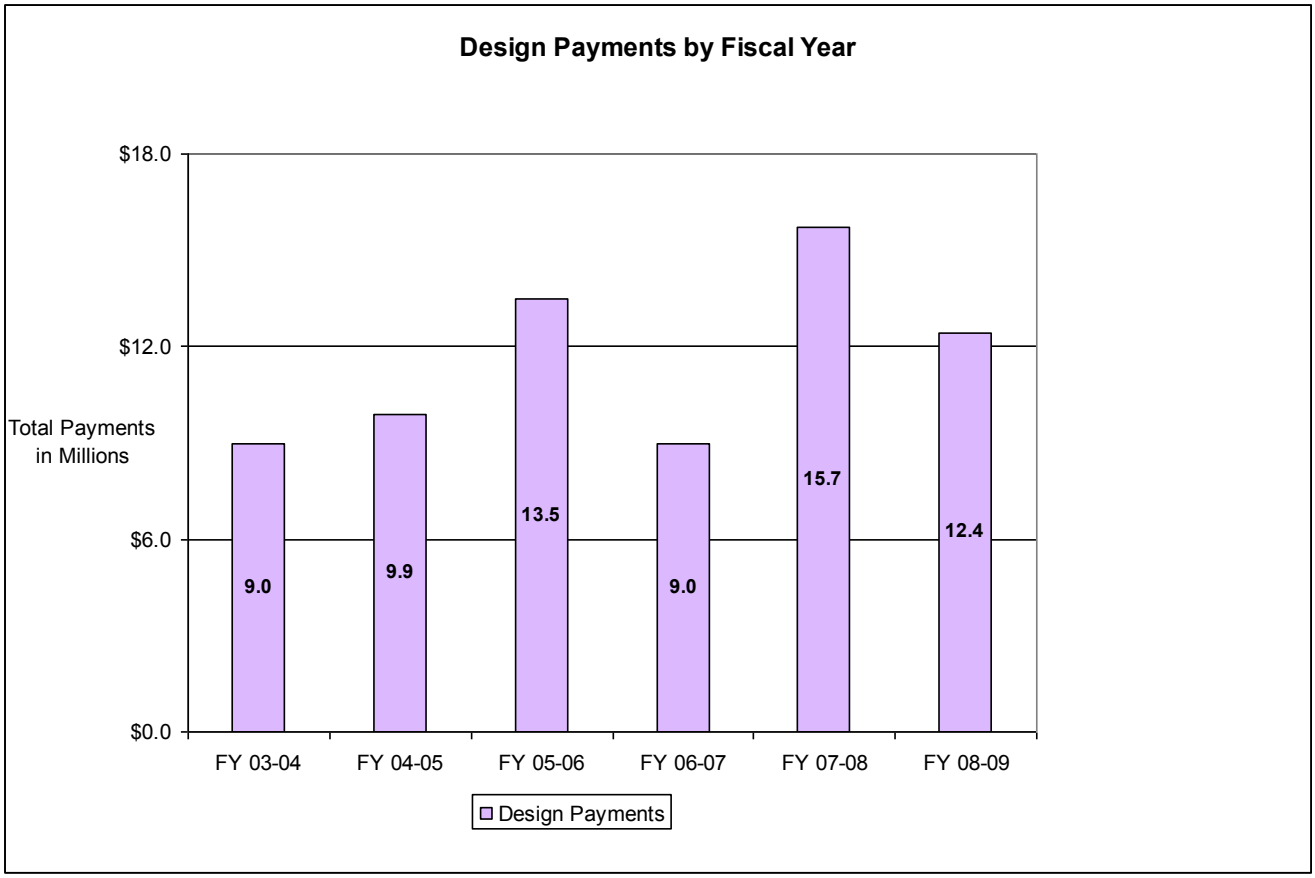


Figure 2. *Design payments by fiscal year.*

The 2009-10 construction payments should increase as work continues on the Secchia Center, Brody Hall Renovation, T.B. Simon Power Plant–Coal Handing Modifications, and as work commences on the Eli and Edythe Broad Art Museum, the Plant Sciences Expansion, Morrill Hall Replacement, Life Sciences Addition, and Emmons Hall Renovations. Design activity may decline beyond 2009-10 until the Facility for Rare Isotope Beams (FRIB) design begins in earnest.

Construction Change Orders

As Campus Planning and Administration (CPA) and Engineering and Architectural Services (EAS) strive to make improvements, one of the earliest focus areas has been reducing the number of construction change orders, which consistently use approximately 40% of project contingency. Change orders are a reality in the construction process for a number of reasons: 1) undocumented field conditions, such as bad soils and concealed asbestos, 2) document discrepancies where the work specified either cannot be built or does not meet the intent of the project, and 3) scope changes requiring additional work at the discretion of the university. Though often necessary, changes can lead to delays in construction and disputes with contractors. Often these disputes are not from a single change, but numerous small changes

which can lead to a contractor claiming that the volume of changes delayed the project or impacted their productivity. This leads to a demand for substantial additional compensation. It is important to identify and correct recurring mistakes in order to reduce change orders, thereby limiting university exposure.

These concerns have prompted MSU to track change order rates by calculating the dollar value of change orders divided by construction payments (Figure 3). Scope changes modify the function or capacity of a facility, and may include changes to the quality of finishes and furnishings, or change the size of the building or program to be included in the project. These are the most easily controlled sources of change and are discouraged. Initial efforts were good, with overall changes dropping significantly in fiscal year 2004-05. Until this year, scope changes have declined steadily. Field changes also increased this year after decreasing over the past several years. Document changes decreased this year. The overall change order rate increased this year and is still higher than the goal of six percent.

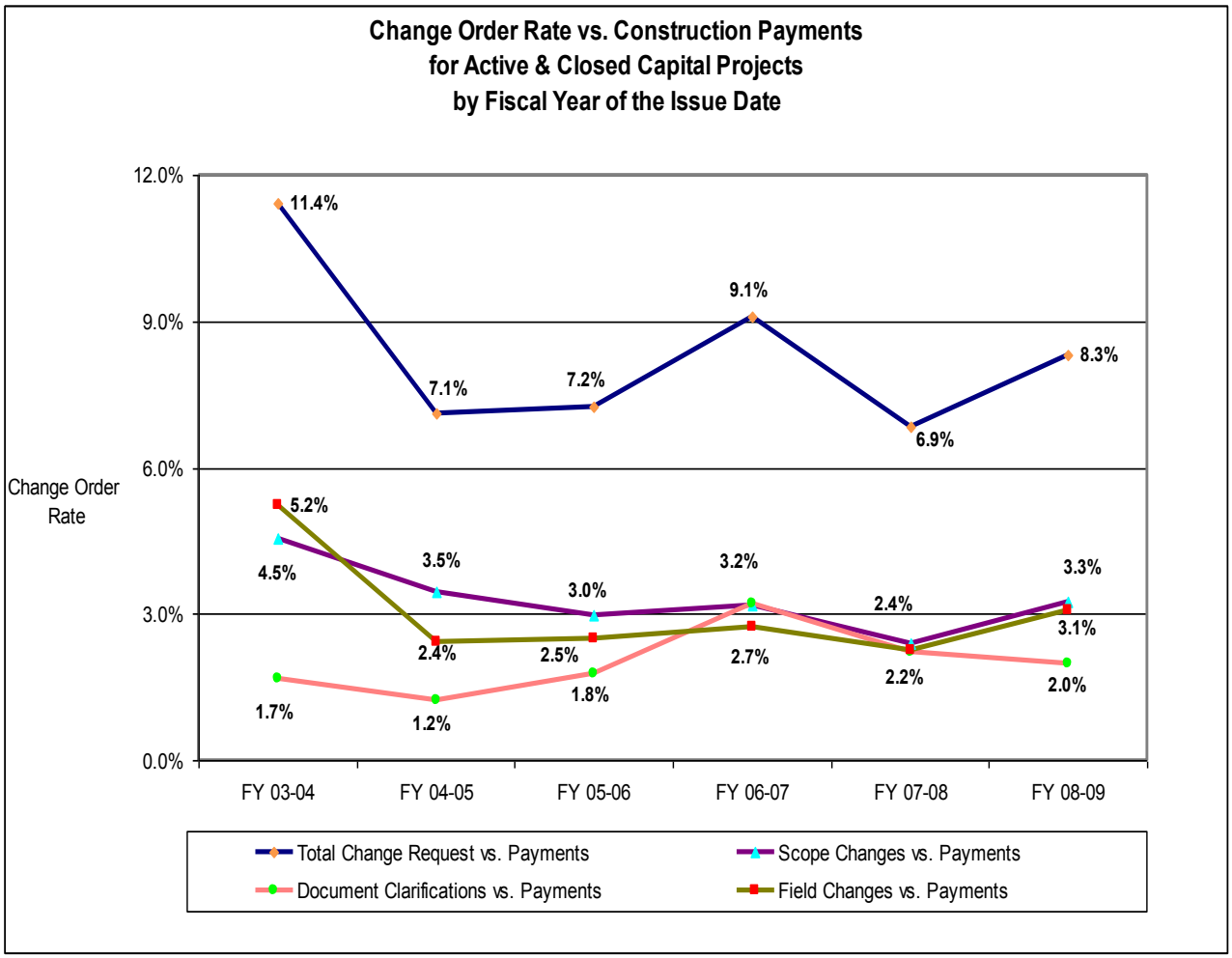


Figure 3. *Change order rate vs. construction payments for active and closed projects by fiscal year. Each percentage point of change order rate represents a one dollar increase per $100 of the construction bid price.For example, for every $100,000 in construction paid during fiscal year 2008-09, the university identified $8,300 in change orders.*

It should be noted that nearly two-thirds of the change order increase is in field changes. Field changes are difficult to control or predict. Scope changes have also jumped significantly.

Reviewing the information, it appears that some larger change orders were taking advantage of the extraordinary market conditions. During design, university faculty and staff are making difficult decisions to eliminate important project elements in order to stay within budget. Some projects are experiencing significant savings on bidding; allowing these elements to be restored through scope changes.

Other factors are being reviewed to determine if they are better indicators of change order performance. Tables 1 and 2 filter projects according to other characteristics, such as categories of construction and work discipline (e.g., roads, mechanical, utilities, etc.) Projects closed in the last four fiscal years have been categorized as new construction (complete new building, road, or parking lot), renovations (reconstruction or reworking of existing space), additions (new space added to an existing facility), and by the work discipline, including roads and parking, mechanical and electrical equipment replacement, elevators, roofs and building envelope, steam and underground utilities, site, and program space (which includes classrooms, offices, laboratories, and clinical space).

Table 1. *Change orders by construction type for closed projects.*

Value of Change Orders by Type of Construction	Cumulative Average of FY 05-06 through FY 07-08			FY 08-09		
	Change Order	Contract Value	% of Contract	Change Order	Contract Value	% of Contract
New Construction:	$13,869	$959,438	1.4%	$2,081,454	$36,530,311	5.7%
Renovation:	$9,244,484	$92,099,628	10.0%	$4,515,442	$60,701,659	7.4%
Addition:	$465,524	$5,217,964	8.9%	$3,325,874	$66,834,126	5.0%
Total:	**$9,723,877**	**$98,277,030**	**9.9%**	**$9,922,771**	**$164,066,096**	**6.0%**

Not surprisingly, more change orders occur in renovations than in new construction or additions. This is to be expected since renovation work has the most unknown conditions and information. This is particularly true in occupied buildings where investigation behind walls and above ceilings may not be possible.

Table 2. *Change orders by construction category for closed projects.*

Value of Change Orders by Category	FY 05-06 through FY 07-08			FY 08-09		
	Change Order	Contract Value	% of Contract	Change Order	Contract Value	% of Contract
Program Space:	$2,529,318	$28,181,948	9.0%	$5,788,747	$109,234,487	5.3%
Elevators:	$209,631	$5,844,326	3.6%	$74,882	$3,549,982	2.1%
Laboratories:	$0	$0	0.0%	$188,666	$1,024,219	18.4%
Mechanical & Electrical:	$2,697,118	$22,652,845	11.9%	$873,156	$7,286,300	12.0%
Roads & Parking:	$2,295,662	$21,845,230	10.5%	$1,626,271	$20,358,846	8.0%
Roof & Building Envelope:	$1,645,399	$14,159,185	11.6%	$101,360	$2,178,382	4.7%
Steam & Underground:	$346,750	$5,593,496	6.2%	$1,269,689	$20,433,880	6.2%
Total:	**$9,723,878**	**$98,277,030**	**9.8%**	**$9,922,771**	**$164,066,096**	**6.0%**

Change order rates for projects closed in fiscal year 2008-09 were largely consistent with prior years where there appeared to be representative samples in both periods. As noted in Table 1, new construction projects only experienced change orders of 5.7% of the original construction contract values. Work disciplines that had the greatest change order rates were mechanical and electrical equipment, roads and parking lots, roofs, and building envelopes. Roads, parking lots, roofs, and building envelopes all have hidden conditions inherent in the work. The existing conditions can only be assessed after removing the existing veneer. The decrease in projects closed this year is likely attributed to chance versus a change in approach. Mechanical and electrical equipment replacement projects are difficult to design to ensure they meet operational requirements in the limited space available. This leads to more changes for both field conditions and design clarifications.

Timely and Cost-Effective Project Completion

Substantial completion requires that a project is usable for its intended purpose (e.g., a road intersection is open, classes or research can be conducted in a laboratory, or an elevator is permitted to carry passengers). MSU has made progress in this area. Figure 4 shows that 50 of 55 projects (91%) met substantial completion on time or ahead of schedule versus 89% and 87% in fiscal years 2006-07 and 2007-08, respectively. This continuous improvement is particularly noteworthy since the number of projects also increased.

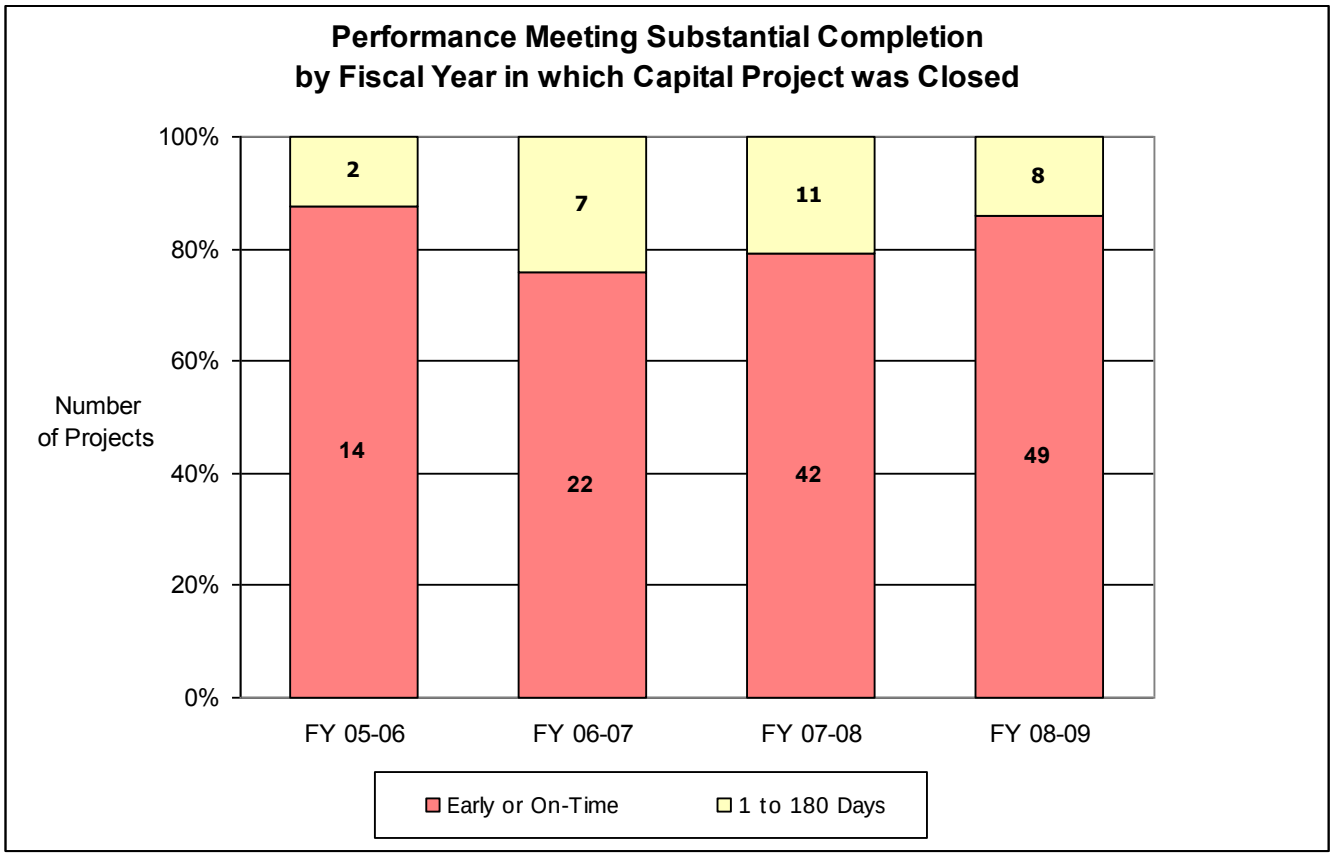


Figure 4. *Performance meeting substantial completion for capital projects.*

In Figure 4, projects not meeting substantial completion on schedule did not impact vital university functions, such as classrooms and laboratories being unavailable for teaching or residence halls not open for fall semester move-in. MSU emphasizes schedule requirements

by setting realistic substantial completion dates with MSU clients, specifying those requirements clearly in the bid documents and then holding contractors to a high standard of compliance. EAS is using more demanding schedule specifications for most large projects and has emphasized schedule importance at contractor and consultant forums.

Final completion requires that all activities for a project be finished, including the contractor's punch list of corrective items and work performed by MSU forces for tasks such as landscaping, installation of telecommunications, data networks, instructional media, and procurement of furnishings and equipment. It is required that all expenses are complete and unused funds are returned. Slightly more than half of the projects closed during fiscal year 2008-09 met final completion on schedule, a modest improvement from last year (36%). Figure 5 shows progress during the last four fiscal years. There is still room for improvement.

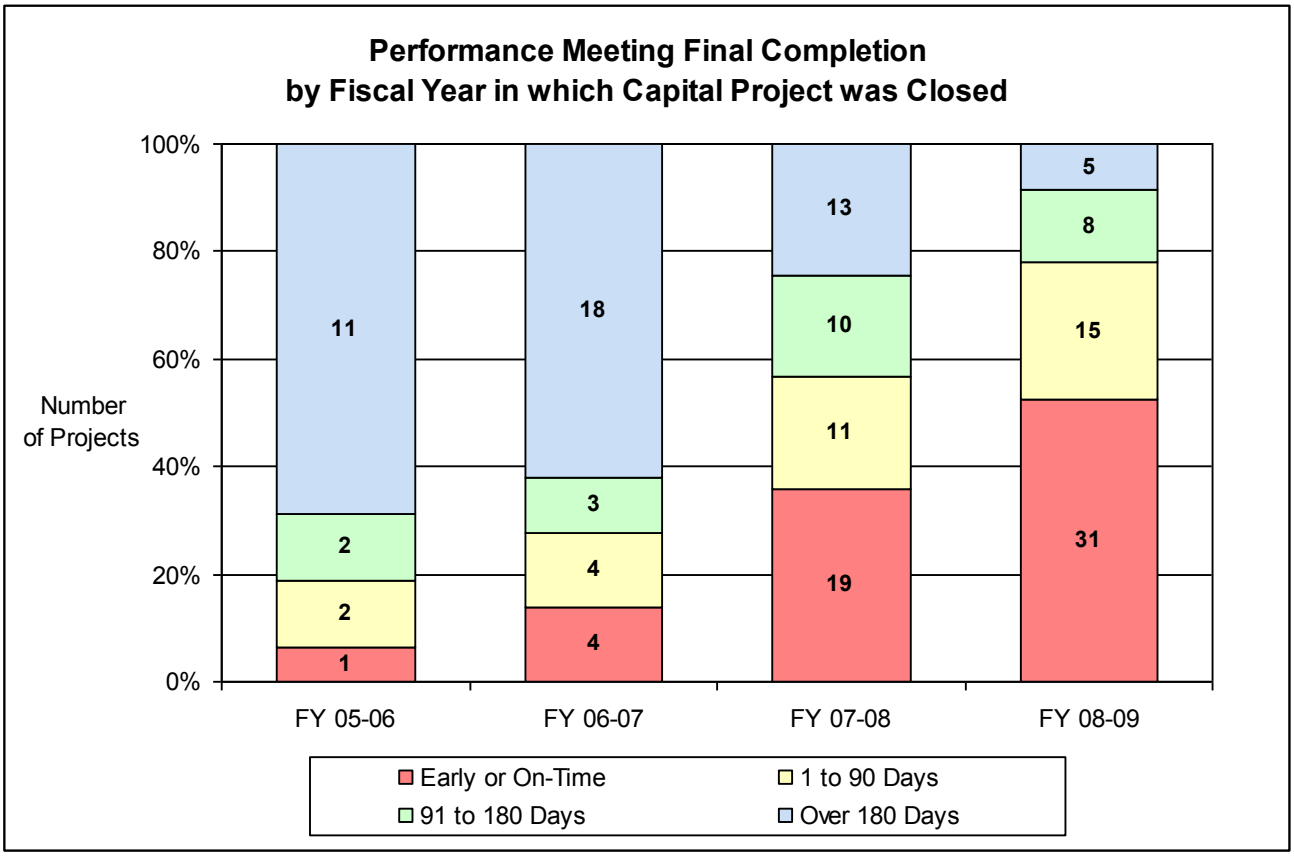


Figure 5. *Performance meeting final completion for capital projects by fiscal year in which the project was closed.*

There are a number of factors that hinder timely final completion. The university performs many functions on a construction project, including landscaping, procurement of furnishings and equipment, computer and telecommunication networking, and the selection and installation of public art. These functions tend to occur toward the end of a project. Many projects have not had realistic schedules for accomplishing these activities. The closeout process is, in many ways, controlled by the inputs at the beginning of the project, including realistic schedules and budgets, and a clear understanding of the project requirements. Incremental improvement in project closeout is a result of better planning.

In order to be successful in timely project completion, university performed work must be better integrated into the schedule. The university is putting forth greater effort to set and maintain schedule information throughout a project. Schedules are assembled in consideration of MSU activities. Rather than waiting for the completion of all field activities, staff members are closing portions of the work as they are completed. CPA and EAS meet regularly to review the status of projects which are substantially complete and to review projects with customers such as MSU's Residential and Hospitality Services (RHS).

In April 2008, the School of Planning Design and Construction (SPDC) completed a study to evaluate the project close-out process. Timelier project close-out was found to benefit all project stakeholders, including the MSU user, the project implementation team, contractors, and designers. One recommendation was to track project closeout in two segments; from substantial completion to final payment to the contractor, called T1, and from final payment to final closeout of the project, called T2. Figure 6 displays the average duration for these times, along with total closeout duration for the last three fiscal years.

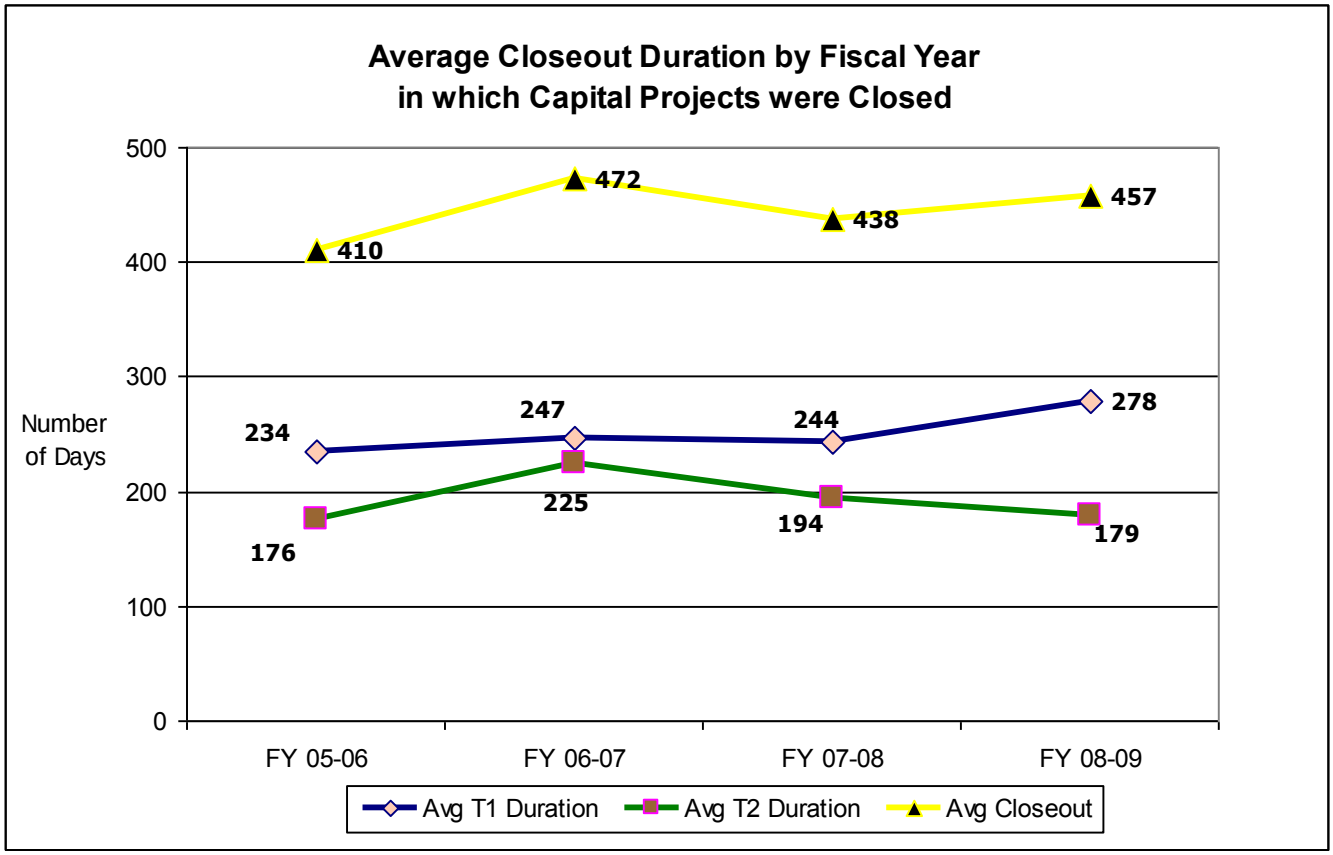


Figure 6. *Average days for T1 and T2 durations for closed projects by fiscal year.*

Figure 7 breaks down closeout time by each category for the last four fiscal years. Overall closeout time increased slightly in fiscal year 2008-09 and has not moved significantly in the last three years. T2 time has dropped considerably during the same time frame. This is a product of better planning for owner-performed work and closer reviewing of project budgets and status as construction proceeds. At the same time, T1 time is increasing, essentially stagnating progress. As Skire project management software continues to be implemented, it is MSU's hope that closeout requirements will be further automated, allowing more accurate tracking and faster performance with the end result of returning funds quicker to MSU sources.

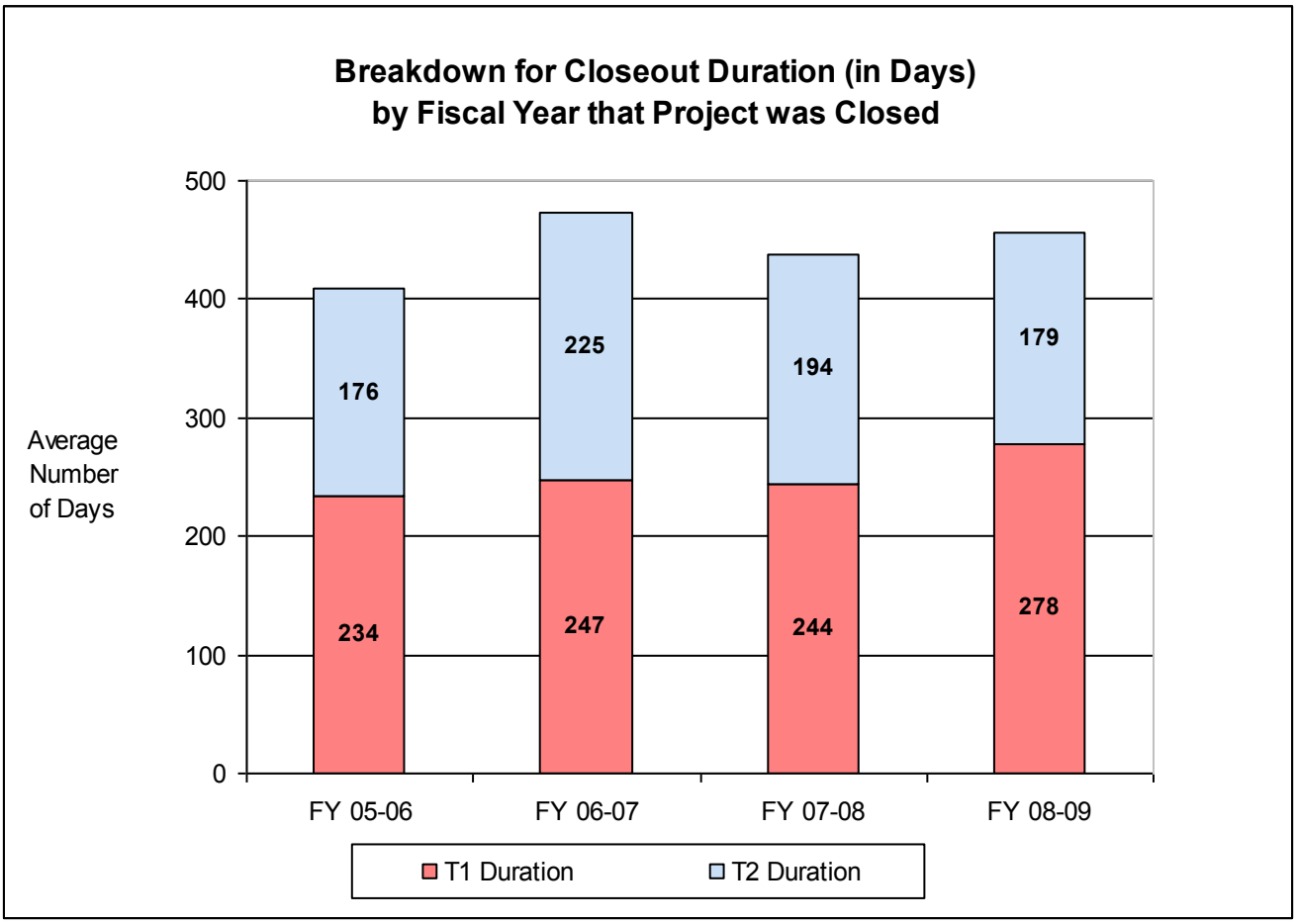


Figure 7. *Average T1 and T2 durations for closed projects by fiscal year.*

Table 3 summarizes the budgets for projects closed by fiscal year. There were approximately 10% more projects closed in fiscal year 2008-09 than in fiscal year 2007-08. The value of the 2008-09 projects was more than 250% of the 2007-08 projects.

Table 3. *Budget for major and minor closed capital projects, by fiscal year.*

Budget for Closed Projects	FY 05-06	FY 06-07	FY 07-08	FY 08-09
Authorized Budget:	$11,426,000	$52,928,587	$77,483,334	$206,398,900
Final Cost:	$10,120,619	$50,353,767	$75,836,038	$198,930,659
Returned:	$1,305,381	$2,574,820	$1,647,296	$14,890,367
% Returned:	11.4%	4.9%	2.1%	7.2%
Contract:	$7,567,538	$41,163,906	$59,658,023	$164,066,096
Number of Projects Closed:	**17**	**42**	**53**	**59**

Note: The Board of Trustee project approval process was changed during fiscal year 2005-06. As a result, fiscal year 2005-06 does not include minor projects.

Table 4 summarizes the final costs for the 59 projects closed in fiscal year 2008-09. The table details cost by the major categories of contract (construction performed by contractors under general contractor, construction manager, or design build delivery systems), design (which includes external design firms or design work performed in-house), project administration (MSU project management costs), project development (preliminary fees and services generally required prior to commencing construction), construction by owner (includes tasks such as keying, high voltage connection, landscaping, and technology installation performed by MSU), movable furnishings and equipment, and contingency (funds in reserve for potential project clarifications, particularly change orders for unforeseen conditions and document clarifications).

Table 4. *Budget for major and minor closed capital projects by budget group for fiscal year 2008-09.*

Budget Code & Description	*Authorized Budget*	*Total Cost*	*Money (Over) / Under Budget*	*Percent (Over) / Under Budget*	*Percent of Contingency Used*
CONTRACT:	$154,428,366	$164,066,096	$(9,637,730)	-6.2%	43.1%
DESIGN:	$14,519,289	$17,787,253	$(3,267,964)	-22.5%	14.6%
PROJECT ADMINISTRATION:	$3,718,107	$4,238,843	$(520,736)	-14.0%	2.3%
PROJECT DEVELOPMENT COSTS:	$871,610	$928,930	$(57,320)	-6.6%	0.0%
CONSTRUCTION BY OWNER:	$6,626,399	$8,104,449	$(1,478,050)	-22.3%	6.6%
MOVEABLE FURNISHINGS AND EQUIPMENT:	$3,876,521	$3,805,089	$71,432	1.8%	0.0%
CONTINGENCY:	$22,358,608	$0			
TOTAL PROJECTS: 59	**$206,398,900**	**$198,930,659**	**$7,468,241**	**3.6%**	**66.6%**

As is typical, the construction contract consumed more of the contingency than all other lines. Design costs are the next largest contingency burden, then work by owner, which includes tasks MSU typically performs, such as telecommunications, final landscaping, access control, and high voltage connections. As an aggregate, these projects returned one-third of

contingency to the university. It is important to have an effective closeout process to free up and return funds to be repurposed. Most of the increases were in the contract section, as is to be expected. Overruns continue in design and construction by owner. Design, construction by owner, and project administration were also significantly over budget. More effort needs to be put into better budgeting at the onset of construction. Efforts have been made to improve budgeting, including better spreadsheets to review potential owner project costs. Since this graph reports on projects budgeted on average three years ago, results will lag behind the improvements.

Figure 8 shows aggregate schedule and cost information, by fiscal year, on a single graph. It is meant to assess the overall project closeout performance. This result clearly demonstrates that the final completion, while improving, still has room for growth. Nearly 95% of projects were completed within budget and 91% met substantial completion. It should be noted that all factors are trending in a positive direction. There were three minor projects over budget. Physical Plant reviewed these projects with the Vice President for Finance and Operations.

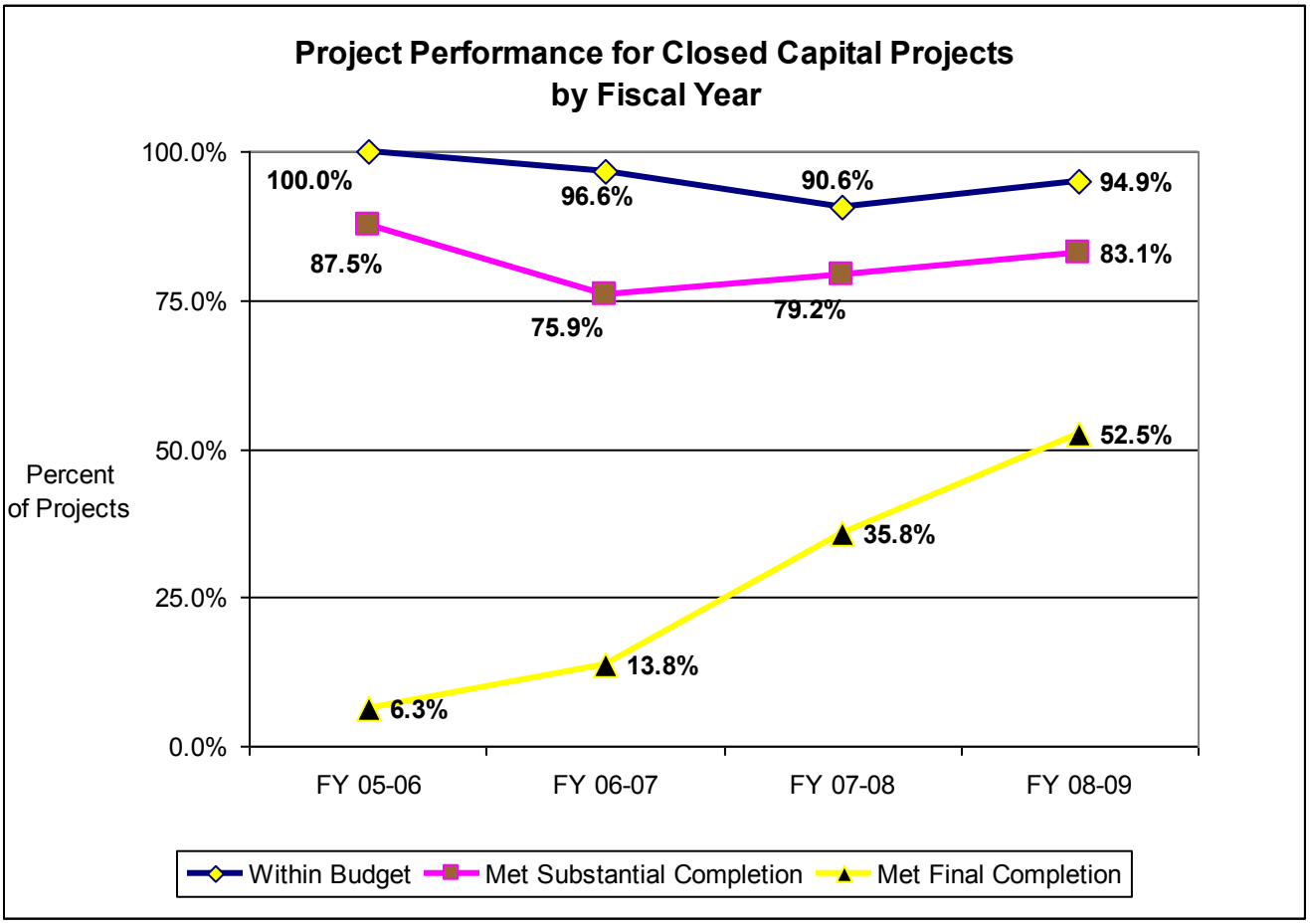


Figure 8. *Project performance for meeting budget, substantial completion, and final completion for capital projects by fiscal year in which the project was closed.*

Quality Control (Contractor, Owner, and Designer Feedback)

The university has established a scorecard for general contractors and construction managers to provide feedback. Typically, contractors view MSU as a preferred customer and want to meet requested expectations. The scorecard is a tool for making contractors and construction

managers aware of opportunities for improvement in their work performances. It may also become a resource when considering contractors for hire. As part of project close-out for major capital projects, the construction representative or project manager evaluates contractor performance through a standardized score card to rate each project and vendor.

It is the construction representative who shares the scorecard with the contractor, along with average scores. The construction superintendent reviews poor performance with contractors who have had multiple mediocre or unacceptable projects.

MSU strives to be an owner of choice for contractors and that includes continuing to improve practices and processes to accentuate value. To that end, contractors are asked to complete a scorecard on university performance. Figure 9 shows contractor scores to date by fiscal year, compared to the goal of scoring 100%.

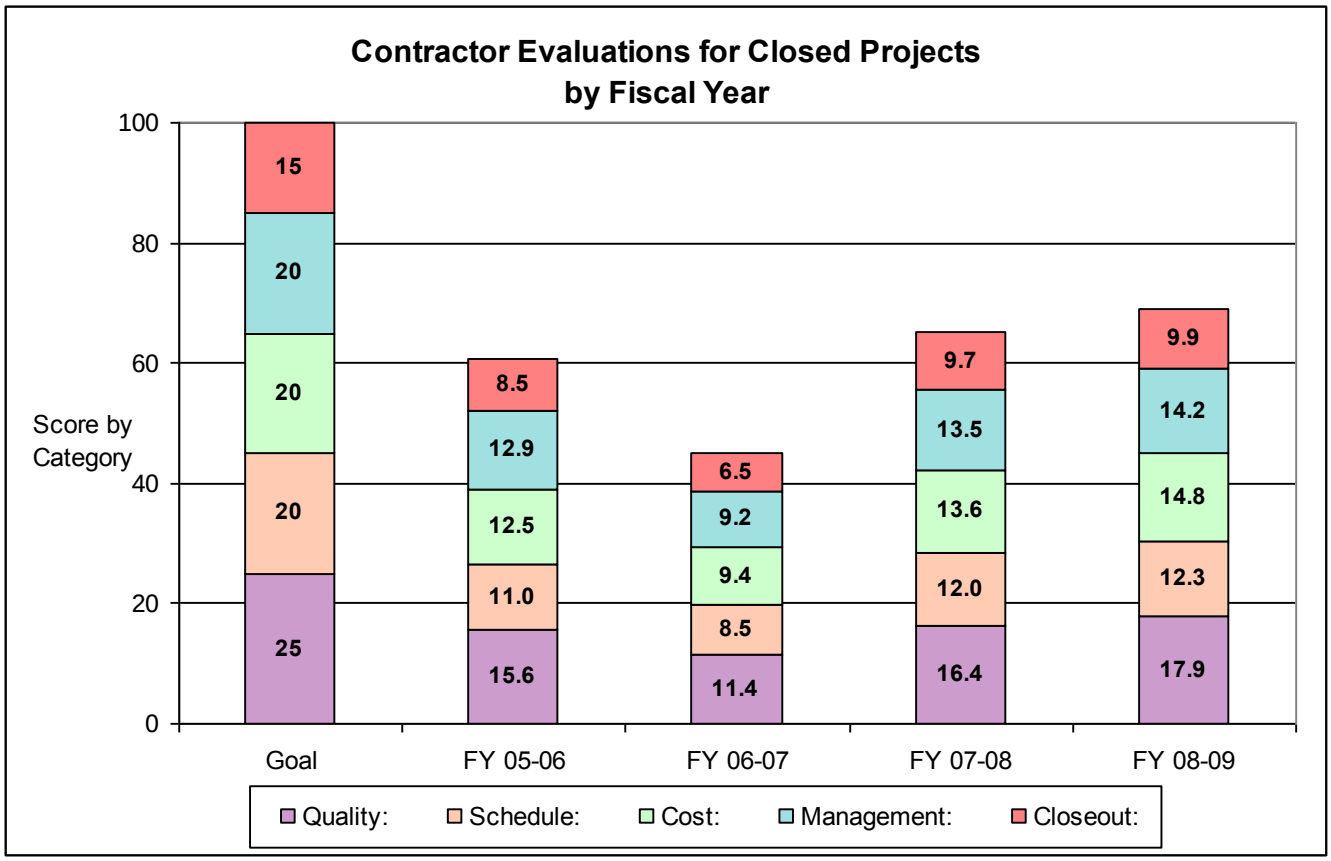


Figure 9. *Average score for contractor score card by category and fiscal year that the project was closed.*

MSU's goal is 80% of total points in each category. Figure 10 shows contractor scores by component and year, along with the goal. Contractor scores have slowly improved over the last three years. This is a reasonable reflection of contractor performance. The improvement stems in part from better emphasis of MSU's expectations, not just in specifications and contract documents, but in pre-bid meetings, reviews with contractors, the annual contractor and consultant forum, and in smaller meetings with firms that regularly do business with MSU.

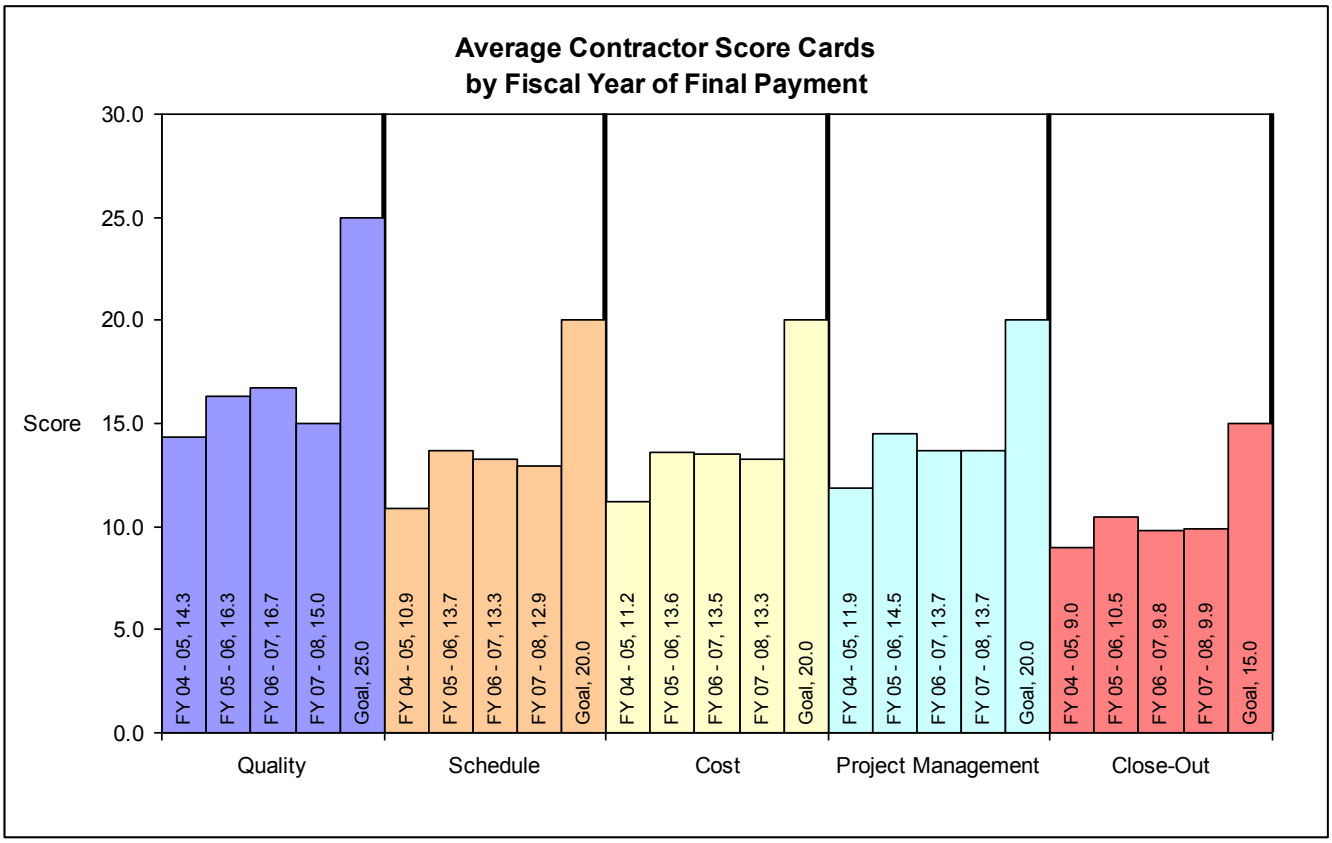


Figure 10. *Average score for contractor score card by category and fiscal year of final payment to the contractor.*

The current economic climate is bringing more bidders to campus, many of whom are not familiar with MSU policies and procedures or even building practices in an institutional environment. Construction representatives are spending more time with these contractors to ensure compliance and hopefully meet expectations. It seems clear that contractor bids have much tighter margins, which is reducing project supervision and overhead costs. Combined with the heavy construction load for the next two years, contractor scores and performance may decline. MSU's Physical Plant and CPA staff are working with contractors to emphasize MSU's requirements, striving to provide a good end product for the campus users.

Although contractors see the close-out process as a challenge, it is encouraging that they continue to view MSU as a preferred customer. Contractors rate MSU strongest in project management and closeout, which is a product of the emphasis placed on these areas, particularly with the continuing implementation of Skire project management software.

In fiscal year 2008-09, EAS began using a design professional scorecard to provide similar feedback to architectural and engineering firms. The MSU design representative reviews performance on bidding (the quality of the documents put out for bid and used to construct the project); coordination among the design disciplines; communication, including responsiveness to MSU throughout the project; management, including professionalism and reasonableness; and schedule, which includes meeting the design milestones necessary for the project.

Figure 11 details average scores against each of these factors, with the performance goal in the background.

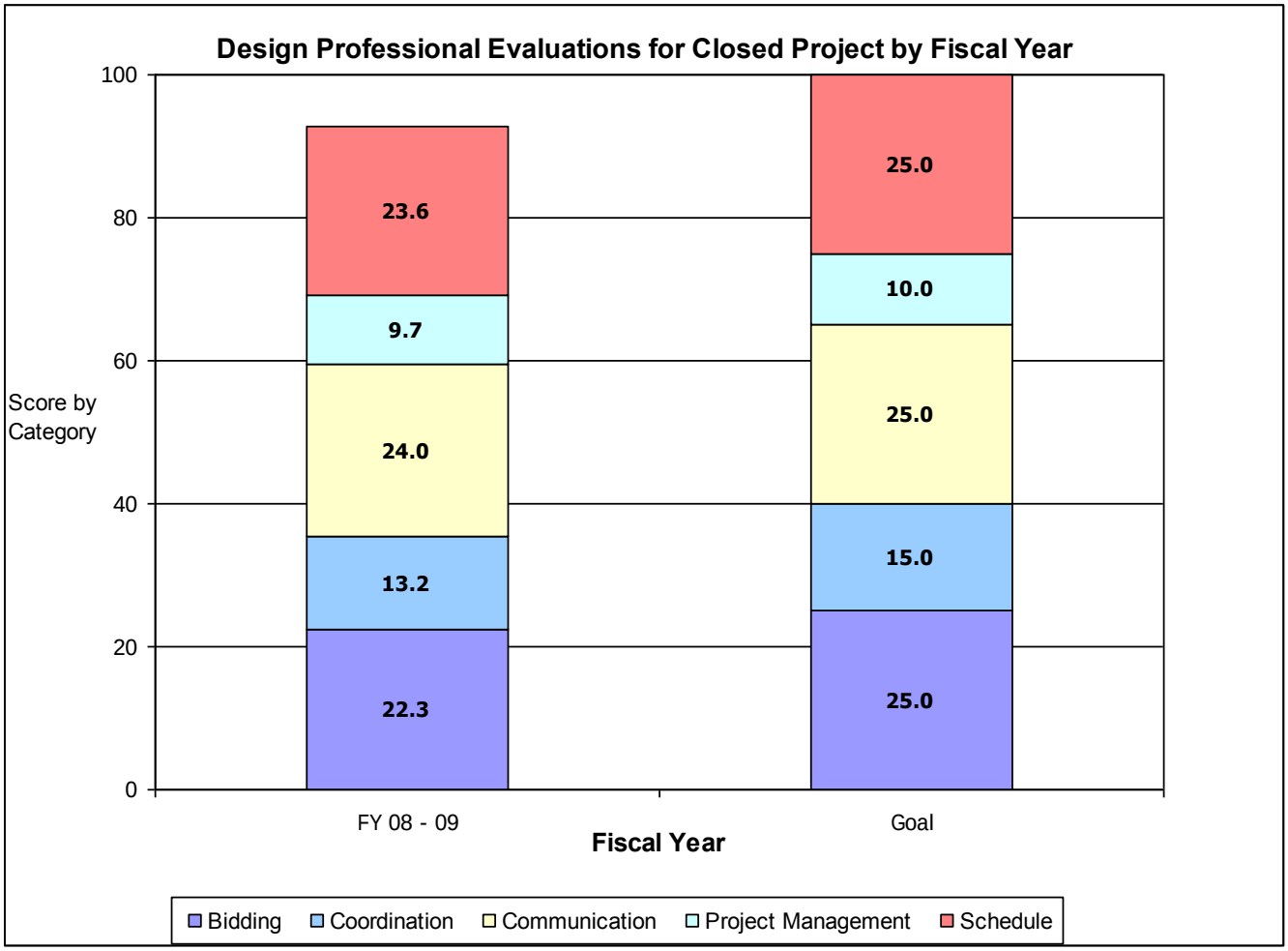


Figure 11. *Average design professional score by category.*

Initial scores are very positive, with firms scoring particularly well in communication, project management, and to a lesser degree in schedule. Bidding and coordination can be improved. EAS is addressing these issues through Building Information Modeling (BIM), which creates a true, three dimensional model of the design that contractors and subcontractors can use to coordinate details prior to installation in the field. This technique eliminates waste during construction by allowing more fabrication in the shop rather than the field and reduces conflicts that require work to be removed and reinstalled. The model can also be used as a tool for operations and maintenance, giving precise information on the equipment that must be maintained.

The Secchia Center was designed using BIM, and it appears to be a major factor in the high quality construction documents created for the project. Most of MSU's current large projects are using BIM, including the Broad Art Museum, Morrill Hall Replacement, and the Plant Science Expansion. EAS is working with the design community to establish new standards for MSU to use BIM on all projects for both construction and the entire life cycle of the building.

Construction Future Directions

Post Occupancy Evaluations

This chapter has focused on a number of issues related to project execution, particularly cost and schedule. MSU's efforts will expand to include information about customer satisfaction and perceptions, building performance, and accomplishment of stated design goals. The university is in the process of filling a new position of Building Process Analyst (BPA). One the most important tasks of the BPA will be to institute a formal Post Occupancy Evaluation (POE) program, which will gather information about customer satisfaction and perceptions, building performance, and accomplishment of stated design goals. The position will work with stakeholders to define MSU's current building processes, measure and analyze the current effectiveness of these processes, develop and implement improvements, and monitor success of implemented changes. The successful candidate will work collaboratively with the entire team to find solutions to identified problems. This will be accomplished through meetings with MSU staff and administrators, architects/engineers, contractors, construction managers, and building occupants. As well as through, collecting and analyzing data related to the campus-built environment from initial concept through occupancy, conducting post-occupancy evaluations of projects, and other methods and techniques as appropriate. The position will prepare reports of findings, develop and implement process improvements with the stakeholders, measure the effectiveness of changes, and collaborate on further process improvements.

Expediting Final Closeout

To date, the university has not been able to significantly improve project closeout times. As noted above, some improvement will come as projects with better budgeting and schedule progress through construction. CPA and EAS are continuing to implement business processes in Skire project management software that will help complete tasks more timely. Change orders have been implemented for all projects in construction since March 2008. This allows management to track aging change orders and force resolution. A new process for work by MSU is in the process of implementation. This new process requires providers to validate cost and schedule for their functions prior to the establishing the project budget. Process such as scorecards, submittals, supplier diversity verification, and construction waste management are either in use now or will be by the end of fiscal year 2009-10. All of these processes will expedite the closeout process for the university and the contractor.

Building Information Modeling

As discussed above, the design and construction industry is undergoing a technological transformation. BIM tools will allow the design intent to be more efficiently constructed and support maintenance throughout the life cycle of the building. Figures 12 and 13 show examples of 'clash detection' on the Eli and Edythe Broad Art Museum. In both cases, the mechanical system specifications conflicted with other systems. Identifying these conflicts prior to bidding and construction will expedite project schedules, reduce costs, and minimize claims and disputes.

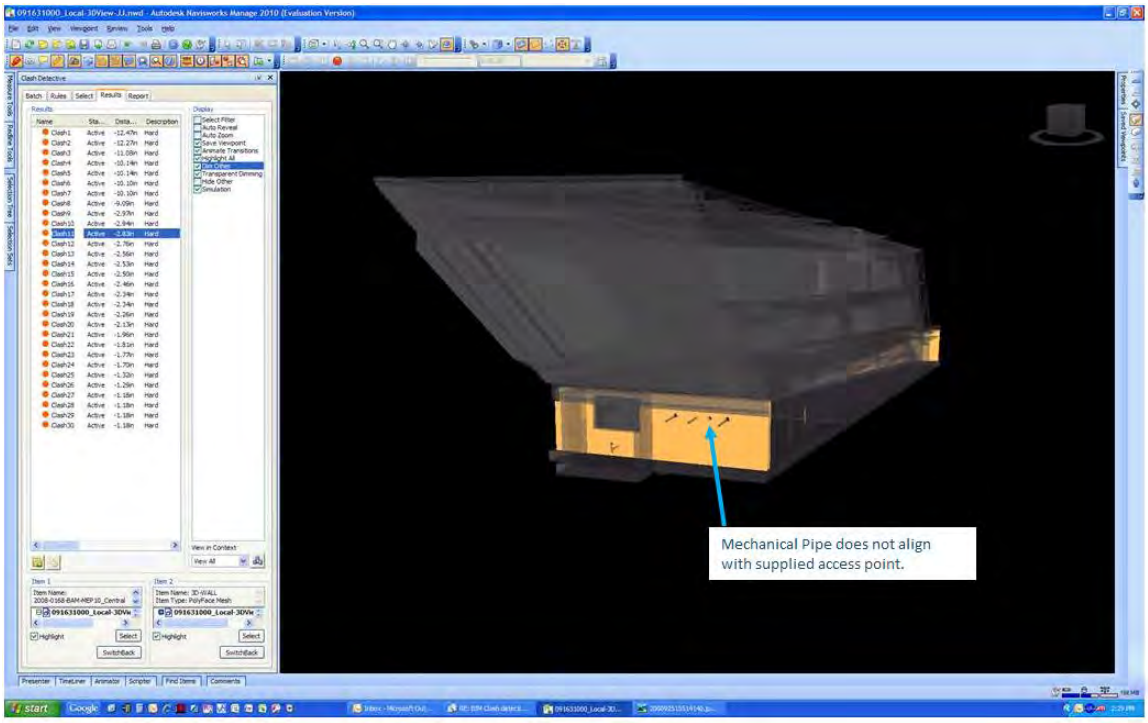


Figure 12. *Example of BIM clash detection report on the Eli and Edythe Broad Art Museum. The mechanical pipe does not align with the access point.*

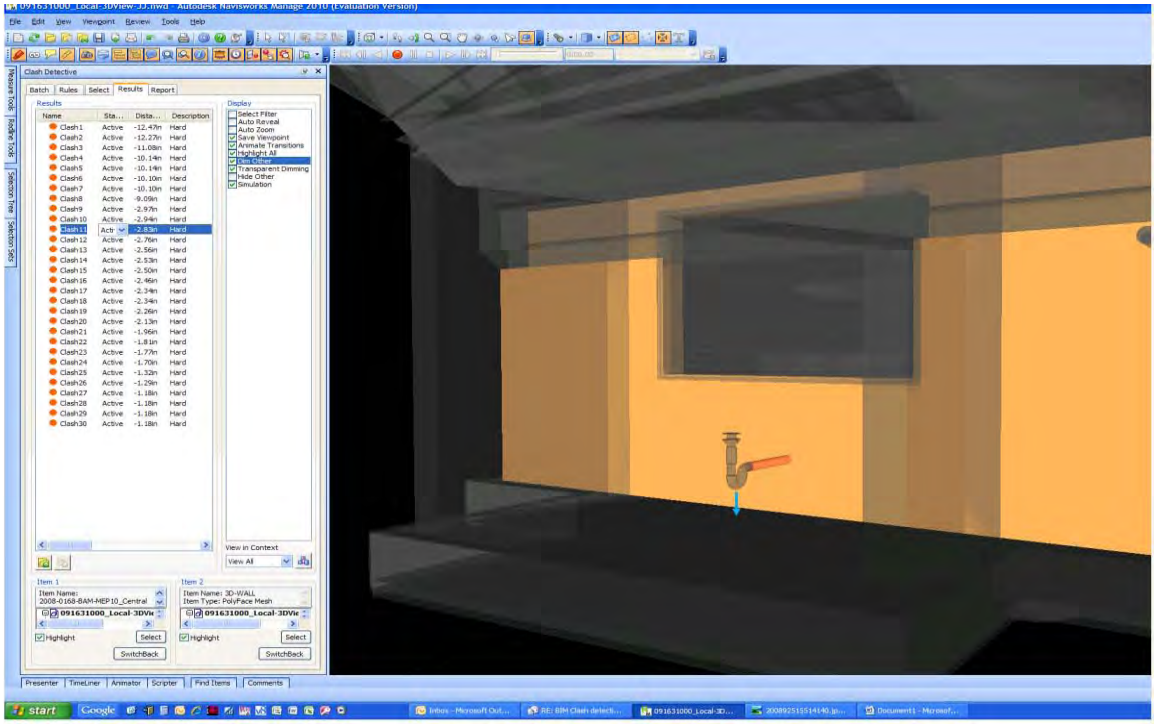


Figure 13. *Example of BIM clash detection report on the Eli and Edythe Broad Art Museum project. The drain is not set at the proper height.*

BIM is also a powerful visual tool, particularly for those not familiar with detailed construction plans and specifications. Figure 14 shows a cross-section of the Plant Sciences expansion, highlighting the ductwork. These images can be very helpful tools for reviews with building occupants and help MSU meet the customer project requirements.

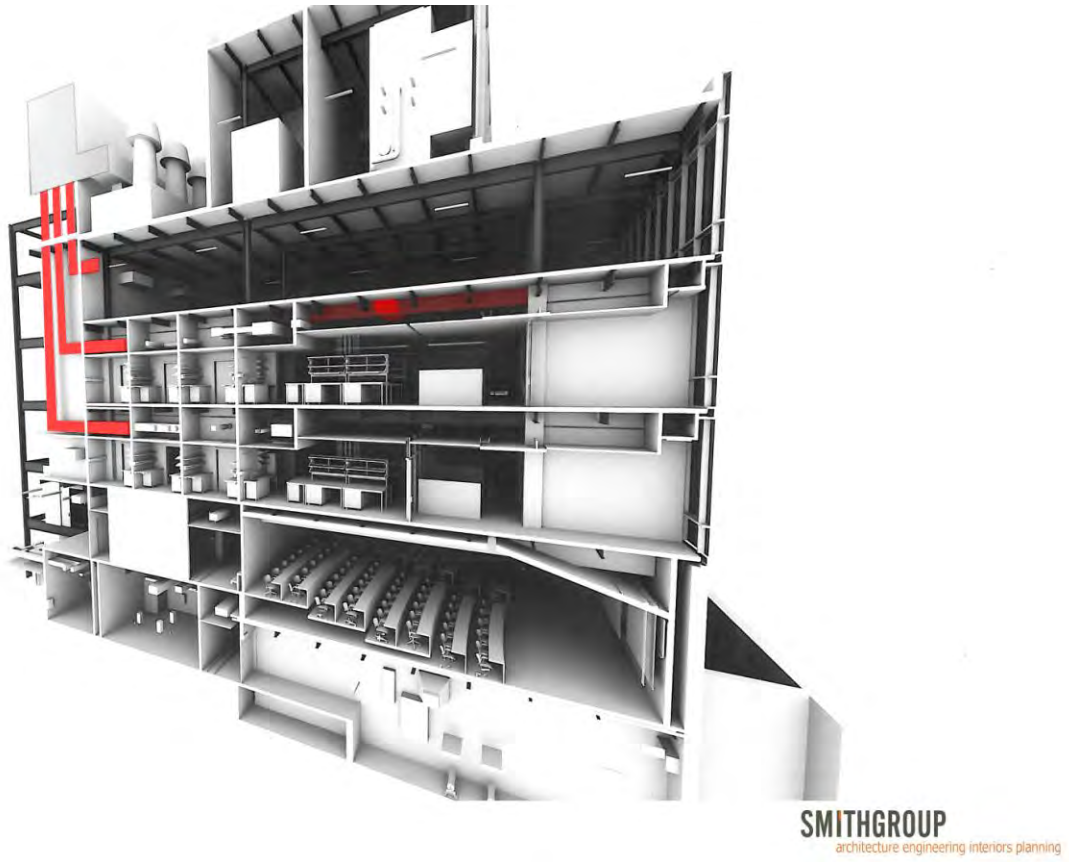


Figure 14. *Example of BIM cross section of the Plant Sciences expansion, highlighting the air handling ductwork.*

Regulatory Issues

Summary

Michigan's Department of Environmental Quality's (MDEQ), Air, Water, and Solid Waste Divisions regulates the operation of utility generation systems for electricity, steam, and drinking water supplying Michigan State University (MSU) and the management of storm water and ground water aquifer systems. MDEQ is responsible for administering and ensuring compliance with existing regulations and incorporating new requirements mandated by the Federal Environmental Protection Agency (EPA).

MSU is responsible for managing the following in accordance with regulatory requirements:

1. Air Quality: Emissions from the power plant under a renewable operating permit
2. Solid Waste: Practices under subpart D of the Resource Conservation Recovery Act
3. Potable Water: Disinfection under the Safe Drinking Water Act
4. Ground Water: Sanitary Surveys of public water supplies under the Federal Groundwater Rules
5. Storm Water: Discharges under a watershed-based storm water permit

Several regulatory changes are being considered by the U.S. Congress and the EPA which will impact the above listed activities. The analysis section of this report provides information about developing regulatory issues in these areas and the potential impact on campus resources.

Analysis

1. AIR QUALITY

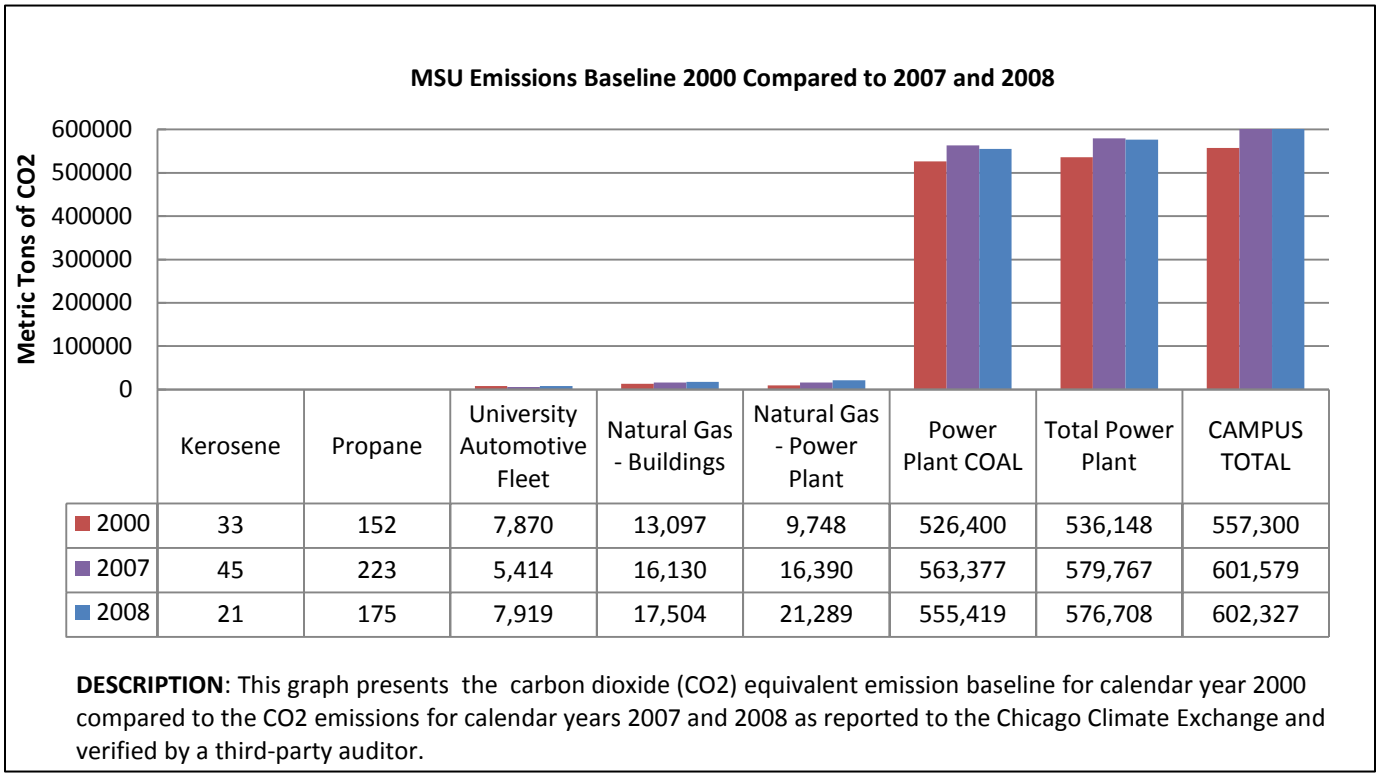
A. Climate – Greenhouse Gas Regulation

The EPA and U.S. Congress are considering administrative and legislative processes to control future greenhouse gas (GHG) emissions from U.S. combustion practices. Three of the six major greenhouse gases include carbon dioxide (CO2), methane, and nitrous oxide. On October 30, 2009, the EPA issued mandatory reporting of greenhouse gases with reports due in March 2011 for emissions from calendar year 2010.

The debate, from both the EPA and Congress, centers on the extent and pace of future GHG reductions. MSU compliance will likely include the use of alternative fuels and fuel switching at the T. B. Simon Power Plant. A plan for the "Next Generation of Energy" for the power plant is being developed to consider options for GHG reduction. This plan will outline the potential for renewable fuels and other types of fuel. It is estimated that 24,000 tons of CO2 reduction would occur if a processing facility for renewable fuels was available for fuel used in boiler number four. The estimated cost of a bio-processing facility, developed under the November

26, 2008 BOT Authorization to Plan T. B. Simon Plant-Bio Fuel Production Facility, is $20-25 million.

MSU reported 602,327 tons of campus CO2 emissions for the calendar year 2008 (Figure 1). Total potential CO2 reductions from renewable fuel and fuel switching of boiler number three to natural gas (see Industrial Boiler MACT "B" below) is 84,000 tons or 14% of 2008 emissions.



	Kerosene	Propane	University Automotive Fleet	Natural Gas - Buildings	Natural Gas - Power Plant	Power Plant COAL	Total Power Plant	CAMPUS TOTAL
2000	33	152	7,870	13,097	9,748	526,400	536,148	557,300
2007	45	223	5,414	16,130	16,390	563,377	579,767	601,579
2008	21	175	7,919	17,504	21,289	555,419	576,708	602,327

DESCRIPTION: This graph presents the carbon dioxide (CO2) equivalent emission baseline for calendar year 2000 compared to the CO2 emissions for calendar years 2007 and 2008 as reported to the Chicago Climate Exchange and verified by a third-party auditor.

Figure 1. *MSU emissions baseline 2000 compared to 2007 and 2008.*

B. Industrial Boiler MACT (Maximum Achievable Control Technology)

The EPA is currently preparing new regulations for hazardous air pollutants from industrial boilers. It is expected that draft rules for the regulation of mercury, chlorine, particulates, and others will be released in mid-2010.

At this time, it appears likely that T.B. Simon Power Plant boiler units one and two will maintain coal firing with the addition of new emission control devices. Preliminary budget estimates for an installation of a hydrated lime injection system are $1.5-2 million per boiler capital cost plus $400,000 annual operating expense.

T. B. Simon Power Plant boiler number three may have to operate on only natural gas beginning fiscal year 2013-2014, as a result of this developing rule. Switching boiler number three to natural gas because of Boiler MACT will provide a reduction of approximately 60,000 tons CO2, which is approximately 10% of the campus CO2 footprint. Based on historical coal

and gas costs, the fuel budget to purchase power plant fuel would increase $4-5 million annually for increased natural gas burn.

T. B. Simon Power Plant boiler number four is not expected to require modifications.

2. SOLID WASTE

A. Coal Ash Classification

MSU has been generating coal ash since the turn of the century when the North Campus Power Plant was in operation. Coal ash and coal ash disposal practices have historically been defined by the EPA as non-hazardous materials and practices. Coal ash produced from the North Campus Power Plant and the Shaw Lane Power Plant was considered to be an inert waste material and was commonly used to fill in low land and road sub base areas. The classification of coal ash has been reviewed by the EPA over the last decade with no regulatory changes.

The reclassification of coal ash from coal combustion is, again, receiving national attention. Two recent catastrophic failures at utility coal ash impoundment sites have created public pressure for the EPA to write new standards. The EPA is considering designating coal ash from power plants as a hazardous material. They are considering a hybrid rule where dry disposal practices could be considered non-hazardous. A final ruling is expected in December of 2009. MSU will closely monitor this decision.

Disposal for coal ash is accomplished by using dry and wet practices. Dry practices include recycling manufactured cement, gypsum and concrete industries, and landfill. Wet practices involve slurry transport systems to impoundment ponds.

The T. B. Simon Power Plant uses dry recycling and landfill practices for the disposal of coal ash. A change in the regulatory status could eliminate future disposal of coal ash in recycling opportunities and change remediation practices for known landfill disposal sites on MSU property.

Recycling options of coal ash have provided an economic savings for MSU's cost of utilities. MSU began using recycling opportunities in 1990, when coal ash was used as a raw ingredient in the manufacture of cement. Later, MSU's coal ash was used in the manufacture of agricultural fertilizer. This saving is estimated at an annual cost avoidance of $150,000-200,000 for fiscal year 2008-09.

Material that was not recycled has been disposed of in a Type II landfill, regulated under Michigan PA 451 Part 115 of the Natural Resource and Environmental Protection Act. A Type II landfill is licensed for all non-hazardous municipal waste. A reclassification of coal ash as a hazardous material would mean all future MSU coal ash would be sent to a regulated hazardous waste landfill. Disposal costs (tipping fees) at hazardous waste landfills are more

than 10 times greater than municipal waste landfills. MSU coal ash disposal costs would increase $9 to $10 million annually (a significant increase) if this becomes a reality. Currently, there is not enough hazardous waste landfill space in operation to accept all the coal ash that currently is land filled by utilities in the state of Michigan or in the entire country.

Because of landfill capacity issues and the impact on the cost of energy, it appears likely that the final rules will recognize the need to allow existing Type II landfills to continue accepting coal ash under a new classification. It is also likely that coal ash disposal costs from local landfills will increase because of the changes. If this happens, the increased costs may not be as high as disposing at a hazardous waste landfill.

B. Coal Ash Classification – Remediation

Rules for disposal of waste and regulation of landfills did not begin in Michigan until 1978. Prior to the development of Service Road in the early 1960s, MSU disposed of unregulated waste materials in the area which is now known as the T. B. Simon Power Plant site. Solid waste refuse (bottles, glassware, and construction debris) has been uncovered during the construction of the T. B. Simon Power Plant foundations.

In 2008, during Phase I of the Farm Lane Underpass project, coal ash was uncovered and an additional site investigation confirmed that coal ash (dry) is widespread in the greater vicinity of the power plant (Figure 2) and was also historically disposed of at the Jolly Road site (Figure 3). During construction of the Farm Lane Underpass project, samples of the coal ash were collected and submitted for waste characterization analysis. Concentrations of metals in the coal ash were present above MDEQ 201 criteria. Based on exceeding Part 201 criteria, the coal ash is deemed as a regulated substance and must be handled in accordance with MDEQ regulations. As part of waste characterization, the coal ash was also analyzed for Toxic Characteristic Leach Potential (TCLP) for metals. Results of the TCLP analysis showed no reported metal concentrations above the regulated reporting criteria. This indicates that the coal ash is not a hazardous waste and has a very low potential for metals to leach from the coal ash.

Because of the already developed campus buildings with extensive infrastructure, it is not practical to remove all of the verified coal ash at the power plant site. Given the aforementioned circumstances, MSU and MDEQ staff came to an agreement on the management of coal ash encountered during construction/excavation activities. Coal ash that is present beneath the “footprint” of the construction project can be left in place. To comply with Part 201 criteria, any coal ash that is excavated either must be disposed of in a Type II landfill or relocated to an on-site property with similar contamination such as the Jolly Road site. MDEQ lists 201 sites with concentrations that exceed the Generic Residential Cleanup Criteria for soil and groundwater. The property surrounding the T.B. Simon Power Plant was recently classified as such a site, and the Jolly Road site has been classified as 201 since the early 1980s. Both sites are designated as low priority by the MDEQ for site closure.

Figure 2. *Power Plant greater vicinity.*

Figure 3. *Jolly Road site.*

3. POTABLE WATER

A. Chlorination System

Injecting chlorine gas is a relatively inexpensive and highly effective disinfection method for potable water. All municipal water supplies use some form of disinfection in order to prevent the outbreak of waterborne diseases such as cholera, typhoid fever, and others. Disinfection is considered the single most important treatment in the production of safe, potable water.

In 2008, with grant money from the U.S. Department of Homeland Security, the MDEQ hired two engineering firms to meet with representatives of all public water and wastewater systems in the state of Michigan using chlorine gas, to encourage them to switch to another method of disinfection. Gaseous chlorine is highly toxic and there is concern among security experts that it can be used for weaponries. MSU met with a consultant from Prein and Newhof who identified non gaseous chlorine alternatives, such as sodium hypochlorite (liquid chlorine), ozone, and ultraviolet radiation, and encouraged MSU to give serious consideration to switching to one of them.

Currently, the U.S. House of Representatives is working on chemical security legislation that would require public water and wastewater utilities to use Inherently Safer Technology (IST) for water treatment. Passage of this legislation could lead to the banning of gaseous chlorine for potable water disinfection and switching to another method.

Because of the MDEQ suggestion in 2008 and because of the U.S. regulatory activity in 2009, Fishbeck, Thompson, Carr, and Huber were commissioned to study implementation of alternative potable water disinfection methods. The capital project cost to switch is estimated at about $1,500,000. Operating cost for the MSU drinking water system will increase approximately $25,000 per year due to the higher cost of the alternative disinfectant.

In anticipation of this change becoming required, this item is being included in the forecast of Power and Water Major Repair and Replacement projects. A chlorination treatment change will be recommended when the activity is required.

4. GROUNDWATER RULE

A. MSU Water Storage Capacity

The federal Groundwater Rule became effective December 1, 2009. This rule requires individual state primacy agencies (the MDEQ in Michigan) to conduct sanitary surveys of public water supplies (PWS) and identify “significant deficiencies” that the PWS must correct. The rule stipulates that the MDEQ must assess a PWS’ source of water, treatment processes, distribution system, finished water storage, pumping systems, monitoring and reporting, system management and operation, and operator certification. Once identified, a PWS has a fixed amount of time to correct or submit a plan to correct such deficiencies.

The MDEQ has conducted periodic surveys and provided comments on MSU's public water supply for quite some time. In this most recent 2009 survey, they commented that MSU's current storage capacity is only 20% of the *Recommended Standard for Water Works* and advised, "It is still important that the need for additional storage be seriously evaluated. It should also be noted that the existing reservoir was constructed in 1947 and is over 60 years old. Although this type of buried concrete structure has a long service life, planning for a replacement facility should be started." The new Groundwater Rule will provide MDEQ the authority to require MSU to plan for the increase of water storage capacity.

The existing concrete structure is cleaned and inspected every five years. The most recent inspection occurred in summer of 2009. This inspection confirmed continued satisfactory structural performance of the reservoir. An increase of water storage capacity will be recommended if the MDEQ makes this a requirement.

5. STORM WATER MANAGEMENT

A. Watershed-wide Coordination

In September 2009, the MDEQ issued a Certificate of Coverage (COC) to MSU for its watershed-based storm water permit. The COC allows for the discharge of storm water through the storm drainage network to the Red Cedar River, outlines responsibilities under the permit, and provides a timeline for deliverables through July 1, 2013.

As throughout the first permit cycle (2003-2008), MSU continues to work with approximately 20 watershed partners in the greater Lansing region to implement watershed management plans for the urbanized area. These plans provide the framework for regional and campus-based activities that will be undertaken as part of the new five-year storm water permit. As a member of the Greater Lansing Regional Committee (GLRC), the university plays an active role in the GLRC through participation on various subcommittees.

Tasks specified in the COC, which will be accomplished through the GLRC with full participation by MSU, include the development and implementation of a watershed-wide public participation plan to ensure stakeholder involvement in watershed protection activities, a large-scale public education campaign for the region, information sharing for the development of approaches for post construction controls of storm water runoff, and updates to the Red Cedar River Watershed Management Plan (WMP).

B. Storm Water Pollution Prevention Initiative

An update to the university's Storm Water Pollution Prevention Initiative (SWPPI) will be submitted to the MDEQ by July 1, 2010. The purpose of the SWPPI is to bring together the following storm water pollution controls on campus:

- Goals and actions from the Red Cedar River WMP.
- Actions applicable to pollution prevention and good housekeeping for the MSU campus, including staff and contractor training, inspection and maintenance of storm water structural controls, reduction of total suspended solids from roadways to the maximum extent practicable, and the use of best management practices for vegetated properties.
- Actions applicable to post construction controls for areas of significant development and redevelopment described in this section.
- Details and schedules to describe the process for implementing the program.
- Evaluation methods to demonstrate the reduction of storm water pollution to the maximum extent practicable.

The SWPPI will include an updated Illicit Discharge Elimination Plan (IDEP) and updated Public Education Plan (PEP). Implementation of SWPPI activities, with the exception of the alternative approach to post construction controls, is to commence upon submittal.

C. Alternative Approach to Post Construction Controls

As stated in the 2009 report, the new storm water regulations contain much more prescriptive standards for both water quality and quantity controls. In its storm water discharge permit application, MSU requested an alternative approach to meeting the regulations. Negotiations continue with MDEQ regarding this approach. MDEQ representatives have agreed to the concept of an offset approach for the university. A storm water credit system would be established to allow for runoff credits from areas of campus which are able to hold and treat runoff that can be used in areas of development where highly impermeable soils or an ultra-urbanized setting would make meeting the standards onsite difficult (e.g., the Eli and Edythe Broad Art Museum site).

Specific standards for water volume and quality controls as part of this alternative approach are still being negotiated. A final approach will be submitted for MDEQ approval by July 1, 2010. Implementation of the alternative approach is required once final approval is received from MDEQ. Once again, it is important to stress that construction of storm water treatment systems and long-term operation and maintenance of them may significantly affect future project costs and scheduling.

D. Focus on Low Impact Development Techniques

The university continues to emphasize Low Impact Development (LID) techniques for providing credits to meet post construction storm water standards. A bio-retention area has been constructed as part of the Farm Lane Underpass project that will treat storm water runoff from the roadway and sidewalks, and will also serve as an LID research and demonstration site. Several LID design techniques were incorporated into the MSU Surplus Store and Recycling Center, including bio-retention areas, cisterns for rainwater harvesting, and reuse and porous pavement.

In addition to LID design techniques, proprietary treatment systems can also be used to address water quality concerns in urban areas, such as the water treatment device that was installed as part of the Birch and Wilson Roads project in 2009 (Figure 4).

Figure 4. *Nutrient separating baffle box being installed at Birch and Wilson Roads in 2009.*

Regulatory Future Directions

Developing air quality and climate regulations are likely to impact the historical coal fired practices used at T.B. Simon Power Plant. These regulations are being monitored and will be the basis for planning the next generation of energy supplies for MSU.

Reclassification of coal ash is likely to limit MSU's ability to recycle this material and will cause an increase in the cost of landfill disposal. Currently, in conjunction with an MSU professor, there is ongoing research for a recycled alternative use for coal ash.

Developing drinking water rules may cause MSU to change the current chlorination process to a non-aqueous source. Developing groundwater rules may give MDEQ the authority to require MSU to increase drinking water storage capacity.

Storm water management activities on MSU's campus will continue to emphasize an integrated approach that draws upon the expertise of faculty, staff, and students representing multiple departments and service units. The university's partnership with communities throughout the greater

Lansing area as a member of the GLRC provides an excellent opportunity to lead by example and protect water quality on a watershed basis. The storm water management work will be an important component of the campus environmental stewardship initiative during the coming years.

ENVIRONMENTAL STEWARDSHIP

Summary

Environmental stewardship continues to be an important focus for Michigan State University (MSU). Success in this area has multiple impacts including reducing the environmental footprint of the university and cost savings for energy and material resources.

The Environmental Stewardship Systems Team continued to conduct research and pilot projects to reduce inputs to the campus, increase reuse and recycling, and decrease outputs from campus. In addition, the team established key indicators to illustrate campus wide progress toward its goals of reducing greenhouse gases and electrical energy by 15% and landfill waste by 30%, by the year 2015.

The third phase of the Environmental Stewardship Systems Team recommendations reflect the continued focus on decreasing energy and reducing waste, with additional focus areas on transportation and food. Additionally, a new Boldness by Design initiative was developed to focus on water use and conservation. The next year's work will include a focus on food waste and how operationalizing food composting on a broader scale may lend itself to reducing environmental impacts.

In spring 2009, the opportunity arose to examine the roles of the Environmental Stewardship Systems Team and the Office of Campus Sustainability to gain efficiencies, and transition environmental stewardship from an initiative of Vice President Fred Poston to a more permanent structure. As a result, a new model for the Office of Campus Sustainability was created integrating the attributes of environmental stewardship and sustainability.

Analysis

Key Indicators

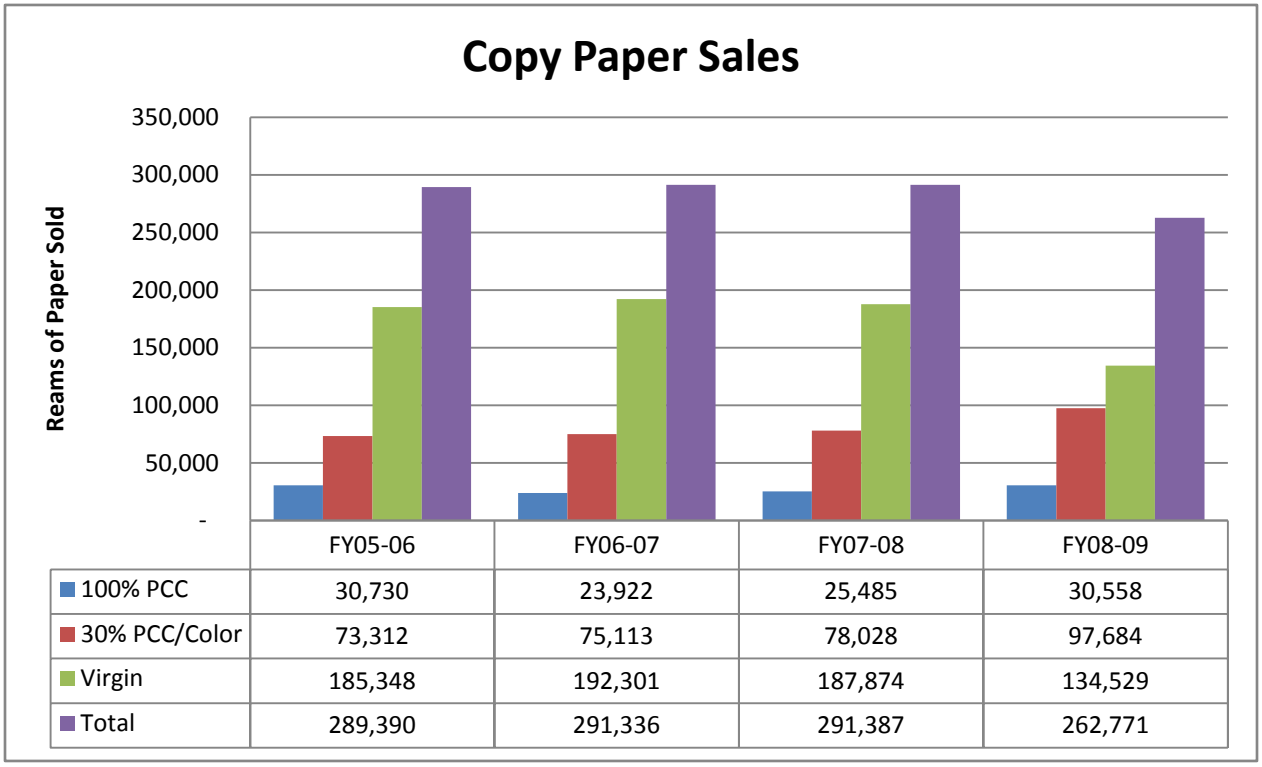
Data has been paramount to making decisions and recommendations for environmental stewardship. Many metrics have been identified and collected. However, there was a need to select key indicators to communicate MSU's progress toward environmental stewardship goals to wide audiences. As such, key indicators for emissions, energy, and waste were selected at the input, recycling/reuse, and output parts of the campus system. The key indicators will reflect the overall campus progress.

The following key indicators illustrate the environmental stewardship data and progress through fiscal year 2008-09:

White Copy Paper Key Indicator

Copy paper was selected as a key material input indicator because the majority of copy paper purchases are made through MSU Purchasing. All material inputs to campus are not always purchased through University Stores, thus an aggregate input data point was not feasible.

Figure 1 shows the MSU purchasing activity for copy paper. Copy paper purchase options include paper made from virgin (non-recycled) pulp, 30% recycled post consumer content (PCC), and 100% recycled PCC. The 30% PCC copy paper reflected in this chart includes both white and colored copy paper.



	FY05-06	FY06-07	FY07-08	FY08-09
100% PCC	30,730	23,922	25,485	30,558
30% PCC/Color	73,312	75,113	78,028	97,684
Virgin	185,348	192,301	187,874	134,529
Total	289,390	291,336	291,387	262,771

Figure 1. ***Key Indicator – White Copy Paper:*** *Copy paper sales from purchasing data.*

Copy paper sales volume is based on the standard 8.5” x 11” paper sheets used in copiers. The percentage reflects the percentage of recycled post consumer content used to manufacture the finished product. As an example, 30% recycled content means 30% of recycled material is used in the manufacturing process.

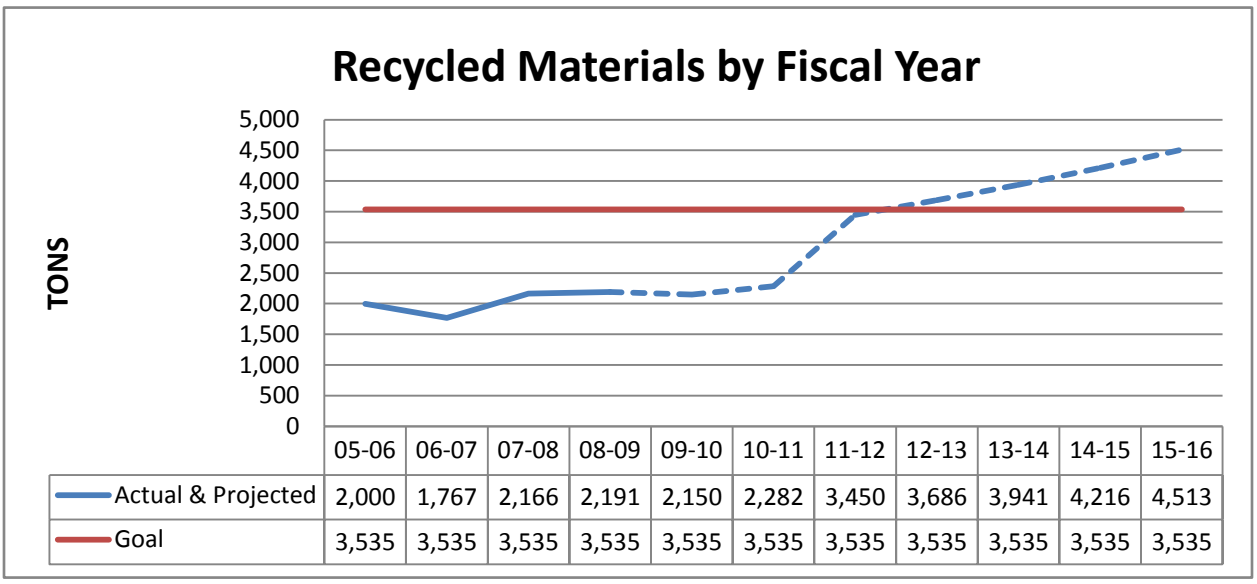
During fiscal year 2008-09, environmental stewardship initiatives appear to have resulted in behavior changes. Total copy paper sales have decreased by 10%; virgin content copy paper sales have decreased by 28.5%; 30% recycled PCC copy paper sales have increased by 25.2%, and 100% recycled PCC copy paper sales have increased by 19.9%.

Reduced paper usage, especially virgin pulp paper, has a positive impact on the MSU environmental footprint; less energy used to produce paper, reduced fuel/transportation costs, fewer trees used to produce paper, and less refuse going to the landfill. The 28,616 fewer reams of copy paper purchased in fiscal year 2008-09 means that over 143,080 pounds of copy paper never entered the waste stream.

Landfill Waste and Recycling Materials Key Indicators

Campus landfill waste and recycling for five major materials (white paper, mixed office paper, newspaper, cardboard, and #1and #2 plastics) were selected as key indicators and are

measured in tons. The recycling rate reflects the impact in reuse/recycling and the waste indicator shows the impact of the environmental stewardship program on waste outputs. In 2008, the Environmental Stewardship Systems Team set a goal to double the amount of materials recycled by 2012 based on fiscal year 2006-07 data (Figure 2). The MSU Surplus Store and Recycling Center business plan assumes that the recyclables should double in fiscal year 2011-12, due to the collection of new materials, then, increase at a rate of eight percent per year. Driving the projected capture rate is increased capacity and new technology that allows MSU to collect additional materials beginning January 2010. Those materials include boxboard, plastics #3 through #7 (plastic film, tubs, and containers), and metals.



	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16
Actual & Projected	2,000	1,767	2,166	2,191	2,150	2,282	3,450	3,686	3,941	4,216	4,513
Goal	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535	3,535

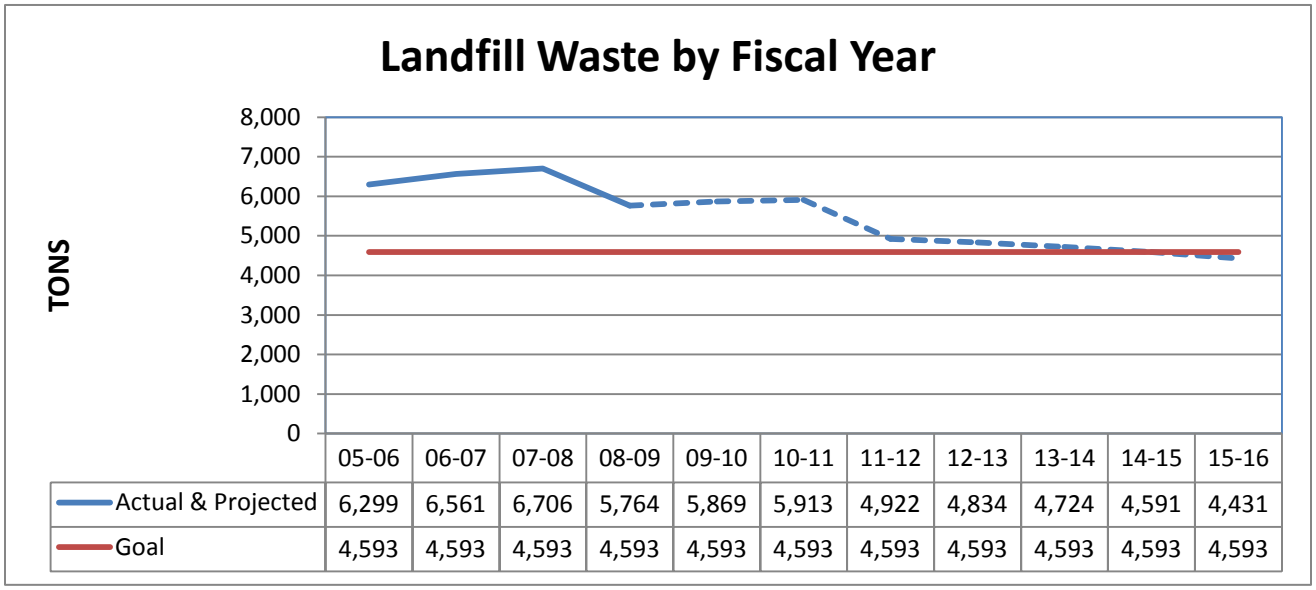
Figure 2. ***Key Indicator – Recycling Materials****: Actual tons of recyclable material through fiscal year 2008-09 (blue solid line) and projected (blue dotted line) recyclable material collected through fiscal year 2015-16. The red line indicates the goal of doubling the collection of recycled materials from fiscal year 2006-07.*

Prior to fiscal year 2007-08, recycling volumes decreased slightly, but when the enhanced recycling program was implemented, campus recycling volumes increased by 22.6%, or 191 tons.

White office paper recycling increased by 15.3% from 2007-08 to 2008-09 (201 tons, or 80,360 reams, of paper). Mixed office paper recycling increased by 12.2% from 2007-08 to 2008-09 (52 tons or 193,600 reams of paper). Cardboard recycling increased by six percent from 2007-08 to 2008-09 (45 tons of cardboard). Plastics #1 and #2 (clear plastics, such as water bottles, milk/juice jugs, and detergent bottles) recycling increased by 56.9% from 2007-08 to 2008-09, an increase of 16 tons.

It is important to note, that the campus goal is based on waste reduction. MSU is using a two-pronged strategy of reducing material inputs and increasing recycling to achieve the waste reduction goal. In some instances, the decrease of inputs may decrease the amount of recycled materials collected. Newspaper is a good example of this trend. Newspaper recycling decreased by 11.1% from 2007-08 to 2008-09. The decrease is likely the result of the national trend of lower newspaper circulation and increased use of online news media. Recycling may still increase over time as it increases the breadth of materials collected.

Figure 3 shows that campus landfill waste decreased by 14% from fiscal year 2007–08 to fiscal year 2008–09, for a reduction of 1,037 tons. This resulted in a landfill tipping fees savings of approximately $53,000. The reduction of landfill waste will be the result of multiple factors such as reduced inputs, re-use of materials, and recycling. Recycling is one of the major factors that contributed to the decreased landfill. However, fewer inputs also contribute to the reduction. For example, the bottled water purchase reduced from 1,114,910 water bottles in 2007-08 to 751,860 water bottles in 2008-09 for a total reduction of 363,050 bottles. The reduction of plastic inputs, coupled with the increase of plastic recycling, shows that MSU is reducing environmental impact upstream (inputs) and downstream (outputs).



	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16
Actual & Projected	6,299	6,561	6,706	5,764	5,869	5,913	4,922	4,834	4,724	4,591	4,431
Goal	4,593	4,593	4,593	4,593	4,593	4,593	4,593	4,593	4,593	4,593	4,593

Figure 3. ***Key Indicator - Landfill Waste****: Actual landfill data (blue solid line) through fiscal year 2008-09 and projected landfill data (blue dotted line) through fiscal year 2015-16 in tons. The red line represents the goal of reducing landfill waste 30% below a fiscal year 2006-07 baseline. Fiscal years run from July 1-June 30.*

Greenhouse Gas and Energy Key Indicators

Greenhouse gas (GHG) emissions goals and the activities, such as electrical energy use and alternative fuel utilization, which directly impacts these goals, were selected as key indicators.

Figure 4 shows MSU's GHG emissions, measured in carbon dioxide equivalents, have been increasing since 2005. In recent years, the rate of increase has slowed as a result of the environmental stewardship program. However, real reductions must be achieved to reach MSU's immediate goal of a six percent reduction from 2000 for the Chicago Climate Exchange (CCX) and the 2015 goal (indicated on the graph) of a 15% reduction by 2015. Although campus is using energy more efficiently, shown in figures later in this report, there has not been an overall net reduction. One of the biggest challenges is, while conservation programs are successful, the campus continues to add new square footage each year, thereby neutralizing conservation efforts.

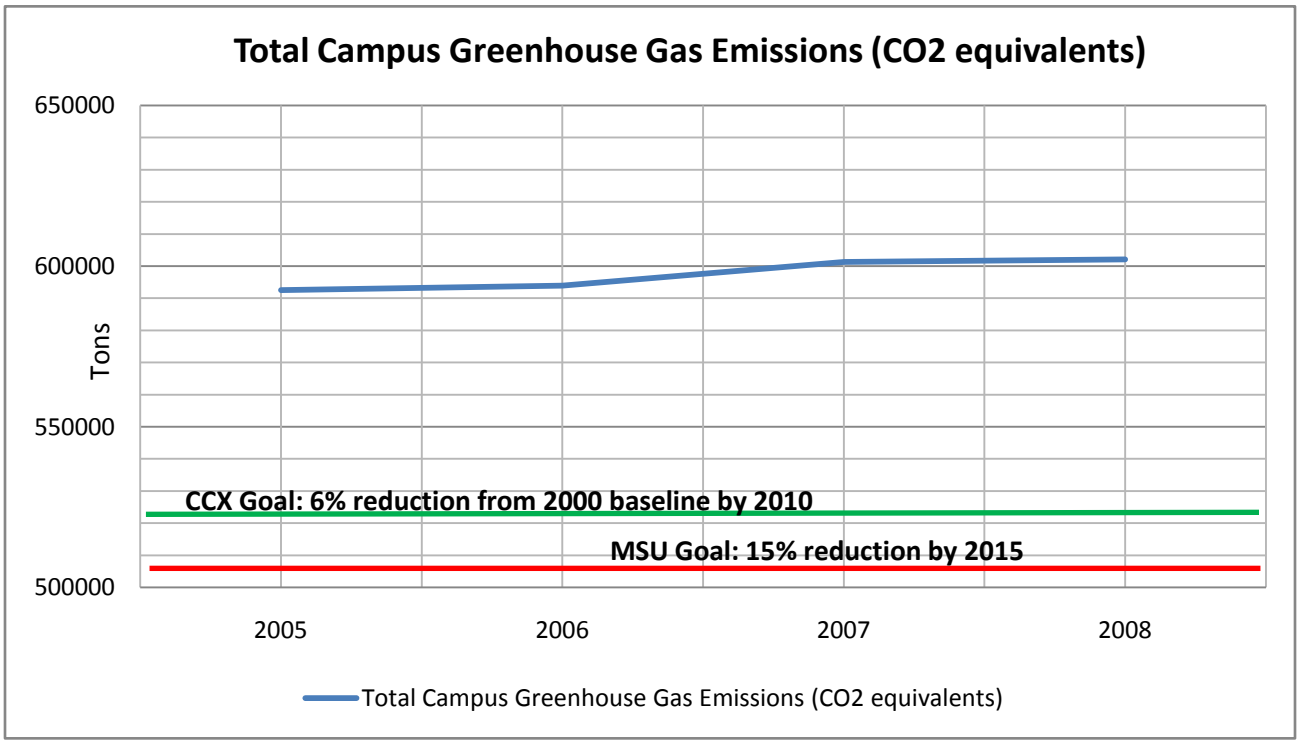


Figure 4. ***Key Indicator - Greenhouse Gas Emissions:*** *Total campus greenhouse gas emissions from 2005-2008. Figures include emissions from the power plant and University Automotive Fleet. The Chicago Climate Exchange (CCX) goal is based on a 2000 baseline vs. a 2005 baseline for the MSU goal.*

Figure 5 shows the upward trend of electrical consumption since 1983-84. Installing campus-wide data and computing technologies account for the increased demand on the energy infrastructure. The downward trend in 2008-09 may reflect the impact of renewed energy conservation efforts and other active operational changes.

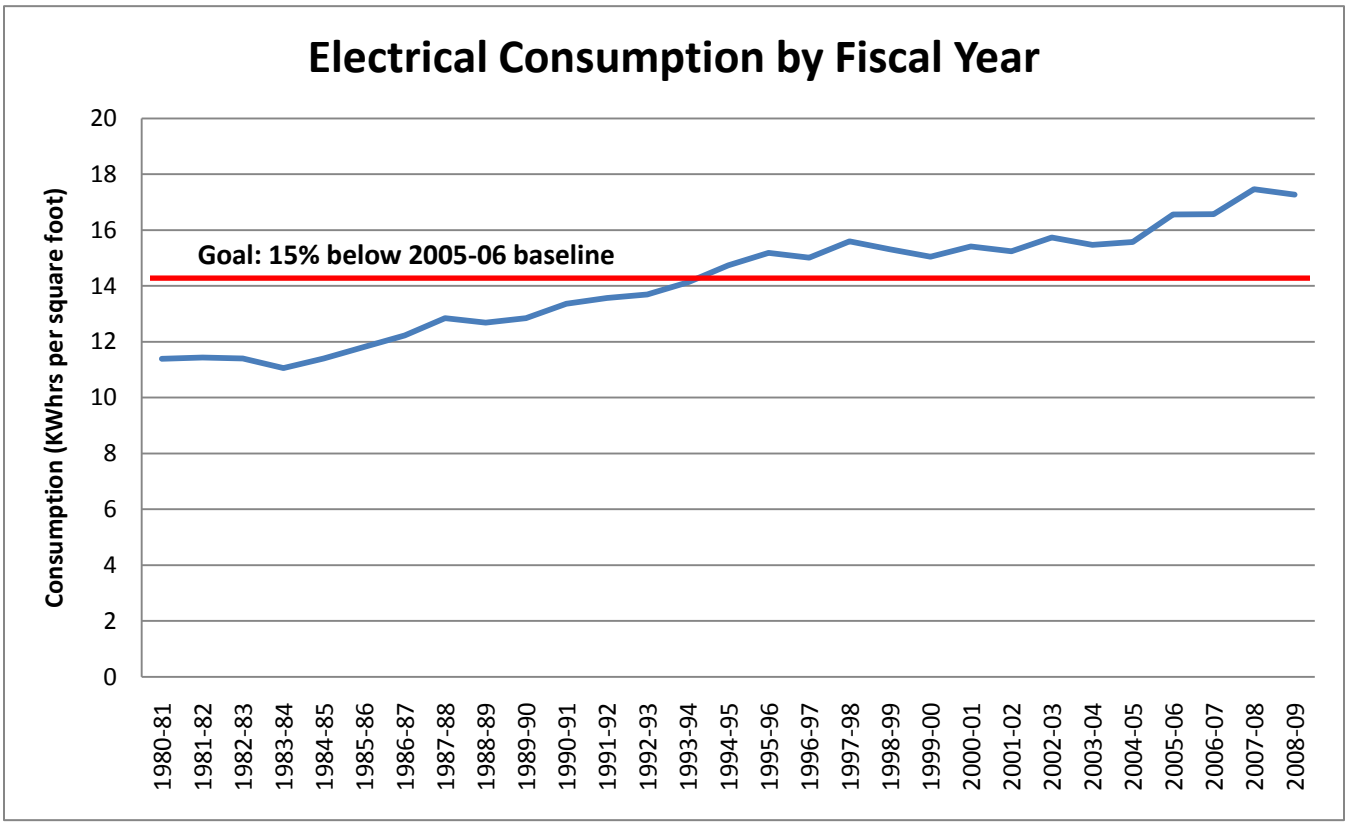


Figure 5. ***Key Indicator – Electrical Consumption****: Electricity consumed in kilowatt hours (KWhrs) per square foot from 1980-2009.*

The choice of fuels used to produce campus steam and electricity is based on power plant operating criteria and fuel costs. Historically, fuel costs have heavily favored coal firing, so natural gas was only used when coal systems were under repair. Since 2005, national coal markets have caused increased pricing and reduced the number of suppliers. In fiscal year 2008-09, decreasing natural gas market costs favored the increased burns of natural gas. As a result, natural gas usage percentage has been increasing since 2005. Whenever natural gas is burned it directly impacts the reduction of the campus CO2 emissions. Figure 6 shows the changes in the fuel mix from 2005-2009.

The power plant is a co-generation plant which means that electricity is a by-product of steam production. Steam is used for heating. When the demand for electricity and steam are equal, the plant is at its peak efficiency. For several years, electrical demand has exceeded steam demand and, as such, the plant is less efficient. Campus electrical and steam usage also show changes in energy conservation behaviors.

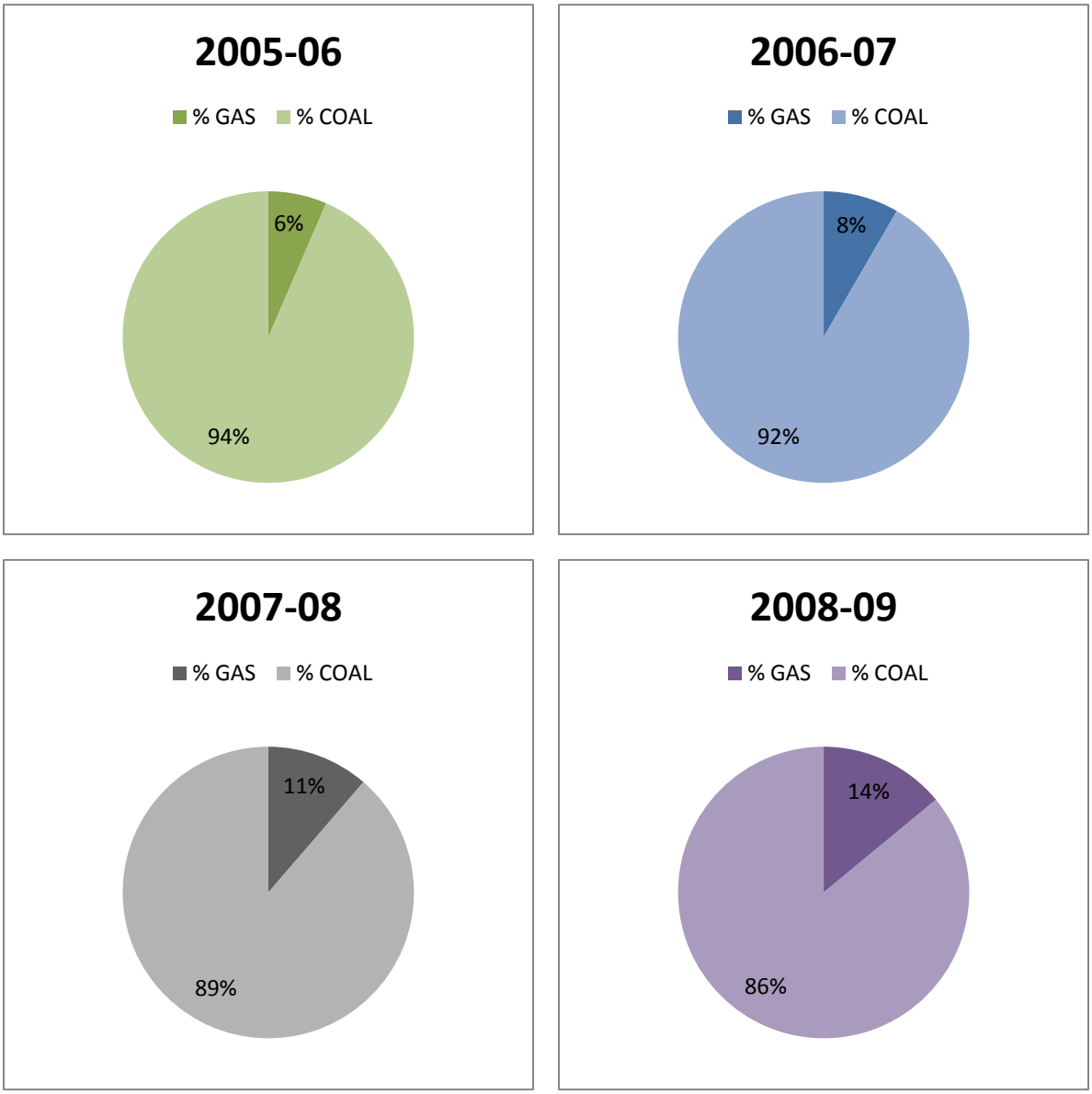


Figure 6. *Percentage of coal and gas usage by the MSU campus since 2005.*

Figures 7 and 8 show the change in electricity usage since 2005, by the MSU campus, averaged against campus building space (campus building space is based on the gross square footage of the buildings using electricity served by the power plant) and campus population. Campus population figures are provided by the Office of Planning and Budgets.

Kilowatt hour (KWhr) is a measure of electricity used in a one hour time block. Since 2005-06, while population has increased 7.4% and campus space increased 1.8%, KWhr/gross square feet has been flat and KWhr/person has decreased the last two years. This supports the conclusion that the campus community is individually using less electricity and conservation efforts are taking hold. New campus buildings are on average not increasing energy use per square foot, thus indicating that newer buildings use energy more efficiently. This may be attributed to Leadership in Energy and Environmental Design (LEED) standards being incorporated into MSU construction standards.

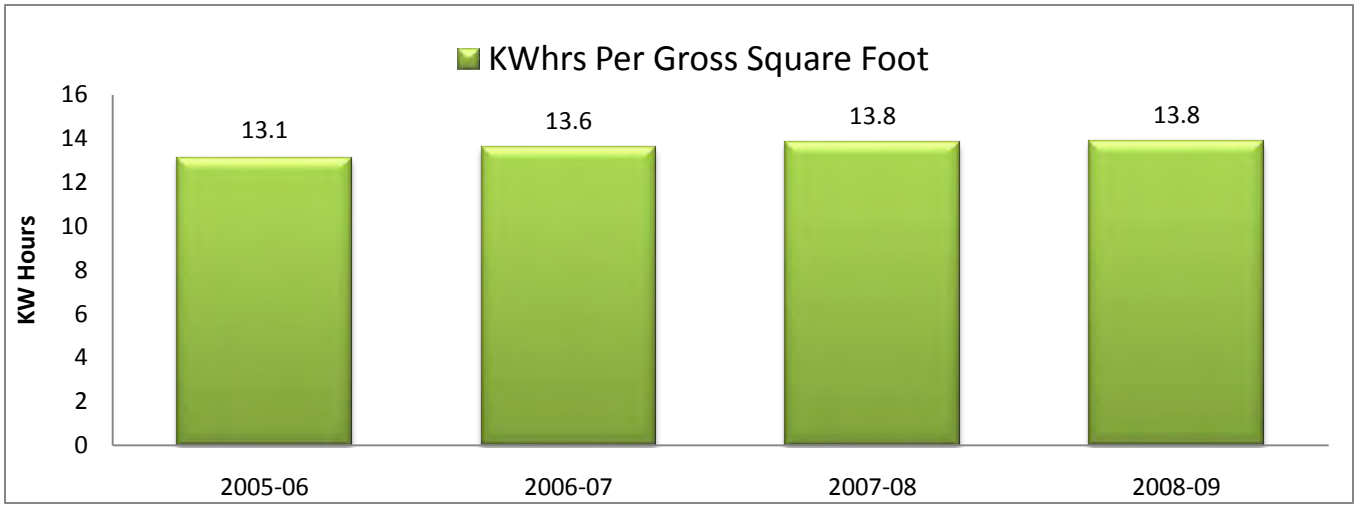


Figure 7. *Electrical usage measured in kilowatt hours (KWhrs) per gross square foot.*

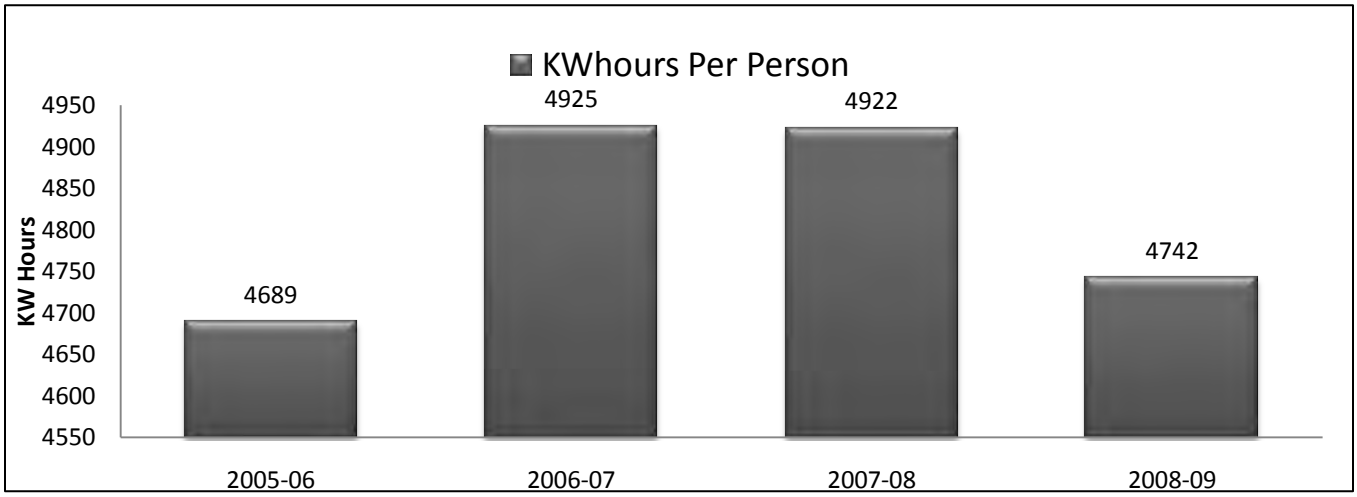


Figure 8. *Electrical usage measured in kilowatt hours (KWhrs) per person.*

Figures 9 and 10 show changes in energy consumed by the MSU campus, averaged against campus building space and campus population, since 2005.

British Thermal Units (BTUs) are a standard measurement of energy. It is approximately the amount of energy needed to heat one pound of water by one degree Fahrenheit. It is used in the power, steam generation, heating and cooling context. Energy from coal, natural gas, and other fuel sources can be expressed as BTUs to aggregate and/or compare data. Since 2005-06, while population has increased 7.4% and campus space increased 1.8%, BTU/square feet has reduced 1.8% and BTU/person has reduced 6.9%. This supports the conclusion that the campus population and buildings are being more energy efficient.

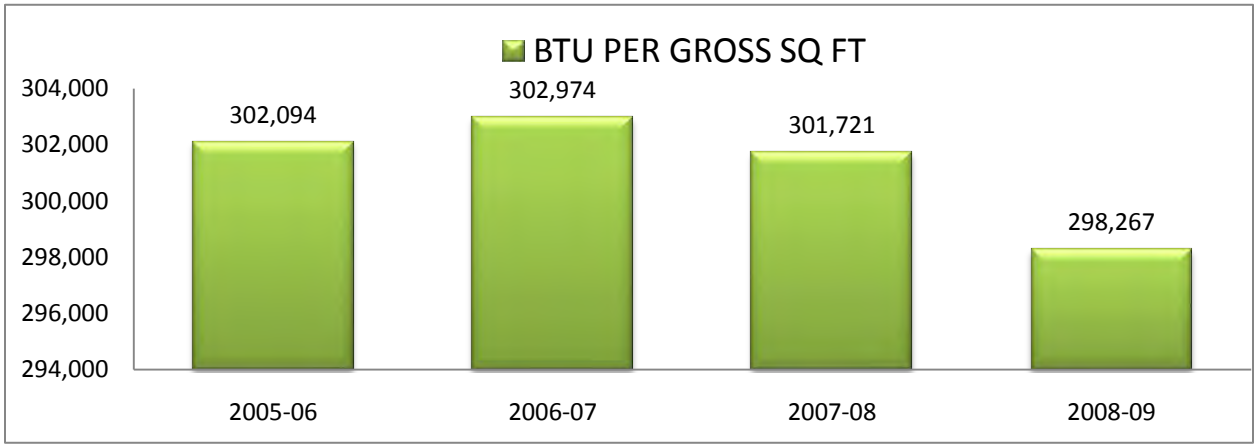


Figure 9. *British thermal units (BTU), a measure of energy, per gross square foot.*

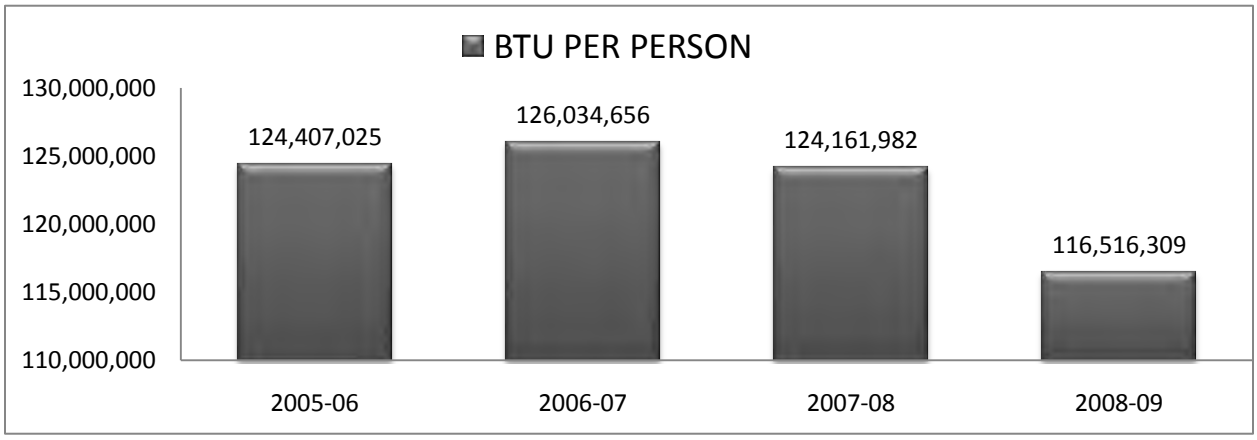


Figure 10. *British thermal units (BTU), a measure of energy, per person.*

Coal ash is produced as a by-product of burning coal. Figure 11 shows the amount of coal ash that is recycled and land filled. Coal ash is recycled as much as possible and what is not recycled goes to landfill. Coal ash landfill numbers are tracked separately from campus waste. Consequently, tons of coal ash are not included in overall campus waste data.

Annual coal ash recycling tons decreased from 2005 through 2008 and increased in 2008-09. Coal ash land filled decreased between 2005 and 2007; partly because of the increased use of natural gas as fuel (natural gas fuel does not create any waste ash). Due to the loss of a recycling vendor in Michigan, landfill coal ash increased in 2008-09.

Data from the indicators show that inputs are decreasing and MSU is on-track to meet its waste goals. Although the campus is using its energy more efficiently, emissions have not significantly decreased. More must be done to reduce GHG emissions.

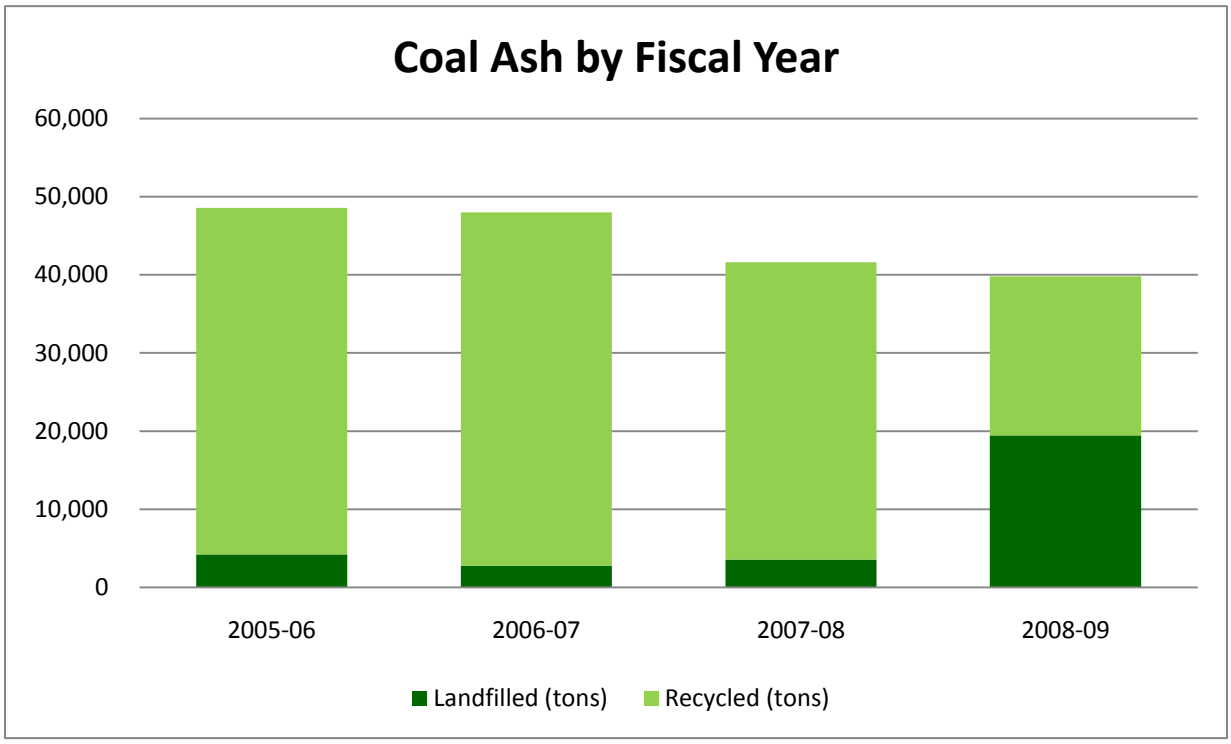


Figure 11. ***Key Indicator – Coal Ash:*** *Annual coal ash recycled and land filled since 2005.*

Long Range Energy Plan

To ensure MSU has the capability to deliver cost effective, reliable power, heating and cooling to campus to support the education and research goals of the university, it is essential that a strategic energy plan is developed. The plan would address issues such as campus demand, regulatory requirements for emissions, increasing fuel costs, facility and resource utilization, power plant changes, and future projections for these areas. The plan would include energy conservation initiatives, outline investment strategies, explore alternative energy solutions, and engage the campus community to create a culture that supports environmental stewardship.

The current energy and emission reduction goals set by the Environmental Stewardship Systems Team are to reduce energy consumption on campus 15% by 2015 and reduce

greenhouse gas emissions 15% by 2015. MSU has not achieved a net reduction of greenhouse gases; refer to Figure 4. MSU adds about one million square feet to campus every 10 years. Conservation programs and new technology has slowed the growth of greenhouse gas emissions. Figure 8 reflects that MSU is using energy more efficiently, but has not yet had a significant net decrease. The university should continue to increase the success of current programs and undertake new programs to meet its goals.

Initial steps taken to ensure reliable energy is delivered, while at the same time reducing consumption and emissions are:

- Modifications to fuel delivery system at the MSU power plant
- Biomass facility study
- Alternative energy concepts study
- Be Spartan Green energy conservation campaign
- GHG emissions reporting for campus through the Chicago Climate Exchange
- Heating, ventilating, and air conditioning studies in existing buildings
- Retro-commissioning of existing buildings - ten-year plan
- Real time smart electrical meter upgrades - three-year plan
- Increased number of buildings being continuously monitored by MSU's Physical Plant
- Classroom consolidation
- Weekend consolidation - ongoing
- Review of summer classes and consolidation opportunities
- Campus lighting retrofits
- Environmental stewardship program - over 600 stewards
- Green certification

Communication to the campus community on progress towards the energy and emission reduction goals is essential to create and sustain the conservation initiatives. The energy plan would provide a timeline for major capital expenditures required to meet the energy needs of campus and to comply with regulatory requirements at the T.B. Simon Power Plant. The energy plan should align with state and federal energy regulatory requirements at a minimum, along with greenhouse gas emissions reduction targets. The plan should allow flexibility to move in new directions as technology becomes available and economically viable.

Global climate change concern has put the spotlight on coal fired electric generation plants in particular, as they are only around 30% efficient and GHG emissions are relatively high. The T.B. Simon Power Plant is a cogeneration steam heating and electric generation plant that is primarily coal fired. The university investment in a cogeneration power plant with twice the efficiency of an electric generation only plant (60% efficient) has proven to be a cost effective choice for campus over the years.

While MSU is keeping electrical consumption per square foot low, the overall consumption of the campus continues to rise every year as new buildings are added. Fuel costs also rise every year. The campus growth in energy demand can be seen in Figure 12. With continued campus growth, rising fuel costs, and GHG emissions regulations expected in the future, the challenge will be to continue to meet the campus needs, while at the same time reducing consumption and GHG emissions.

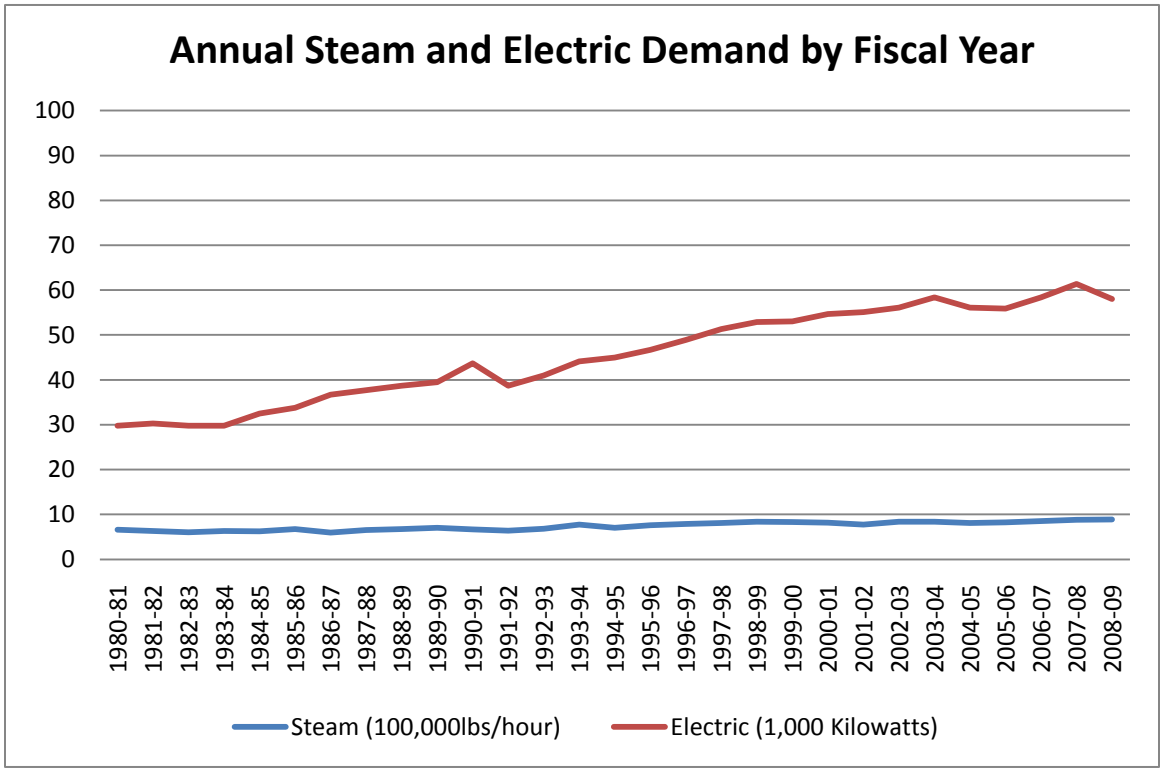


Figure 12. *Historical steam and electrical demand from fiscal year 1980-81 through 2008-09.*

Figure 12 reflects the historical campus electric demand. The graph illustrates how electrical demand has outpaced steam demand in the last 30 years. In order to achieve maximum efficiency, the electrical and steam demand should be nearly equal. As a result, excess steam has to be produced in order to generate the electricity needed to satisfy campus demand.

Based on the potential to have a backup for one of the large units at any time, the MSU firm electrical capacity date is 2023 (Figure 13). The firm electrical capacity date is the time which MSU will reach its capacity for electrical demand. This projection is based on historical consumption behaviors and the 2020 Master Plan assumption that one million square feet of new space will be added over the next decade. Electric demand determines electrical generation capacity requirements. Due to budget limitations, construction is projected to slow down. This coupled with additional conservation measures will potentially push the firm electrical capacity date beyond 2023.

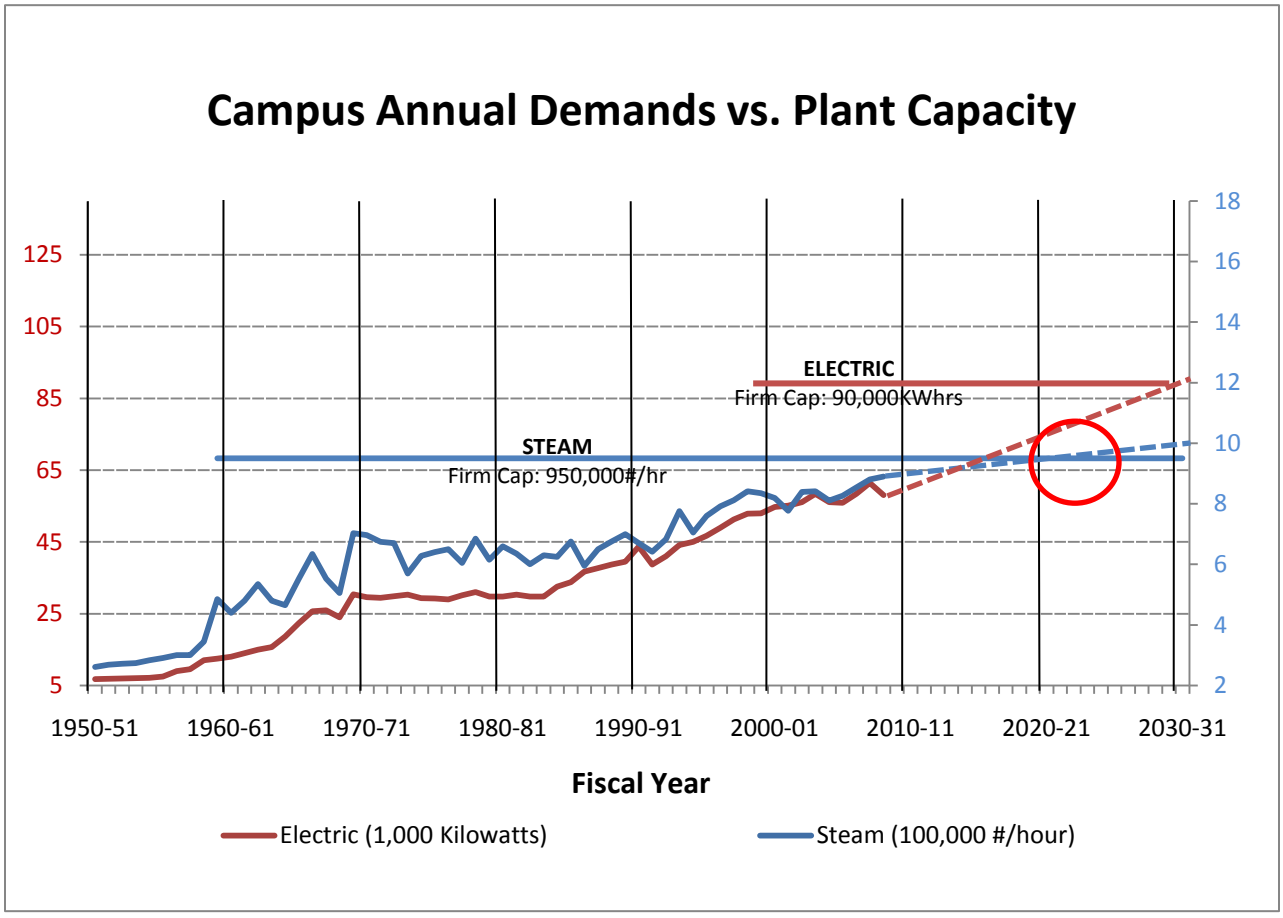


Figure 13. *Firm electrical capacity projection*. *The dotted lines show the projection of electrical and steam demand through 2030. The red circle indicates the year where the steam demand reaches the steam capacity (firm capacity) in 2023.*

Creating a team of faculty, students, and staff to outline a strategic energy plan for MSU is essential to meet the university demands for reliable, clean energy in the future. The campus community should be engaged in the process. The strategic energy plan will establish a path which will support the environmental stewardship goals, while at the same time meet the long term energy needs of the university. In order to achieve the energy and emission reduction goals, a suite of options should be explored as future investments. Options including potential offset projects, energy conservation measures, fuel sources, central generation equipment expansion and replacement, distributed generation, and purchased energy with associated emission reductions and costs should be identified in the energy plan. The energy plan will recommend the right mix of investments for the university over the next 20 years to meet the

campus demands, while at the same time move the campus towards the environmental stewardship goals.

Water Resources Management

In 2009, a team was created to address water resources management issues as part of the Boldness by Design Environmental Stewardship Initiative. The goals of the water resources management work include:

1. Ensure that water resources on the MSU campus are managed in a comprehensive fashion and encourage the campus community to be responsible stewards of our groundwater and surface water supplies.

2. Capitalize on the unique nature of the MSU campus and use it as a living laboratory for comprehensive water resources management.

3. Ensure a balanced and sustainable approach to water use/consumption on the MSU campus.

Activities underway in support of these goals include developing a campus storm water management plan, identifying potential water resources management demonstration sites on campus and along the river corridor, and quantifying water use across various sectors of the university in order to make recommendations about water conservation practices.

Storm Water Master Plan

As part of the university's federal storm water permit requirements, a storm water master plan is being developed to help ensure a more holistic approach to water resources management for areas of new development or redevelopment. The Storm Water Master Plan will guide future development decisions to ensure that runoff to the Red Cedar River is minimized and water quality concerns are addressed. Significant modeling of storm water flow from the campus was completed as part of the planning process in 2008 and 2009. That modeling information is being used to identify locations for regional storm water treatment projects, which will focus on low impact development (LID) techniques.

The plan is being integrated with the MSU Master Plan, aspects of the existing wellhead protection plan, which addresses campus groundwater supplies, and the irrigation master plan. The storm water master plan will be completed in 2010, and will serve as the basis for meeting the new storm water permit requirements.

Best Management Practices Demonstration Sites

Another goal of the water resources management initiative is to increase the number of demonstration sites that highlight best management practices for campus water resources. These practices include the installation of bio-retention sites, green roofs, and other vegetated practices for capturing runoff and treating storm water, porous pavement to increase infiltration of runoff, cisterns for water capture, and reuse and various storm water treatment devices. A number of LID practices have been installed on campus, including bio-retention sites at Erickson Hall, the Farm Lane Underpass, and the MSU Surplus Store and Recycling Center; a

green roof on the Plant and Soil Sciences building; and cisterns for water reuse at the recycling center. A baffle box for treating storm water has also been installed at Birch and Wilson Roads. Recommendations for additional LID sites will be included in the storm water master plan.

Demonstration sites are being considered to address existing river bank erosion and channel wall problems along the Red Cedar River as it winds through campus. The river presents signs of erosion despite past attempts to stabilize it (Figure 14). A group of Biosystems and Agricultural Engineering students and faculty members are exploring options for a pilot-scale stream bank stabilization strategy for the Red Cedar River using bioengineering techniques. Bioengineering is preferred in order to satisfy the sustainability initiatives within the MSU Master Plan, as well as to enhance the ecological and aesthetic functions of the river. The stabilization strategy will include construction plans, specifications, and preliminary cost estimates.

Figure 14. *Erosion along the south bank of the Red Cedar River on campus.*

Planning for Sustainable Water Use

As a first step in addressing water use issues, a campus water audit is currently underway. The audit will include an analysis of water use across sectors, including process-water use, as well as, water used in residence halls, for facilities and infrastructure needs, for research purposes, and for landscaping and irrigation, in order to target areas for improved water conservation.

A number of notable water conservation activities are underway across the campus, including water-conserving irrigation techniques, pilot programs in residence halls such as the use of low-flow restroom fixtures and tray-less cafeterias, and planning for plumbing fixture replacement in high-use restrooms. Residential Housing and Food Services (RHS) staff members have implemented a program that encourages students to use campus drinking water supplies rather than purchasing bottled water. The campaign distributes Be Spartan Green water bottles along with information about locations of filtered water machines in the residential halls. In 2009, MSU Purchasing reported that individual water bottle purchases on campus decreased by 33% from the previous year.

The campus water audit is being conducted in collaboration with campus staff members responsible for various aspects of water treatment, conveyance, and usage. Based on the information gathered through the audit process, a plan will be developed to identify potential sources of water reduction, including behavioral changes, plumbing system upgrades, distribution system repair, changes in irrigation practices and water reuse projects. Recommendations for additional educational programs for faculty, staff, and students regarding water conservation practices are being developed.

Environmental Stewardship Future Directions

There has been much activity and progress since the beginning of the environmental stewardship initiative in 2006. The systems team produced 24 new recommendations for Phase III of the environmental stewardship program for a total of 74 recommendations over the last three-year period. All have been supported and implemented.

- Energy reduction and offsets
- Waste reduction
- Transportation
- Behavior, communication, and education
- Compliance and technology

A full listing of the recommendations is available in Appendix B.

Notably, energy recommendations were focused on lowering GHG emissions from fuel burns at the power plant whereas offset recommendations would enable MSU to capture offsets from campus acres and off-campus properties. In addition, behavior research confirmed the campus' desire to be affiliated with a 'green' university and support policy decisions that encouraged the use of renewable fuels and new technologies. Further supported by behavior team research is the need to make environmental stewardship projects more visible on campus. In spring 2009, an effort began to catalog major environmental projects, describe them using a variety of multi-media sources, and display them on an interactive campus map. Over 45 environmental projects have been identified in two major operations units. Examples of projects include the new MSU Surplus Store and Recycling Center (Figure 15) and retro-commissioning team (Figure 16).

Figure 15. *Surplus and Recycling manager, Ruth Daoust, showing the new recycling baler to VP Fred Poston, undergraduate student Ashley Hale, MSU Trustee Melanie Foster, and MSU President Lou Anna K. Simon.*

Figure 16. *Retro-commissioning team working at the International Center to improve building systems for increasing electrical efficiency.*

The environmental stewardship program began as an initiative from the Office of the Vice President for Finance and Operations; however, at the same time, the Office of Campus Sustainability and the University Committee for a Sustainable Campus were also working to decrease MSU's environmental footprint. Vice President Fred Poston and Assistant Vice President Kathy Lindahl recognized the opportunity to decrease duplication and move the initiative to a permanent office. A task force was convened to recommend a new model for Campus Sustainability which would include environmental stewardship and sustainability programs. The transition began in November with the appointment of an assistant director and a director to be named at a later date. The task force executive summary is available in Appendix C.

One of the most urgent priorities for environmental stewardship is to create an energy plan. Nearly all leaders at all levels agree that climate change is real and requires urgent action. Michigan State University must be prepared to make significant reductions to comply with regulations. An energy plan will help MSU mitigate fiscal and regulatory risk due to climate change.

Construction Management Report

Prepared for the Michigan State University Board of Trustees January 2010

The Annual Construction Report, as requested by the Board of Trustees, includes construction projects which have been completed and project accounts which have been closed. Of the 59 closed projects, 21 are major capital projects and 38 are minor capital projects.

Major capital projects are those that are $1 million or greater and require Board approval. Minor capital projects are greater than $250,000 and less than $1 million. The Board requests a listing of these projects on an annual basis. In addition to the annual report, the Board receives quarterly construction reports reflecting current construction projects.

The Closed Major Capital Projects Report highlights three areas for the 21 major capital projects that were closed during fiscal year 2008-09. These areas include authorized budget, final cost of the project, contingency use, schedule adherence, and change order management. The reports are utilized to provide timely and accurate project information, and report on project performance in the aggregate, analyzing strengths and weaknesses, and improving processes.

The Closed Minor Capital Projects Report highlights final cost for the 38 minor capital projects that were closed during the fiscal year.

After MSU makes final payment to the general contractor or construction manager, a Capital Project Owner Scorecard Report is completed that summarizes the owner performance on the project. MSU will be evaluated on several factors, including quality, schedule, cost, project management, and close out. Scores from 100 to 80 are considered good, 51 to 79 acceptable, and 50 and below are unacceptable.

Closed Major Capital Projects
Fiscal Year 2008-09

Summary of Data
Twenty-one major projects were closed during the fiscal year ending June 30, 2009. The approved budgets for the projects totaled $206,398,900. The final cost of these projects was $198,930,659, a difference of $7,468,241 (3.7%), which was returned to the appropriate unit.

One project, the Spartan Stadium Expansion, was closed during the past fiscal year which made up 33% of the budget for the 59 closed projects during fiscal year 2008-09.

Approximately 25% of the closed projects focused primarily on repairing or improving the university infrastructure. About 65% or 10 of the closed projects focused on program space. The remaining 10% of projects were for elevators and mechanical and electrical systems.

Analysis
When evaluating closed projects, the university focuses on quality, cost, and schedule. Historically, MSU has been very successful in meeting these goals. During fiscal year 2008-2009, MSU continues to meet schedule and budget targets on a regular basis. Of the closed major projects, 95% of projects were completed within budget and 83% (or 49 of the 59 projects) reached substantial completion on schedule. Although the university has not made great reductions in the length of time to meet final completion, it has improved in meeting final completion schedule. Of the 59 projects, 31 projects (53%) met the planned final completion final date for fiscal year 2008-09 as opposed to 35% of projects that met final completion the previous fiscal year.

Measuring quality for a project has been somewhat of a challenge for MSU. There is limited data to measure and/or support any conclusions that can be made in regards to the quality of construction services that are performed on campus. In past fiscal years, MSU has collected data focused on contractor performance. This effort will be expanded to collect data on all parties that are involved in making a construction project successful. MSU will utilize the data to measure quality of the construction services performed on campus and identify opportunities for improvements for internal university operations, contractors, and consultants.

Future Focus
The design and construction industry is undergoing a technological transformation. Building Information Modeling (BIM) tools will allow the design intent to be more efficiently constructed and support maintenance throughout the life cycle of the building. MSU's initial experience with the product is positive, but human capital will need to be invested in order to take full advantage of the product's capability.

Closed Major Capital Projects for Fiscal Year 2008-2009

CP02076 - VETERINARY MEDICAL CENTER - ONCOLOGY ADDITION

Authorized Budget:	$12,676,000	**Final Cost:**	$12,540,758	**Classification:**	Clinical
Construction:	8,826,333	**Returned:**	135,242	**Delivery Method:**	Design Bid Build
Professional Services:	1,160,972			**Contractor:**	JM OLSON CORPORATION
Owner Work and Material:	1,075,000			**A/E (Consultant):**	DUCE SIMMONS ASSOCIATES
Contingency:	1,613,695			**Funds returned to:**	N/A – Bond Funds

Change Orders		% of Contract	% of Contingency
Scope:	-318,731	-3.6%	-19.8%*
Document:	372,817	4.2%	23.1%
Field:	106,529	1.2%	6.6%
Total:	$160,616	1.8%	10.0%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	9/30/2005	9/30/2005	0
Close Out:	6/30/2008	6/30/2008	0

***Note: MSU held the HVAC controls subcontract, thereby reducing scope of general contractor.**

CP02083 - SPARTAN STADIUM - SEATING EXPANSION

Authorized Budget:	$67,660,000	**Final Cost:**	$66,323,118	**Classification:**	Site
Construction:	53,292,928	**Returned:**	1,336,882	**Delivery Method:**	Construction Manager
Professional Services:	6,096,797			**Contractor:**	BARTON MALOW/CLARK CONST.
Owner Work and Material:	2,574,103			**A/E (Consultant):**	HNTB
Contingency:	5,696,172			**Funds returned to:**	N/A – Bond Funds

Change Orders		% of Contract	% of Contingency
Scope:	860,745	1.6%	15.1%
Document:	1,522,829	2.9%	26.7%
Field:	620,300	1.2%	10.9%
Total:	$3,003,874	5.6%	52.7%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	1/1/2006	2/15/2006	45
Close Out:	1/1/2007	6/30/2009	911*

***Note: Close Out delayed by additional work required after contract completed to resolve occupant comfort issues**

CP03081 - VETERINARY MEDICAL CENTER - "PEGASUS" CRITICAL CARE CENTER - CONSTRUCT ORIGINAL BUILDING

Authorized Budget:	$4,360,000	**Final Cost:**	$4,236,469	**Classification:**	Clinical
Construction:	3,272,800	**Returned:**	123,531	**Delivery Method:**	Design Bid Build
Professional Services:	406,000			**Contractor:**	FRYLING CONSTRUCTION CO., INC.
Owner Work and Material:	155,000			**A/E (Consultant):**	DUCE SIMMONS ASSOCIATES
Contingency:	526,200			**Funds returned to:**	College of Veterinary Medicine

Change Orders		% of Contract	% of Contingency
Scope:	-3,948	-0.1%	-0.8%*
Document:	178,544	5.5%	33.9%
Field:	43,950	1.3%	8.4%
Total:	$218,545	6.7%	41.5%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	11/30/2005	9/30/2005	(61)
Close Out:	6/1/2006	6/30/2008	760

***Note: Scope reduction due to deleting paving requirement.**

CP03220 - PARKING RAMP NO. 6 - MORRILL HALL - CONSTRUCT ORIGINAL BUILDING

Authorized Budget:	$19,500,000	**Final Cost:**	$19,383,801	**Classification:**	Roads & Parking
Construction:	15,260,000	**Returned:**	116,199	**Delivery Method:**	Design Bid Build
Professional Services:	1,552,195			**Contractor:**	GRANGER CONSTRUCTION COMPANY
Owner Work and Material:	333,355			**A/E (Consultant):**	FTC&H
Contingency:	2,354,450			**Funds returned to:**	N/A – Bond Funds

Change Orders		% of Contract	% of Contingency
Scope:	649,323	4.3%	27.6%
Document:	773,059	5.1%	32.8%
Field:	31,998	0.2%	1.4%
Total:	$1,454,381	9.5%	61.8%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	12/11/2006	12/11/2006	0
Close Out:	2/17/2009	12/9/2008	(70)

CP04030 - JENISON FIELDHOUSE - INDOOR POOL MODIFICATIONS

Authorized Budget:	$1,477,000	**Final Cost:**	$1,114,825	**Classification:**	Site
Construction:	769,706	**Returned:**	362,175	**Delivery Method:**	Design Bid Build
Professional Services:	322,780			**Contractor:**	THATCHER CONSTRUCTION CO., INC
Owner Work and Material:	70,000			**A/E (Consultant):**	FTC&H
Contingency:	314,514			**Funds returned to:**	Just in Time Funds

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	119,736	15.6%	38.1%
Field:	0	0.0%	0.0%
Total:	$119,736	15.6%	38.1%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	5/1/2007	6/1/2007	31
Close Out:	11/15/2008	11/14/2008	(1)

CP04131 - HOLMES HALL - LYMAN BRIGGS SCHOOL - HVAC MODIFICATIONS & LAB RENOVATIONS

Authorized Budget:	$5,881,755	**Final Cost:**	$5,805,093	**Classification:**	Mechanical & Electrical
Construction:	4,652,756	**Returned:**	76,662	**Delivery Method:**	Construction Manager
Professional Services:	515,179			**Contractor:**	GRANGER CONSTRUCTION COMPANY
Owner Work and Material:	57,048			**A/E (Consultant):**	PETER BASSO ASSOCIATES
Contingency:	656,772			**Funds returned to:**	Lyman Briggs College

Change Orders		% of Contract	% of Contingency
Scope:	112,703	2.4%	17.2%
Document:	217,709	4.7%	33.1%
Field:	232,210	5.0%	35.4%
Total:	$562,621	12.1%	85.7%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	8/15/2006	8/15/2006	0
Close Out:	3/11/2008	6/20/2008	101

CP04171 - BRESLIN CENTER - ALTERATIONS TO MEN'S & WOMEN'S LOCKER ROOM

Authorized Budget:	$2,800,000	**Final Cost:**	$2,799,845	**Classification:**	Classrooms
Construction:	1,958,000	**Returned:**	155	**Delivery Method:**	Construction Manager
Professional Services:	264,600			**Contractor:**	THE CHRISTMAN COMPANY
Owner Work and Material:	105,927			**A/E (Consultant):**	RAYMOND O'LEARY
Contingency:	471,473			**Funds returned to:**	Athletics

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	236,722	12.1%	50.2%
Field:	16,530	0.8%	3.5%
Total:	$253,252	12.9%	53.7%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	11/1/2007	11/1/2007	0
Close Out:	11/30/2008	11/14/2008	(16)

CP04360 - FOOD STORES - RELOCATE MSU BAKERY

Authorized Budget:	$4,095,000	**Final Cost:**	$4,087,528	**Classification:**	Site
Construction:	3,306,000	**Returned:**	7,472	**Delivery Method:**	Design Bid Build
Professional Services:	365,210			**Contractor:**	KARES CONSTRUCTION COMPANY
Owner Work and Material:	22,415			**A/E (Consultant):**	DESIGN PLUS
Contingency:	401,375			**Funds returned to:**	Residential and Hospitality Services

Change Orders		% of Contract	% of Contingency
Scope:	31,051	0.9%	7.7%
Document:	121,134	3.7%	30.2%
Field:	120,647	3.6%	30.1%
Total:	$272,832	8.3%	68.0%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	9/15/2006	9/15/2006	0
Close Out:	8/9/2008	7/28/2008	(12)

CP04385 - ERICKSON HALL - ADDITION 3

Authorized Budget:	$2,475,000	**Final Cost:**	$2,459,827	**Classification:**	Site
Construction:	1,904,000	**Returned:**	15,173	**Delivery Method:**	Design Bid Build
Professional Services:	291,180			**Contractor:**	IRISH CONSTRUCTION COMPANY
Owner Work and Material:	91,445			**A/E (Consultant):**	DESIGN PLUS
Contingency:	188,375			**Funds returned to:**	College of Education

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	73,608	3.9%	39.1%
Field:	87,777	4.6%	46.6%
Total:	$161,385	8.5%	85.7%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	12/12/2006	11/17/2006	(25)
Close Out:	6/30/2008	2/17/2009	232

CP05249 - UNIVERSITY VILLAGE APARTMENTS - CONSTRUCT NEW APARTMENTS (DEMOLISH OLD)

Authorized Budget:	$17,010,598	**Final Cost:**	$16,818,454	**Classification:**	Site
Construction:	15,019,189	**Returned:**	192,144	**Delivery Method:**	Design Build
Professional Services:	450,061			**Contractor:**	THE CHRISTMAN COMPANY
Owner Work and Material:	797,395			**A/E (Consultant):**	THE CHRISTMAN COMPANY
Contingency:	743,953			**Funds returned to:**	N/A – Bond Funds

Change Orders		% of Contract	% of Contingency
Scope:	-410,748	-2.7%	-55.2%*
Document:	191,241	1.3%	25.7%
Field:	67,228	0.4%	9.0%
Total:	-152,279	-1.0%	-20.5%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	7/30/2007	7/30/2007	0
Close Out:	5/28/2009	6/8/2009	11

***Note: Bids for subcontracts were significantly lower than anticipated, leading to significant scope changes.**

CP05323 - STEAM DISTRIBUTION - NEW STEAM TUNNEL FROM STM0229 TO STM0268 (BOGUE STREET)

Authorized Budget:	$4,799,625	**Final Cost:**	$4,279,466	**Classification:**	Steam & Underground
Construction:	3,544,000	**Returned:**	520,159	**Delivery Method:**	Design Bid Build
Professional Services:	397,175			**Contractor:**	CLARK CONSTRUCTION CO.
Owner Work and Material:	37,000			**A/E (Consultant):**	FTC&H
Contingency:	821,450			**Funds returned to:**	Just in Time Funds

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	22,681	0.6%	2.8%
Field:	254,936	7.2%	31.0%
Total:	$277,617	7.8%	33.8%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	8/18/2006	8/1/2006	(17)
Close Out:	8/30/2008	8/12/2008	(18)

CP05382 - STEAM DISTRIBUTION - NEW TUNNEL FROM STM0169 TO STM0237 (SHAW LANE) AND ROAD REPLACEMENT

Authorized Budget:	$10,481,000	**Final Cost:**	$8,731,734	**Classification:**	Steam & Underground
Construction:	7,104,000	**Returned:**	1,749,266	**Delivery Method:**	Design Bid Build
Professional Services:	945,700			**Contractor:**	CLARK CONSTRUCTION CO.
Owner Work and Material:	651,000			**A/E (Consultant):**	FTC&H
Contingency:	1,780,300			**Funds returned to:**	Just in Time Funds

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	96,559	1.4%	5.4%
Field:	188,233	2.6%	10.6%
Total:	$284,792	4.0%	16.0%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	11/1/2006	11/1/2006	0
Close Out:	1/31/2009	3/16/2009	44

CP05473 - ROADS - WILSON ROAD - RECONSTRUCTION 2006 - PHASE I

Authorized Budget:	$2,100,000	**Final Cost:**	$1,845,943	**Classification:**	Roads & Parking
Construction:	1,241,000	**Returned:**	254,057	**Delivery Method:**	Design Bid Build
Professional Services:	276,200			**Contractor:**	AGGREGATE INDUSTRIES
Owner Work and Material:	136,214			**A/E (Consultant):**	M.C. SMITH ASSOCIATES
Contingency:	446,586			**Funds returned to:**	Just in Time Funds

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	91,594	7.4%	20.5%
Field:	-12,396	-1.0%	-2.8%*
Total:	$79,197	6.4%	17.7%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	8/12/2006	8/12/2006	0
Close Out:	3/30/2008	6/24/2008	86

***Note: Field reduction largely due to return of unused allowances for poor soils. (Soil was better than anticipated.)**

CP05533 - CHEMISTRY - ALTERATIONS TO ROOMS 403-405, 414, 414A, 524, 525, AND 526

Authorized Budget:	$2,040,000	**Final Cost:**	$2,017,838	**Classification:**	Classrooms
Construction:	1,593,757	**Returned:**	22,162	**Delivery Method:**	Construction Manager
Professional Services:	203,795			**Contractor:**	GRANGER CONSTRUCTION COMPANY
Owner Work and Material:	81,000			**A/E (Consultant):**	FTC&H
Contingency:	161,448			**Funds returned to:**	General Fund

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	464,208	29.1%	287.5%
Field:	42,793	2.7%	26.5%
Total:	$507,001	31.8%	314.0%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	3/30/2007	3/30/2007	0
Close Out:	4/30/2008	10/14/2008	167

CP06036 - HANNAH ADMINISTRATION BUILDING - ALTERATIONS TO 4TH FLOOR (ROOMS 411 TO 442)

Authorized Budget:	$1,540,000	**Final Cost:**	$1,536,525	**Classification:**	Offices
Construction:	721,838	**Returned:**	3,475	**Delivery Method:**	Construction Manager
Professional Services:	100,418			**Contractor:**	GRANGER CONSTRUCTION CO
Owner Work and Material:	381,282			**A/E (Consultant):**	BERNATH COAKLEY
Contingency:	336,462			**Funds returned to:**	General Fund

Change Orders		% of Contract	% of Contingency
Scope:	144,146	20.0%	42.8%
Document:	10,027	1.4%	3.0%
Field:	14,009	1.9%	4.2%
Total:	$168,182	23.3%	50.0%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	4/30/2008	3/10/2008	(51)
Close Out:	3/30/2009	2/26/2009	(32)

CP06092 - ROADS - WILSON ROAD - RECONSTRUCTION 2007 - PHASE II

Authorized Budget:	$2,600,000	**Final Cost:**	$2,174,903	**Classification:**	Roads & Parking
Construction:	1,624,000	**Returned:**	425,097	**Delivery Method:**	Design Bid Build
Professional Services:	340,300			**Contractor:**	GRANGER CONSTRUCTION COMPANY
Owner Work and Material:	186,000			**A/E (Consultant):**	M.C. SMITH ASSOCIATES
Contingency:	449,700			**Funds returned to:**	Campus Fiber Optic Reconstruction

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	102,902	6.3%	22.9%
Field:	-49,010	-3.0%	-10.9%
Total:	$53,892	3.3%	12.0%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	8/10/2007	8/10/2007	0
Close Out:	2/15/2009	4/20/2009	64

CP06156 - STEAM DISTRIBUTION & ROAD RECONSTRUCTION - EAST & WEST CIRCLE DRIVE - 2007

Authorized Budget:	$12,000,000	**Final Cost:**	$10,877,178	**Classification:**	Steam & Underground
Construction:	7,814,000	**Returned:**	1,122,822	**Delivery Method:**	Design Bid Build
Professional Services:	1,752,100			**Contractor:**	GRANGER CONSTRUCTION COMPANY
Owner Work and Material:	678,500			**A/E (Consultant):**	FTC&H
Contingency:	1,755,400			**Funds returned to:**	Physical Plant

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	283,517	3.6%	16.2%
Field:	379,779	4.9%	21.6%
Total:	$663,296	8.5%	37.8%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	9/28/2007	9/10/2007	(18)
Close Out:	1/15/2009	6/10/2009	146

CP06206 - OLD COLLEGE FIELD - RENOVATIONS - PHASE I (HITTING FACILITY)

Authorized Budget:	$1,425,000	**Final Cost:**	$1,424,074	**Classification:**	Site
Construction:	1,051,700	**Returned:**	926	**Delivery Method:**	Design Bid Build
Professional Services:	184,924			**Contractor:**	COMMERCIAL CONTRACTING CORP.
Owner Work and Material:	23,411			**A/E (Consultant):**	NEUMAN SMITH
Contingency:	164,965			**Funds returned to:**	Athletics

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	73,589	7.0%	44.6%
Field:	-11,064	-1.1%	-6.7%*
Total:	$62,525	5.9%	37.9%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	10/9/2007	11/7/2007	29
Close Out:	7/30/2008	8/12/2008	13

***Note: Field reduction due to elimination of requirement to remove and replace 1,300 cubic yards of soil, which was in better condition than anticipated.**

CP06243 - ERICKSON, FEE, INTERNATIONAL CNTR & REGIONAL CHILLED WATER PLANT NO. 1 - CHILLER REPLACEMENT

Authorized Budget:	$7,860,000	**Final Cost:**	$7,825,811	**Classification:**	Site
Construction:	6,530,000	**Returned:**	34,189	**Delivery Method:**	Design Bid Build
Professional Services:	965,450			**Contractor:**	JOHN E GREEN COMPANY
Owner Work and Material:	107,667			**A/E (Consultant):**	PETER BASSO ASSOCIATES INC.
Contingency:	256,883			**Funds returned to:**	N/A – Bond Funds

Change Orders		% of Contract	% of Contingency
Scope:	-19,700	-0.3%	-7.7%*
Document:	180,643	2.8%	70.3%
Field:	12,127	0.2%	4.7%
Total:	$173,070	2.7%	67.4%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	3/30/2007	3/30/2007	0
Close Out:	2/15/2009	3/25/2009	38

***Note: Scope savings result of negotiating favorable terms for prepayment of chillers, which save $56,000.**

CP06345 - I.M. SPORTS WEST - INDOOR POOL MODIFICATIONS

Authorized Budget:	$1,900,000	**Final Cost:**	$1,809,003	**Classification:**	Site
Construction:	1,019,000	**Returned:**	90,997	**Delivery Method:**	Design Bid Build
Professional Services:	156,900			**Contractor:**	THATCHER CONSTRUCTION, INC.
Owner Work and Material:	264,500			**A/E (Consultant):**	FTC&H
Contingency:	459,600			**Funds returned to:**	General Fund

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	388,625	38.1%	84.6%
Field:	-1,329	-0.1%	-0.3%*
Total:	$387,296	38.0%	84.3%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	12/31/2007	12/31/2007	0
Close Out:	6/30/2008	11/12/2008	135

***Note: Field reduction largely due to return of unused allowances.**

CP07238 - OLD COLLEGE FIELD RENOVATIONS - PHASE II - SOCCER FIELD

Authorized Budget:	1,920,000	**Final Cost:**	1,889,622	**Classification:**	Site
Construction:	1,239,877	**Returned:**	30,378	**Delivery Method:**	Design Bid Build
Professional Services:	209,100			**Contractor:**	KARES CONSTRUCTION CO., INC.
Owner Work and Material:	384,912			**A/E (Consultant):**	HAMILTON ANDERSON
Contingency:	86,111			**Funds returned to:**	Athletics

Change Orders		% of Contract	% of Contingency
Scope:	0	0.0%	0.0%
Document:	-24,105	-1.9%	-28.0%*
Field:	-985	-0.1%	-1.1%
Total:	$-25,090	-2.0%	-29.1%

Schedule	Planned	Actual	Days (Under)/Over
Substantial Completion:	8/15/2008	8/15/2008	0
Close Out:	6/16/2009	5/12/2009	(35)

***Note: Document reduction due to deletion of sidewalks not required in the project**

Closed Minor Capital Projects for Fiscal Year 2008 - 2009

CP Number	Project Description	Budget	Final Costs	Returned
CP06124	STEAM DISTRIBUTION - VAULT 213 STRUCTURAL AND PIPING REPAIRS	$975,000	$934,375	$40,625
CP06112	COMMUNICATION ARTS & SCIENCES - ELEVATOR REPLACEMENT	950,000	882,339	67,661
CP05580	PLANT & SOIL SCIENCE - ELEVATOR REPLACEMENT	940,000	865,475	74,525
CP07046	ROADS - DORMITORY ROAD REMOVAL	922,000	885,848	36,152
CP06303	GILTNER HALL - REPLACE FIRE ALARM SYSTEM	890,000	831,890	58,110
CP07124	PHYSICAL PLANT STORAGE BLDG NO 1 - INTERIOR	850,000	834,918	15,082
CP05581	POULTRY TEACHING & RESEARCH CENTER - HIGH VOLTAGE ALTERATIONS	800,000	728,179	71,821
CP07274	STEAM DISTRIBUTION REPLACE STEAM/CONDENSATE LINE ACROSS HARRISON ROAD - STEAM VAULT 124 TO STM 341	800,000	758,952	41,048
CP06239	PHYSICAL PLANT STORAGE BUILDING NO. 1 - ADDITION NO. 1	710,000	709,986	14
CP04453	ENGINEERING RESEARCH - CONCRETE LAB - ADD #1-MODIFICATIONS FOR TEST FURNACE	705,000	704,679	321
CP07129	ATHLETIC FIELDS - IMPROVE VET. MED. I.M. FIELD	622,000	530,927	91,073
CP05579	LIFE SCIENCE - ELEVATOR REPLACEMENT	600,000	541,921	58,079
CP05372	NATURAL SCIENCE BUILDING - ALTERATIONS TO ROOMS 405 – 418	582,000	580,901	1,099
CP03243	FARRALL HALL - ALTERATIONS TO ROOM 132, BSL-2 FOOD SAFETY LABORATORY	580,000	581,466	-1,466
CP06046	HANNAH ADMINISTRATION BUILDING - ELEVATOR REPLACEMENT	580,000	566,542	13,458
CP06048	JENISON FIELDHOUSE - ROOF REPLACEMENT AREAS 1 THRU 7 AND 9 THRU 17	570,000	558,302	11,698
CP06038	WONDERS HALL - KIVA RENOVATIONS	550,000	539,221	10,779
CP04441	I.M. SPORTS WEST - ALTERATIONS TO ROOMS 130/130A, 142/142C & ROOMS 136 & 140	528,000	526,934	1,066

Closed Minor Capital Projects for Fiscal Year 2008 - 2009

CP Number	Project Description	Budget	Final Costs	Returned
CP05553	DAIRY CATTLE TEACHING & RESEARCH CENTER - ROOF REPLACEMENT	$506,000	$383,194	$122,806
CP05456	WELL HOUSE NO. 31 - CONSTRUCT NEW DISTRIBUTION WELL	500,000	490,647	9,353
CP06045	PLANT & SOIL SCIENCE - FIRE ALARM UPGRADE	485,000	484,077	923
CP06335	CYCLOTRON - EAST HIGH BAY AIR CONDITIONING	475,000	467,598	7,402
CP06543	DEMONSTRATION HALL - ALTERATIONS TO ROOM 109, BALLROOM	461,000	491,246	-30,246
CP05595	HUMAN ECOLOGY - ALTERATIONS TO SUITE 2, RMS 4, 4C & 6	450,000	445,463	4,537
CP05341	BIOMEDICAL PHYSICAL SCIENCES - AIR CONDITION COMPUTER ROOM 1221	435,000	425,024	9,976
CP07211	PAOLUCCI BUILDING - DEMOLITION	425,000	350,587	74,413
CP07258	BRESLIN CENTER - ALTERATIONS TO ROOMS 17 & 26 AND LOCKER ROOM D	368,000	343,379	24,621
CP06295	GILTNER HALL - EXTERIOR RESTORATION	350,000	341,654	8,346
CP07012	T.B. SIMON POWER PLANT - EXTERIOR MASONRY RESTORATION	350,000	343,571	6,429
CP05223	ENGINEERING BUILDING - REPLACE COMPUTER ROOM AIR CONDITIONING	345,000	331,258	13,742
CP05583	FOOD SCIENCE - ELEVATOR REPLACEMENT	325,000	303,538	21,462
CP06601	KRESGE ART CENTER - ELEVATOR REPLACEMENT	320,000	306,551	13,449
CP05218	ENGINEERING RESEARCH COMPLEX - RENOVATIONS TO ROOM A18, A24, & A37	310,000	314,746	-4,746
CP05555	MUSIC PRACTICE BUILDING - ELEVATOR REPLACEMENT	300,000	293,484	6,516
CP06264	OLIN HEALTH CENTER - ELEVATOR REPLACEMENT	300,000	294,911	5,089
CP06300	AGRICULTURE HALL - EXTERIOR RESTORATION	300,000	298,274	1,726
CP07526	HOLMES HALL - INSTALL HELICAL ANCHORS ON EXTERIOR BRICK PANEL	290,000	230,800	59,201

Closed Minor Capital Projects for Fiscal Year 2008 - 2009

CP Number	Project Description	Budget	Final Costs	Returned
CP07050	SPARTAN VILLAGE - ROOF REPLACEMENT BUILDINGS 1441, 1565 & 1567	$264,079	$252,278	$11,801
	Total Projects: 38	**$20,713,079**	**$19,755,135**	**$957,944**

Phase III Environmental Stewardship Recommendations

Environmental Stewardship Systems Team
Team Leader: Kathy Lindahl

December 4, 2009

be green spartan

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EXECUTIVE SUMMARY

The Boldness by Design environmental stewardship initiative now concludes its fourth year. The first year's work began with the development of an Environmental Stewardship Systems Team and Steering Committee along with identifying and funding associated research projects.

Years two and three produced 50 recommendations as outcomes from the research in the areas of energy, materials, communication, behavior, and systems management. All 50 recommendations have been implemented and are in various stages of completion.

Now at the end of year four, the environmental stewardship initiative has been the catalyst for reducing Michigan State University's (MSU) environmental footprint. Phase III recommendations continue to tackle some of MSU's most pressing environmental challenges. Twenty-four recommendations focused in energy reductions and offsets, waste reduction, transportation, behavior, communication and education, compliance, and new technologies will likely require solutions that are more complex and longer term.

The Environmental Stewardship Systems Team and Steering Committees, as they have existed for the last four years, will now be recast through the Office of Campus Sustainability where the best practices of this office and the processes and work done by the Systems and Steering Committees will be integrated. It is anticipated that there will continue to be future recommendations with the focus to continue on reducing the inputs to campus, increasing the reuse of materials, and reducing the outputs to campus resulting in a reduced environmental campus footprint.

Systems Team and Technical Team Members

Name	Unit	Other Information
Adam Largent	Undergraduate Student	
Adrian Donovan	Undergraduate Student	
Aimee Wilson	Undergraduate Student	
Alexandra Peralta	Graduate Student	
Amalia Villarriel	Research Team Member	
Ashley Hale	Undergraduate Student	
Ashley Miller	Research Team Member	
Beth Bonsall	Academic Technology Services	
Bob Ellerhorst	Power Plant/Physical Plant	
Brett Kersh	Alumni	
Brett Simpson	International Agriculture	
Brian Watts	Transportation Services	
Brian Wolf	Transportation Services	
Brianne Haner	Alumni	
Cathleen Edgerly	CATA	
Chuck Reid	Land Management	
Dave MacFarlane	Forestry	
David Kandow	Undergraduate Student	
David Skole	Forestry	Energy Team Lead
Debbie Alexander	CATA	
Debby Gulliver	Controller	
Doug Buhler	MI Ag. Experiment Station	
Diane Barker	Residential & Hospitality Services	
Emily Pochubay	Entomology	
Eric Cova	Undergraduate Student	
Eric Kasten	Forestry	
Evan Bowling	Undergraduate Student	
Frank Lupi	Agricultural, Food & Res. Econ.	
Harry Perlstadt	Sociology	
Jeff Kacos	Campus Planning & Admin.	
Jennifer Sowa	Campus Sustainability	Comm. Team Lead
Joe Arvai	CARRS	
Jon Brouker	Undergraduate Student	
Jordan Fox	Forestry	
Judy Marteniuk	Veterinary Medicine	
Julia Hilliker	Undergraduate Student	
Kailey Poort	Undergraduate Student	
Kallie McConkie	Undergraduate Student	
Karen Zelt	Physical Plant	
Katherine Ball	Academic Technology Services	
Kathy Lindahl	VP Finance & Operations	Systems Team Lead
Kevin Eisenbeis	Env. Health & Safety	

Korey Cater	Undergraduate Student	
Kwame Yeboah	Graduate Student	
LaShonda Windham	Mason-Abbot/Snyder-Phillips Halls	
Laura James	Graduate Student	
Lauren Olson	Campus Sustainability	
Laurie Thorp	RISE	Behavior Team Lead
Lin Han	Graduate Student	
Linda Dunn	Advancement Services	
Lindsey Latour	Residential & Hospitality Services	
Lisa Parker	Forestry	
Lynda Boomer	Physical Plant	Energy Team Lead
Marc Allen	Alumni	
Marci Baranski	Undergraduate Student	
Maria Giggy	Residential & Hospitality Services	
Mary Lindsey-Frary	Env. Health and Safety	Transportation Team Lead
Maureen McDonough	Forestry	
Maya Fischhoff	Env. Studies & Policy Program	
Meredith Gore	Fisheries and Wildlife	
Michael Kaplowitz	CARRS	
Mike Rice	MSU Police	
Nancy Aitcheson	Recycling	
Nick Vandermolen	Research Team Member	
Nickita Mehta	Alumni	
Nicole Grabowski	Alumni	
Nina Boychuck	Undergraduate Student	
Pam George	University Services	
Patrick Kelly	Undergraduate Student	
R. Duncan Selby	Graduate Student	
Ria Mehta	Alumni	
Rich Grogan	Graduate Student	
Rick Lyles	Mechanical Engineering	
Rob Shupp	Agricultural, Food & Rec. Econ.	
Ruth Daoust	Surplus/Recycling	
Ruth Kline-Robach	MSU Water Institute	
Ryan Ohagan	Undergraduate Student	
Sarah Jordan	Undergraduate Student	
Satish Joshi	Agricultural, Food & Res. Econ.	Cost & Returns Team Lead
Scott Donovan	Undergraduate Student	
Scott Swinton	Agricultural, Food & Res. Econ.	Cost & Returns Team Lead
Shantanu Kelkar	Graduate Student	
Stan Kaplowitz	Sociology	
Steve Frank	Landscape Services	
Steve Troost	Campus Planning & Admin.	Transportation Team Lead
Stuart Gage	Entomology	Special Projects Team Lead
Subbu Kumarappan	Graduate Student	

Summer Nash	Alumni
Tara Lehman	Undergraduate Student
Tim Komareck	Graduate Student
Tim Potter	MSU Bikes
Timothy Matthews	Research Team Member
Tyler Syring	Undergraduate Student
Vennie Gore	Residential & Hospitality Services
Victoria Campbell	Graduate Student
Walter Chomentowski	Forestry
Zijia Zhang	Graduate Student

SUMMARY OF RECOMMENDATIONS

The following are 24 recommendations brought forward by the Environmental Systems Team. The detail and intent behind each recommendation follows these recommendations. Vice President Poston and Provost Wilcox have reviewed the recommendations and approved all of them for implementation. The list below gives a short overview of each recommendation. Background information and intent for each recommendation is contained in the next section.

ENERGY REDUCTION AND OFFSETS

1. Decision-Support Tool
Develop a decision-support tool for optimizing financial and environmental performance of the T.B. Simon Power Plant.

2. Fuel Switching
In response to campus community preference, MSU decision makers should consider a more aggressive fuel switching plan to include the use of more alternative fuels, natural gas, and other available technologies that result in reducing the campus carbon footprint.

3. Green Technology
In response to campus community preference, MSU decision makers should expand the energy portfolio to include effective renewable energy (e.g. wind and solar) as part of the electricity generating capacity.

4. Database Improvement to Support Carbon Planning
Improve the campus and properties databases to provide more systematic and integrated access to information to support carbon offset planning and monitoring.

5. Forest Property Expansion
Conduct a feasibility study to evaluate the costs and benefits of expanding MSU forest properties in the Upper Peninsula (UP) and to provide enough growing stock for significant future carbon offsets. Other benefits could be obtained, including feedstock source for biomass energy research and production.

6. Reforestation Offset
Develop a multi-site reforestation offset project on all eligible MSU properties beyond the main campus and demonstrate feasibility and protocol for future projects.

7. Urban Forestry and Widely Spaced Tree Offset Project
Implement an urban and widely spaced trees offset project on the MSU main campus and register it with the Chicago Climate Exchange (CCX) based on an approved protocol.

WASTE REDUCTION

8. Feasibility and Best Practices for Composting Campus Food Waste
Develop and implement several pilot studies to evaluate the feasibility and best practices for composting campus food waste.

9. Recycling and Reuse of Electronic Equipment
Improve energy efficiency and lower greenhouse gas (GHG) emissions associated with purchased goods and equipment by extending their life through recycling and reuse. As demonstrated through a life cycle assessment

of computers, extension of life can reduce GHG emissions associated with manufacturing of the purchased equipment.

10. Alternative Textbook Sources
Expand student and faculty knowledge of alternative textbook sources (bookstore, online download, rental, etc.) with information on best textbook sources on MSU's bookstore website, promoting those that offer lower prices while producing less paper and transport waste than traditional bookstores.

11. Communication via Electronic Media
Proceed to replace paper-based, unsolicited MSU internal communications by electronic media. Establish a university-wide electronic publication hub that lists all available publications by department and allows recipients to sign up to receive specific publications or information from groups of interest. Educate the community, especially student and certain staff groups, on different electronic publishing tools, including MSU electronic information systems, email, and website publication, in order to ensure continued access to valuable internal communications.

12. Flow of Recycled Materials—Bin Sensor Fullness-Monitoring System
Transfer and expand the bin sensor fullness-monitoring system to a larger building in order to evaluate the usefulness and labor-savings conferred by the system.

TRANSPORTATION

13. Bicycle Use Study for Better Resource Allocations
Conduct a bicycle utilization study that estimates bike use/trends around campus and commuting to campus. This effort will be coordinated with All University Traffic and Transportation Committee (AUTTC) and the University Traffic Engineer who are identifying a more substantial process for annual assessment of bicycle use and safety issues on campus. This information will allow for more focused resource allocations on future prioritized needs to improve bicycle routes, encourage ridership, and provide a safer campus circulation system.

14. Car Share Pilot Project
Establish a three-year pilot car share program managed by a third-party on campus for use by eligible faculty, staff, and students (e.g., Zipcar, Enterprise WeCar, etc.). Identify and monitor specific indicators to assess if the program is meeting its environmental stewardship goals and if it should be continued beyond the pilot program status.

15. Eco-Map Transportation Patterns
Integrate 2009 transportation survey data with Tri-County Regional Planning Commission's existing mapping and modeling data to change commuting patterns and reduce operational costs (parking, enforcement, safety), reduce environmental impacts (resource consumption, GHG emissions), and increase pedestrian safety (reduced vehicular traffic on campus).

16. Student Transportation Survey
Develop a student transportation survey to complement the faculty/staff survey recently completed. The purposes of the student transportation survey include accurately describing the current transportation behavior of MSU students, gauging a more accurate overall university carbon footprint, and learning possible ways to reduce this footprint through alternative modality choices.

BEHAVIOR, COMMUNICATION, AND EDUCATION

17. Expand Environmental Steward Program in Energy Conservation

Support and expand the environmental steward program to advance communication efforts in energy conservation and carbon reduction.

18. Communication Approaches Differentiation

Differentiate the design and implementation of energy communications plan to the specific needs and preferences of students, faculty, and staff.

19. Community Education

Education is needed for faculty, staff, and students on specific strategies to conserve energy, coupled with education, on the relationship between personal energy use and climate change. A campus-wide environmental literacy effort is needed to improve basic knowledge throughout the MSU community.

20. Regular Updates on Energy Conservation Publicity Campaign

Provide the university community with regular updates on MSU's progress towards its conservation goals coupled with regular feedback on the energy saved by MSU members to encourage and enhance individual energy conservation behavior.

21. Signage for Campus Projects

Develop signage for campus environmental and sustainability projects to increase visibility and perceived benefits to students, faculty, and staff for being associated with a 'green' university.

22. Sustainability Projects Reporting Process

Create a streamlined process for reporting campus sustainability projects. By publicly cataloging projects, the community will be able to support, confirm, and collaborate on environmental projects.

COMPLIANCE AND TECHNOLOGY

23. Compliance Readiness

Begin a serious strategic planning process for emissions compliance readiness in advance of new greenhouse gas federal legislation and for all other emissions.

24. Web Conferencing Technology

Extensively integrate web conferencing technology into campus life and better educate all faculty and staff in the use of such technology.

Background and Intent to Recommendations

ENERGY REDUCTION AND OFFSETS

1. Decision-Support Tool

Recommendation
Develop a decision-support tool for optimizing financial and environmental performance of the T.B. Simon Power Plant.

Background
As a member of the Chicago Climate Exchange (CCX), Michigan State University (MSU) is committed by the year 2010 to reduce its GHG emissions by six percent compared to the year 2000. Over 90% of MSU's GHG emissions come from the T.B. Simon Power Plant, which produces both electricity and steam for campus heating and cooling. As of September 2009, the T. B. Simon Power Plant is permitted to burn two carbon-neutral bio-fuels, wood and switchgrass, in addition to coal and natural gas. As more different fuels become feasible, it becomes more complex to balance the objectives of cost containment, compliance with the CCX commitment, and compliance with other environmental regulations. A pilot model has been developed to support fuel choice decisions at the power plant. That model evaluates alternative fuels with the goal of minimizing the cost of fuel required for generating electricity and steam while meeting CCX and other operating requirements. Preliminary results suggest that co-firing with switchgrass, along with increased use of natural gas to offset coal, could be one cost-effective alternative for achieving the CCX goals. However, the current model lacks the detail required to become operationally useful for fuel acquisition planning at the T.B. Simon Power Plant. A parallel need is for analysis of local markets and long-term contract designs for procurement of bio-fuels such as switchgrass in order to implement bio-fuel combustion plans.

Intent
Further development of the current decision support model will lead to an instrument that incorporates market price variations, alternative fuels, power plant burner maintenance schedules, U.S. Environmental Protection Agency air pollution regulations, and multiple time horizons. Such a decision tool would help MSU identify the lowest cost means to meeting its institutional commitments to environmental quality. Analysis of local biomass markets and contract designs will help the T.B. Simon Power Plant arrange future supplies of bio-fuels as needed.

Community Impact
By identifying the most cost-effective ways to manage the T.B. Simon Power Plant fuel supply, while meeting MSU's environmental commitments, this decision support tool can ensure that MSU's power generation budget is used as effectively as possible. Minimizing the cost of compliance with MSU's CCX commitment also makes it possible to adhere more strongly to that commitment to reduce the university's impact on global climate change. Analyzing markets and designing contracts for local biomass production to meet needs at the power plant could lead to new crop and forestry opportunities for growers in mid-Michigan, while meeting MSU's commitment to reduce its global warming impact.

Next Steps
Recruit a graduate student to develop the decision support tool.

2. Fuel Switching

Recommendation
In response to campus community preference, MSU decision makers should consider a more aggressive fuel switching plan to include the use of more alternative fuels, natural gas, and other available technologies that result in reducing the campus carbon footprint.

Background
The results from an MSU 2009 energy survey of the campus community indicate that students, faculty, and staff show strong support for producing steam from less carbon intensive fuels in comparison to the heavily coal status quo. The survey used a choice experiment method to evaluate respondents' preferences for energy producing fuels. Biomass was the most preferred steam producing technology by all of the segments of the campus community. The campus' energy demand includes steam for the heating, ventilation, and air conditioning (HVAC) system as well as electricity. Therefore, the study examined steam-producing fuels, which included coal, natural gas and biomass, as well as the electricity only technologies of wind and solar power. Campus stakeholders indicated a preference for carbon footprint reductions from the power plant sooner rather than later. Therefore, decision makers should consider fuel switching within the power plant infrastructure currently equipped for lower carbon fuels as well as upgrading to technologies able to use less carbon intensive steam producing fuels when part of the current electricity capacity is due for replacement in 2023.

Intent
To reduce the power plant's carbon footprint through fuel switching.

Community Impact
Fuel switching (e.g., from coal to natural gas), when possible, will demonstrate MSU's commitment to lower its carbon footprint and be a leader in environmental stewardship. The increased use of more environmentally neutral fuel mix and the communication of that fact to the MSU community will increase MSU's 'green' reputation; something highly valued by MSU community members.

Next Steps
MSU Physical Plant administrators should develop a business model and decision tool to assist in the implementation of an improved fuel mix for meeting MSU's electricity, heating, and cooling demands.

3. Green Technology

Recommendation
In response to campus community preference, MSU decision makers should expand the energy portfolio to include effective renewable energy (e.g. wind and solar) as part of the electricity generating capacity.

Background
The results from an MSU 2009 energy survey of the campus community show that students, faculty, and staff indicate wind and solar power as the most preferred electricity production technologies in comparison to coal, natural gas, and biomass. The survey used a choice experiment method to evaluate respondents' preferences for energy producing fuels. The campus' energy demand includes steam for the HVAC system as well as electricity. Therefore, the study examined steam-producing fuels, which included coal, natural gas, and biomass, as well as the electricity only technologies of wind and solar power. The study found that all segments of the campus community (i.e., students, faculty, and staff) would be willing to pay the most in semester energy fees for electricity generated using wind power followed closely by their willingness to pay for electricity from solar power. The willingness to pay estimates revealed that faculty, generally with higher incomes than students and staff, revealed higher willingness to pay preferences for electricity generated using green technologies. Furthermore, the survey results suggest that the campus constituencies' preferences toward 'green' technologies do not come purely from respondents' view of these technologies' environmental benefit. Instead, it was found that the MSU community positively values the enhanced 'green' reputation effects that accompany MSU's adoption of renewable energy technologies along with the reduction in the university's carbon footprint.

Intent
Incorporating renewable energy technologies, such as wind and solar power, for producing electricity will help to address the MSU community's preferences to reduce the campus' carbon footprint and increase the university's 'green' reputation.

Community Impact
Implementation of this recommendation will have a three-fold effect on the community: 1) community members will see MSU making a visible commitment to a renewable energy portfolio (previous research by the behavior team surfaced this concern by community members (in other words, walk the talk); 2) switching to either wind or solar will reduce overall carbon dioxide (CO2) emissions associated with our power generation; 3) among the larger community of Big Ten institutions, MSU will continue to build its reputation as a leader in environmental stewardship.

Next Steps
MSU Physical Plant administrators should begin to explore viable options for the addition of both wind and solar to our power generation portfolio.

4. Database Improvement to Support Carbon Offset Projects on Campus and on MSU Properties

Recommendation
Improve the campus and properties databases to provide more systematic and integrated access to information that will support carbon offset planning and monitoring.

Background
Campus and off-campus properties analyses of carbon offset potentials found that the database system for the properties is less integrated than is useful for these kinds of assessments. While each property is individually and separately well organized, their systematic use across the whole of all properties is rather limited. Because carbon assessment is just one of the types of inquiries and/or analyses needed, it makes sense that a separate project should be developed to improve these data and develop a comprehensive database.

Intent
This will vastly improve the organization of information on MSU campus tree management, as well as off-campus MSU properties. It will integrate the individual off-campus property datasets into a common database.

Community Impact
These measures should make the use of campus offsets and the MSU off-campus properties more efficient and expand the opportunities in operations, research, and teaching using these properties.

Next Steps
Work with Campus Planning and Administration, Land Management, and Forestry to create a more robust database for campus and off-campus properties.

5. Forest Property Expansion to Permanently Offset Power Plant Emissions

Recommendation
Conduct a feasibility study to evaluate the costs and benefits of expanding MSU forest properties and the Upper Peninsula (UP), to provide enough growing stock for significant future carbon offsets. Other benefits could be obtained including feedstock source for biomass energy research and production.

Background
Efforts to reduce our GHG have been incremental so far, gaining a savings of few percentage points each year. This has been offset by the increasing growth in the square footage served by the power plant. With federal legislation looming on the horizon, it makes sense to begin thinking about bolder strategies, so proposed target goals that are in draft legislation, and legislation that has been passed by U.S. Congress, can be met. These targets call for an 83% reduction in GHG by 2050. This would mean that MSU's emissions of approximately 600,000 tons of carbon dioxide equivalent (tCO2e) would need to be drastically reduced. Over the short term, much of the emissions reductions could be achieved through the purchase or creation of forest offsets. One option would be to expand our forest property areas in the UP by 50,000 acres, which, if planted in red pine or white spruce, could ***permanently*** sequester more than 30% of our current emissions. These lands could be devoted to a range of uses, including commercial forest, bio-fuel or bio-energy feedstock (with the potential of creating another offset), or experimental land. Approximate cost would be on the order of $50 million plus minor taxes each year. One option to review would be to lease the land with an easement at about the current tax rate plus a margin ($1.20 + $0.50) or approximately $85,000 per year.

Intent
This rather large outlay would ward off future carbon risk liability and provide additional benefits or income streams. At the level of 30% emission reductions at $10 per tCO2e, MSU's forward liability is approximately two to four million dollars per year. Rather than outlay this amount, it can be invested in property that services the research needs of MSU bio-economy, or as a commercial/investment opportunity for bio-energy.

Community Impact
This recommendation would allow for a permanent compliance with all future emission reductions until about 2030. At the same time, it maintains the forest legacy landscape in Michigan for a range of multiple benefits such as biodiversity, hunting, and scenic beauty. It could also support a range of significant MSU research or be put into direct action as a source of bio-energy feed stock.

Next Steps
Conduct a full feasibility study to assess the potential of this strategy.

6. Reforestation Offset Projects on MSU Properties

Recommendation
Develop a multi-site reforestation offset project on all eligible MSU properties beyond the main campus and demonstrate feasibility and protocol for future projects.

Background
MSU owns and manages a large number of properties with significant forest and agricultural land. These properties could be used to support carbon offset projects in forestry and soil management. This research effort is focused only on assessing the potential for reforestation offsets. Future efforts will focus on the potential for offsets on agricultural land. Thirty eight (38) properties were surveyed and a geographic information system (GIS) data base was built using existing GIS files and new acquisition of historical and current high resolution imagery. The project assessed the total forest land that was eligible as a reforestation offset according to the CCX rules. There are approximately 830 acres of land available for measurement and registration, with the largest tracts on about four to five properties (e.g. Brook Lodge, Lux Arbor, Hidden Lake Gardens, Kellogg Biological Station). This would total approximately 3320 tCO2e per year, or about 25% of our annual incremental reduction commitments. Because MSU can count back to 2003 in the first year of submission, this would amount to about 16,600 tCO2e in the first year or about half of its 2010 total reduction commitments. The exact estimate needs to be further elaborated since only a fraction of the 830 acres would be practical for enrollment in the project.

Intent
This project would provide a small fraction of offsets required to meet CCX targets. A more precise elaboration of the potential needs to be done, but it seems prudent to create the project as the next step.

Community Impact
This would be a highly visible project that makes use of existing MSU forest and agriculture assets. It would provide an excellent opportunity for local community outreach and engagement, student venues, and research.

Next Steps
Use CCX protocols to assess on and off-campus forest and agricultural assets.

7. Urban Forestry and Widely Spaced Tree Offset Project

Recommendation
Implement an urban and widely spaced trees offset project on the MSU main campus and register it with the CCX based on an approved protocol.

Background
The energy team has evaluated the potential for creating a modified and improved version of the existing CCX protocol on urban forestry and widely spaced tree planting programs. This protocol was reviewed by CCX and has been approved. It represents a new standard to be followed by other organizations and likely acceptance by a U.S. federal program. It should now be implemented. It would form the basis for a carbon offset project using the campus tree planting efforts as well as the three natural areas. Basic biometric work demonstrates that a marginal sequestration would be produced that is the same order of magnitude emission reduction as some other recommended programs. The findings of this study show that MSU can successfully offset some current emissions and perhaps expand the current tree planting efforts in light of their added value as a carbon offset.

Intent
This would create a verifiable carbon offset project that would produce a tangible added benefit from maintaining a 'green' campus. It would be used in the regular inventory of emissions to counter balance a small fraction of emissions in order to meet a portion of the reduction commitments.

Community Impact
This project would be the first of its kind, and as such, have high visibility. MSU's carbon offsets would be seen throughout the campus. It is also an important prototype for others to follow, and while the emissions offsets would be relatively small, its impact on behavior could be large.

Next Steps
Use recently approved CCX protocol to quantify carbon offsets for MSU urban and widely spaced trees.

WASTE REDUCTION

8. Feasibility and Best Practices for Composting Campus Food Waste

Recommendation
Develop and implement pilot studies to evaluate the feasibility and best practices for composting campus food waste.

Background
In July 2009, 25 stakeholders (faculty, staff, and graduate students) were brought together as part of a workshop to map the MSU food system. Among the goals of this workshop were the identification of key areas for future environmental stewardship research and initiatives related to the MSU food system. As a result of this workshop and follow-up meetings with Residential and Hospitality Services (RHS) management, the development of a system for composting campus food waste was ranked as a top priority.

Therefore, the proposed research will include the design and implementation of pilot composting studies that will handle both pre and post-consumption food waste in selected venues across campus. These studies would assess alternate variables including compost method (e.g., anaerobic vs. aerobic), facility location, input type, infrastructure, and transportation. These studies will collect baseline data such as compost inputs including weight, volume, porosity, and moisture content. In addition, output data (e.g., quality of compost, market-price equivalence, etc.) will be collected. As part of the proposed research, the logistics of collection and movement of material will be tracked, measured, and assessed to help evaluate relative cost/benefit tradeoffs of alternative compost systems. There will also be an assessment of each alternative composting system as well as an overall evaluation of alternative inputs, final products, potential uses, marketing strategies, and revenue generation. The proposed project will develop, test, and evaluate educational materials and programs for various target audiences (students, kitchen staff, chefs, etc.). These materials will be systematically developed, piloted, and evaluated for effectiveness. Likewise, it is anticipated that a decision-making tool can be developed as part of this project to support food service criteria for evaluating and adopting alternative composting options.

Impact
This research will help MSU stay ahead of possible new food recycling regulations as seen in Seattle and San Francisco. San Francisco's new city law requires residents to compost food waste. Seattle was the first city in the United States to require all households to compost food waste. Moreover, institutional implementation of composting will help reduce waste disposal costs, provide a potential source of revenue, and advance MSU's efforts to be environmentally sustainable. Many institutional food handlers (schools, hospitals, prisons, etc.) will be looking for food residual recommendations in the future and MSU will be ready to provide them with options.

Not only does this study align well with the environmental stewardship goal of 30% waste reduction by 2015, but it does so while creating awareness of the quantity of food waste and generating a possible revenue stream from the sale of MSU branded compost to the public.

Next Steps
Design and implement pilot composting studies that will handle both pre and post-consumption food waste in selected venues across campus.

9. Reduce MSU's Total Life Cycle Greenhouse Gas Emissions Associated with Purchased Goods and Equipment

Recommendation
Improve energy efficiency and lower GHG emissions associated with purchased goods and equipment by extending their life through recycling and reuse. As demonstrated through a life cycle assessment of computers, life extension can reduce GHG emissions associated with manufacturing of the purchased equipment.

Background
Energy consumption and GHG associated with the full life cycle of equipment purchased by the university was calculated, from the mining of raw materials to the disposal of the equipment in a landfill. Life cycle analyses (LCA) are important tools for finding the most effective ways to reduce energy and GHG emissions. Not only does a life cycle analysis look at the energy consumption and GHG emissions of a product, but it also examines the energy consumption and GHG emissions of the manufacturing stages (often referred to as upstream) and the end-of-life stages (often referred to as downstream) for the product. By looking at the upstream, usage, and downstream (i.e. life cycle) of a product in terms of energy and GHG emissions, it is easier to see where the most energy is expended. This type of analysis was developed for computers as a representative type of equipment purchase. It was found that the full life cycle GHG emissions of computers increased by 25-100% over the direct energy consumption, or plug load. In addition, energy savings exist when the equipment is recycled, saving as much as 20%. One of the most important savings comes from extending the life of the equipment, either through upgrading the equipment or reusing it through the salvage process. For example, using a computer for only two years, rather than four, increases the life cycle GHG by 50%.

Intent
A program that actively encourages longer life cycles and life times for equipment will reduce a major inadvertent part of MSU's overall carbon footprint. One way to increase the life span of equipment is to increase use of the salvage process. If reuse is not possible, then an active, perhaps mandatory, recycling effort on equipment should be pursued to reduce the carbon footprint. This policy should be extended to all purchasing decisions. An improved understanding of the full life cycle implications of purchases will reduce the university's impact on the environment. Furthermore, the lessons learned by computer life cycle assessment can be applied to almost all purchased goods.

Community Impact
By focusing on environmental stewardship from a life cycle or end-of-life perspective, MSU can amplify the benefits of its actions to the environment.

Next Steps
Use data to inform the MSU community, including environmental stewards, Purchasing, Surplus, and the Computer Store, to encourage extending the life cycle of computers through reuse.

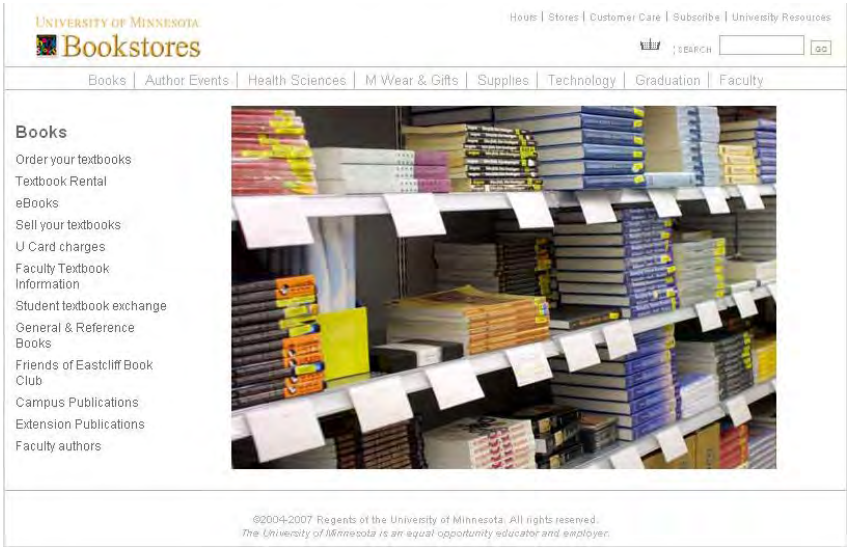
10. Alternative Textbook Sources

Recommendation

Expand student and faculty knowledge of alternative textbook sources (bookstore, online download, rental, etc.) with information on best textbook sources on MSU's bookstore website; highlighting those that offer lower prices while producing less paper and transport waste than traditional bookstores.

Background

Along with buying the book in a bookstore, the average student textbook may now be purchased from an online distributor, downloaded as a PDF, purchased as an audiovisual book, rented from a store or online distributor, purchased from a friend, or read in the library. These new options are defined as "textbook alternatives" and many of them promise less expensive course texts using less paper. Some universities (e.g. Princeton) have been providing their students with textbooks on Amazon's Kindle E-Reader, while others (e.g. Cornell and University of Minnesota (shown) have advanced college bookstore websites providing students with digital textbook downloads, shopping tips, tax advice, and book-rental programs. New private enterprises also have challenged normal bookstore models (for example, the book-rental sites www.chegg.com and www.flatworldknowledge.com). However, there is no information available on which of these options MSU students prefer or whether the faculty is aware of all these options, nor are there current resources available for students and faculty to understand their options. The textbook market is also changing so rapidly that any new textbook source must immediately reflect the economic realities and technological capabilities of modern students if it is to be successful.



Intent

Promote new textbook alternatives at MSU and better understand the habits of students and faculty to create a plan of action to utilize these alternatives.

Community Impact

The proposed website improvements will allow MSU students (and their parents) to find better textbook deals, making college more affordable for them while likely reducing environmental impact. The expanded website will also provide a resource to improve faculty awareness of textbook options and will increase MSU's perceived commitment to environmental stewardship and to Congress's Higher Education Opportunities Act recommendations for July 2010.

Next Steps

The next steps are to determine the textbook sources with the most potential for current MSU students and faculty. After the best sources are identified, actively promote the sources to the community.

11. Communication via Electronic Media

Recommendation
Proceed to replace paper-based, unsolicited MSU internal communications by electronic media. Establish a university-wide electronic publication hub that lists all available publications by department, and allows recipients to sign up to receive specific publications or information from groups of interest. Educate the community, especially student and certain staff groups, on different electronic publishing tools, including MSU electronic information systems, email and website publication, in order to ensure continued access to valuable internal communications.

Background
In response to a survey in fall of 2008, 21 departments reported spending over $1 million to print over 4.7 million items for internally-targeted paper mailings. Interviews with campus mail staff indicated that paper mail had a negligible cost impact on their parcel delivery services, so eliminating paper mail would not result in a reduction of vehicle traffic or cost related to distribution. Looking at the recipient side, a separate survey of MSU students, staff, and faculty in summer of 2009 revealed that e-mail and web-based communication is preferred to paper-based communication for all three recipient groups, across all types of information. Nearly everyone in the MSU community has on-campus access to electronic communication by e-mail and web. However, students and certain staff groups are less likely than other groups to open e-mails. Also, some staff members tend to seek little information on the web. Many members of the MSU community have limited familiarity with list serves and really simple syndication (RSS) feeds that can help them to manage receiving email on topics of interest.

Intent
Replacing paper-based internal mass communication with electronic communication will reduce the university's paper consumption and allow departments to save money. A formal process for educating both senders and recipients on ways to use e-mail and web-based tools to share and receive information will ensure a smooth transition. In particular, recipients (especially students and certain staff) will need training on how to manage e-mail filters and how to seek relevant information on the web. Senders of current paper-based internal mass communications will need advice on strategies for reaching desired audiences via electronic media. A university-wide system for registering publications and signing up to receive them electronically, such as a web-based publications hub, can coordinate such flows of information.

Community Impact
Reduced paper-based mass communication at MSU will reduce production and disposal costs to university units while shrinking the university's material use footprint. Reduced paper consumption would also likely reduce the future throughput at MSU's recycling center.

Next Steps
Work with the appropriate departments to develop a website to manage campus publications.

12. Flow of Recycled Materials—Bin Sensor Fullness-Monitoring System

Recommendation
Transfer and expand the bin sensor fullness-monitoring system to a larger building to evaluate the usefulness and labor-savings conferred by the system.

Background
Real-time monitoring of office recycling bins (officially called 'intermediates' by operations' staff) allows for within-building comparison of recycled material generation on both a spatial and a temporal scale. This information in turn allows for a much better understanding of human recycling habits and also allows for more efficient material collection. Human monitoring of bin fullness is unreliable both because of human error and because no observer can be everywhere at once. To overcome this problem, an automated monitoring system was developed using expertise in remote sensing technology.

The Manly Miles Building has 58 white and mixed paper intermediates and each now contains a soap-box-sized pressure sensor that transmits a radio frequency identification (RFID) wireless signal when the bin is full. This signal is picked up by a receiver, stored in a database, and displayed as 'FULL BIN' on a bin sensor webpage (www.bserv.real.msu.edu/bins/). The sensor works regardless of the type of material in the bin and has an effective battery life of over four months. While Manly Miles represents an excellent test bed, as a building it is not interesting enough for a full study because of its homogenous room types – offices and computer labs.

Intent
Understanding how recycled material generation correlates with room type, temporal factors, and major campus events (such as the end of a semester) aid in future recycling collection planning and design. The bin sensor system will permit an effective investigation of these correlations. At the same time, the developed system has the potential to act as a permanent monitor of bin fullness, producing information which will improve the efficiency of bin emptying across campus by eliminating the need for human bin-monitoring and by complete optimization of bin space usage.

Community Impact
If this project can be successfully scaled, labor costs and time could be reduced for servicing recycling bins. Custodial and recycling staff would be able to better monitor bin fullness and track data remotely without depending on routine visual measurements.

Next Steps
It is recommended that the bin sensors be tested in a larger, multi-use building such as Anthony Hall to produce meaningful comparisons of different locations for recycling bins – offices, hallways, classrooms, laboratories, etc. Then there can be further evaluation of operational effectiveness of the bins' sensors.

TRANSPORTATION

13. Bicycle Use Study for Better Resource Allocations

Recommendation
Conduct a bicycle use study that estimates bike use/trends both around campus and commuting to campus. This effort will be coordinated with All University Traffic and Transportation Committee (AUTTC) and the University Traffic Engineer who are identifying a more substantial process for annual assessment of bicycle use and safety issues on campus. This information will allow for more focused resource allocations on future prioritized needs to improve bicycle routes, encourage ridership, and provide a safer campus circulation system.

Background
The 2009 faculty and staff transportation survey identified a significant potential to increase bicycle use as a regular mode of transportation for employee commuting and on-campus business travel.

As MSU encourages the use of alternative modes of transportation (in lieu of single occupancy vehicle trips), bicycle use is becoming more important. However, one of the greatest challenges facing the bicycle field is the lack of documentation on usage and demand. Without accurate and consistent demand and use figures, it is difficult to measure the positive benefits of investments in these modes, especially when compared to the other transportation modes such as the private automobile or mass transit. Some proposed information to be gathered from the study includes the following:

- Current utilization of existing bike racks.
- How bikes are being used for departmental use during the work day.
- Understanding of common barriers to bicycle use both for commuting and business use.

Intent
The results of a bicycle use study will provide a more accurate picture of the current uses of bikes and potential future needs for bicyclists on campus. With the ultimate goal of encouraging bicycling as an alternative mode of transportation to and around campus, understanding current biking trends is essential. The results from this study would be used to identify educational programs, prioritize bicycle system enhancement projects, and establish strategies for resolving existing barriers or safety issues on campus.

This study will be coordinated with the AUTTC bicycle and pedestrian subcommittee efforts and the University Traffic Engineer who will take a lead on analysis of riding habits, routes, and safety issues. Together the efforts of environmental stewardship and safety can have a long-lasting impact on changing commuting habits and adverse environmental impacts.

Community Impact
Increasing the use of bicycles will help resolve the various negative environmental impacts associated with vehicular traffic on campus. Establishing a better understanding of current patterns and future trends will allow a focused use of resources to enhance the bicycle system and increase the reality of bicycling as a favorable mode of transportation. The study will also help show how the campus and adjacent communities can better interconnect their bicycle systems for greater regional accessibility.

Next Steps

- Establish a baseline of data for future measurement and assessment.
- Identify specific educational programs to enhance user safety and resources that leverage increased utilization.
- Reduce conflicts with pedestrians and motor vehicles on campus.
- Reduce vehicular traffic on campus.
- Enhance regional bicycle accessibility.
- Reduce GHG emissions.

14. Car Share Pilot Project

Recommendation
Establish a three-year pilot car-share program managed by a third-party on campus for use by eligible faculty, staff, and students (e.g., Zipcar, Enterprise WeCar, etc.). Identify and monitor specific indicators to assess if the program is meeting its environmental stewardship goals and if it should be continued beyond the pilot program status.

Background
Based on metrics from large public and private universities across the nation, car-share programs are beneficial in reducing single vehicle occupancy trips to, from, and around campus while providing a desirable service for the campus population. Support for this program has been received from the vice president for governmental affairs, employees, and students. The program will be managed by a private company with minimal staff and financial requirements from the university. Peer institutions are using these programs and are happy with the results.

Intent
- Establish a pilot program to test a car-share program at MSU.
- Provide a unique transportation option for the university.
- Provide a program that can help reduce single-vehicle occupancy trips on campus and the resultant GHG emissions.
- Provide an alternative mode of transportation for business and personal use.

Community Impact
Providing alternative modes of transportation for university employees and students has both personal and business-related benefits. For the university, it provides a cost-effective alternative for business-related travel for departments/units. For employees, who choose to ride mass transit, it provides an alternative mode of transportation for emergencies when they arise. For students, it provides the ability to access community services, off-campus internships, or retail shopping; an amenity to help attract and retain students on campus. Combining various alternative transportation modes has been used effectively at universities across the nation.

Next Steps
- Design and manage a request for a proposal process to evaluate various vendor programs and select a preferred provider.
- Identify measurable objectives that will be used to assess the pilot program and long-range program viability.
- Provide a viable transportation service that can help increase the use of mass transit or other alternative modes for commuting.
- Reduce single-vehicle occupancy trips on campus.
- Provide an amenity to help attract and retain students on campus.
- Provide a cost-effective amenity for employees and departments to use for on and off-campus business purposes.

15. Eco-Map Transportation Patterns

Recommendation
Integrate 2009 transportation survey data with Tri-County Regional Planning Commission's (TCRPC) existing mapping and modeling data to change commuting patterns and reduce operational costs (parking, enforcement, safety), reduce environmental impacts (resource consumption, GHG emissions), and increase pedestrian safety (reduced vehicular traffic on campus).

Background
The 2009 transportation survey of faculty and staff revealed opportunities to change traditional modality patterns that can have a positive impact on reducing single vehicle occupancy trips to and from campus.

TCRPC has prepared numerous models as a part of their long-range planning initiative depicting commuting patterns (routes) from specified Transportation Accumulation Zones (TAZ) to specific building destinations on campus.

Capital Area Transportation Authority's (CATA) Clean Commute initiative offers a rideshare program that can be targeted to specific population groups on campus to encourage carpooling, ridesharing, and alternative modality choices. In addition, desirable routes for expanded off-campus bus service can be identified and prioritized.

As a major employer in the region, MSU has both a responsibility to enable change and a unique connection with its employees to educate and encourage change that will have positive benefits to the university and tri-county region.

Intent
Further leverage the data obtained in the 2009 faculty and staff transportation survey through coordination with the TCRPC and mass transit providers to enable changes in modality patterns that will have positive operational cost and environmental stewardship outcomes.

Establish a working group comprised of university and non-university entities to identify specific opportunities, new modeling requirements, and specific initiatives that offer options for MSU employees to engage alternative transportation options.

Community Impact
MSU is a major contributor to vehicular traffic patterns within the tri-county region. The TCRPC updates their long-range plan every five years. The tri-county area works diligently to maintain its air quality and avoid ozone non-attainment. The ability to reduce the number of single vehicle occupancy trips for commuting to and from the campus can help the region meet air quality regulations, enhance safety, and reduce the use of non-renewable resources. This effort will work to establish incentives that promote the use of alternative transportation modes and reduce university-related GHG.

Next Steps
- Reduce single vehicle occupancy trips related to employee commuting.
- Identify new programs offering alternative commuting options.
- Reduce vehicular traffic on campus.
- Enhance pedestrian and bicycle safety on campus.
- Lower commuting and parking costs for university employees.
- Reduce GHG emissions.

16. Student Transportation Survey

Recommendation:
Develop a student transportation survey to complement the faculty/staff transportation survey recently completed. The purposes of the student transportation survey are to accurately describe the current transportation behavior of MSU students, gauge a more accurate overall university carbon footprint, and learn possible ways to reduce this footprint through alternative modality choices.

Background
In spring 2009, an online survey of university faculty and staff was conducted to study employees' transportation methods. In addition, the survey looked at knowledge of alternative methods of transportation, willingness to use alternative transportation, and general attitudes toward energy conservation and climate change issues. Several conclusions were drawn from this survey regarding choices that university employees make regarding what alternative transportation they currently do or would choose and when they would choose these methods (as opposed to single vehicle occupancy trips). As students make up the majority of the university population, a parallel survey with questions specific to student patterns and needs will allow a complete understanding the university's commuting preferences.

Intent
The results of a student transportation survey will provide a more accurate picture of the transportation carbon footprint for the university and some possibilities for reducing this impact. Understanding students' driving habits and attitudes toward alternatives is essential to reduce single vehicle occupancy trips to and around campus. The results from this survey could be used to gauge the need for additional education on existing alternative transportation or what incentives will encourage the use of energy saving alternatives.

Based on the 2009 employee survey, a budget of $5,000 - $6,000 is recommended for this effort. This survey can also be combined with other environmental stewardship survey needs to minimize duplication and "survey fatigue" among those being surveyed.

Community Impact
Students contribute significantly to campus vehicular traffic. Reducing student-related vehicle trips on campus will in turn reduce GHG, vehicular/pedestrian conflicts, and the consumption of non-renewable resources. The survey will provide a better understanding of student commuting habits and what incentives will encourage the use of environmentally sustainable transportation modalities.

Next Steps
- Identify specific strategies to encourage student use of environmentally friendly transportation modalities.
- Identify new modality opportunities other than the car.
- Reduce vehicular traffic on campus.
- Enhance pedestrian and bicycle safety on campus.
- Reduce the demand on the parking system and operational costs.
- Reduce GHG emissions.

BEHAVIOR, COMMUNICATION, AND EDUCATION

17. Expand Environmental Steward Program in Energy Conservation

Recommendation

Support and expand the environmental stewards program to advance communication efforts in energy conservation and carbon reduction.

Background

Findings from the MSU 2009 campus-wide survey suggest that the campus community considers environmental stewards as an important source of information. They were highly ranked by students, faculty, and staff as the most effective environmental information provider among other sources including faculty, residence life mentors, unit heads, top university officials, and MSU sports figures. The overall favorable ranking of the environmental stewards partly reflects the pivotal role the environmental stewards are playing to advance communication efforts on campus. Moreover, in corroboration with previous studies, faculty and staff indicated a strong preference for trained personnel to educate and implement MSU conservation initiatives.

Intent

Some energy use behavior may be particular to certain buildings or departments and may thus require specific information. Continued support and expansion of the activities of the environmental steward program will help effectively communicate such specific information regarding energy conservation and other environmental initiatives, which cannot be relayed using mass communication.

Community Impact

Survey data showed that students, faculty, and staff saw stewards as credible resources. Expanding the steward program may potentially help these audiences make better connections between their personal energy consumption and campus energy consumption.

Next Steps

Work with the environmental steward program coordinator to determine how to support and expand the steward program through offering additional learning tools and support to the stewards.

18. Communication Approaches Differentiation

Recommendation

Differentiate the design and implementation of an energy communications plan to the specific needs and preferences of students, faculty, and staff.

Background

Results from an MSU 2009 campus-wide survey indicate that three main campus segments –students, faculty, and staff significantly differ in their preferred communication approaches. Regarding energy conservation information outlets, students prefer the use of the campus newspaper,
The State News, and social networks such as Facebook and MySpace as a medium for communicating environmental information while faculty and staff generally prefer to receive such information at departmental or unit meetings. Likewise, while students perceive MSU sports figures and faculty as the most effective communicators of environmental information, faculty and staff prefer to hear from their department or unit heads and top university officials. This finding is also consistent with previous studies, which reported differences in communication preferences for the recycling program among the three campus segments. The literature on communication efforts also emphasizes the need for tailored communication approaches to effectively promote a behavioral shift (Abrahamse et al. 2007).

Intent

Tailoring communication approaches to the needs of target audiences will help address the information barriers to conservation behavior that are specific to each constituent and thus help promote behavioral change. Communication programs could make use of results from our campus studies examining preferences of the university community regarding communication approaches for environmental information.

Community Impact

Targeted communications to each audience should result in better behavioral shifts.

Next Steps

Incorporate audience differentiation in the communications plan.

19. Community Education

Recommendation
Education is needed for faculty, staff, and students on specific strategies to conserve energy and on the relationship between personal energy use and climate change. A campus-wide environmental literacy effort is needed to improve basic knowledge among the MSU community.

Background
Previous campus studies reveal a high degree of environmental concern among the MSU population. However, recent research suggests that these concerns do not translate into pro-conservation behavior partly due to a lack of knowledge on specific strategies to conserve energy. Results from a 2009 campus energy study show that faculty, staff, and students indicated that technology adoption, which uses energy more efficiently, is a more desirable means of conservation than education. However due to budget constraints, technology is not always feasible. Furthermore, people still need basic energy education to make sound conservation technology choices. Sustainability scholars also agree that technology coupled with behavior change is optimal to reduce energy consumption. Additional energy study results indicate that the MSU community members less often undertake conservation actions such as unplugging electrical appliances when not in use or practice conservation with their computers. There also appears to be confusion over whether certain actions do save/waste energy or contribute to climate change. A survey of literature confirms these findings by suggesting confusion among the public regarding the connection between their electricity use (computer use), GHG, and the depletion of the ozone layer (Bord et al. 2000, Marcell 2004). Although such knowledge may not be the sole determinant of pro-conservation behavior, a misunderstanding of the issues related to energy use and climate change could potentially create significant barriers to behavior change. Thus, educating the community on specific behavioral changes individuals can make to conserve energy as well as how their personal behavior contributes to the effects of climate change could help translate those concerns into the desired behavior.

Intent
Educating the community on specific practices to conserve energy and the connection between personal behaviors and climate change encourage community members to initiate conservation behavior.

Community Impact
Community members should initiate conservation behaviors.

Next Steps
Incorporate education into the communication plan so that faculty, staff, and students have a better understanding of the connection between their actions and climate change. Consider developing environmental education modules for new faculty and staff.

20. Regular Updates on Energy Conservation Publicity Campaign

Recommendation
Provide the university community with regular updates on MSU's progress towards its conservation goals coupled with regular feedback on the energy saved by MSU members to encourage and enhance individual energy conservation behavior.

Background
In an MSU 2009 campus-wide survey, the MSU community strongly indicated their preference for regular feedback on energy saved by their actions as well as updates on progress towards MSU's conservation goals as incentives that would encourage them to conserve energy. This finding also supports previous research in which participants indicated a strong desire to know about MSU energy conservation goals and strategies as well as its progress in reaching those goals. Regular feedback to the university community could help facilitate the desired behavioral shift by inducing individuals to feel capable of making a difference in MSU conservation efforts. The literature on energy conservation behavior also highlights the pivotal role of regular feedback in encouraging energy use behavior (Petersen et al., 2007, Abrahamse et al., 2007). Feedback could be in the form of a monthly updates on energy consumed and cost savings realized from energy conservation efforts undertaken by various campus units/buildings.

Intent
Providing regular feedback on energy saved and updates on MSU progress in meeting its conservation goals may encourage and enhance individual energy conservation behavior. This strategy is designed to increase individuals' self-perceived efficacy to make a difference in MSU's sustainability efforts.

Community Impact
As stated above, according to the 2009 energy survey, updates and progress toward MSU's conservation goals would encourage the community to save energy.

Next Steps
Create a regular public reporting process to make progress more visible to the campus community.

21. Signage for Campus Projects

Recommendation
Develop signage for campus environmental and sustainability projects to increase visibility and perceived benefits to students, faculty, and staff for being associated with a 'green' university.

Background
During a recent environmental stewardship pilot project audit, it was discovered that there were over 45 environmental projects in two units alone. Based on a previous behavior team study, students felt like MSU did not 'walk the talk' (i.e. they were asking students to make changes, but the university was not working on improving sustainability.) A more recent behavior team survey confirmed that students, faculty, and staff felt there were benefits in being associated with a 'green' university. As a result of these studies, it is recommended that the university increase the transparency of its efforts by creating signage to showcase sustainability and environmental stewardship projects on campus.

Intent
Providing signage for campus environmental and sustainability efforts will increase awareness of these projects. Such awareness addresses multiple goals. It is educational, allowing people to learn about environmental alternatives. It increases MSU's sustainability profile, making people aware of the university's commitment. Coordinated signage will link individual projects to the broader Be Spartan Green campaign, creating a coherent, pervasive campus identity.

Community Impact
Community members will be able to attribute campus environmental and sustainability projects to a coordinated campus effort which should help students understand administration's efforts to decrease the environmental footprint and reinforce that MSU is a 'green' university, thus providing benefits to students, faculty, and staff.

Next Steps
Work with the environmental stewardship communications team and Landscape Services to develop a series of signs or visual cues for environmental projects on campus.

22. Sustainability Projects Reporting Process

Recommendation
Create a streamlined process for reporting campus sustainability projects. By publicly cataloging projects, the community will be able to support, confirm, and collaborate on environmental projects.

Background
Several environmental and sustainability projects are occurring across campus. However, no clear mechanism or process exists for collecting and centralizing information. This sometimes results in duplicate efforts across campus, thereby inefficiently using resources. Furthermore, people across campus constantly look to collaborate with those who share common interests or complementary work.

Intent
A streamlined process would provide an efficient way of aggregating project information for compiling reports, initiating project mapping, and creating an archive of MSU projects.

Community Impact
A simple and transparent process for collecting project information would engage the campus community and help elevate departmental projects by including them in the broader Be Spartan Green campaign.

Next Steps
Expand the project information form created for the environmental stewardship project mapping project and develop a database or appropriate mechanism to collect and post projects.

COMPLIANCE AND TECHNOLOGY

23. Compliance Readiness

Recommendation
Begin a serious strategic planning process for emissions compliance readiness in advance of new GHG federal legislation and for all other emissions.

Background
MSU has been developing serious strategies for reduction in GHG and energy use reductions for three years. This has been, in part, an effort to get ahead of the cost and readiness curves in lieu of future climate regulations. This year the U.S. House of Representatives passed the American Clean Energy and Security Act, HB 2454. If passed by the Senate and reconciled by both houses, the implications for the MSU power plant are significant. Reduction targets are stricter than what has been experienced with the CCX, and there is considerable uncertainty about the eligibility of previous offsets and commitments under a new regulatory regime. Additionally, the Environmental Protection Agency (EPA) is now promulgating rules and reporting requirements as a prelude to an extra-legislative regulatory approach. A serious process of review and assessment seems in order.

Intent
The intent is to strategically plan for upcoming federal regulations.

Community Impact
The MSU community will benefit from serious positioning for possible new regulations, and realignment of past work with future prospects to avoid unnecessary costs and risks.

Next Steps
Engage decision-makers in developing a long-term strategy for emissions compliance.

24. Web Conferencing Technology

Recommendation
Extensively integrate web conferencing technology into campus life and better educate faculty and staff in the use of the technology.

Background
Videoconferencing technology already exists on the MSU campus, but it typically requires extensive hardware in conference rooms (cameras, televisions, cable hubs, etc.). While there is nothing wrong with these systems and their use, web-based conferencing systems using webcams and personal computers provide a new, much less expensive communication option that requires minimal hardware and software purchases. The B-SERV team has currently investigated many promising web conferencing brands, including Skype, Yugma, ooVoo, ConnectPro, WebEx, and GotoMeeting. Each software program has its own features and price range, but widespread adoption of any one system will reduce conference travel expenditures at every level. MSU considers that Cisco's WebEx would be suitable for professors and staff members who work intensively on documents, while Skype-like ooVoo is the best program if video chat and basic collaboration are all that is necessary.

Although it is likely that every college will have its own technological needs, the plethora of software options and the advanced nature of MSU's computing infrastructure means that technology will not likely impede web conferencing implementation. Instead, the challenge for this project will be getting MSU people to successfully make use of the software.

Intent
Implementing widespread web conferencing at MSU will reduce financial and fuel expenditures by providing an effective conferencing alternative to travel for faculty, staff, and students in many situations.

Community Impact
Video conference should increase staff productivity though reduced travel time and will improve university image via a reduction in the carbon footprint of MSU's activities and operations.

Next Steps
Conduct workshops on using videoconference technology with faculty and staff audiences.

Environmental Stewardship Process Diagram

Goal: Solve campus-related operational challenges while advancing environmental stewardship and a culture of sustainability at Michigan State University.

PROCESS	EXAMPLE
Goal Setting/Planning (Committee)	**Goal Setting/Planning/Question Identification** **Lean, core committee/big picture thinkers** with representatives from academia, operations, students *Ex. Goal - Reduce water consumption by 15%* Data architect – based on existing data, most impact for water reduction in athletic facilities and high traffic restrooms
Question Identification (Committee)	How can we reduce water use in athletic facilities and high traffic restrooms?
Proposals to Campus (Office) • Use internal communications to broadly share information on opportunities	**Proposal Examples** *Effectiveness of education on water usage* *Feasibility of accelerated fixture replacement in athletic facilities*
Select Proposals based on criteria (Office) • Operational engagement • Cost/return analysis • Timeline	**Data/Results** • Educational campaigns are not effective in reducing water use • MSU can save 10,000 tons of water annually, by replacing shower heads at a cost of $50,000 over two years
Research Accountability (Research Teams) • Timeline/pace (annual results) • Funding to enhance/leverage research • Research forums and regular updates • Research briefs • Recommendations	**Implement Recommendations** • Replace shower heads in existing facilities • Incorporate into construction standards
Update Data/Information (Office) • New information plugged into data information system • Becomes part of data infrastructure	**Evaluation and Progress** • Measure water use after replacing fixtures • Progress toward 15% goal
Implement Recommendations (Operations)	
Evaluation and Reporting (Office)	

Executive Summary
Office of Campus Sustainability Task Force
October 2009

Task Force Charge

The Task force was charged with optimizing the alignment of initiatives being carried out by the Office of Campus Sustainability, the University Committee for a Sustainable Campus, and the Environmental Stewardship Initiative into one core and integrated function.

Organizational Objectives

1. Establish an efficient operational model that is not overly encumbered by a complicated organization model.

2. Build a structure that focuses on addressing critical operational issues while at the same time leveraging cross-cutting research, using the campus as a living learning lab, and facilitating collaboration among faculty, students, and staff.

3. Utilize a problem-based process that identifies key operational questions (issues) and leverages targeted research that generates analytical data to answer the identified questions.

4. The office should assume accountability for leading the stewardship and sustainability process, managing the research efforts, the data that comes out of the research, communications, and the implementation of programs to achieve positive results (cost/return). The office should also lead any long-range planning and visioning initiatives for the university that are operationally focused.

5. Outcomes of the process should achieve a positive return on investment (regulatory compliance, operational cost reductions, partnerships, etc.).

Organizational Model

The process and organizational model establish the framework for a focused and efficient process that engages staff, faculty, and student collaboration on specific operationally-based stewardship and sustainability issues (questions). A smarter and stronger culture of sustainability at MSU will be built through the rigor of the process.

The optimal organizational model for MSU includes a dedicated office with a director and staff addressing core functions. The office's core functions include: 1) leadership of the environmental sustainability advancement initiative; 2) data management of the environmental stewardship information system; 3) internal, external, and outreach communication; and 4) programming to establish initiatives that achieve measurable results.

The office will be influenced by three associations. The areas of influence both inform the office and are informed by the office. These influences include a standing working committee, partnerships, and a visioning group.

The working committee will assist in establishing goals, objectives, and prioritizing specific research questions. They will also assist in evaluating a research proposal process to incentivize campus engagement in targeted research to address prioritized questions/issues.

Given the complexity embodied in the issue of sustainability, numerous partnerships are required both within and outside of the university. The office will coordinate appropriate partnerships to stay abreast of emerging issues and to maximize university engagement on researching and answering the prioritized operational questions.

Visioning is required to continually assess emerging issues, technologies, and future directions. The office will coordinate a series of concurrent processes that inject the necessary assessment through various “think tank” venues that engage the university community and non-affiliated off-campus partners.

Engagement Process

The office and working committee will establish overarching goals, measurable objectives, and specific operationally-focused research questions.

Proposals will be posted to solicit engagement by the campus community to research and provide recommendations that address the specific issue. Funding will be utilized to incentivize the proposal process.

Proposals will be required to demonstrate unique attributes including, but not limited to, on- and off-campus partnerships, alternative or supplemental funding, synergistic research activities, and potential cost/benefit analytics.

Submitted proposals will be evaluated by the office and working committee. Flexibility will exist to address issues/questions that come up outside of the more formalized proposal process.

Research data will be collected and catalogued for future reference and use.

New programs will be identified and initiated by the Office of the Vice President for Finance and Operations after careful review of the cost/benefit potential.

Programs will be monitored and data collected to assess the achievement of specific objectives and future modifications to improve success.

New research questions will be informed through the process and new issues identified for future consideration.

Real Property Holdings

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Hidden Lake Gardens

Photo by: Jack Wikle

Prepared by:

Land Management Office

Real Property Holdings - Table of Contents

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Real Property Holdings - Real Estate Facts

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Summary of Acres

- MSU owned lands comprise 23,846.14 acres
- Main campus lands (North of Mt. Hope) comprise 2,049.577 acres
- Research, education, and outreach lands (south of Mt. Hope) comprise 2,737.492 acres
- The golf course is 325 acres
- 83.156 acres of campus lands are leased to others
- Off-campus properties include 18,645.234 acres
- Property for sale comprise 5.691 acres

Acreage Changes

- 249.52 acres were purchased in Frankenmuth for the new location of the Saginaw Valley Research and Extension Center
- 4.92 acres continguous to the Kellogg Biological Station were purchased
- Approximately .005 acres of the College Avenue property in Grand Rapids were sold to the Michigan Department of Transportation for a road improvement project
- A mineral lease was entered into on approximately 750 acres at Hidden Lake Gardens

Long-Term Leases

- Leases of a term of ten years or greater require Board of Trustee approval. A long-term lease was entered into with the Chippewa County Soil Conservation District, with MSU as Tenant. A second long-term lease was entered into with the Lansing Board of Water and Light and International Transmission Company on MSU's south campus

State Building Authority Projects

- The University has three State Building Authority bond-financed projects. The project site parcel is deeded to the State Building Authority and leased back to the University. Current projects are: Anthony Hall Dairy Plant and Meat Lab (to be repaid 2032); Biomedical and Physical Sciences Building (to be repaid 2037); and Diagnostic Center for Population and Animal Health (to be repaid 2041). SBA bonds are typically issued for 35 years but the State may retire them before their maturity date.

Agreement to Restore Title

- A fifty year lease between Michigan State University and the State of Michigan was entered into February 1956 for approximately six acres on Harrison Road. The Department of Agriculture constructed a lab on the parcel known as the Geagley Laboratory. In 2002, the parcel was deeded to the State of Michigan in order for the State to convey the property to the State Building Authority to obtain bond financing for needed improvements. An "Agreement to Restore Title" requires the State to deed the parcel to Michigan State University at the time the property is conveyed back to the State from the State Building Authority. At that time, a lease will be entered into between Michigan State University (landlord) and the State (tenant) in order for the State to continue occupancy at the Geagley Laboratory. The "Agreement to Restore Title" is on file in the Michigan State University Office of General Counsel and the Land Management Office.

Real Property Holdings - Summary

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

PROPERTY	ACRES
East Lansing Campus	
North of Mt. Hope	2,049.577
Golf Course	325.000
Research, Education and Outreach South of Mt. Hope	2,737.492
Campus Property Leased to Others	83.156
Total Campus Acres	**5,195.225**
Off Campus	18,645.224
Property for Sale	5.691
Total Deeded Acres	**23,846.140**
Property Leased to MSU Long-Term	254.000
Total Leased and Deeded Acres	**24,100.140**

Real Property Holdings - Acquisitions and Properties Sold

MICHIGAN STATE UNIVERSITY

July 1, 2008 - June 30, 2009

ACQUISITIONS **ACRES**

Property: Kellogg Biological Station 4.920
12889 E. B Avenue
Hickory Corners, MI
Kalamazoo County

Acquisition Date: 2/18/2009
Acquisition Cost: $48,000.00
How Acquired: Purchase

Property: Saginaw Valley Research & Extension Center 249.520
9923 Krueger Road
Frankenmuth, Michigan
Tuscola County
Saginaw County

Acquisition Date: 10/27/08
Acquisition Cost: $1,154,800.00
How Acquired: Purchase

PROPERTY SOLD **ACRES**

Property: College of Human Medicine - Grand Rapids 0.005
415 College Avenue
Grand Rapids, Michigan
Kent County

Sold Date: 3/30/2009
Selling Price: $16,700.00
Buyer: Michigan Department of Transportation

PROPERTY FOR SALE **ACRES**

Property: Hulett Road Engineering 5.691

Real Property Holdings - Active Mineral Leases

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

MSU owns the Martin Property, MacCready Reserve, Rogers Reserve, the Management Education Center, and Hidden Lake Gardens. The Mancelona Property and Homer Nowlin Property were sold; MSU retained the mineral rights on both properties.

PROPERTY	**ACRES**
Mancelona Property (MSU owns mineral rights) Section 16, Mancelona Township, Antrim County Leased to Mercury Exploration Co. Lease is continued with producing well	31.400
Martin Property (Rose-Dell Seed Orchard, MSU owns surface and mineral rights) Sections 23 and 24, Albion Township, Calhoun County Leased to West Bay Exploration Three year lease (commenced December 2007)	160.000
MacCready Reserve (MSU owns surface and mineral rights) Sections 11 and 14, Liberty Township, Jackson County Leased to West Bay Exploration Three year lease (commenced December 2007)	408.000
Rogers Reserve (MSU owns surface and mineral rights) Section 4, Liberty Township, Jackson County Leased to West Bay Exploration Three year lease (commenced December 2007)	77.373
Homer Nowlin Property (MSU owns mineral rights) Sections 28 and 23, Rich Township, Lapeer County Leased to Total Petroleum, Inc. Lease is continued with producing well	313.000
Management Education Center (MSU owns surface and mineral rights) Section 9, Troy Township, Oakland County Leased to West Bay Exploration Company Lease is continued with producing well	24.320
Hidden Lake Gardens (MSU owns 750.265 surface acres and 712.655 mineral acres) Sections 17, 18, 19, and 20, Liberty Township, Lenawee County Leased to West Bay Exploration Company Three year lease (commenced August 2009)	750.256
Total Acres Under Mineral Leases	**1,764.349**

Real Property Holdings - Mineral Rights Reserved on Sold Properties

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

PROPERTY	ACRES
Allegan County	
Section 21, Saugatuck Township	53.275
Antrim County	
Section 16, Mancelona Township	29.900
Clinton County	
Section 22, Eagle Township	24.000
Sections 22 & 27, Eagle Township	61.300
Ingham County	20.369
Section 1, Delhi Township	
Lapeer County	
Section 28, Rich Township	10.000
Section 33, Rich Township	303.000
Lenawee County	
Section 29, Adrian Township	80.000
Monroe County	
Section 21, Milan Township	80.000
Oakland County	
Sections 2, 11, 12, Avon Township	234.434
Section 32, Bloomfield Township	5.000
Ontonagon County	
Section 6, Bohemia Township; Section 12, Greenland Township	78.000
Section 23, Bohemia Township	40.000
VanBuren County	
Section 6, Geneva Township	29.000
Section 23, South Haven Township	53.230
Total Mineral Acres Reserved:	**1,101.508**

Real Property Holdings - Gas and Oil Royalty Income

MICHIGAN STATE UNIVERSITY

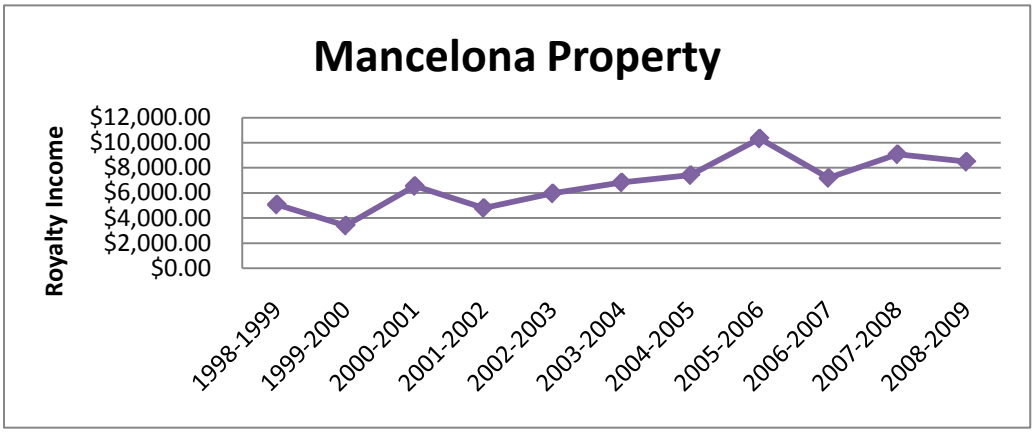
As of July 1, 2009

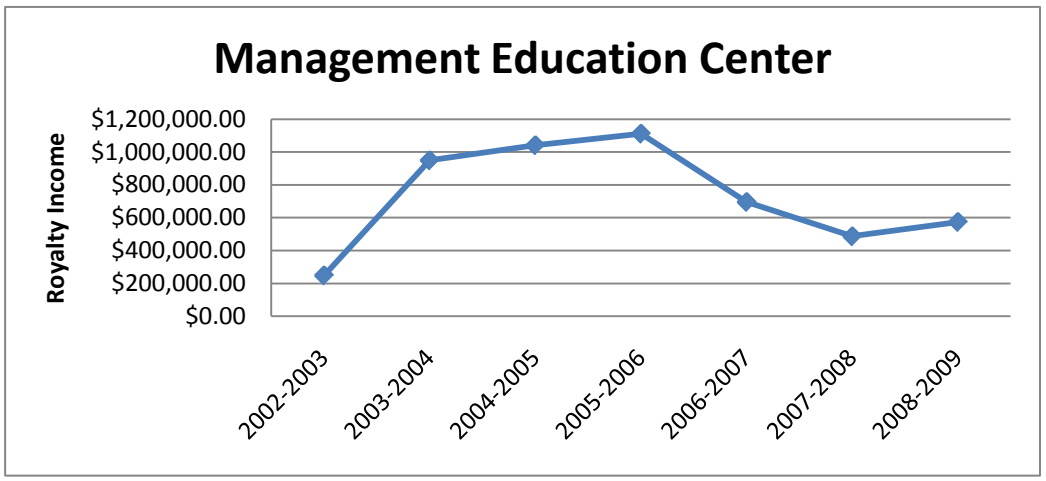
Mancelona Property
(Income funds the Land Fund Account)

1998-1999	$5,068.62
1999-2000	$3,390.42
2000-2001	$6,547.95
2001-2002	$4,789.45
2002-2003	$5,958.69
2003-2004	$6,833.60
2004-2005	$7,415.27
2005-2006	$10,337.62
2006-2007	$7,192.83
2007-2008	$9,082.79
2008-2009	$8,484.09

Management Education Center
(Income funds Eli Broad College of Business Programs)

2002-2003	$248,679.62
2003-2004	$949,191.09
2004-2005	$1,041,242.41
2005-2006	$1,111,581.83
2006-2007	$695,627.95
2007-2008	$486,734.28
2008-2009	$ 573,939.94





Real Property Holdings - Gas and Oil Royalty Income

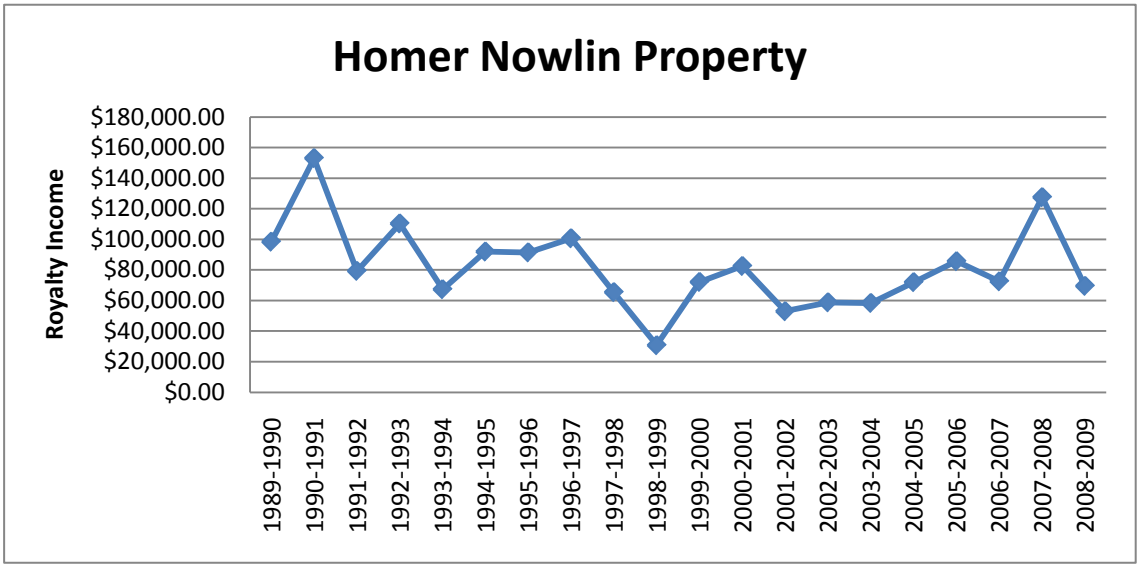
MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Homer Nowlin Property

(Income funds endowed chair in the College of Agriculture and Natural Resources)

1989-1990	$98,404.78
1990-1991	$153,008.72
1991-1992	$79,323.99
1992-1993	$110,311.26
1993-1994	$67,355.68
1994-1995	$91,965.81
1995-1996	$91,421.59
1996-1997	$100,641.83
1997-1998	$65,468.04
1998-1999	$30,788.53
1999-2000	$72,118.88
2000-2001	$82,535.99
2001-2002	$53,000.00
2002-2003	$58,819.50
2003-2004	$58,386.86
2004-2005	$71,997.24
2005-2006	$85,676.23
2006-2007	$72,534.18
2007-2008	$127,494.63
2008-2009	$69,521.30



Real Property Holdings - Leased/Licensed Properties

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Leases of 10 years or longer require MSU Board of Trustee approval. The following leases meet that criteria. Only real property leases are included in the Real Property Holdings annual report.

MSU as TENANT	**ACRES**
Property: Trevor Nichols Research Complex (Kalamazoo Orchard site) Administrative Unit: College of Agriculture and Natural Resources Department of Entomology	45.000
Northwest Michigan Horticulture Research Station Administrative Unit: College of Agriculture and Natural Resources Department of Horticulture MSU Extension	100.000
Tollgate Education Center Administrative Unit: College of Agriculture and Natural Resources Land Management Office MSU Extension	100.000
Upper Peninsula Tree Improvement Center Administrative Unit: College of Agriculture and Natural Resources Department of Forestry	9.000
Total Leased Acres:	**254.000**

Real Property Holdings - Leased/Licensed Properties

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Leases of 10 years or longer require MSU Board of Trustee approval. The following leases meet that criteria. Only real property leases are included in the Real Property Holdings annual report.

TENANT	MSU PROPERTY	ACRES
Prairieville Township	Lux Arbor Reserve	0.800
Berrien County Extension Service	Southwest Michigan Research & Extension Center	1.380
Cass County Historical Commission	Fred Russ Forest	1.800
Cass County Park & Recreation Commission	Fred Russ Forest	14.000
Marcellus Community School	Fred Russ Forest	21.450
Department of Natural Resources	Dunbar Forest	9.400
Michigan State Police Headquarters	Campus	13.000
MSU Federal Credit Union	Campus	4.711
Sewage Plant	Campus	16.500
Consumers Energy	Campus	0.100
Northstar Cooperative, Inc.	Campus	9.710
University Rehabilitation Alliance	Campus	35.000
Candlewood/Vista I, LLC	Campus	3.235
LBWL/METC	Campus	0.900
Gull Lake Bible Conference	Kellogg Biological Station	10.000
Sheridan Lake YMCA (License)	Brook Lodge	415.000
Sheridan Lake YMCA (Lease)	Brook Lodge	40.000
Leland Township	Leland Property	0.700
Avon Players	VanHoosen Jones	1.793
	Total Acres Leased/Licensed to Others:	**599.479**

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Brook Lodge
Augusta, Kalamazoo County

Purpose	Status	Acres
Conference center, teaching, research, and outreach	Active	633.240

Administrator	Comment
Kellogg Center Land Management Office	Long term lease on 40 acres to Sherman Lake YMCA

Clarksville Horticultural Experiment Station
Clarksville, Ionia County

Purpose	Status	Acres
Horticulture research on small fruit and tree fruit	Active	440.000

Administrator	Comment
Department of Horticulture Land Management Office	Agricultural Research Station Coordinator: Dr. Doug Buhler & Charles Reid Farm Manager: Gerald Skeltis

Dobie Road
Okemos, Ingham County

Purpose	Status	Acres
Wildlife research	Active	114.431

Administrator	Comment
Department of Fisheries & Wildlife Land Management Office	Location of WKAR tower T-Mobile tower

Dunbar Forest Experiment Station
Sault Ste. Marie, Chippewa County

Purpose	Status	Acres
Forest research and demonstration	Active Title restricted on 4,668.84 acres Land reverts to State if not used solely for forestry purposes	5,759.815

Administrator	Comment
Department of Forestry Land Management Office	None

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Hidden Lake Gardens
Tipton, Lenawee County

Purpose	Status	Acres
Arboretum and plant conservatory	Active	756.618

Administrator	Comment
Land Management Office	Manager: Steven Courtney

Human Medicine, College of
Grand Rapids, Kent County

Purpose	Status	Acres
Medical School	Active	1.735

Administrator	Comment
	Includes Condominium #5
College of Human Medicine	.005 acres sold to MDOT

Hulett Road Engineering
Okemos, Ingham County

Purpose	Status	Acres
Former facilities and site for	Property is for sale	5.691
College of Engineering research	Building vacant	

Administrator	Comment
Land Management Office	None

Jolly Road Engineering
Okemos, Ingham County

Purpose	Status	Acres
Facilities and site for	Active	3.260
College of Engineering research		

Administrator	Comment
College of Engineering	None
Land Management Office	

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Kellogg, W.K. Biological Station
(Including Farm and Bird Sanctuary)
Hickory Corners, Kalamazoo County

Purpose	Status	Acres
Teaching, research, and extension activities in the environmental sciences focusing on the interdependence of natural and managed landscapes. The programs treat integrated study of biology, wildlife, and production agriculture, including animal input.	Active Title on original gift restricted. Property needs to be maintained and operated for educational purposes.	1,690.850

Administrator	Comment
Director, Biological Station College of Agriculture & Natural Resources College of Natural Science Land Management Office	Agricultural Research Station Director: Dr. Katherine Gross Farm Manager: Jim Bronson Bird Sanctuary Coordinator: Tracey Kast Farm Acreage: 944.674 Bird Sanctuary Acreage: 746.176 4.92 acres acquired in 2009

Kellogg, W.K. Biological Station
Lux Arbor Reserve
Delton, Barry County

Purpose	Status	Acres
Research and education in the agricultural, biological, botanical, and horticulture sciences.	Active	1,323.000

Administrator	Comment
Same as Kellogg Biological Station	Included with Kellogg Biological Station as an Agricultural Research Station Farm Manager: Steve Norris

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Kellogg, W.K. Experimental Forest
Augusta, Kalamazoo County

Purpose	Status	Acres
Forestry research, teaching, demonstration, and public use.	Active Title restricted on 280 acres. To be used for reforestation, education, and experimental purposes	715.995

Administrator	Comment
Department of Forestry Land Management Office	Agricultural Research Station Coordinator: Dr. David McFarlane Resident Forester: Greg Kowalewski

Lake City Experiment Station
Lake City, Missaukee County

Purpose	Status	Acres
Research in beef cattle, forages, and potatoes	Active Title restricted	810.010

Administrator	Comment
Department of Animal Science Land Management Office	Agricultural Research Station Coordinator: Dr. Dan Buskirk Farm Manager: Doug Carmichael

Leland Property
Leland, Leelanau County

Purpose	Status	Acres
Long-term lease to Leland Township	Active	0.700

Administrator	Comment
Land Management Office	None

MacCready Forest and Wildlife Reserve
Clark Lake, Jackson County

Purpose	Status	Acres
Wildlife and forestry demonstration	Active	408.000

Administrator	Comment
Department of Forestry Department of Fisheries & Wildlife Land Management Office	None

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Management Education Center
Troy, Oakland County

Purpose	Status	Acres
Advanced management training center	Active	24.327

Administrator	Comment
College of Business	Manager: Tom Freed
	None

Martin Property (Rose-Dell Seed Orchard)
Calhoun County

Purpose	Status	Acres
Tree seed orchard and demonstration site	Active	160.000
	Proceeds from leases and timber sales to be used for farm maintenance and scholarships	

Administrator	Comment
Department of Forestry	None
Land Management Office	

Mason Research Farm
Mason, Ingham County

Purpose	Status	Acres
Cereal grains and soybean research	Active	117.000

Administrator	Comment
Department of Crop & Soil Sciences	None
Land Management Office	

Michigan State University Campus
East Lansing, Ingham County

Purpose	Status	Acres
Research, education, and outreach	Active	5,195.225

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Montcalm Experimental Farm
Lakeview, Montcalm County

Purpose	Status	Acres
Potato production research and cash crops	Active	57.250

Administrator	Comment
Department of Crop & Soil Sciences	Agricultural Research Station
Land Management Office	Coordinator: Dr. Dave Douches
	Farm Manager: Bruce Sackett

MSU Sailing Club
Haslett, Ingham County

Purpose	Status	Acres
Sailing and wind surfing lessons	Active	0.760

Administrator	Comment
Intramural Sports and Recreatvie Services	None

Muck Soils Research Farm
Laingsburg, Clinton County

Purpose	Status	Acres
Organic soil vegetable and crops research	Not recommended to sell	447.048
	Active	

Administrator	Comment
Department of Crop & Soil Sciences	Agricultural Research Station
Land Management Office	Coordinator: Dr. Darryl Warncke
	Farm Manager: Mitch Fabis

Pfizer Property
Holland, Ottawa County

Purpose	Status	Acres
	Active	6.300
	Land use or resource use restrictions	

Administrator	Comment
Vice President for Research	None
and Graduate Studies	

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 209

River Terrace Property
East Lansing, Ingham County

Purpose	Status	Acres
Investment	Active	1.210

Administrator	Comment
Land Management Office	None

Rogers Reserve
Jackson, Jackson County

Purpose	Status	Acres
Botantical and horticultural sciences research and teaching	Active	115.850

Administrator	Comment
Department of Plant Pathology Land Management Office	Coordinator: Dr. Dennis Fulbright

Russ Forest Experiment Station
Decatur, Cass County

Purpose	Status	Acres
Forestry plantings and genetics research Demonstration and public use	Active Title restricted on 269 acres Land to be used for educational purposes	938.750

Administrator	Comment
Department of Forestry Land Management Office	Agricultural Research Station Coordinator: Dr. David MacFarlane Non-Resident Forestor: Greg Kowalewski

Saginaw Valley Research and Extension Center
Frankenmuth, Tuscola & Saginaw Counties

Purpose	Status	Acres
Dry bean, sugar beet, and crop research research, outreach, and teaching	Active	249.520

Administrator	Comment
Department of Crop & Soil Sciences Land Management Office	Agricultural Research Station Coordinator: Dr. James Kelly Farm Manager: Paul Horny

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Southwest Michigan Research and Extension Center
Benton Harbor, Berrien County

Purpose	Status	Acres
Horticultural research and extension center	Active	350.000

Administrator	Comment
Department of Horticulture	Agricultural Research Station
Cooperative Extension Service	Coordinator: Dr. Thomas Zabadal
Land Management Office	Farm Manager: Dave Francis

Stranahan-Bell (WaWaSum)
Grayling, Crawford County

Purpose	Status	Acres
Inland stream and reforestation research	Active	251.000
Small conference center		

Administrator	Comment
Land Management Office	None

Sycamore Creek
Holt, Ingham County

Purpose	Status	Acres
Support campus water management plan.	Active	54.500
Controlled access to Sycamore Creek flood	Title restricted on 52 acres	
plain	Deed covenants restrict use	

Administrator	Comment
Land Management Office	None

Tollgate Education Center
Novi, Oakland County

Purpose	Status	Acres
Agricultural and environmental	Active	56.675
education and leadership training		

Administrator	Comment
Cooperative Extension Service	Farm Manager: Roy Prentice
Land Management Office	

Real Property Holdings - Inventory

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Trevor Nichols Research Complex
Fennville, Allegan County

Purpose	Status	Acres
Fruit pest research	Active	156.100

Administrator	Comment
Department of Entomology	Agricultural Research Station
Land Management Office	Coordinator: Dr. John Wise
	Farm Manager: Matt Daly

Upper Peninsula Experiment Station
Chatham, Alger County

Purpose	Status	Acres
Dairy, forestry, and crops research	Active	1,262.227

Administrator	Comment
Department of Animal Science	Agricultural Research Station
Land Management Office	Coordinator: Dr. Herb Bucholtz
	Farm Manager: Paul Naasz

Upper Peninsula Tree Improvement Center
Escanaba, Delta County

Purpose	Status	Acres
Research and demonstration in forestry and crops	Active	1,737.260

Administrator	Comment
Department of Forestry	Coordinator: Dr. David McFarlane
Land Management Office	Resident Forester: Dr. Ray Miller

VanHoosen Property
Rochester, Oakland County

Purpose	Status	Acres
Long-term lease to Avon Players	Active	1.793

Administrator	Comment
Vice President for Finance and Operations	Remaining land of Sarah
Land Management Office	Van Hoosen gift acquired in 1956

Total Acres: 23,846.140

Real Property Holdings - Agricultural Research Stations

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Agricultural Research Stations owned by MSU

Clarksville Horticultural Experiment Station
9302 Portland Road
Clarksville, MI 48815

Dunbar Forest Experiment Station
12839 S. Scenic Drive
Sault Ste. Marie, MI 49783

Kellogg, W.K. Biological Station
3700 E. Gull Lake Drive
Hickory Corners, MI 49060

Kellogg, W.K. Experimental Forest
7060 N. 42nd Street
Augusta, MI 49012

Lake City Experiment Station
5401 W. Jennings Road
Lake City, MI 49651

Montcalm Experimental Farm
4747 McBride Road
Lakeview, MI 48850

Muck Soils Research Farm
Route 3
9370 E. Herbison Road
Laingsburg, MI 48848

Russ Forest Experiment Station
20673 Marcellus Highway
Decatur, MI 49045

Saginaw Valley Research and Extension Center
9923 Krueger Road
Frankenmuth, MI 48734

Southwest Michigan Research and Extension Center
1781 Hillandale Road
Benton Harbor, MI 49022

Trevor Nichols Research Complex
6237 124th Avenue
Fennville, MI 49408

Upper Peninsula Experiment Station
E3774 University Drive
P.O. Box 168
Chatham, MI 49816

Upper Peninsula Tree Improvement Center
6005 J. Road
Escanaba, MI 49829

Agricultural Research Stations leased by MSU

Northwest Michigan Horticultural Experiment Station
6686 S. Center Highway
Traverse City, MI 49684

Real Property Holdings - Land Acquisition by Decade

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

	Acres	
	Campus	**Off-Campus**
Prior to 1920	1,026.380	1,060.327
1920's	564.350	2,007.112
1930's	284.614	795.026
1940's	1,605.236	6,281.322
1950's	1,266.862	862.190
1960's	767.850	2,417.390
1970's	188.747	861.049
1980's	13.943	3,265.245
1990's	66.338	1,775.765
2000's	1.069	1,566.310

Real Property Holdings - Land Available for Agricultural Research

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

Off-Campus	**Acres**
13 Outlying Stations (owned)	15,937.825
1 Outlying Station (leased)	100.000
Dobie Road Property, Okemos	114.431
Off Campus owned land used for agricultural research (Not designated as a research station)	1,106.350
Off Campus leased land used for agricultural research	254.000
Campus	
Land used for agricultural research - south of Mt. Hope	2,733.249
Total Acres:	**20,245.855**

Real Property Holdings - Warranty Deeds to State Building Authority

MICHIGAN STATE UNIVERSITY

As of July 1, 2009

The following parcels have been or will be deeded to and leased back from the State Building Authority, for financing pursuant to earlier Board of Trustees approval.

- Anthony Hall Dairy Plant and Meats Lab
- Biomedical and Physical Sciences Building
- Diagnostic Center for Population and Animal Health

The following parcels have been deeded to the State of Michigan, pursuant to Board of Trustees approval, in connection with a State of Michigan financing of improvements. A written agreement obligates the State to deed the property back to MSU at a later date.

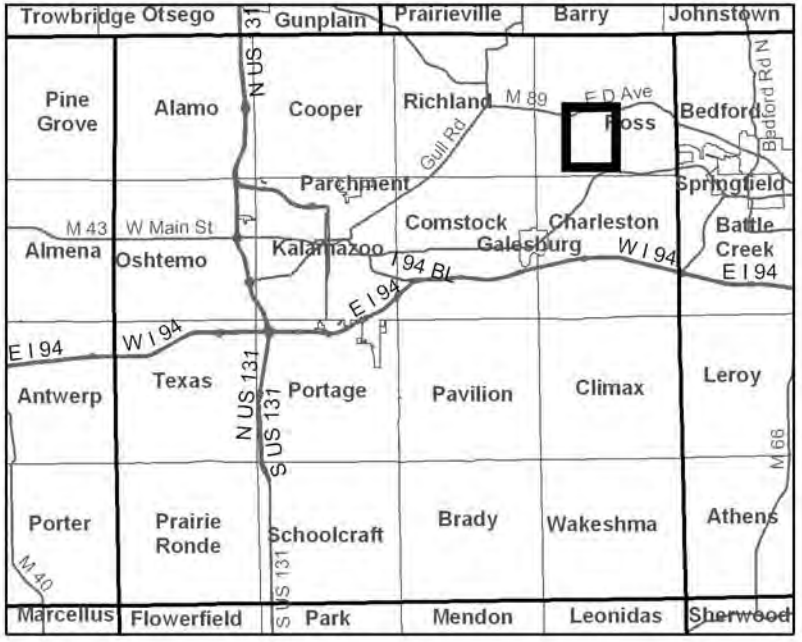
- The Geagley Laboratory

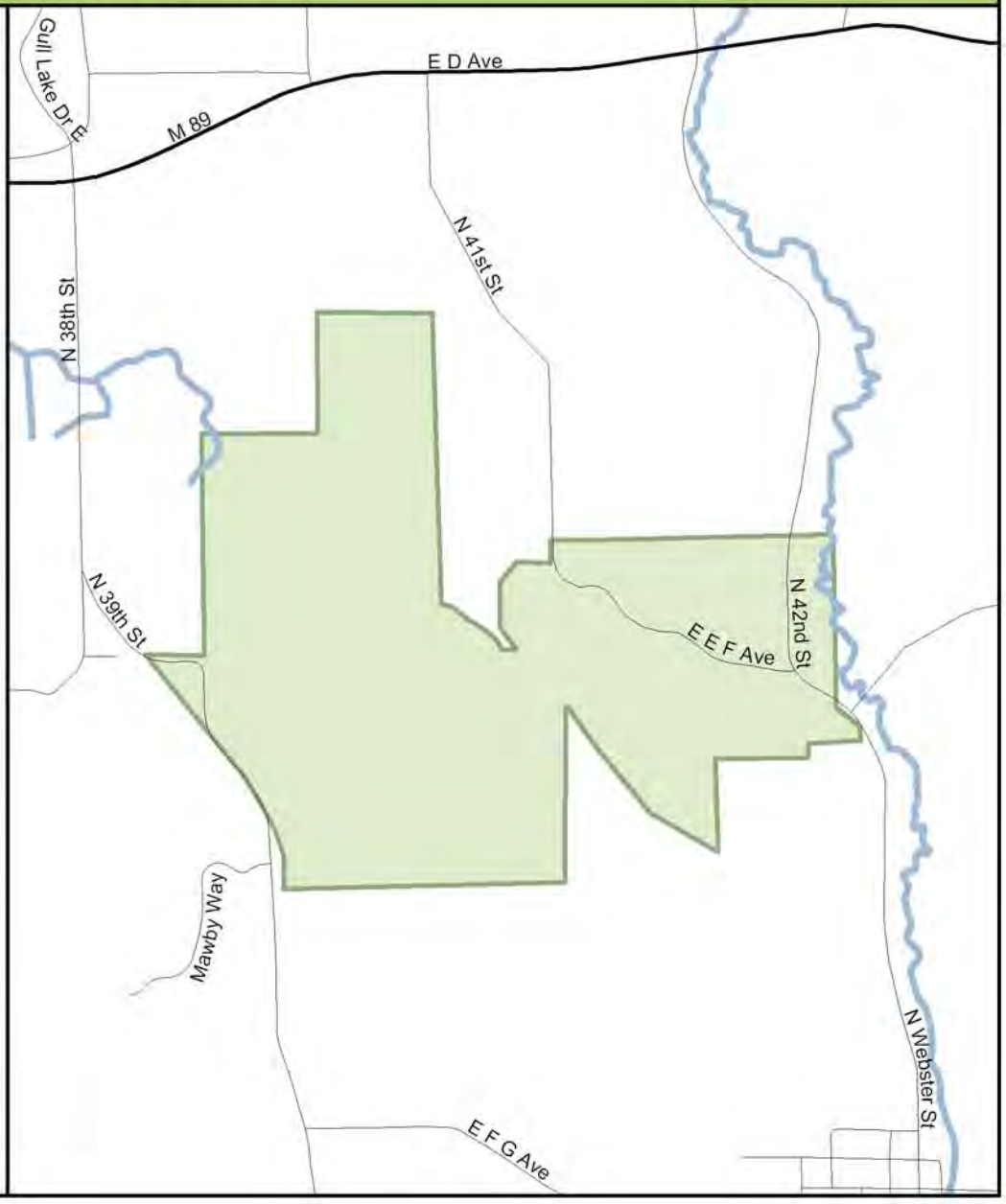
Location Maps
of
Michigan State University Properties
Alphabetical by County

Brook Lodge

Ross Township, Section 21, 27, 28 and 29

Kalamazoo County



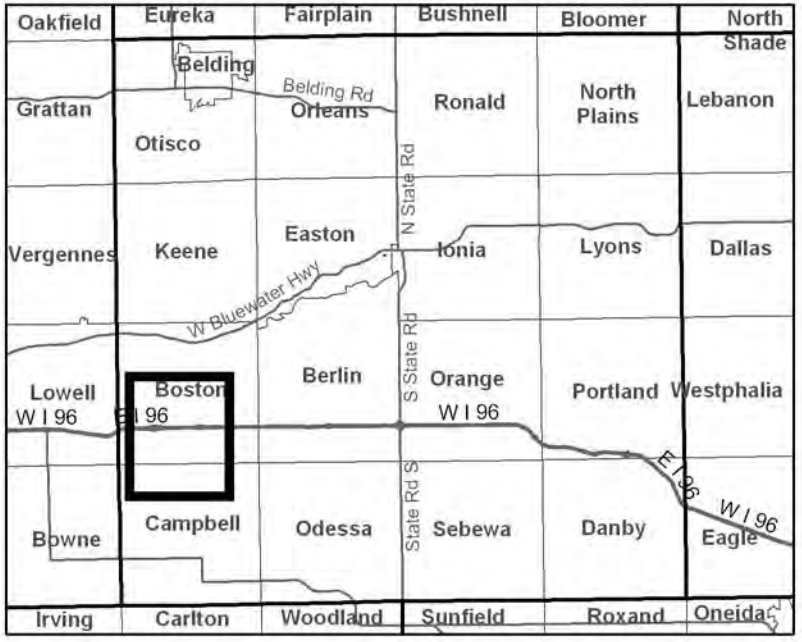


MSU Real Property

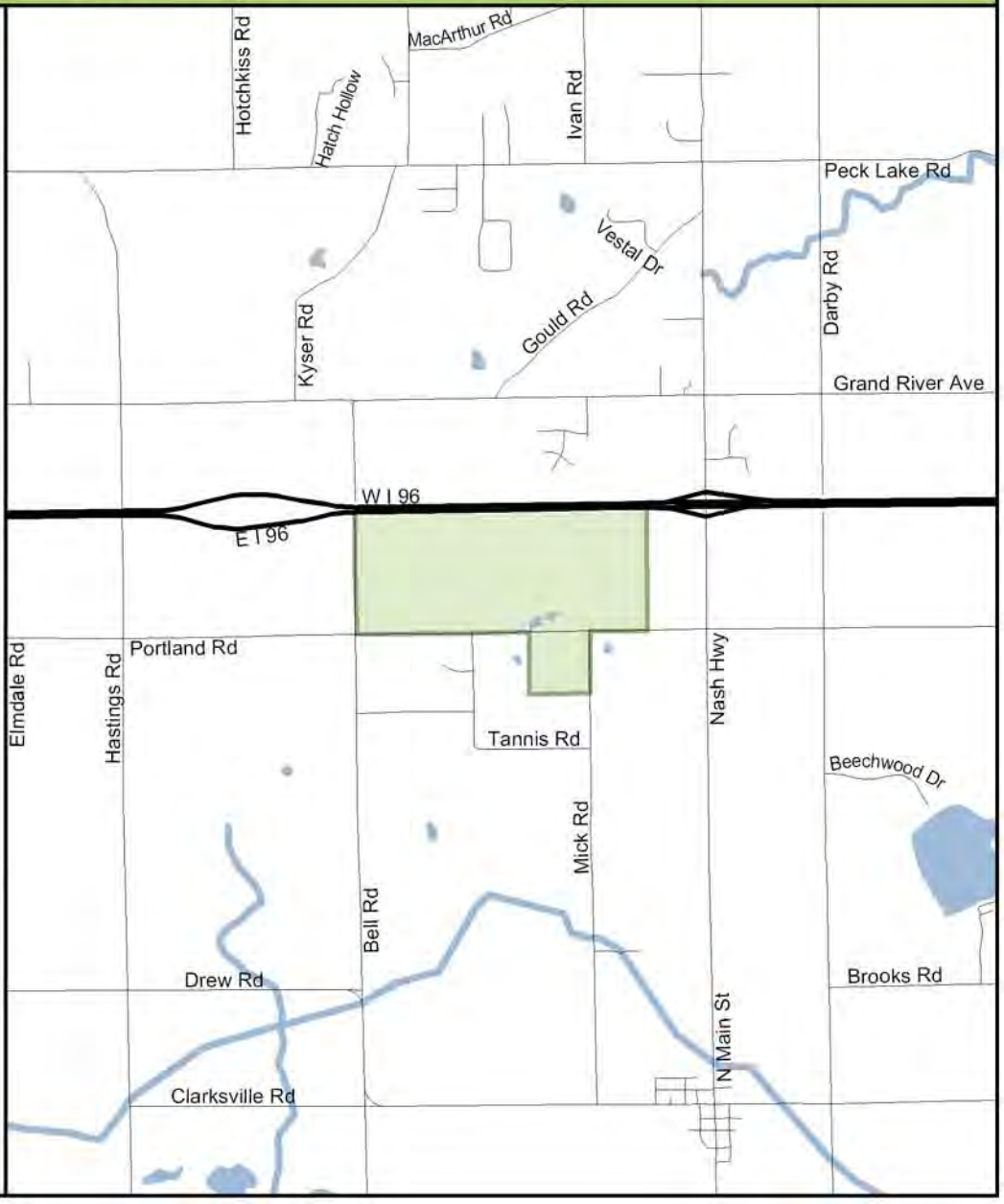
Clarksville Horticultural Experiment Station

Boston Township, Sections 27, 28 and 33

Ionia County



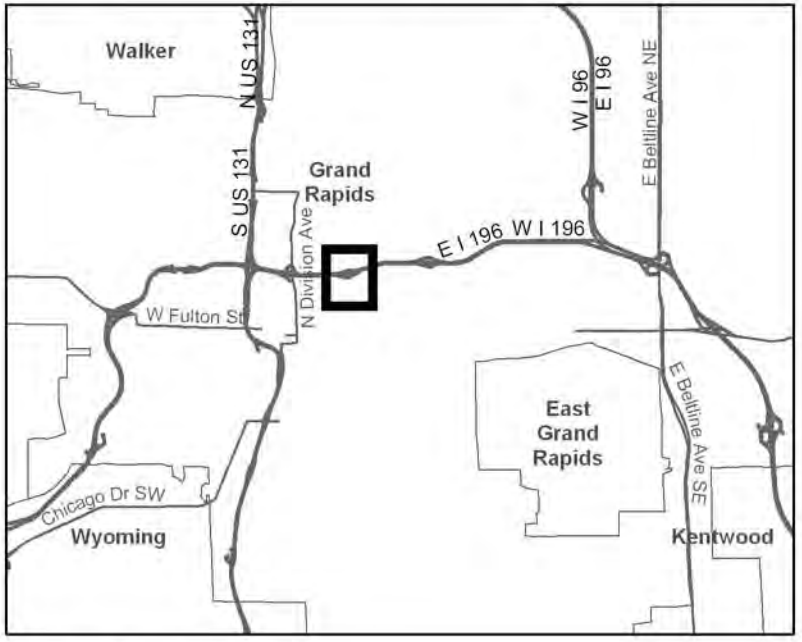
MSU Real Property



College of Human Medicine

Grand Rapids Township, Section 19

Kent County

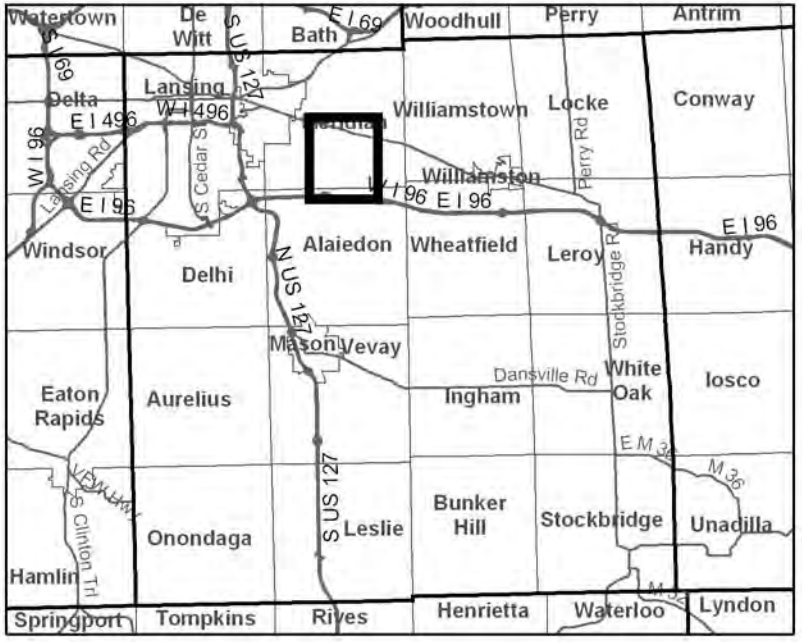


MSU Real Property

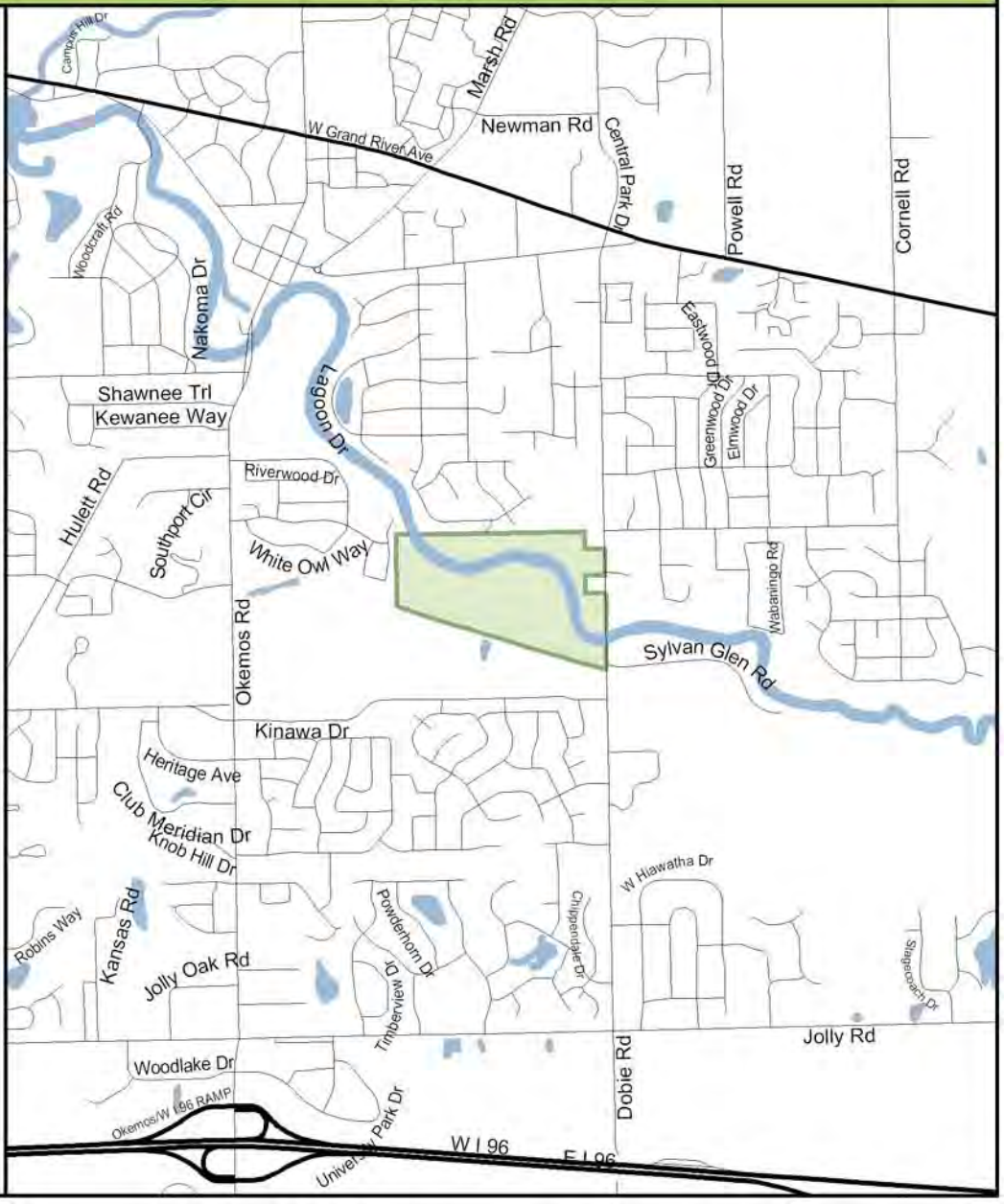
Dobie Road Property

Meridian Township, Section 27

Ingham County



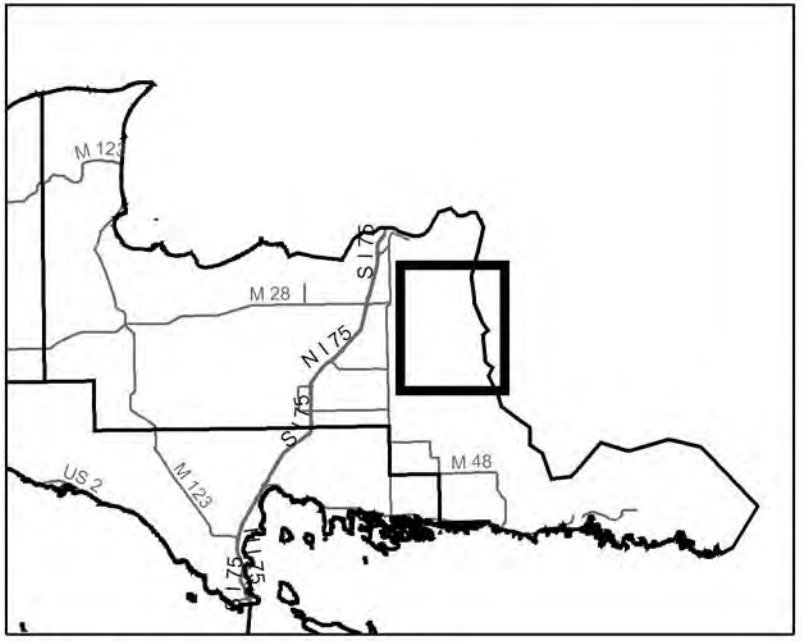
MSU Real Property

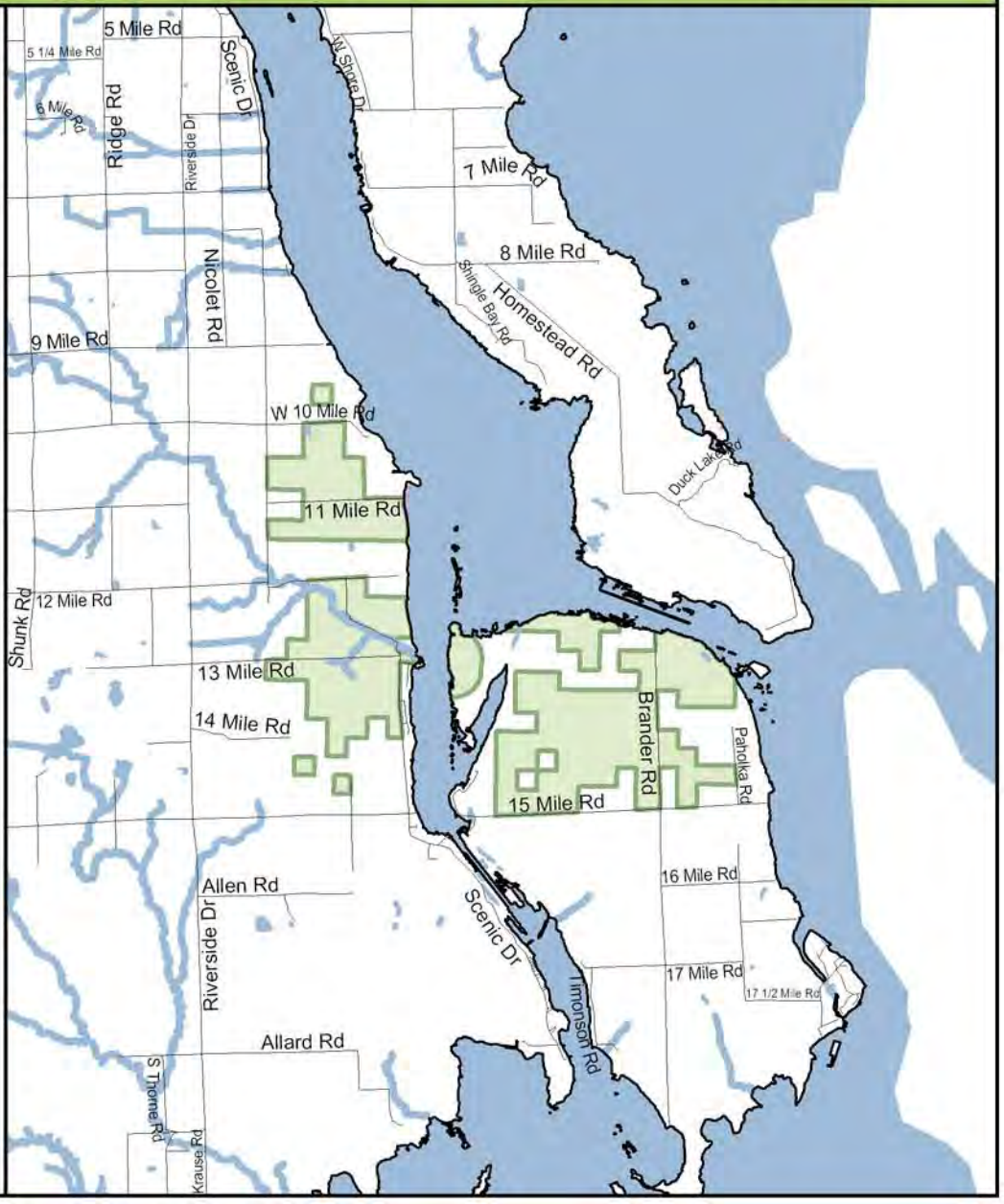


Dunbar Forest Experiment Station

Soo Twp. Sec,3,4,5,8,9,10,11,14,15 and 16; Bruce Twp. Sec.1,6,7,12,13,24,25,30,31 and 36

Chippewa County



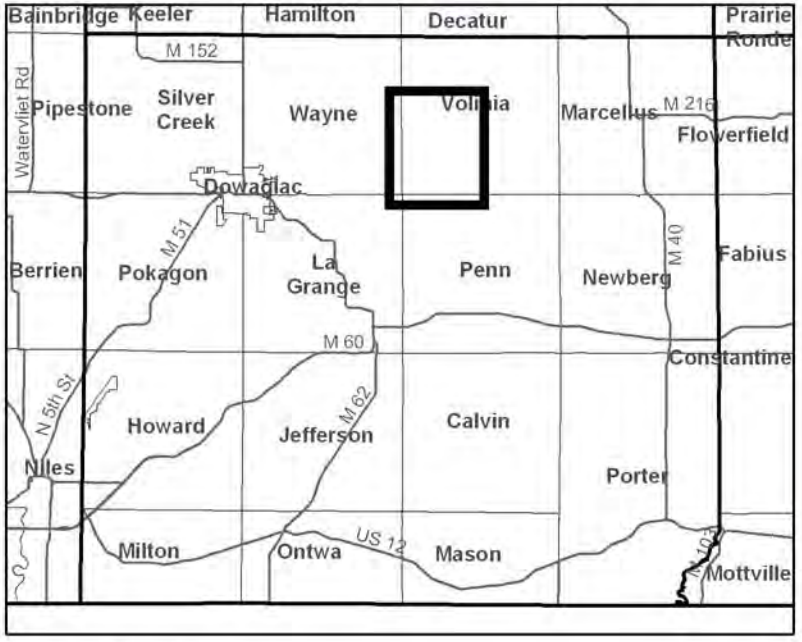


MSU Real Property

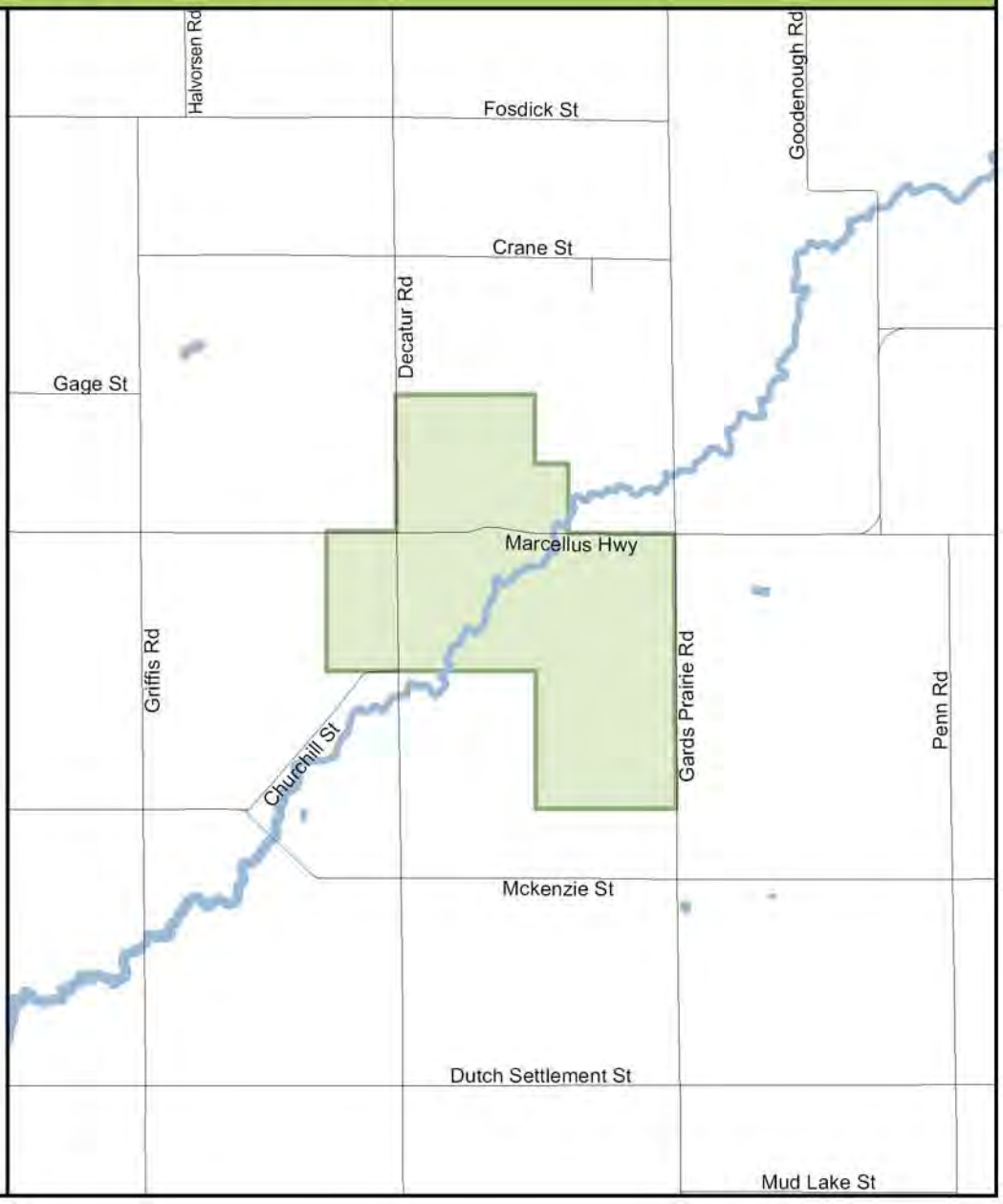
Fred Russ Forest Experiment Station

Volinia Township, Sections 20, 29 and 30

Cass County



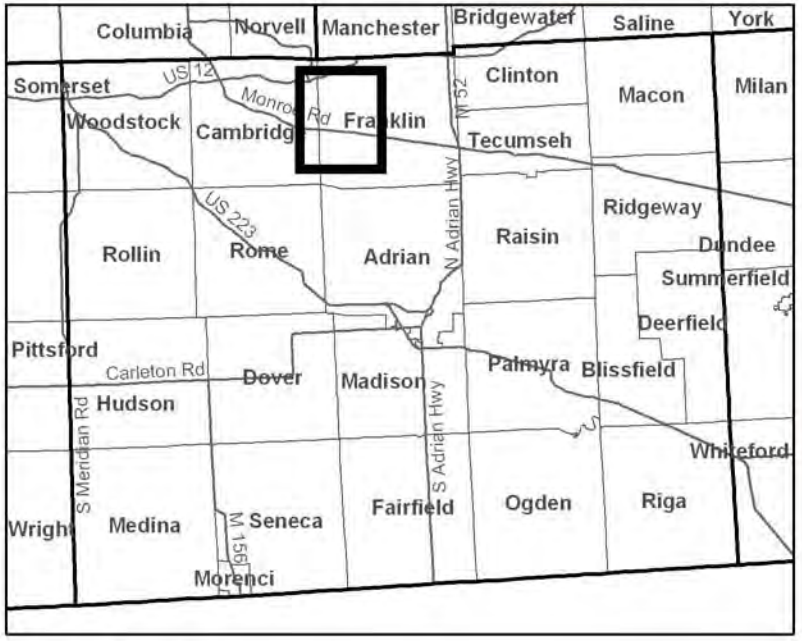
MSU Real Property



Hidden Lake Gardens

Franklin Township, Sections 17, 18, 19 and 20

Lenawee County

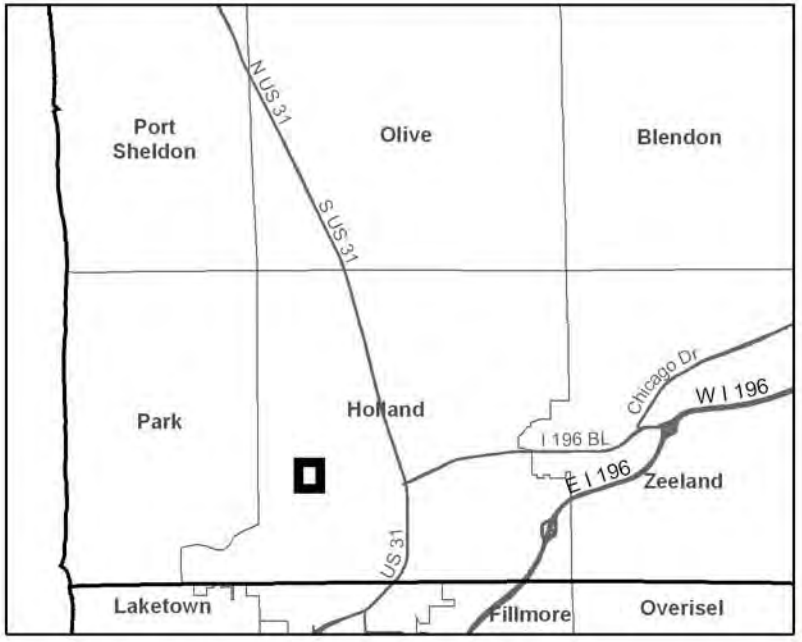


MSU Real Property

Holland Pfizer Property

Holland Township, Section 19

Ottawa County

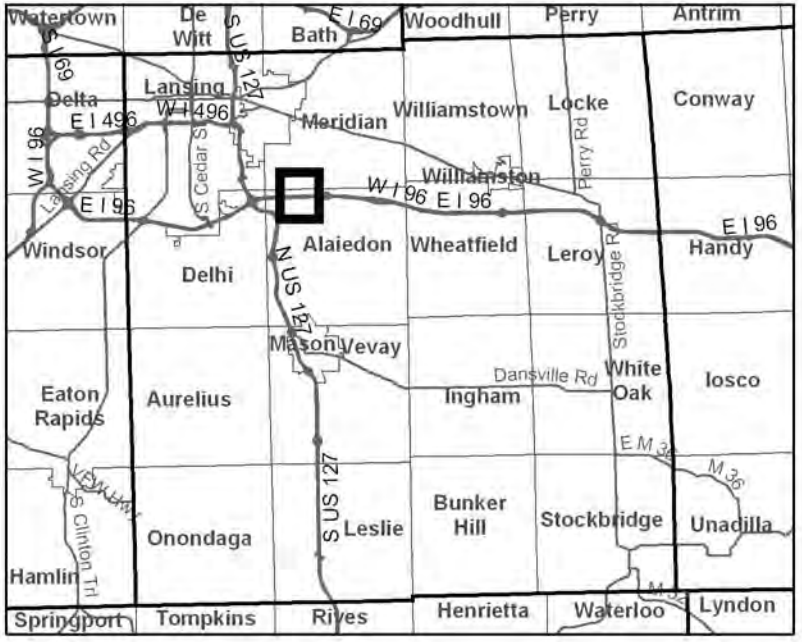


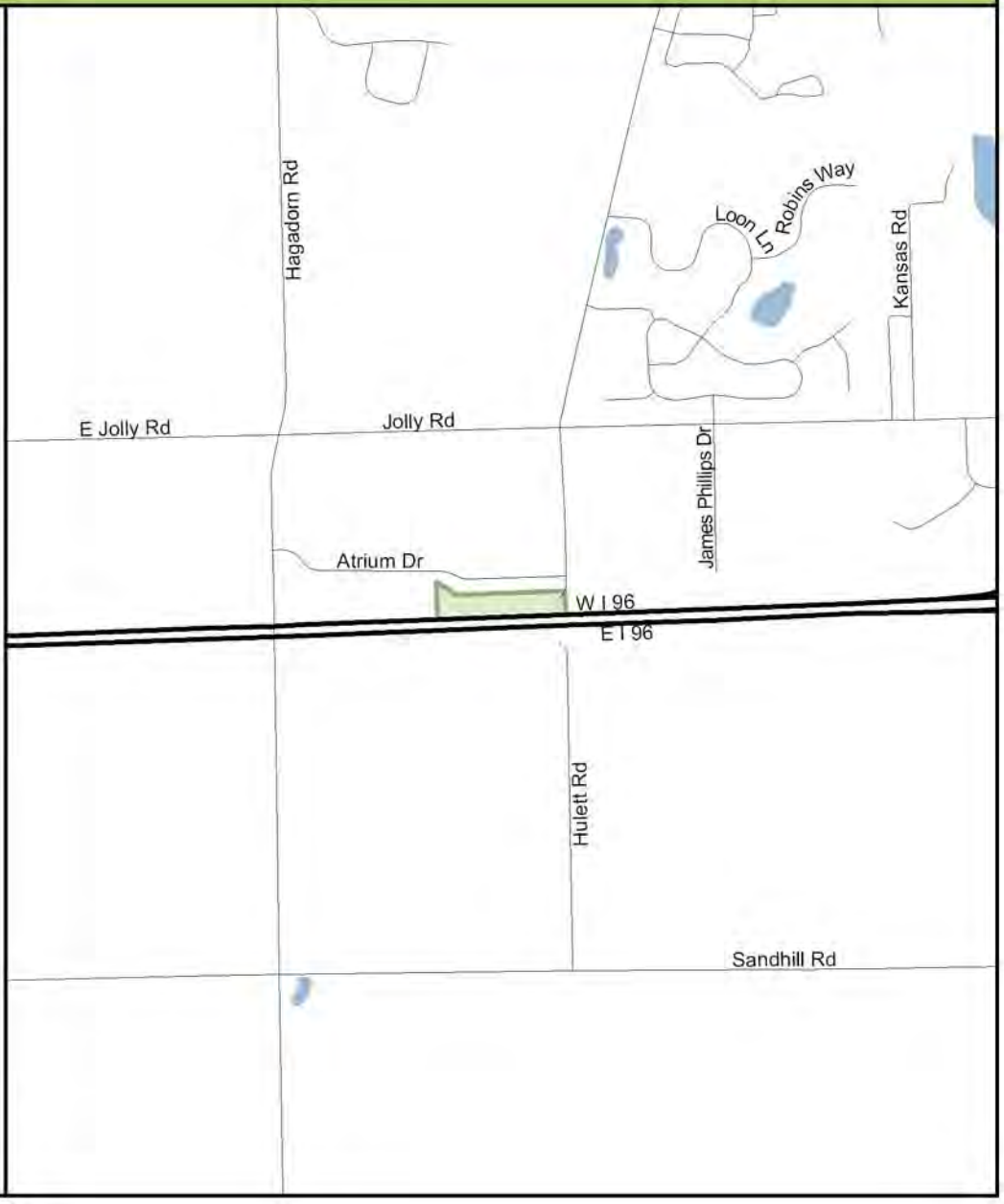
MSU Real Property

Hulett Road Engineering

Alaiedon Township, Section 5

Ingham County



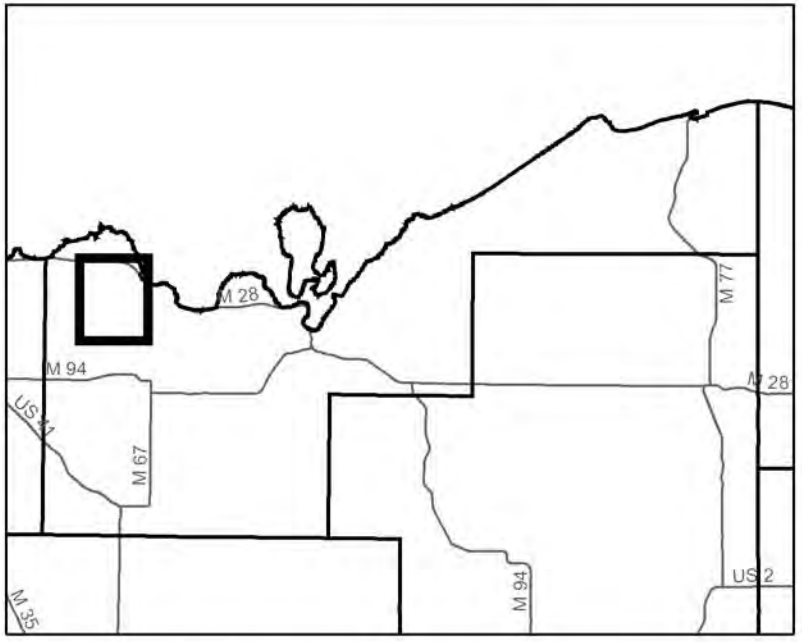


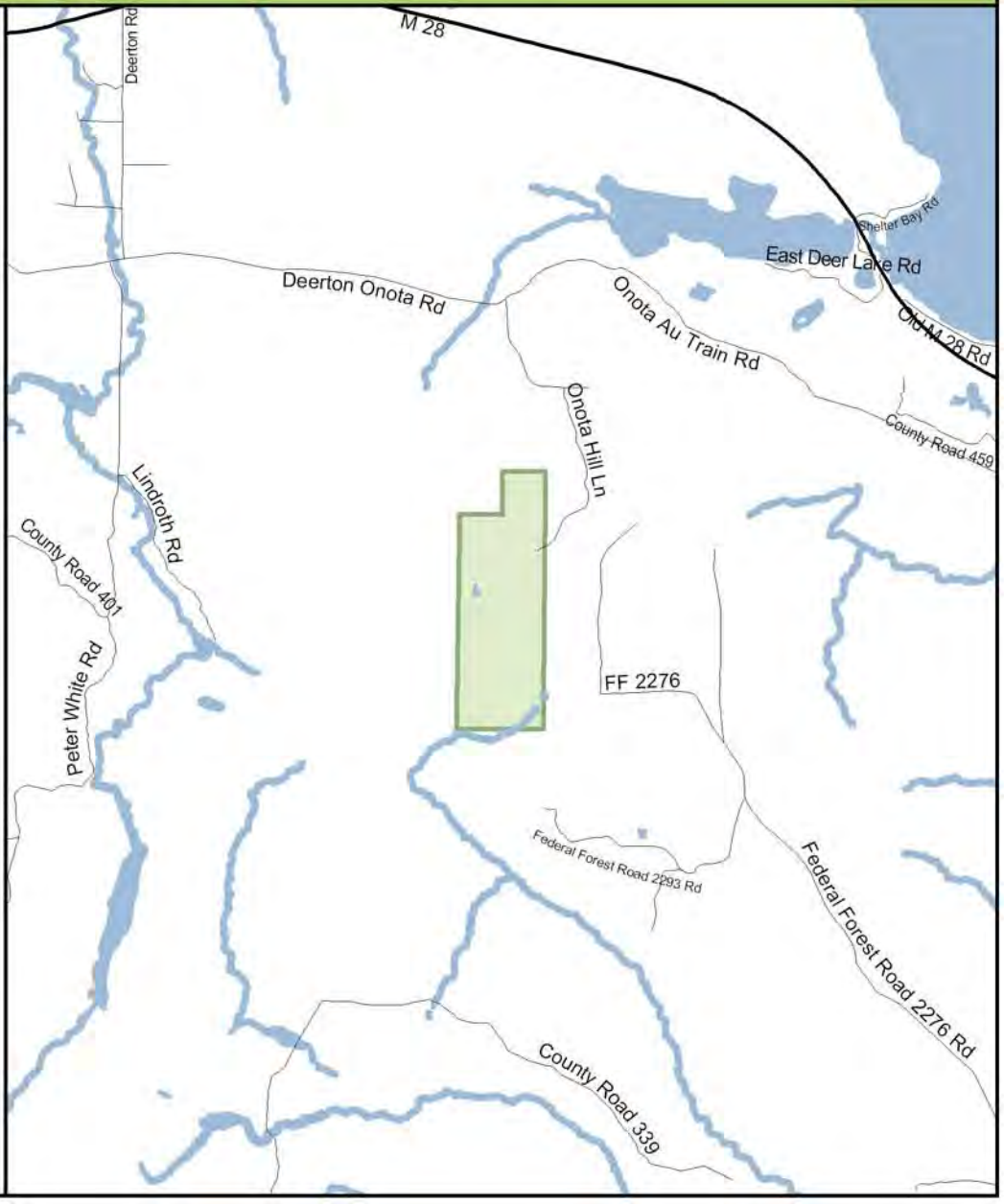
MSU Real Property

Jim Wells Forest

Onota Township, Sections 24 and 25

Alger County



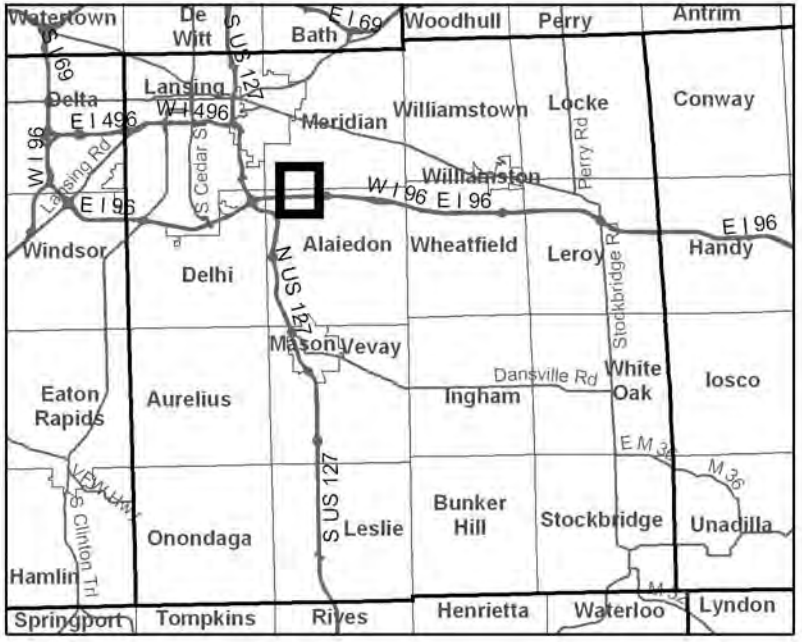


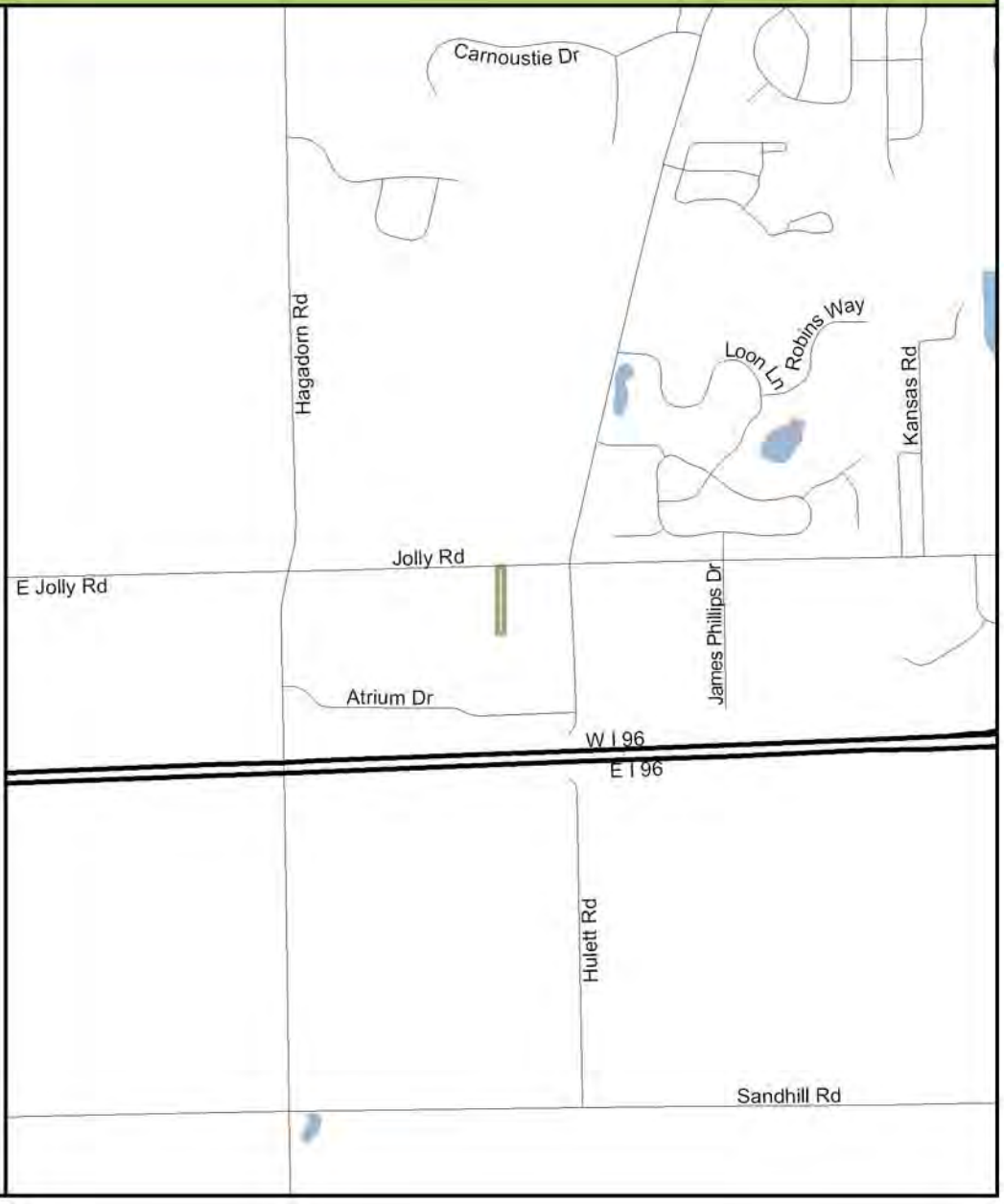
MSU Real Property

Jolly Road Engineering and Civil Infrastructure Lab

Alaiedon Township, Section 5

Ingham County



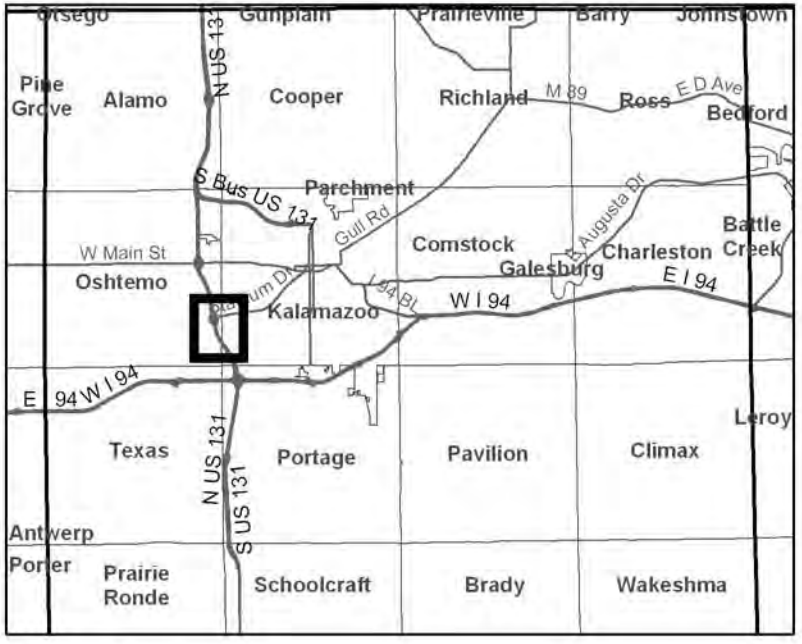


MSU Real Property

Kalamazoo Orchard

Oshtemo Township, Section 25

Kalamazoo County

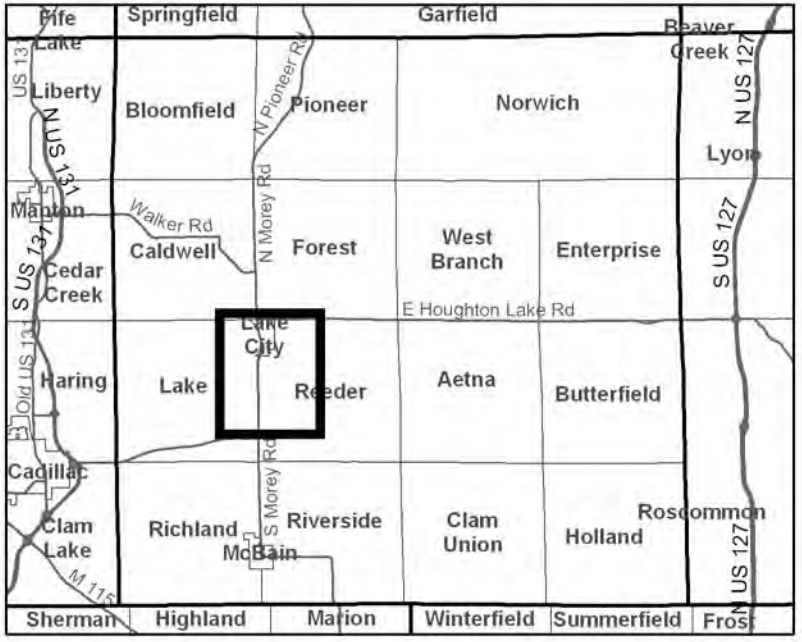


MSU Real Property

Lake City Experiment Station

Reeder Township, Sections 7 and 18

Missaukee County

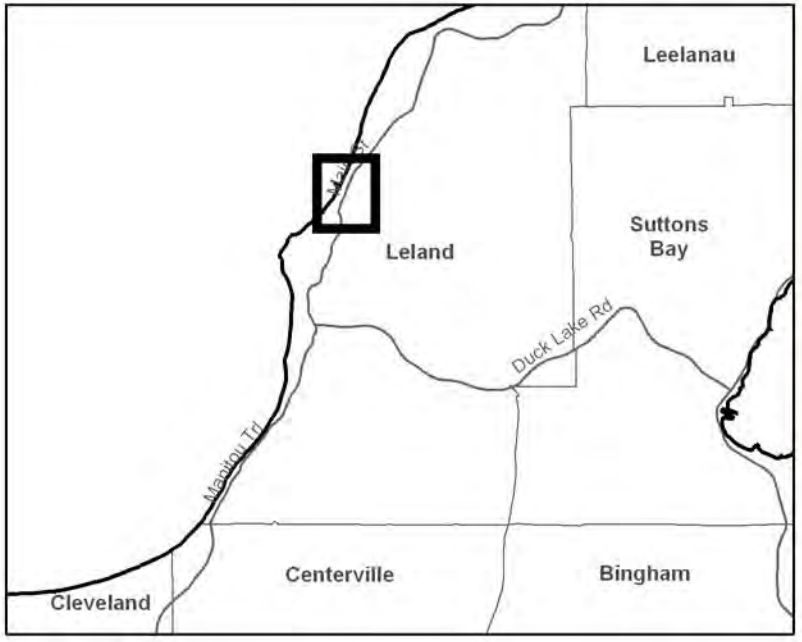


MSU Real Property

Leland Property

Leland Township, Section 9

Leelanau County

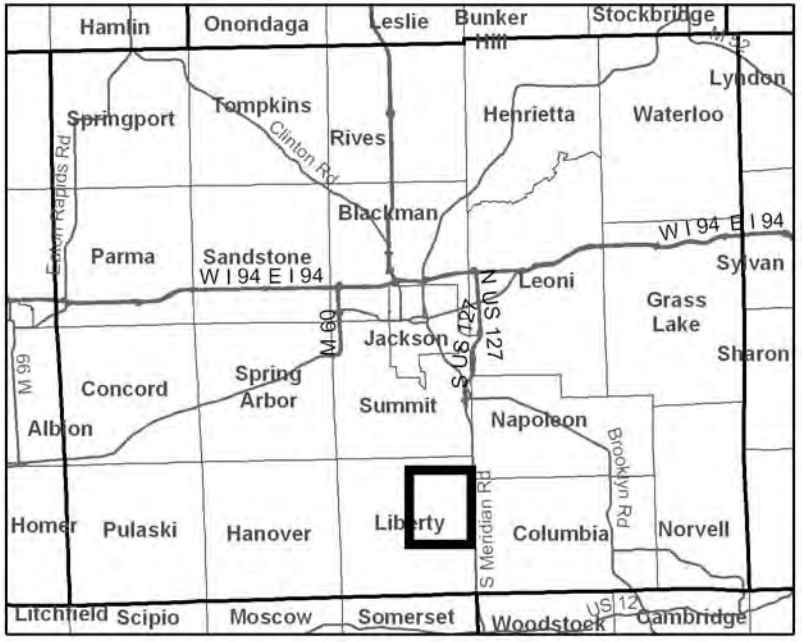


MSU Real Property

MacCready Reserve

Liberty Township, Sections 11 and 14

Jackson County

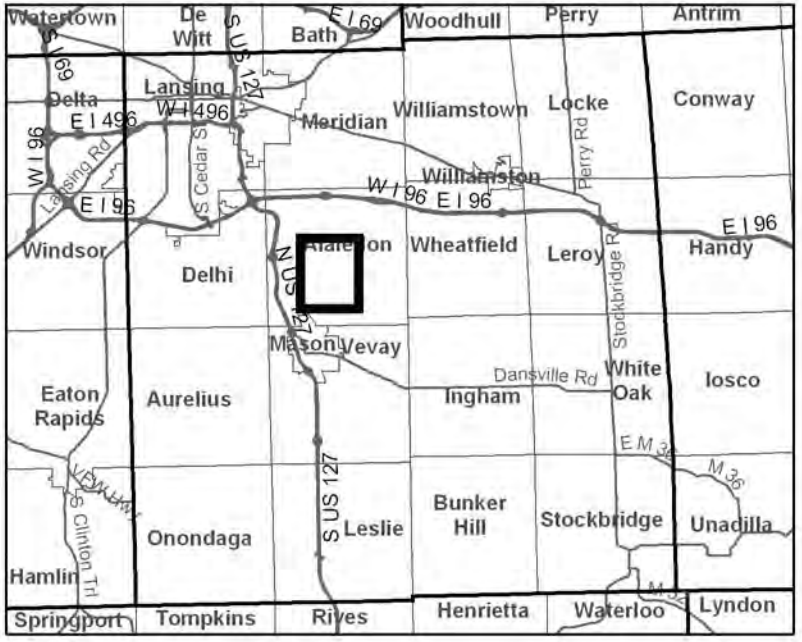


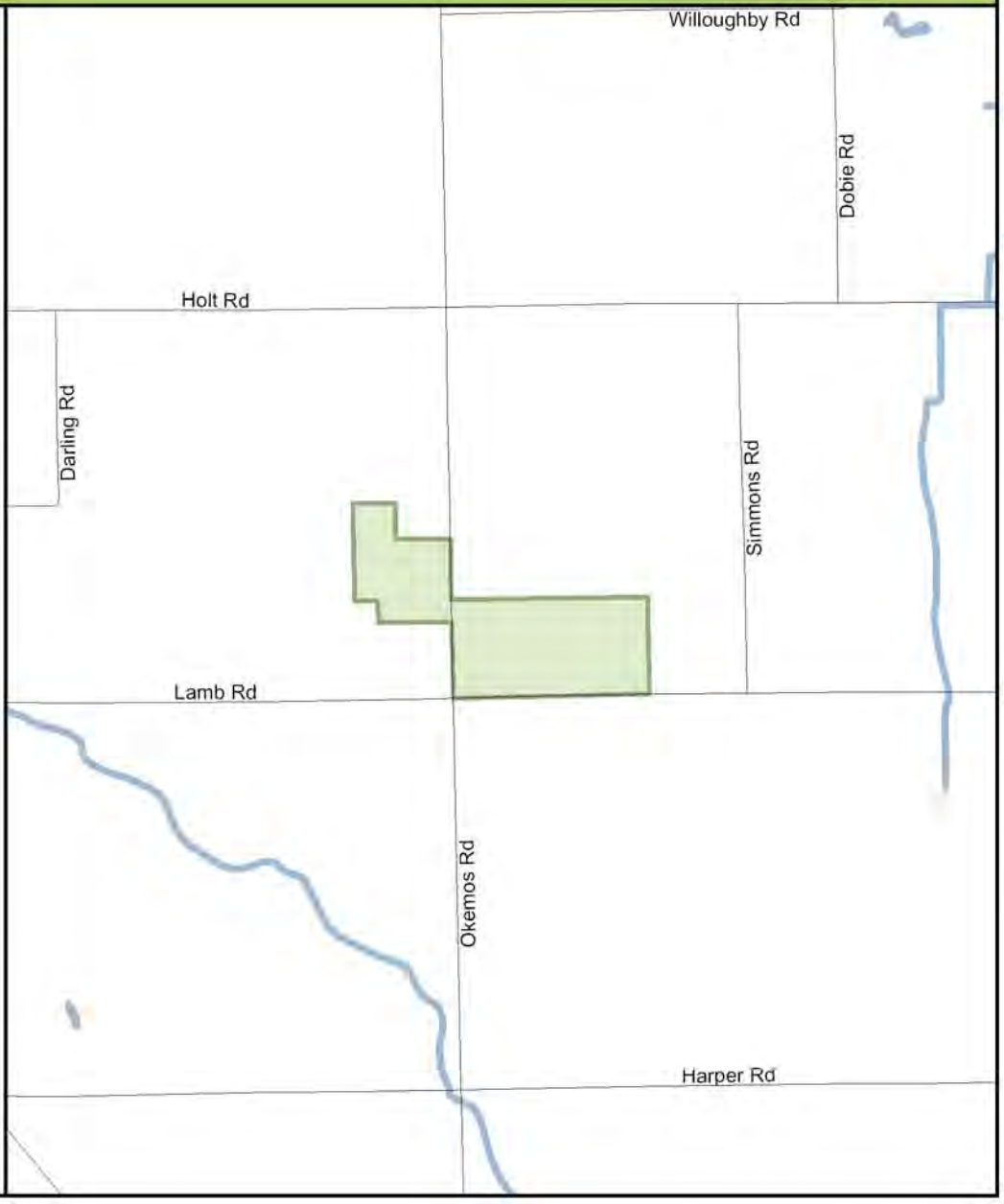
MSU Real Property

Mason Research Farm

Alaiedon Township, Section 21

Ingham County



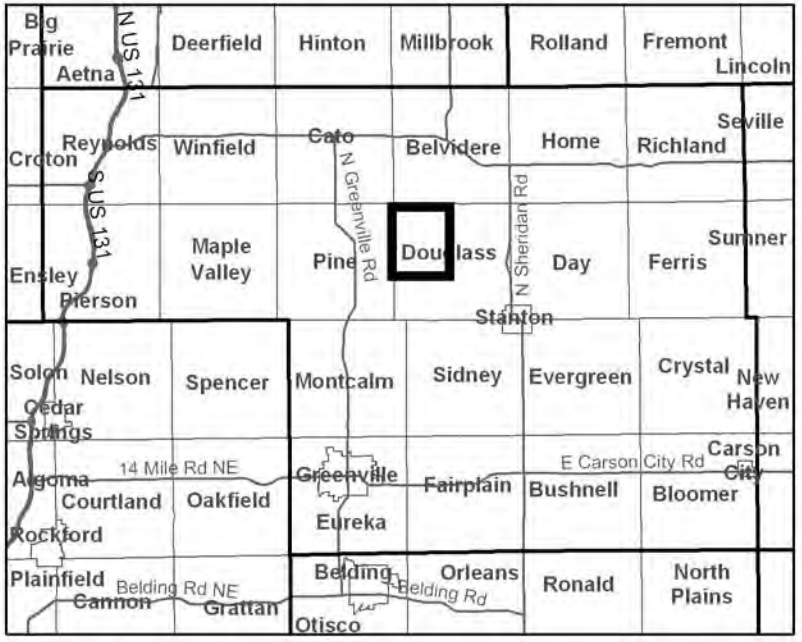


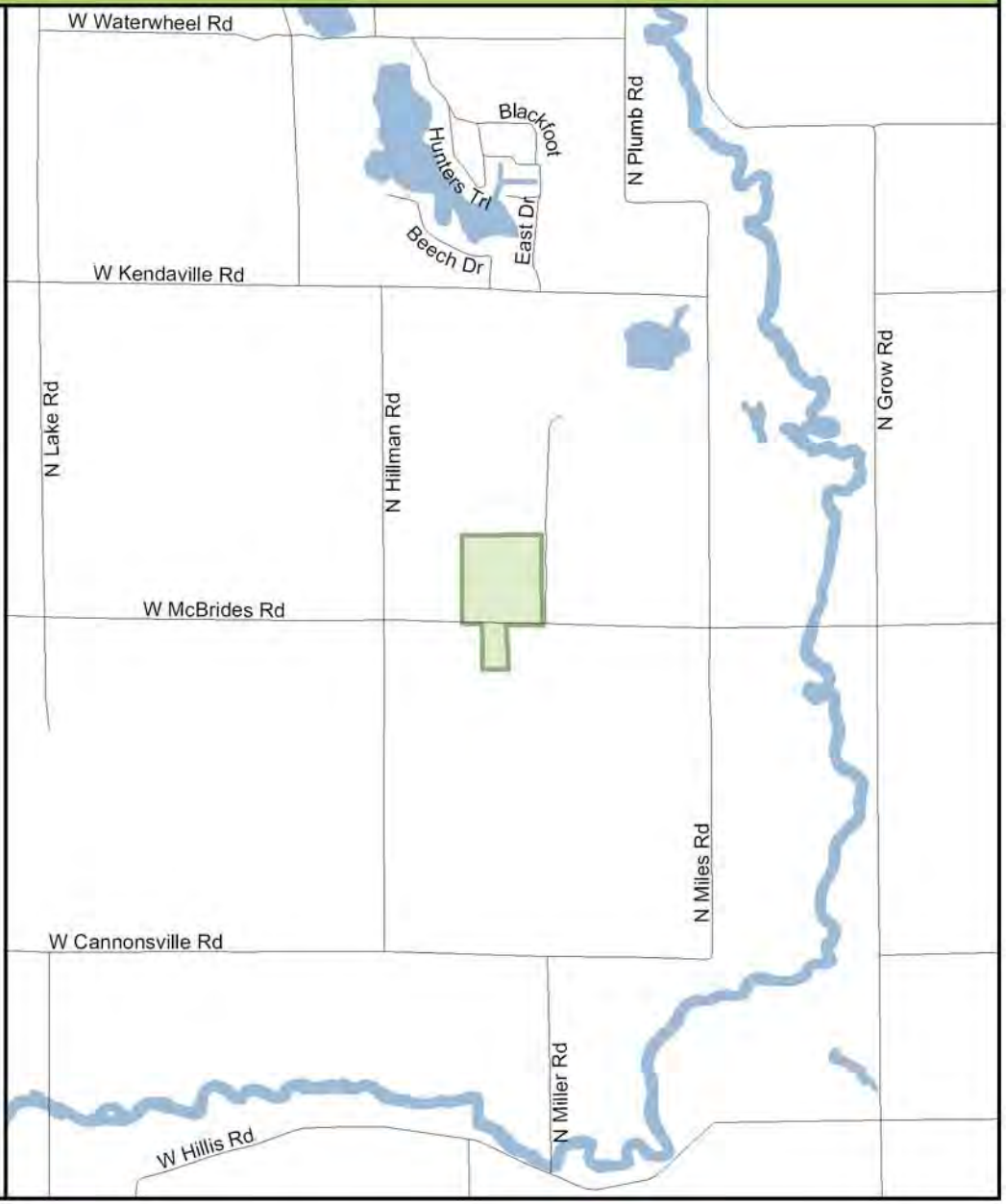
MSU Real Property

Montcalm Research Farm

Douglass Township, Sections 8 and 17

Montcalm County



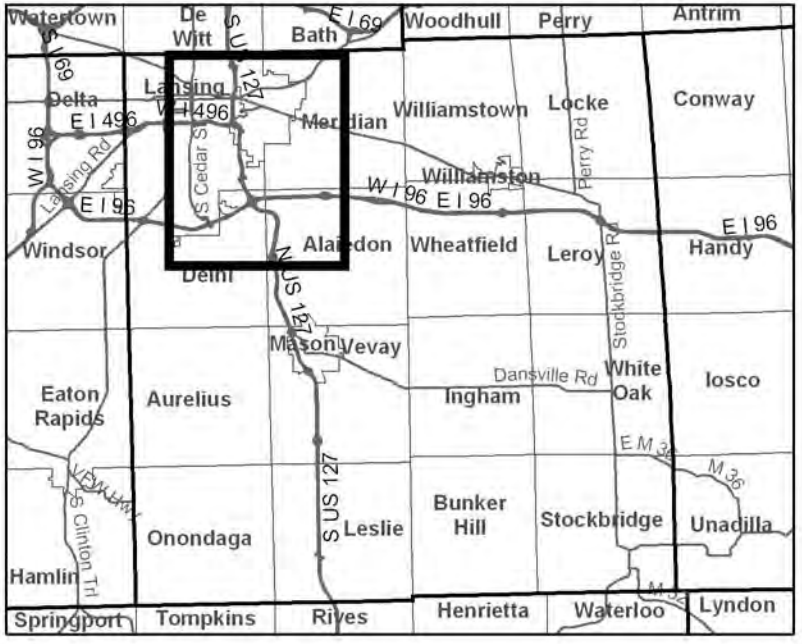


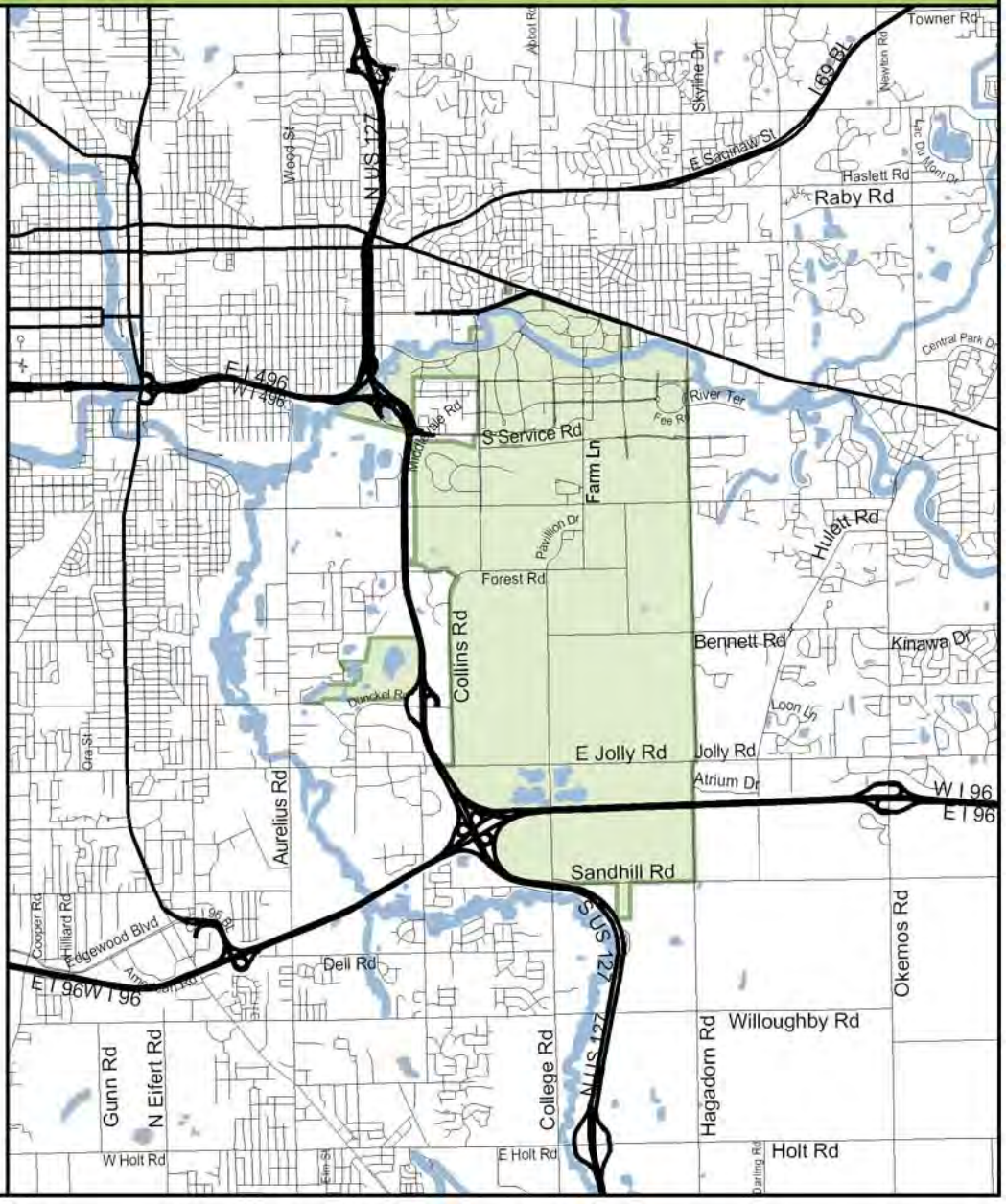
MSU Real Property

MSU Campus, East Lansing

Alaeidon, Delhi, Lansing and Meridian Townships

Ingham County



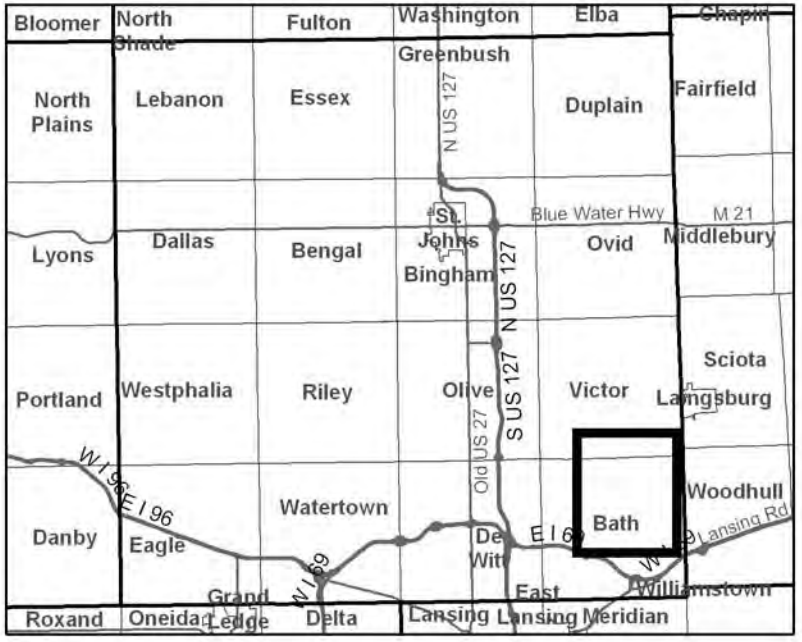


MSU Real Property

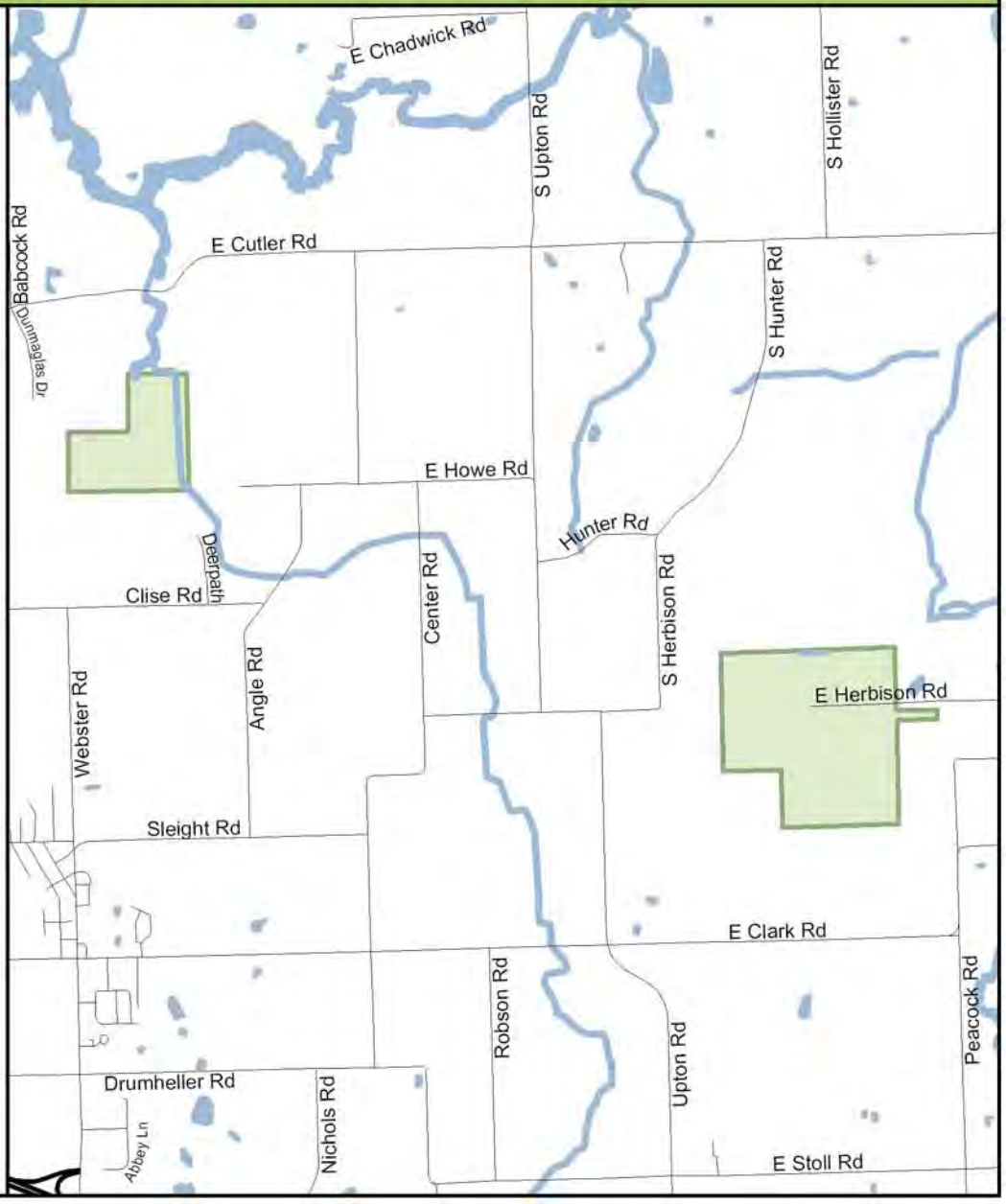
Muck Soils Research Farm

Bath Township, Sections 4, 5, 11, 12, 13 and 14

Clinton County



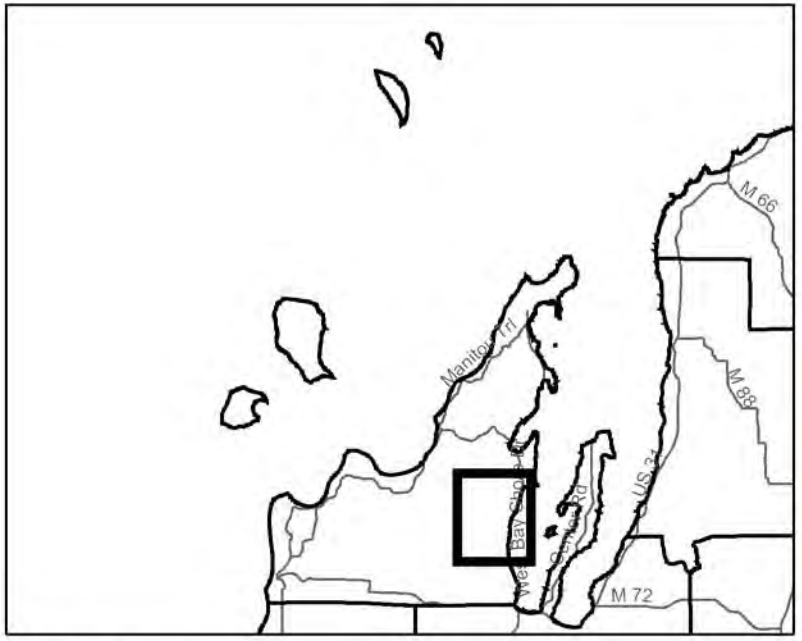
MSU Real Property



Northwest Michigan Horticultural Research Station

Bingham Township, Sections 29 and 30

Leelanau County

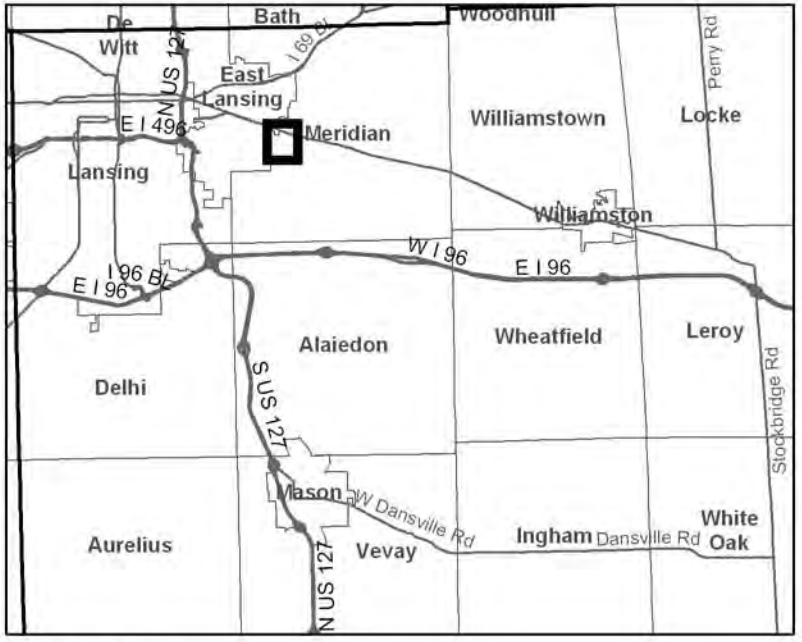


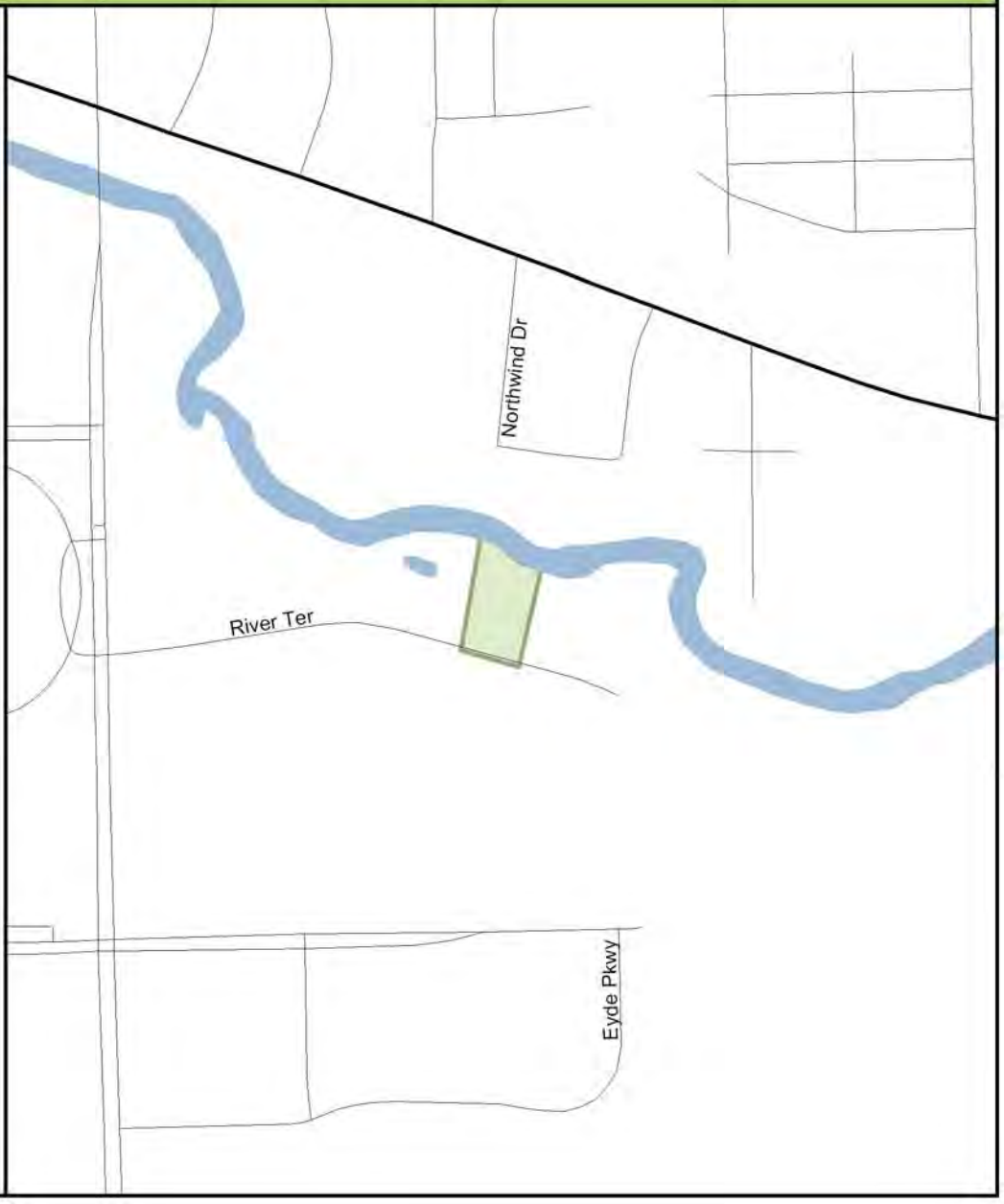
MSU Real Property

River Terrace Property

Meridian Township, Section 20

Ingham County



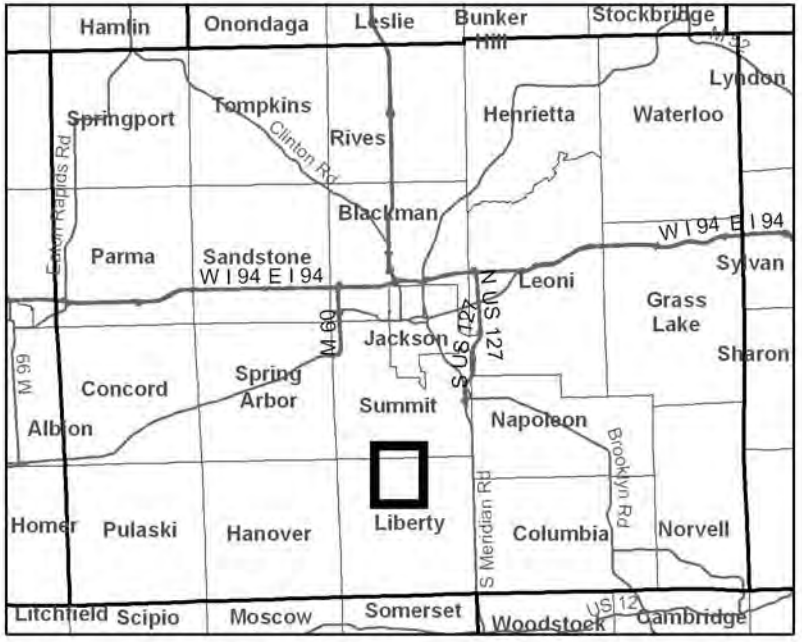


MSU Real Property

Rogers Reserve

Liberty Township, Section 4

Jackson County

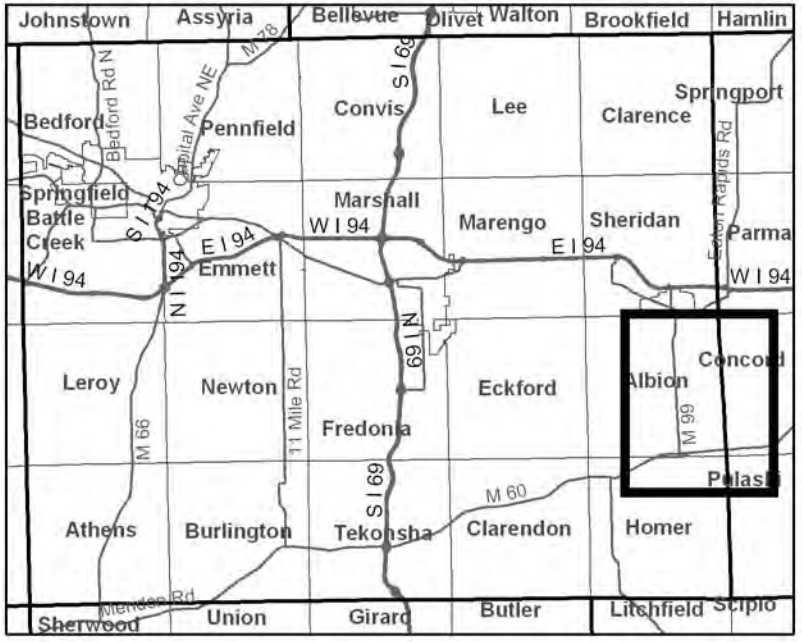


MSU Real Property

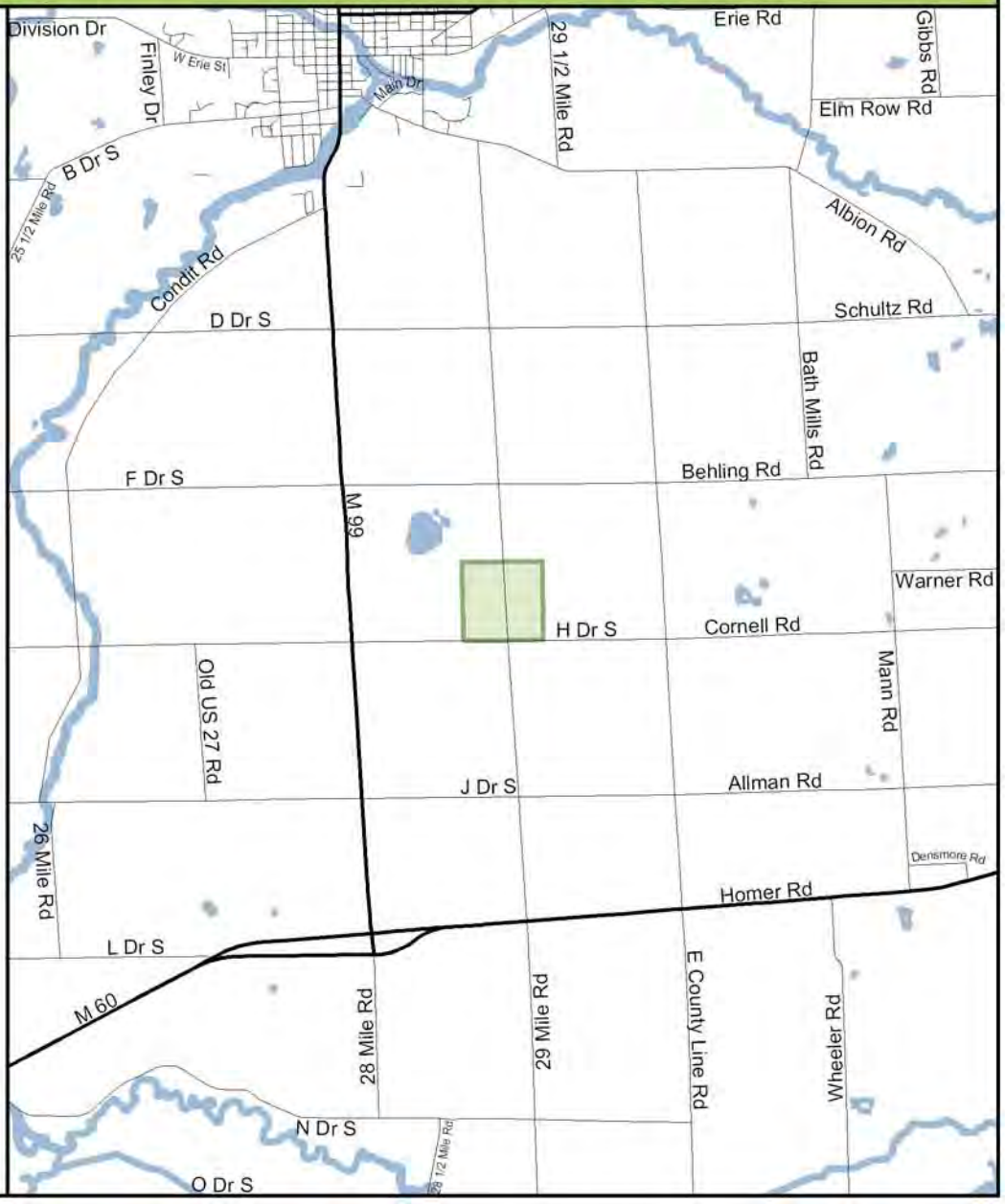
Rose-Dell Seed Orchard Research Facility

Albion Township, Sections 23 and 24

Calhoun County



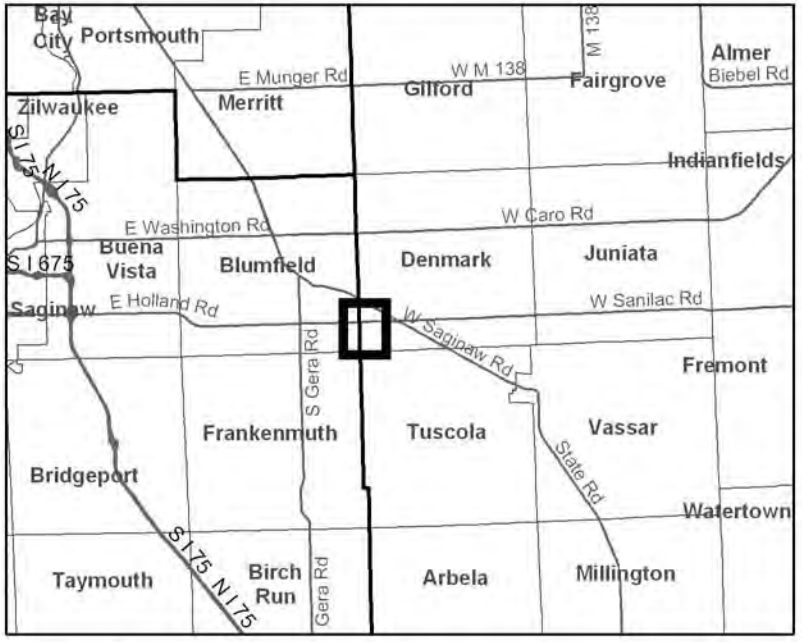
MSU Real Property

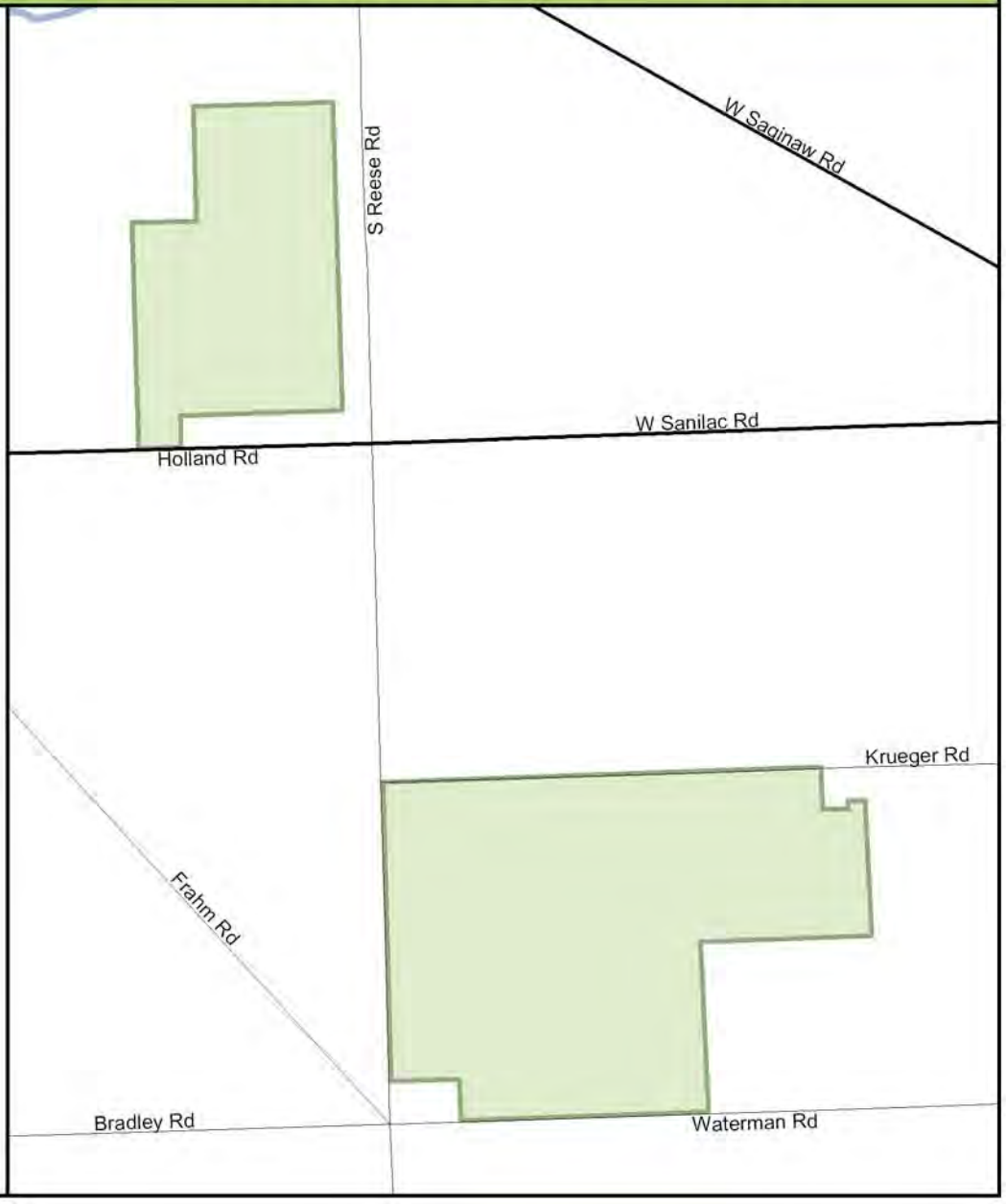


Saginaw Valley Bean and Sugar Beet Research Farm (Leased)

Blumfield Township, Section 25, Denmark Township, Section 31

Saginaw & Tuscola County



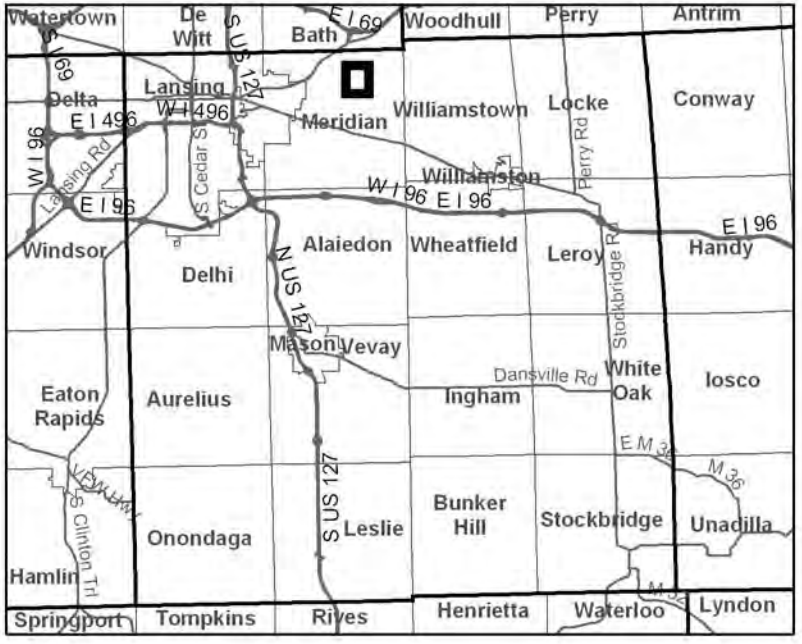


MSU Real Property

Sailing Club

Meridian Township, Section 11

Ingham County

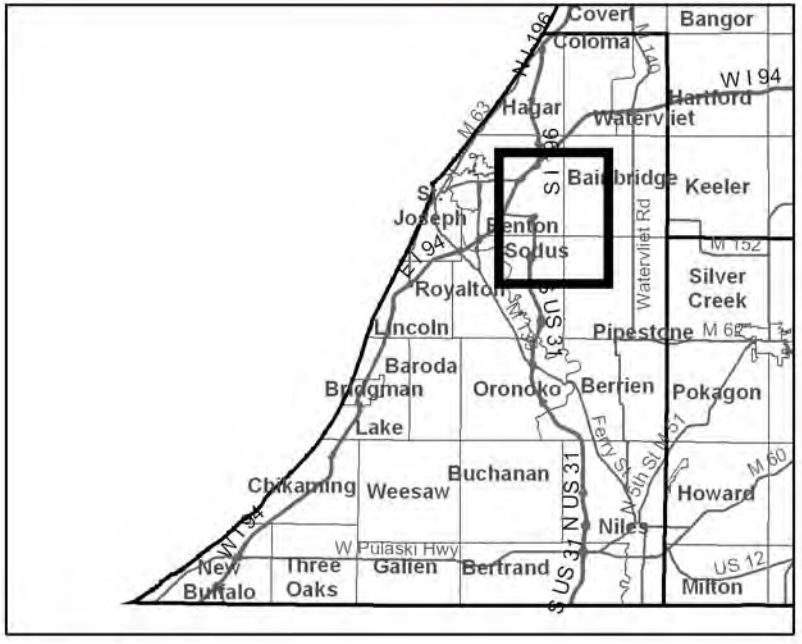


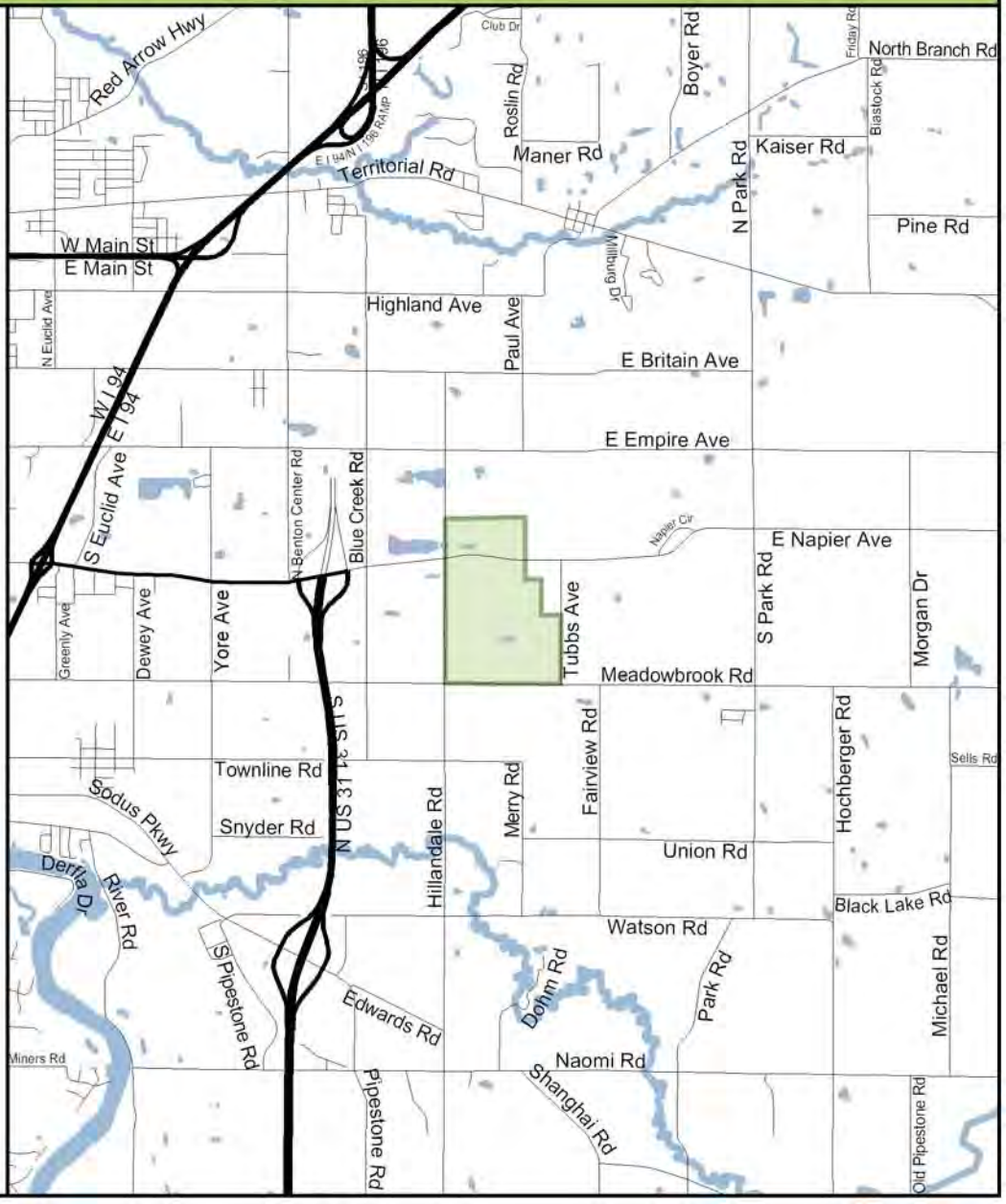
MSU Real Property

Southwest Michigan Research and Extension Center

Benton Township, Sections 25 and 36

Berrien County



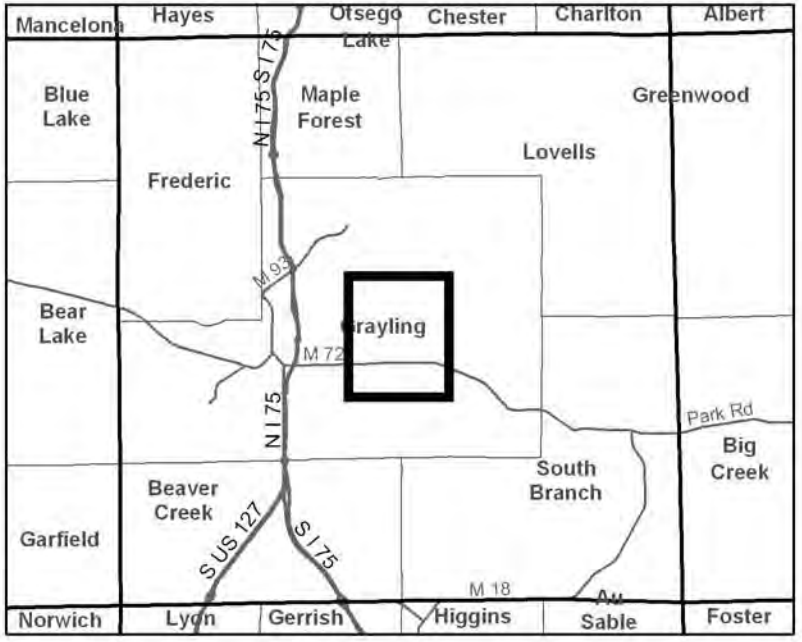


MSU Real Property

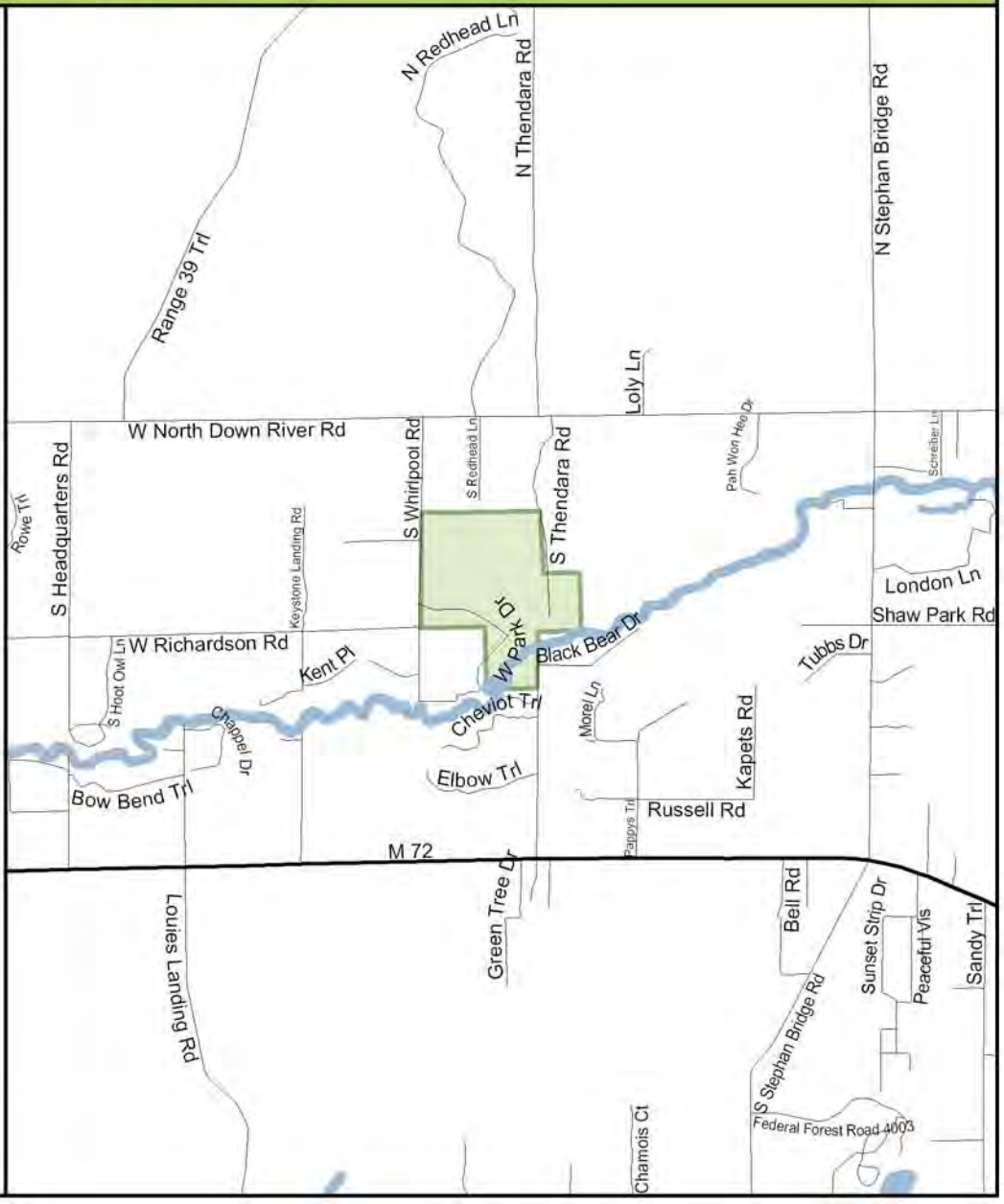
Stranahan-Bell Property (Wa Wa Sum)

Grayling Township, Sections 1, 6 and 12

Crawford County



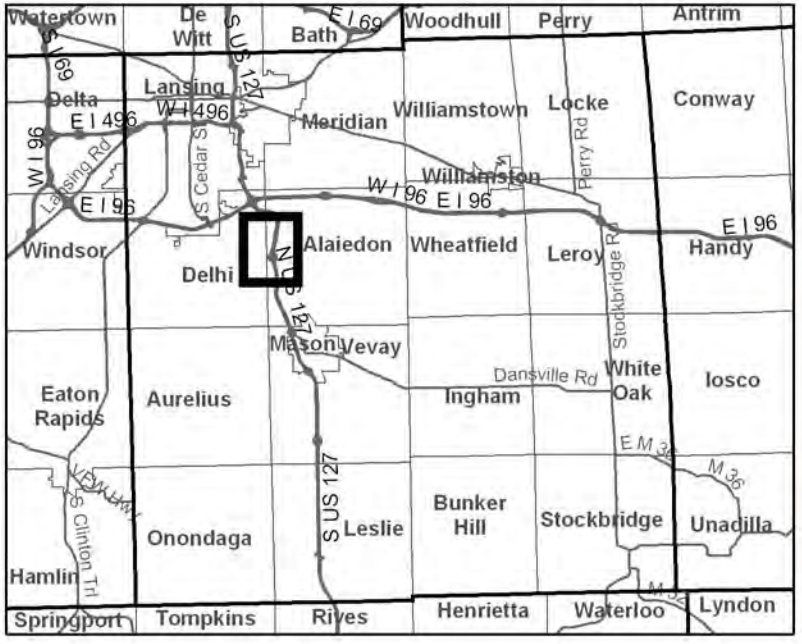
MSU Real Property

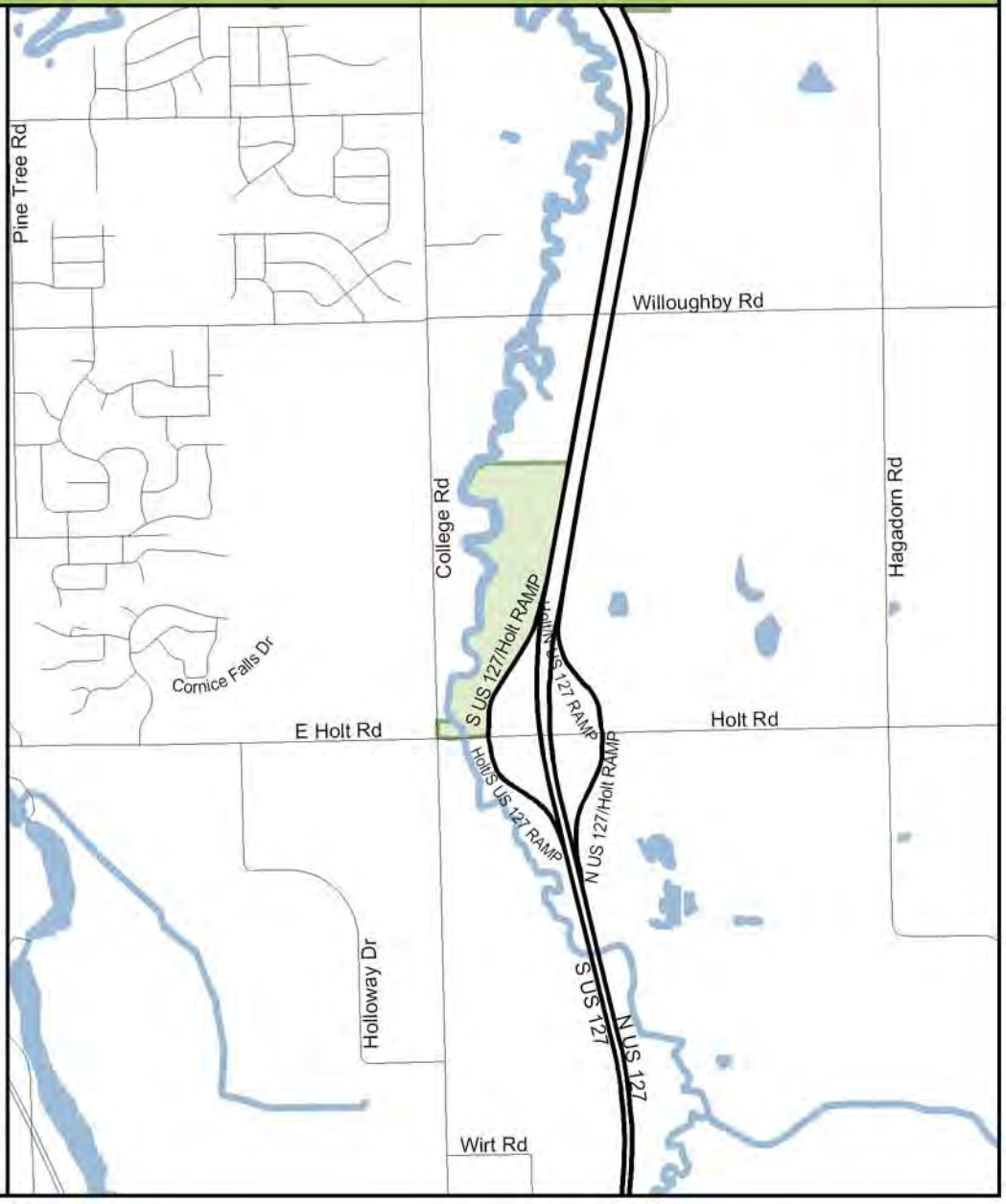


Sycamore Creek Property

Alaiedon Township, Section 18

Ingham County



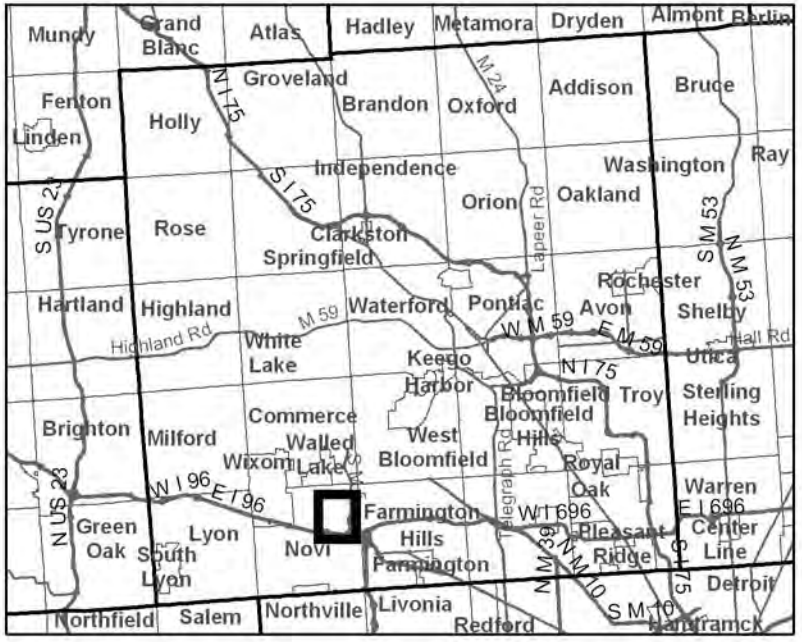


MSU Real Property

Tollgate Education Center and Americana Foundation Property

City of Novi, Section 11

Oakland County

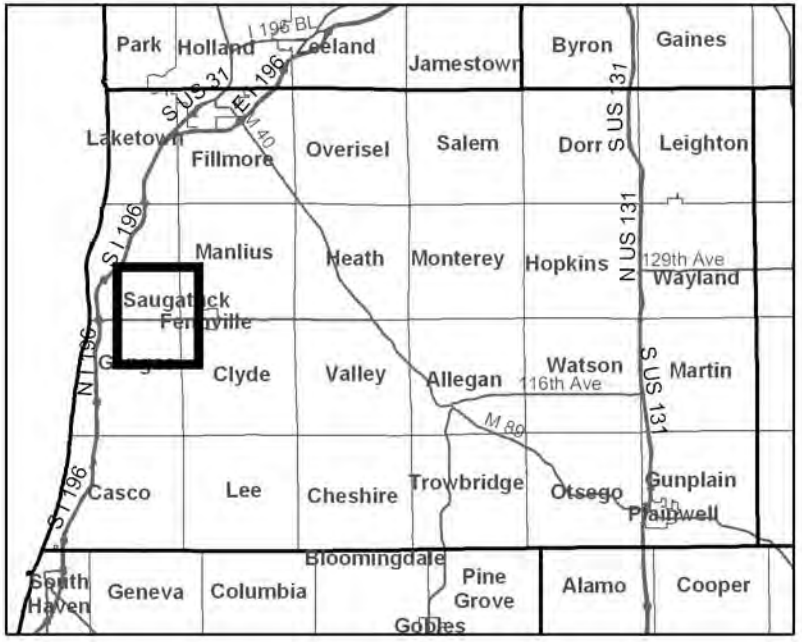


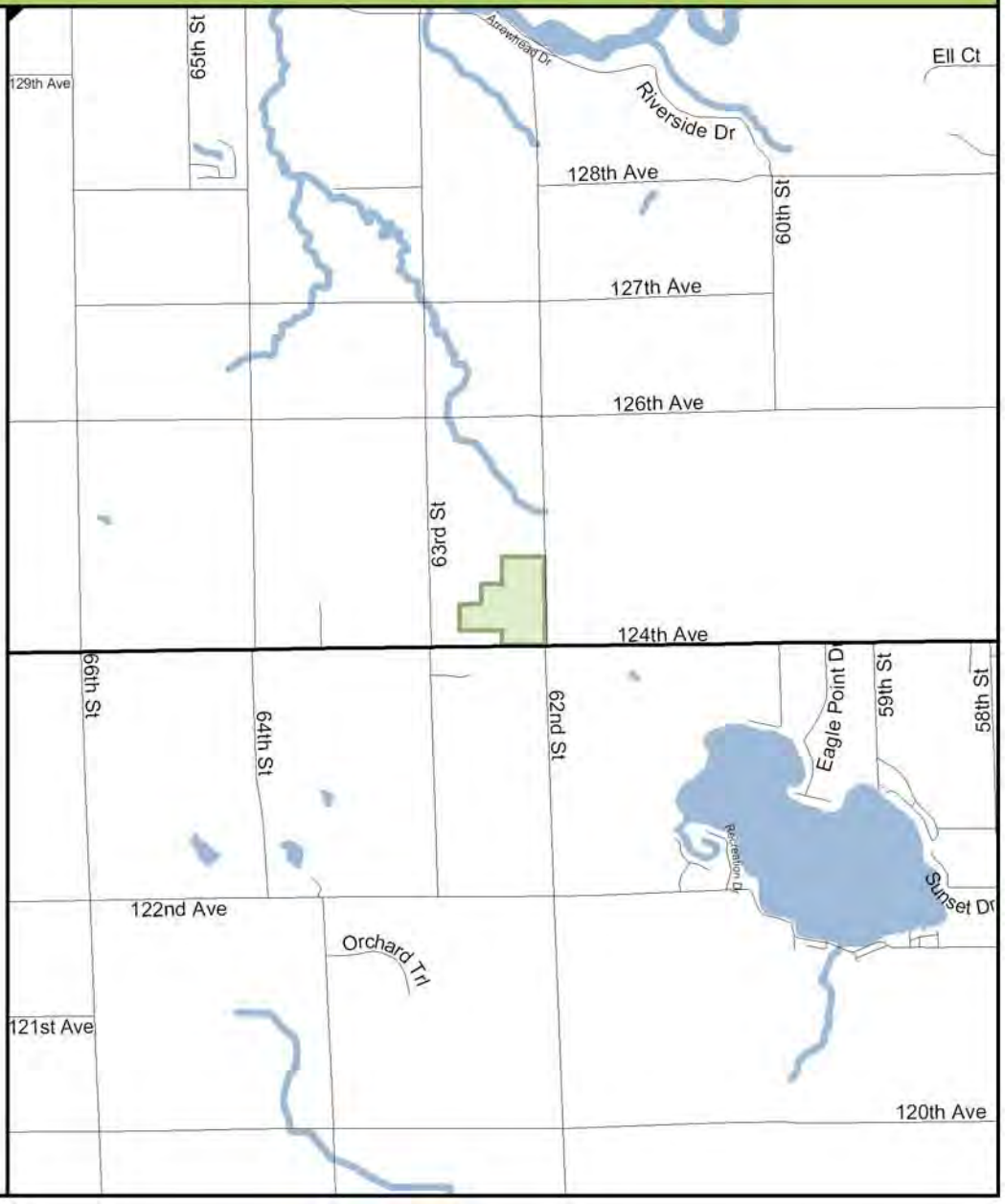
MSU Real Property

Trevor Nichols Research Complex

Saugatuck Township, Section 35

Allegan County



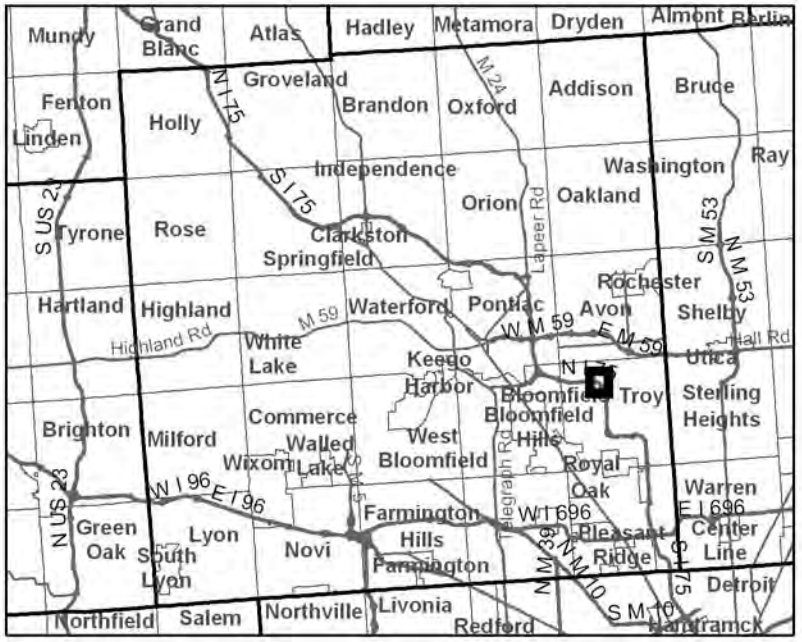


MSU Real Property

Troy Management Education Center

City of Troy, Section 9

Oakland County

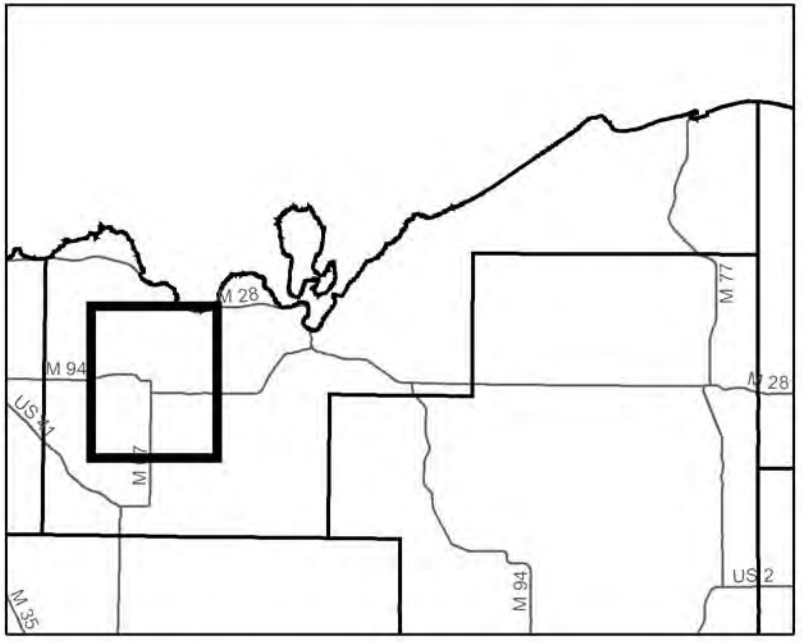


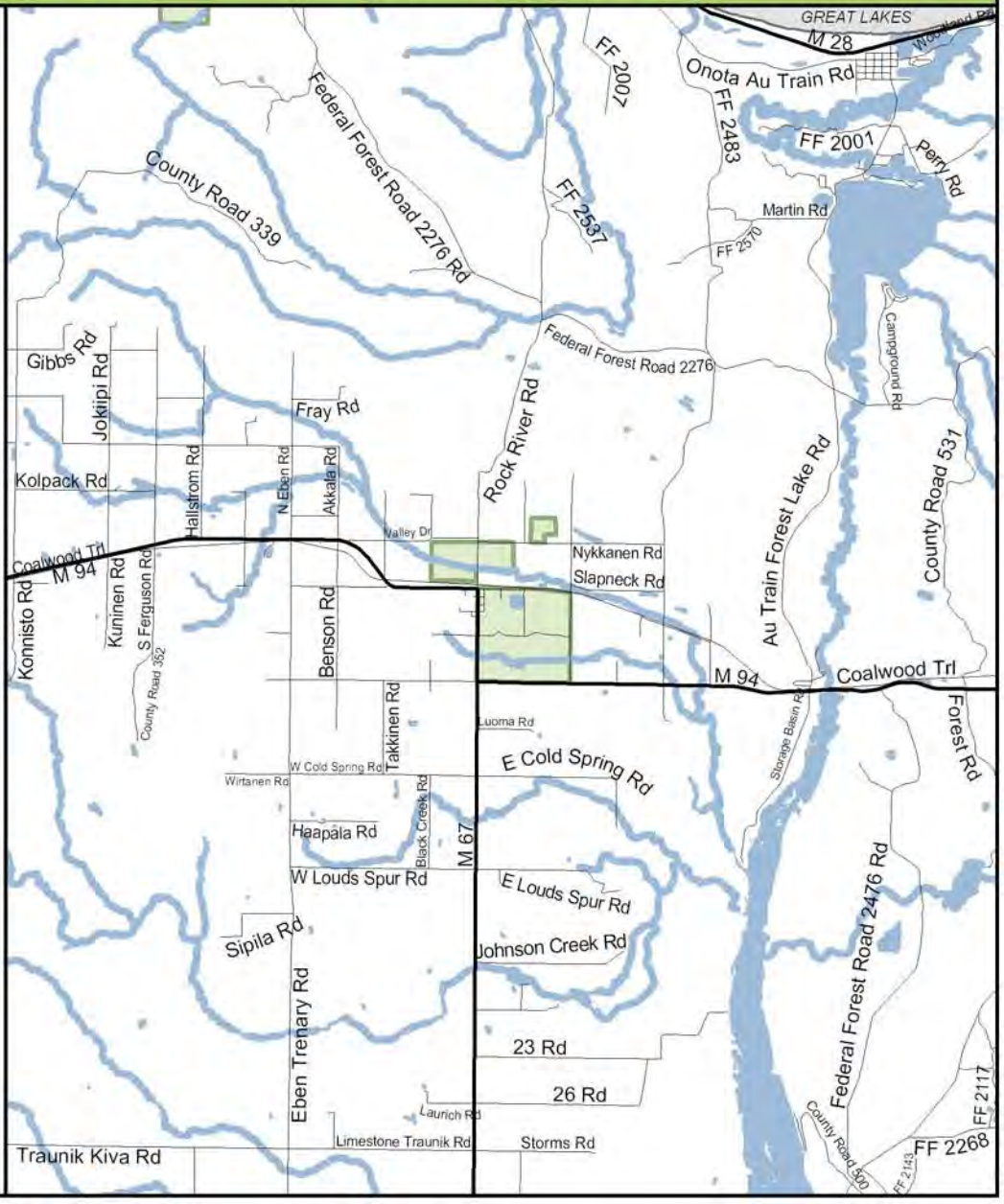
MSU Real Property

Upper Peninsula Experiment Station

City of Chatham and Rock River Township, Sections 24, 25, 27, 28 and 34

Alger County



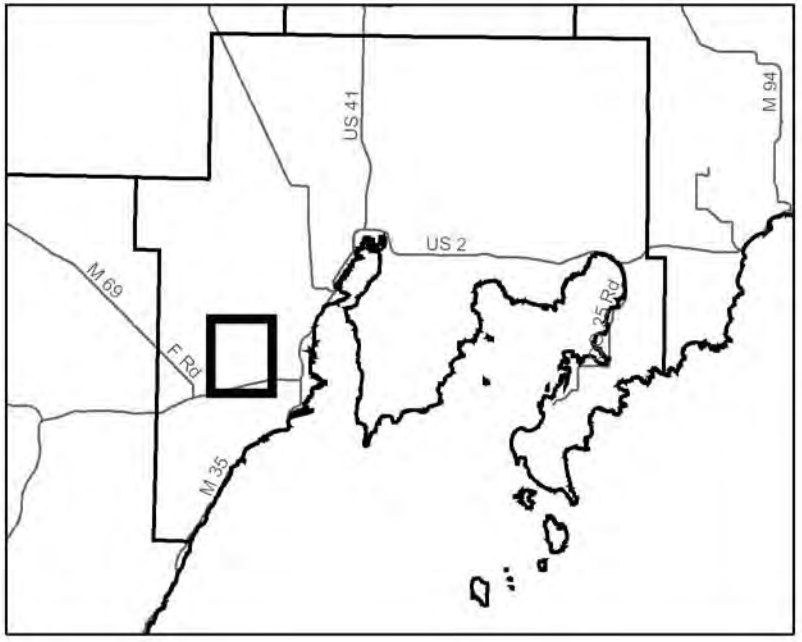


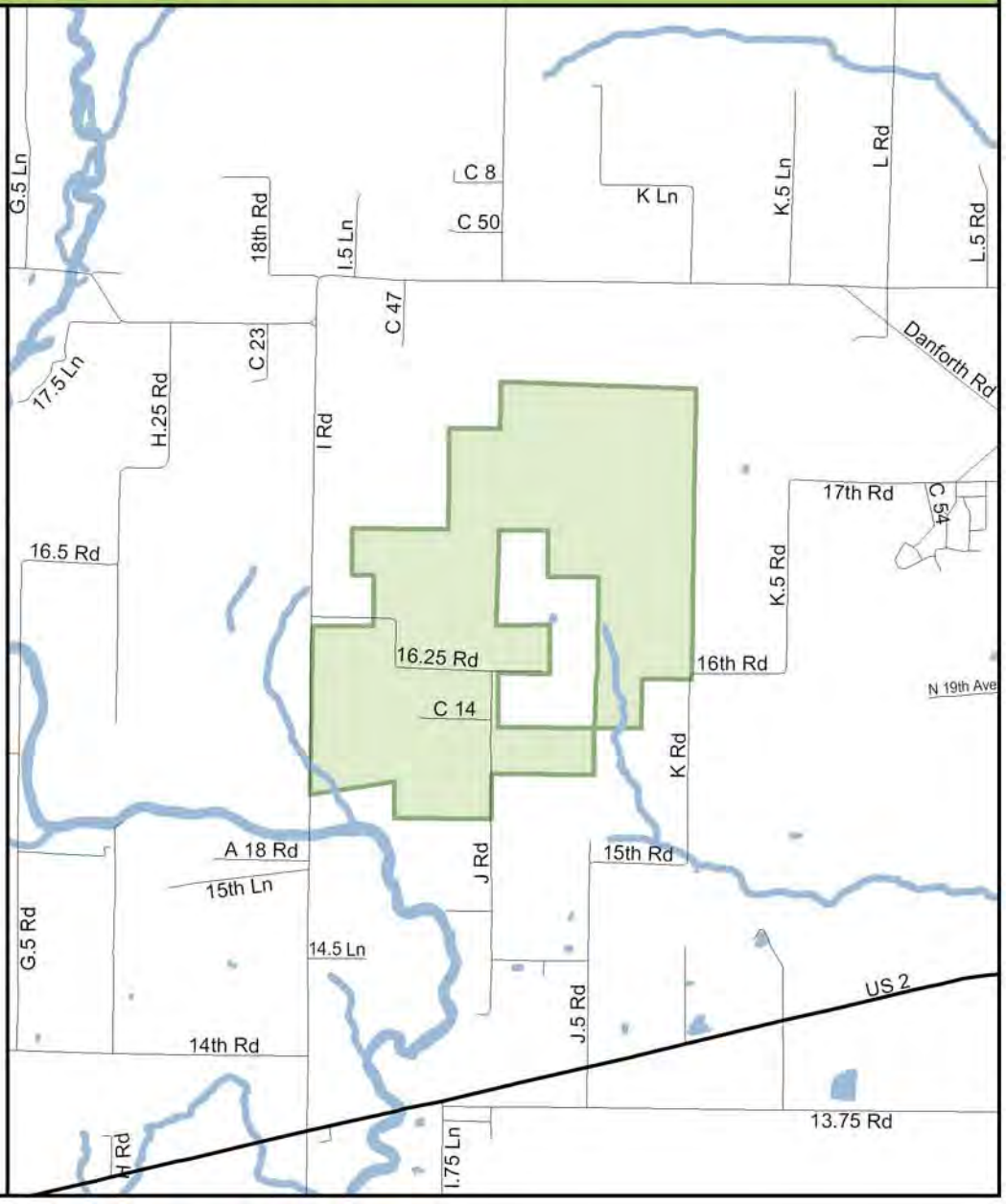
MSU Real Property

Upper Peninsula Tree Improvement Center

Wells Township, Sections 8, 17, 18, 19 and 20

Delta County



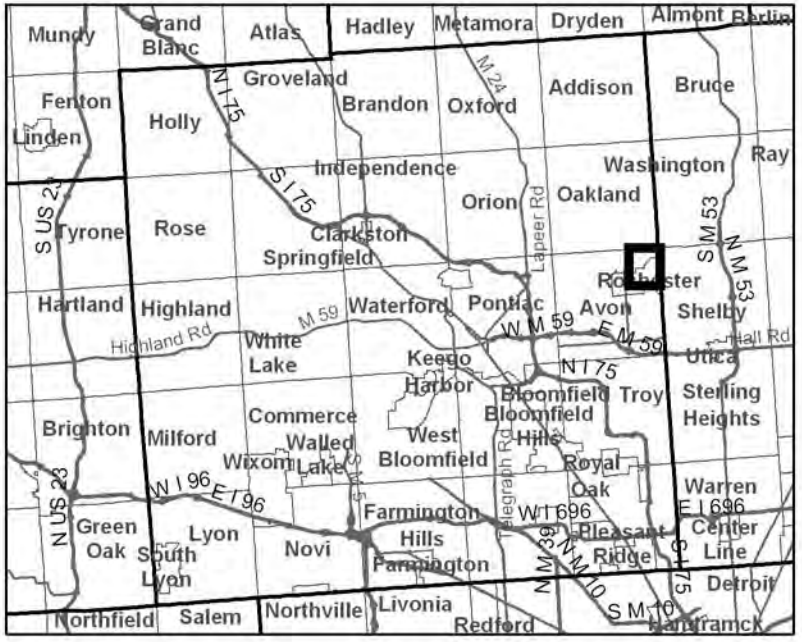


MSU Real Property

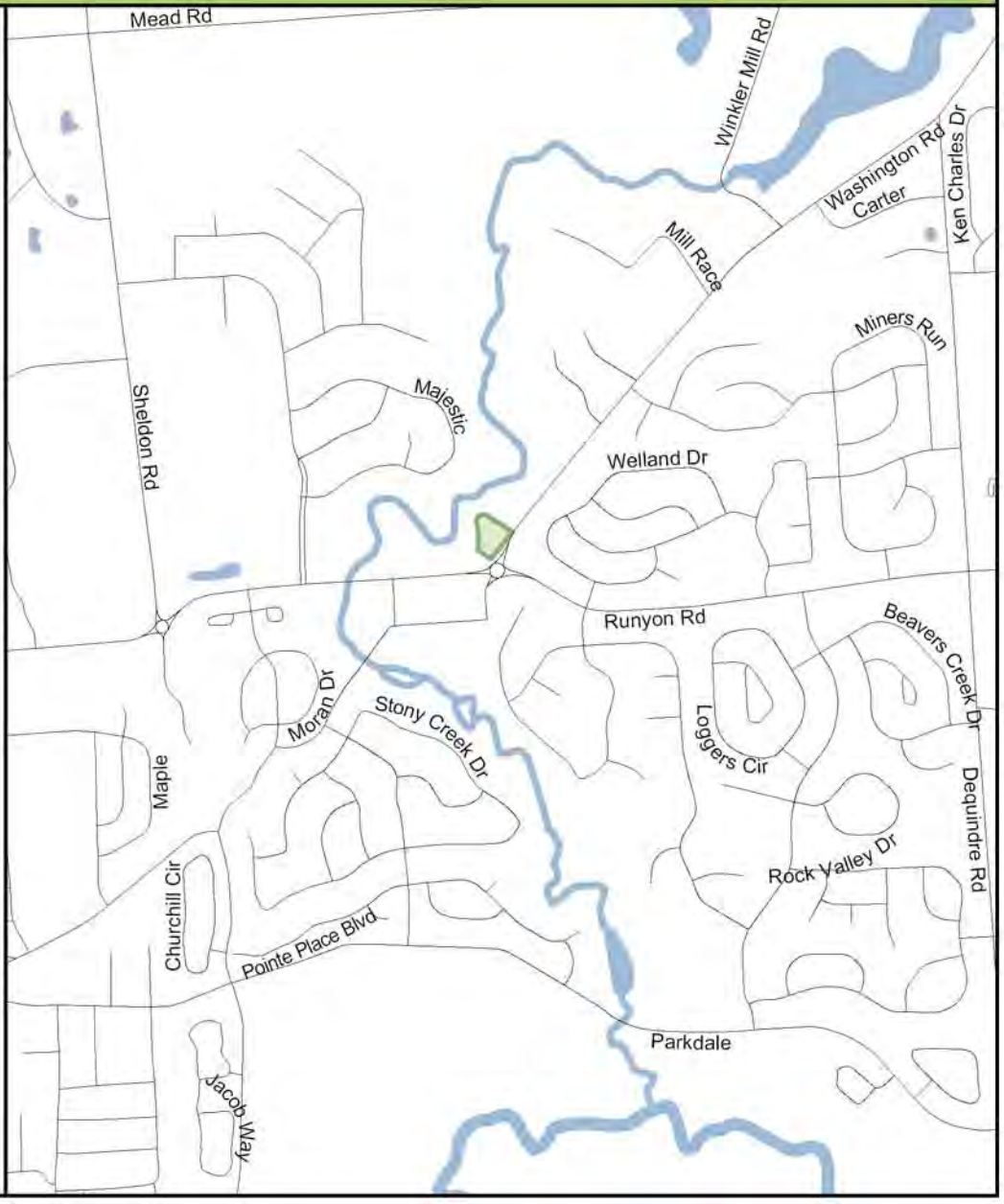
Van Hoosen Property

Avon Township, Section 1

Oakland County



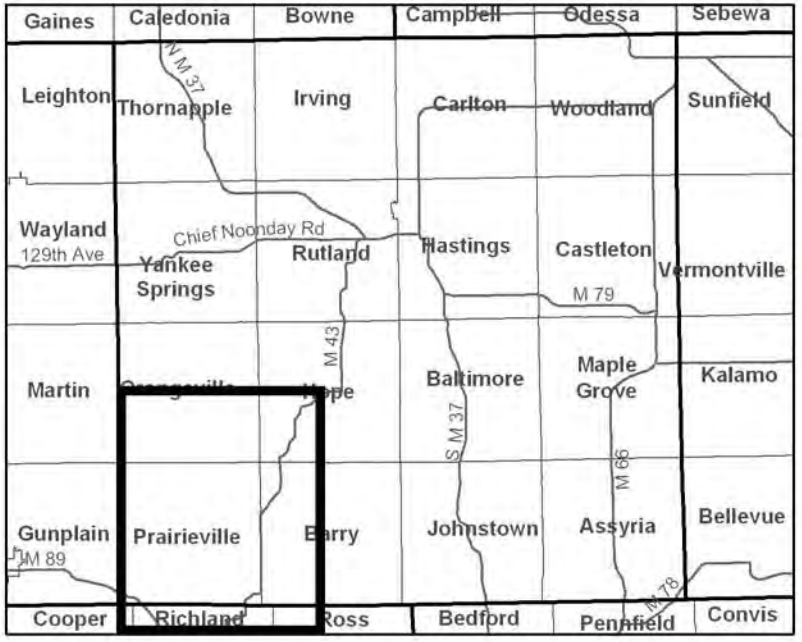
MSU Real Property



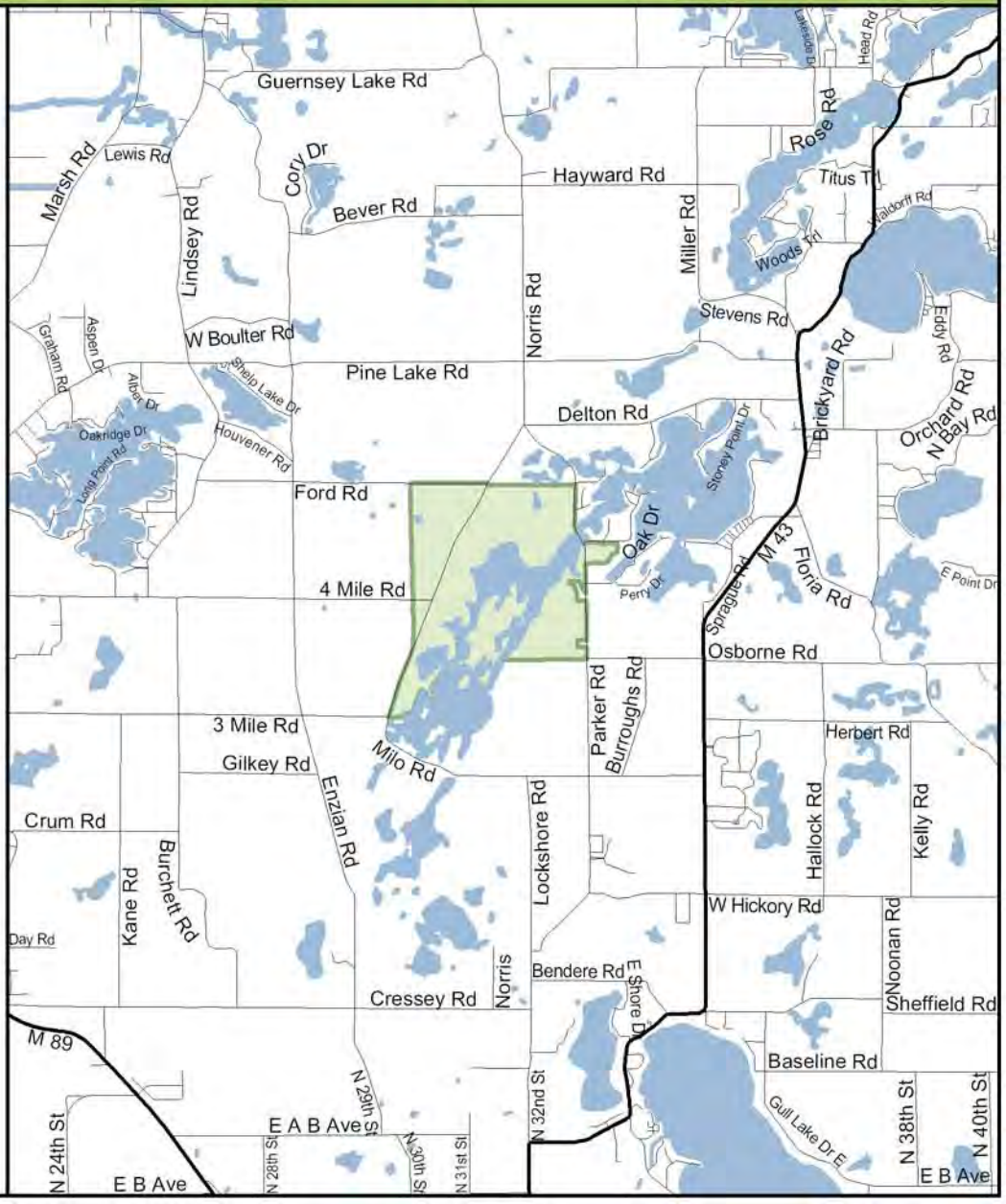
W.K. Kellogg Biological Station (Lux Arbor Reserve)

Prairieville Township, Sections 10, 11, 14 and 15

Barry County



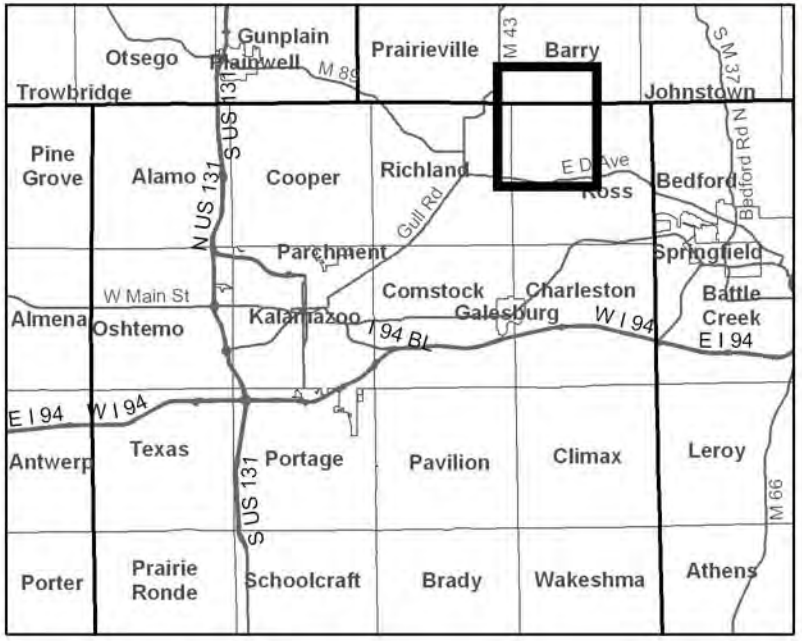
MSU Real Property



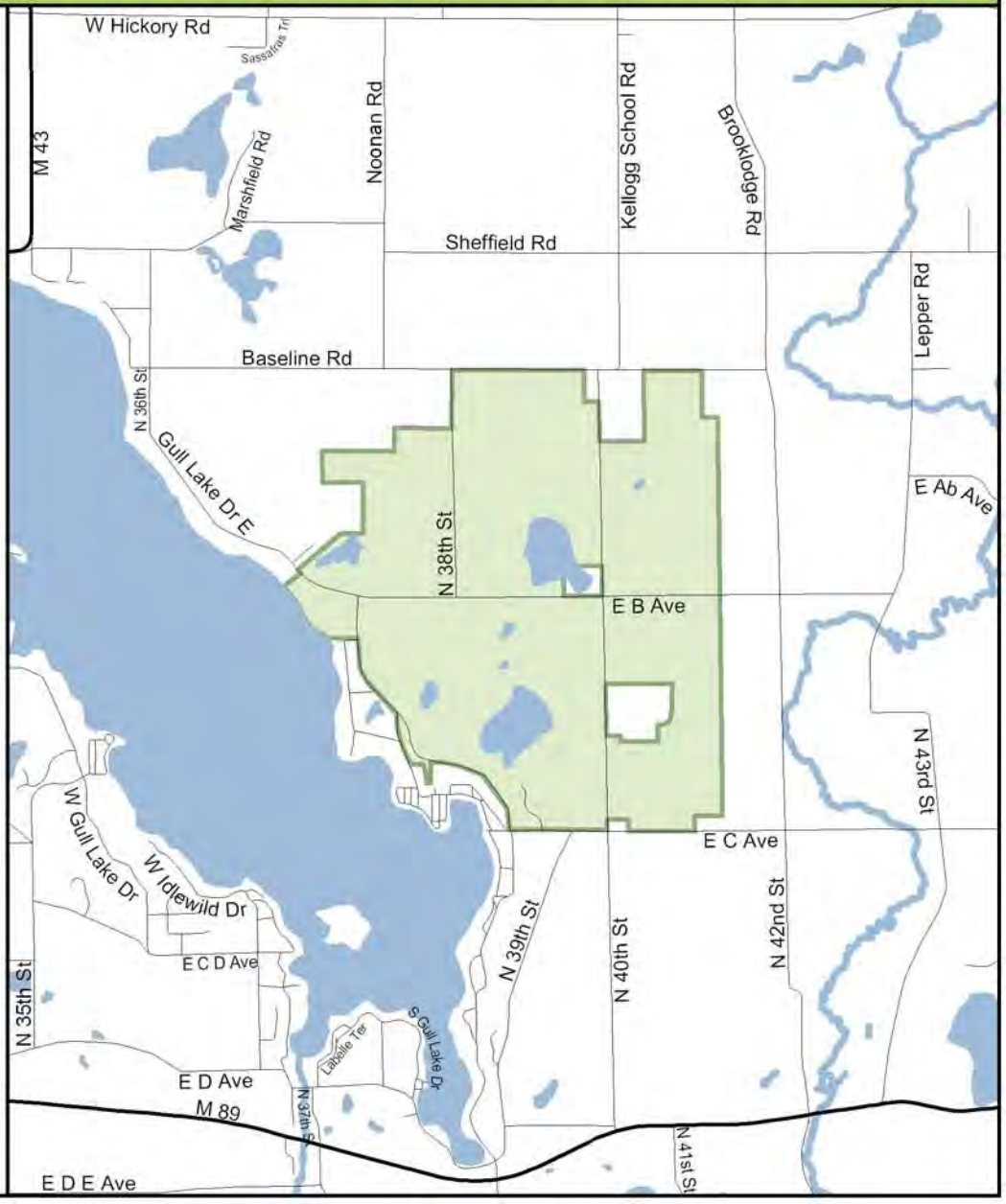
W.K. Kellogg Biological Station, Bird Sanctuary, and Farm

City of South Gull Lake and Ross Township, Sections 4, 5, 6, 8 and 9

Kalamazoo County



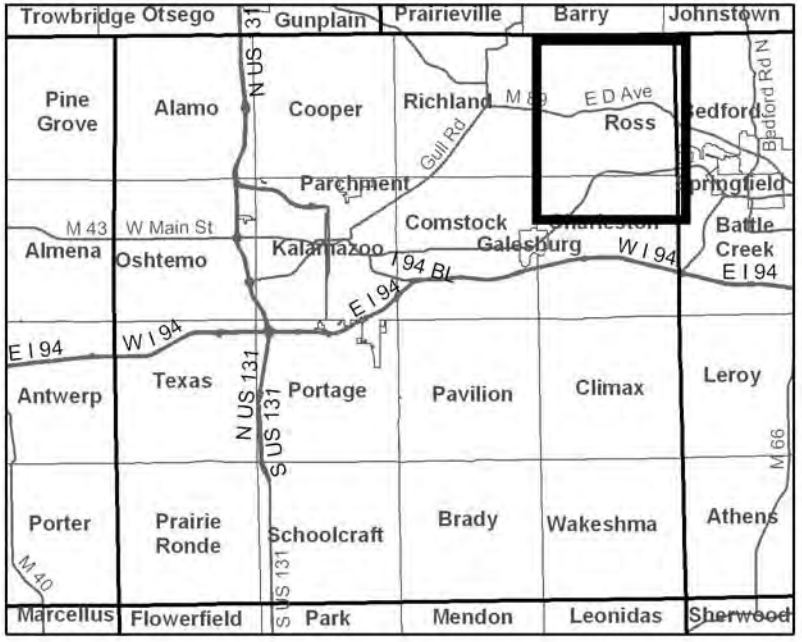
MSU Real Property



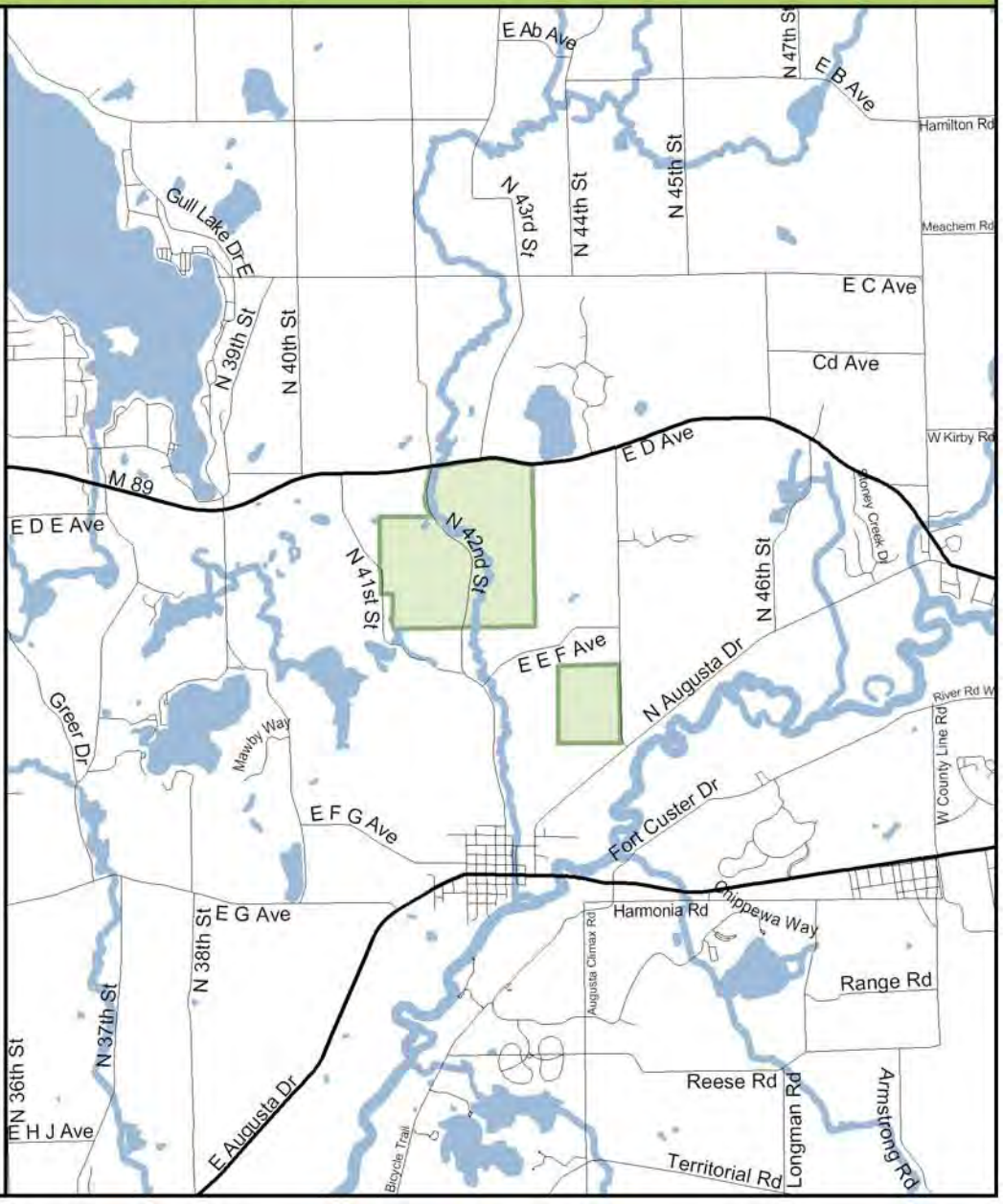
W.K. Kellogg Experimental Forest

Ross Township, Sections 21, 22, 27 and 28

Kalamazoo County

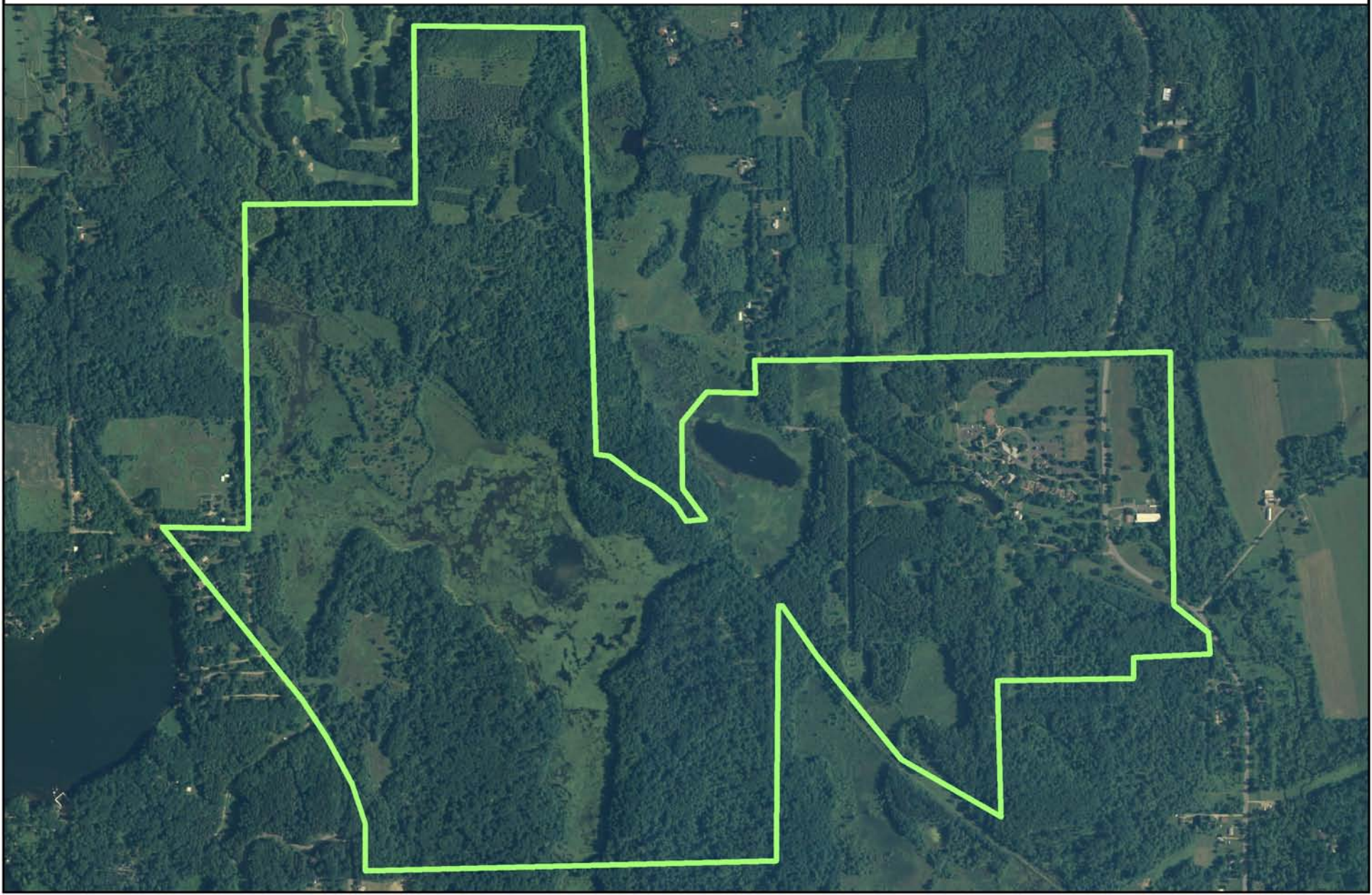


MSU Real Property



Brook Lodge
Kalamazoo County

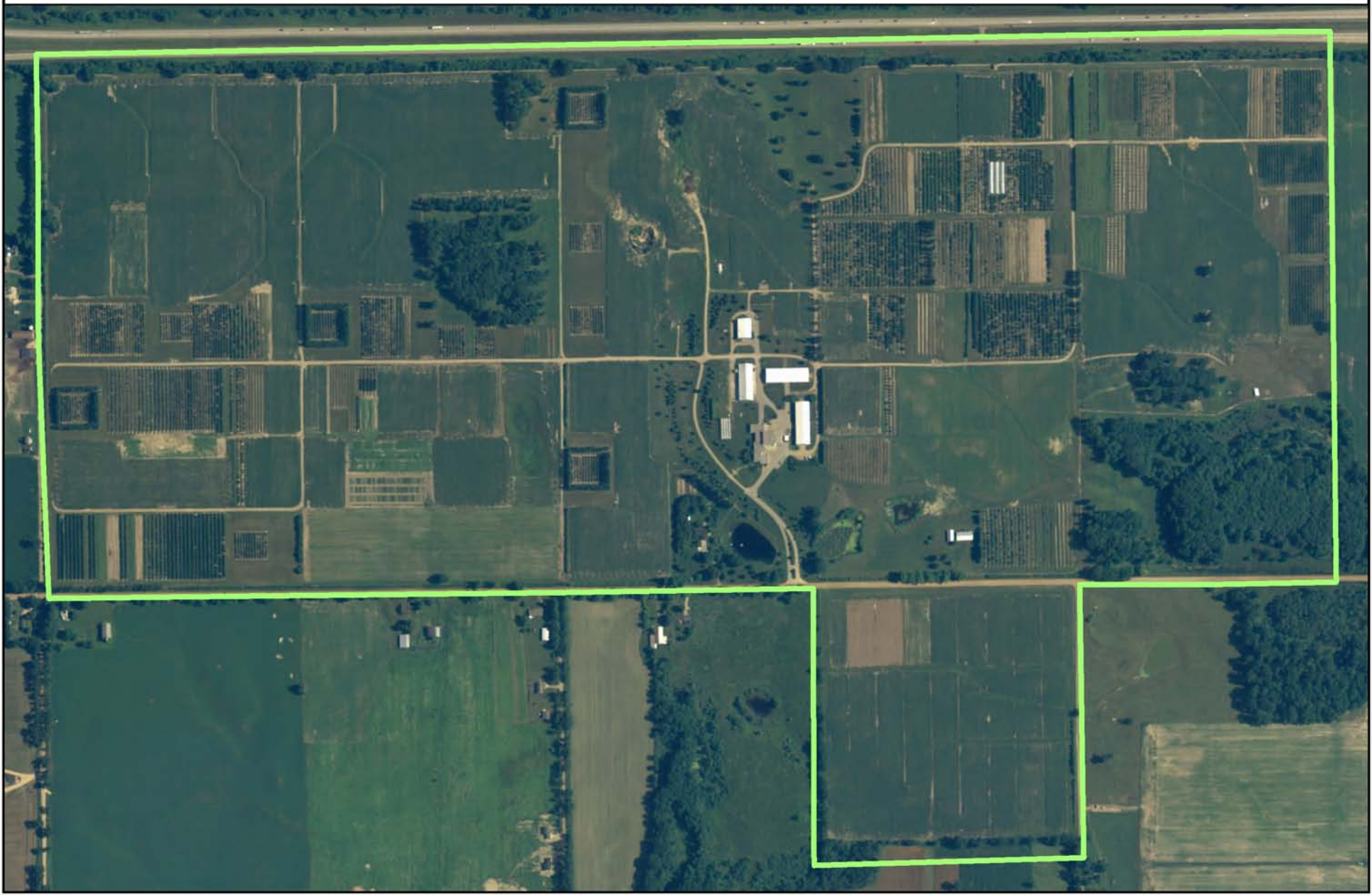
Image Year: 2005



Clarksville Horticultural Experiment Station

Ionia County

Image Year: 2005



College of Human Medicine

Kent County

Image Year: 2005

Dobie Road Property

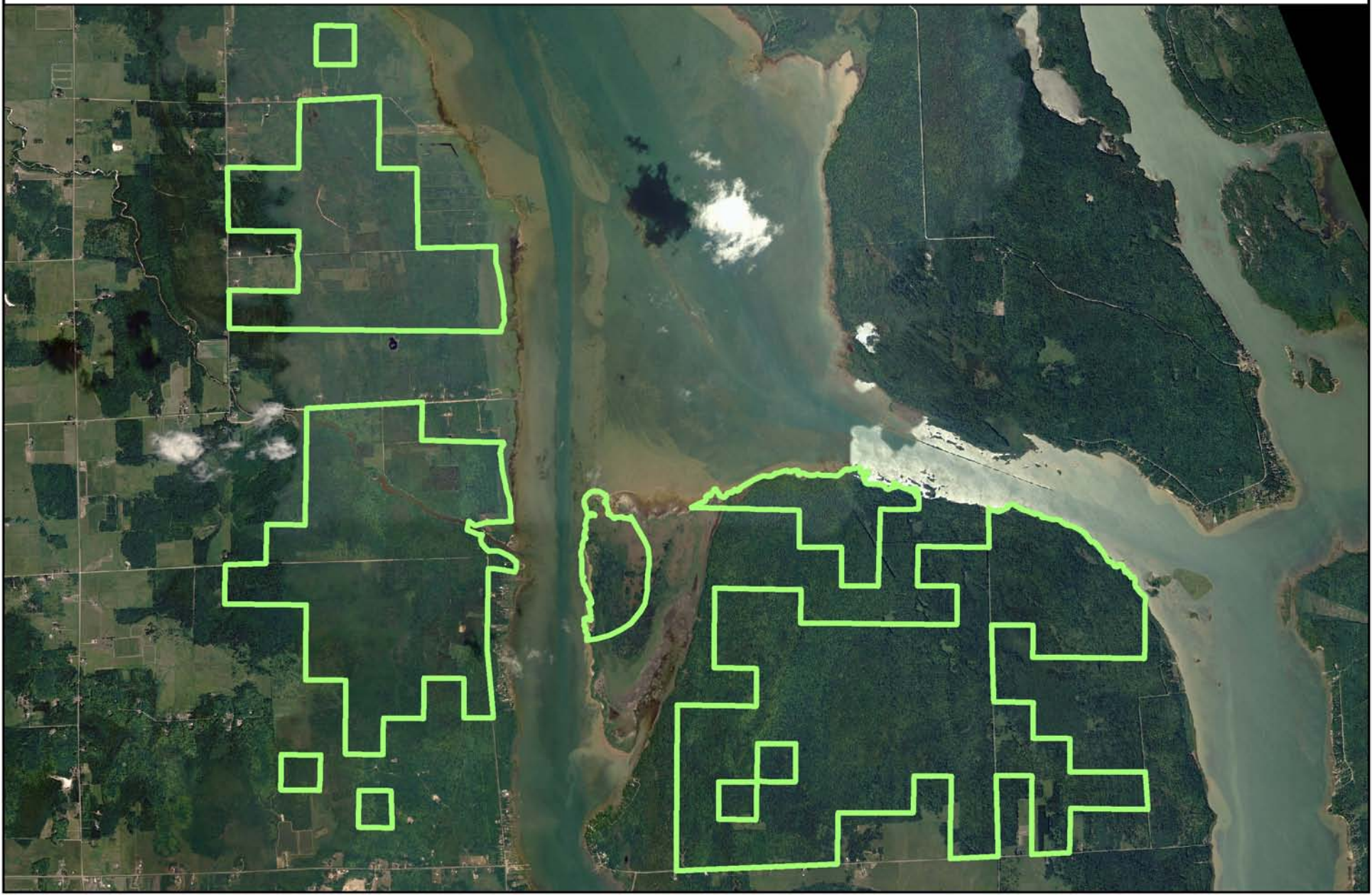
Ingham County

Image Year: 2005

Dunbar Forest Experiment Station

Chippewa County

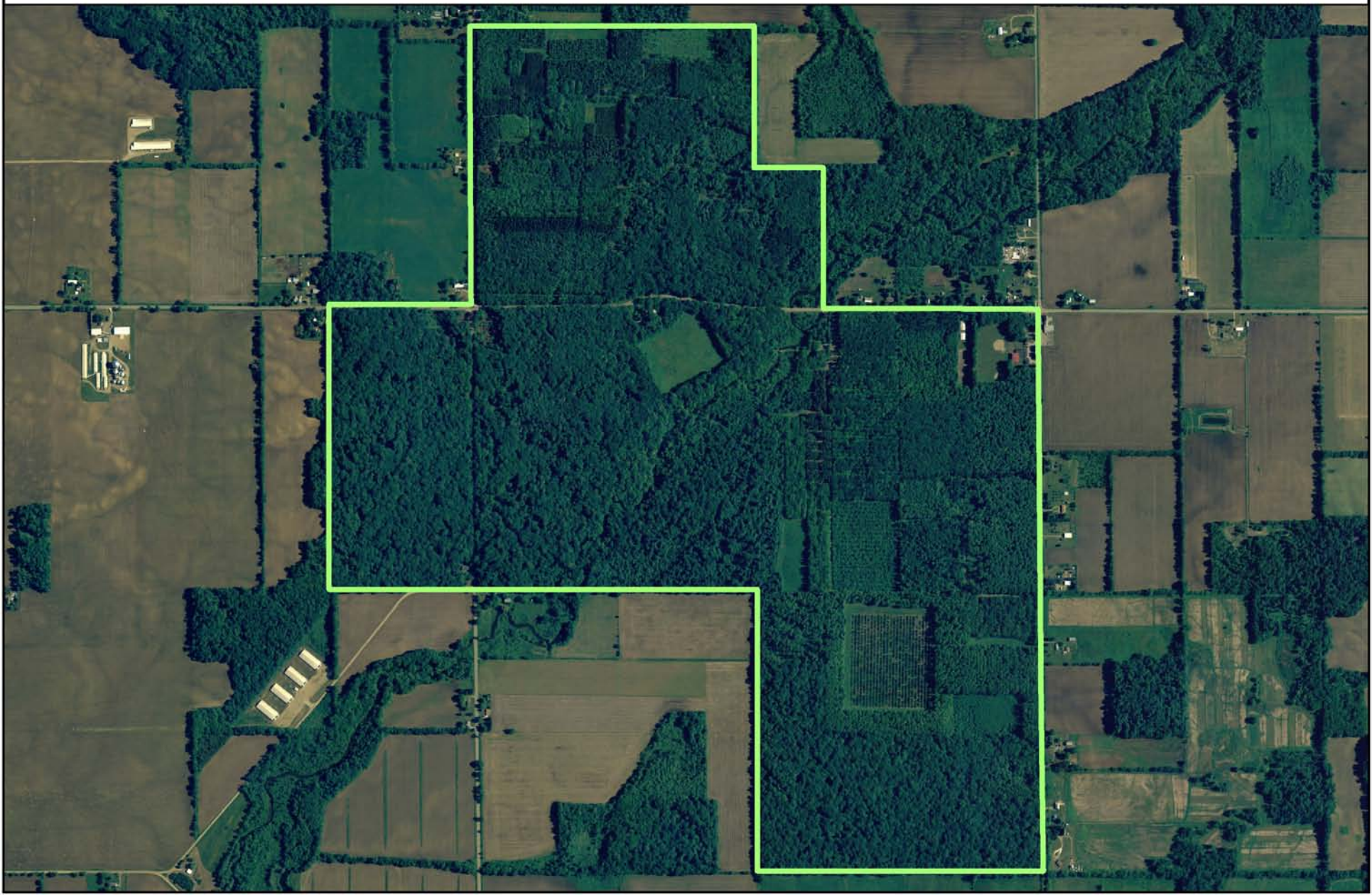
Image Year: 2005



Fred Russ Forest Experiment Station

Cass County

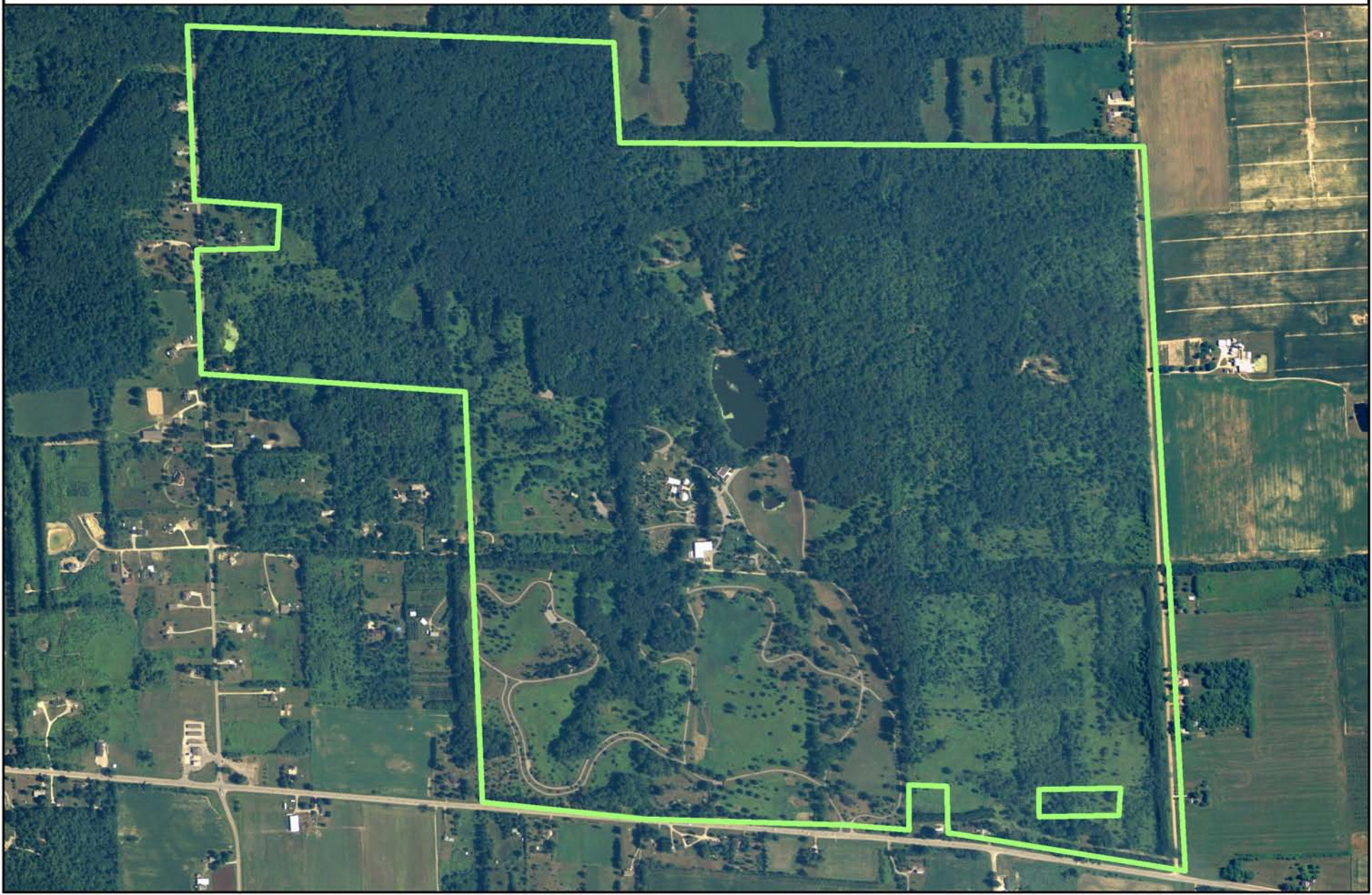
Image Year: 2005



Hidden Lake Gardens

Lenawee County

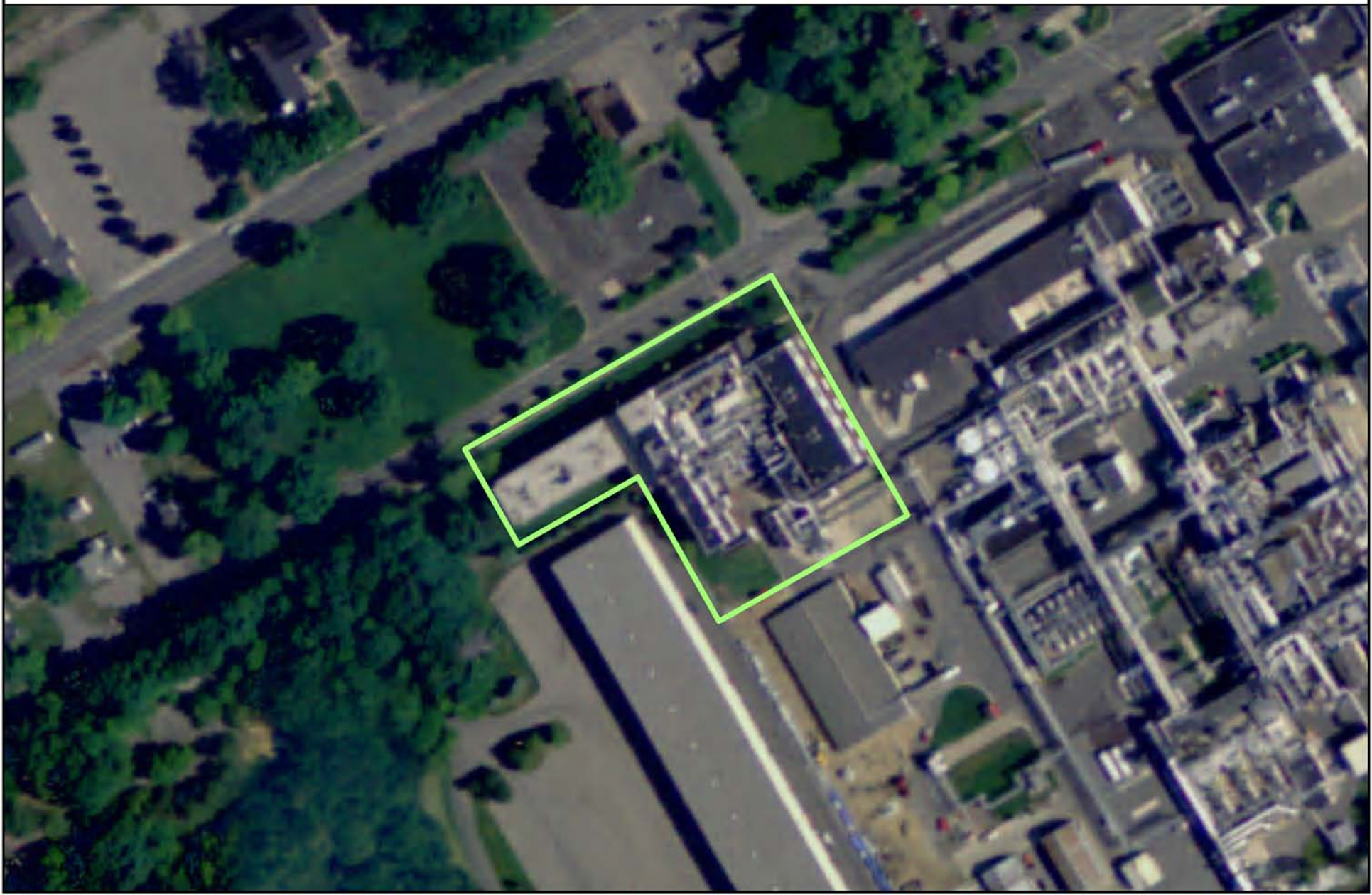
Image Year: 2005



Holland Pfizer Property

Ottawa County

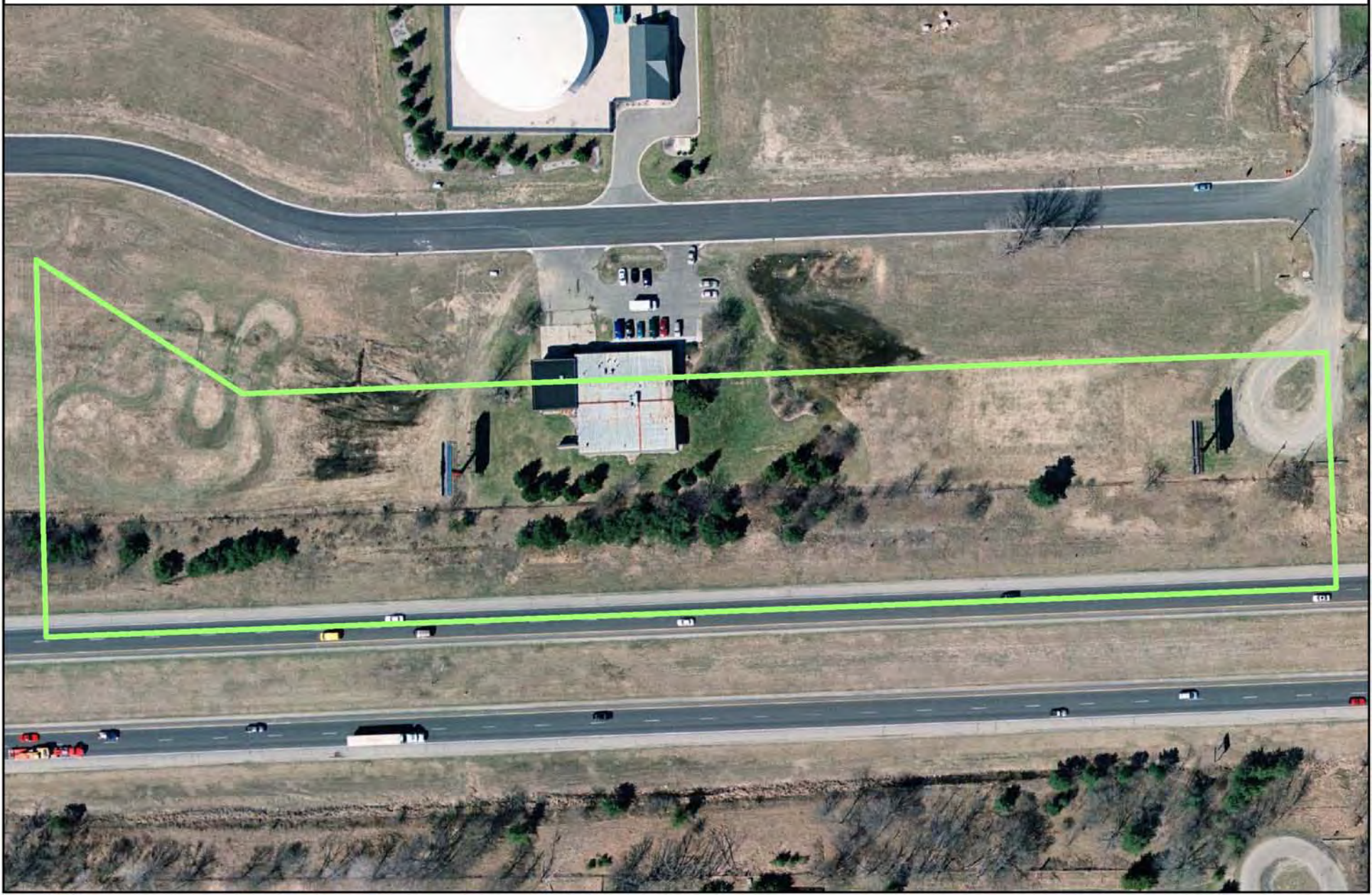
Image Year: 2005



Hulett Road Engineering

Ingham County

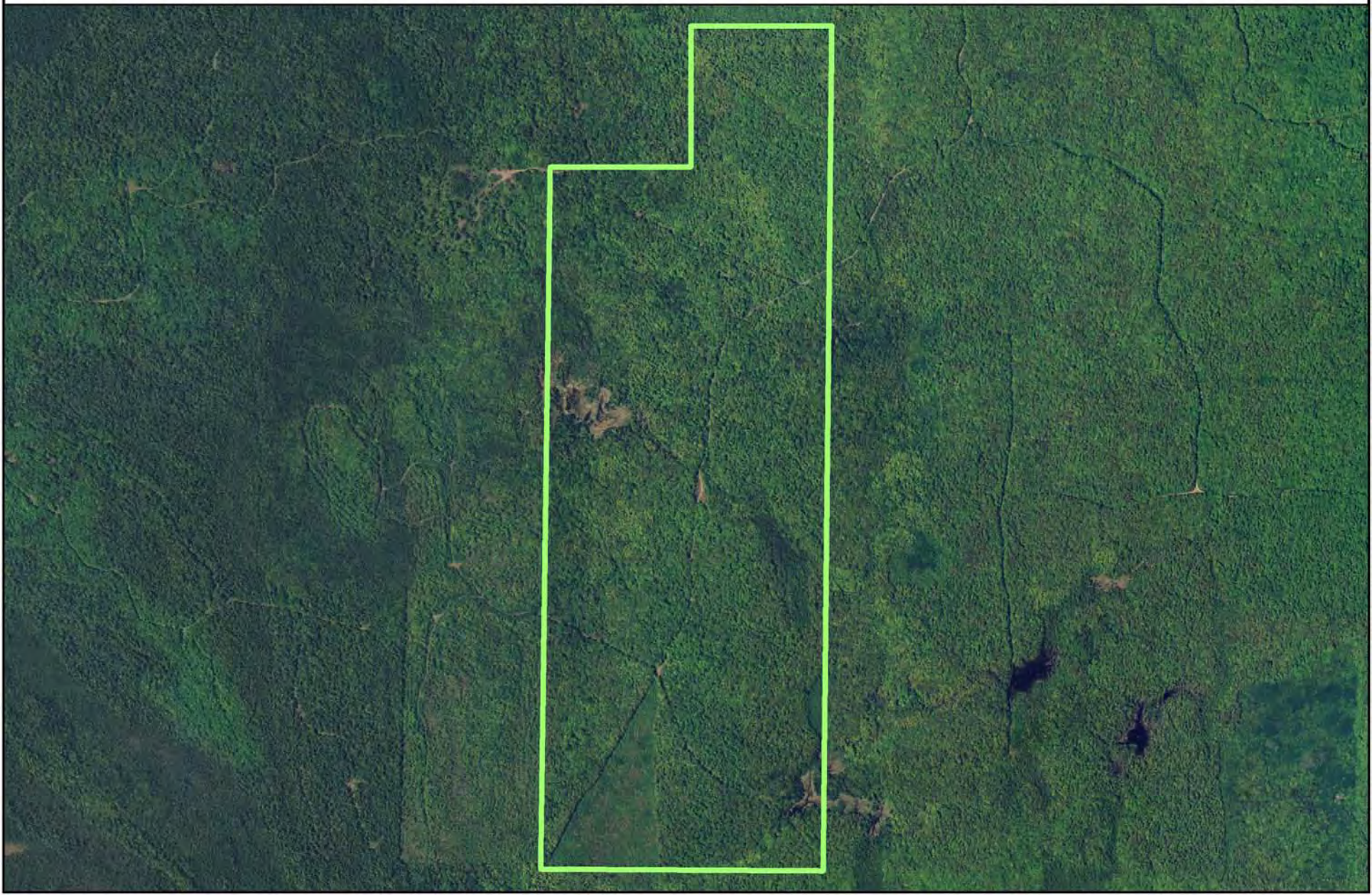
Image Year: 2005



Jim Wells Forest

Alger County

Image Year: 2005



Jolly Road Engineering and Civil Infrastructure Lab

Ingham County

Image Year: 2005

Kalamazoo Orchard

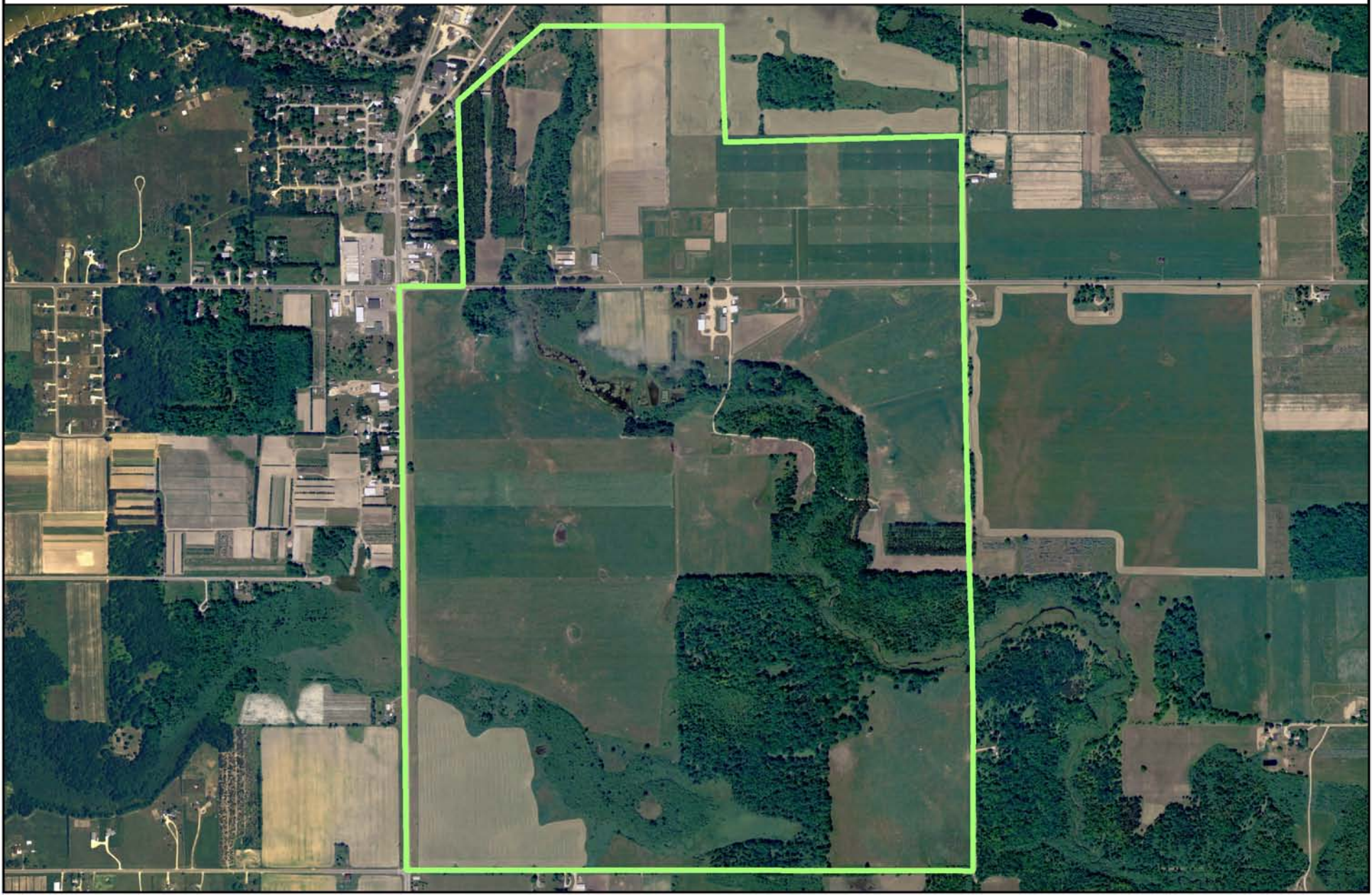
Kalamazoo County

Image Year: 2005

Lake City Experiment Station

Missaukee County

Image Year: 2005



Leland Property

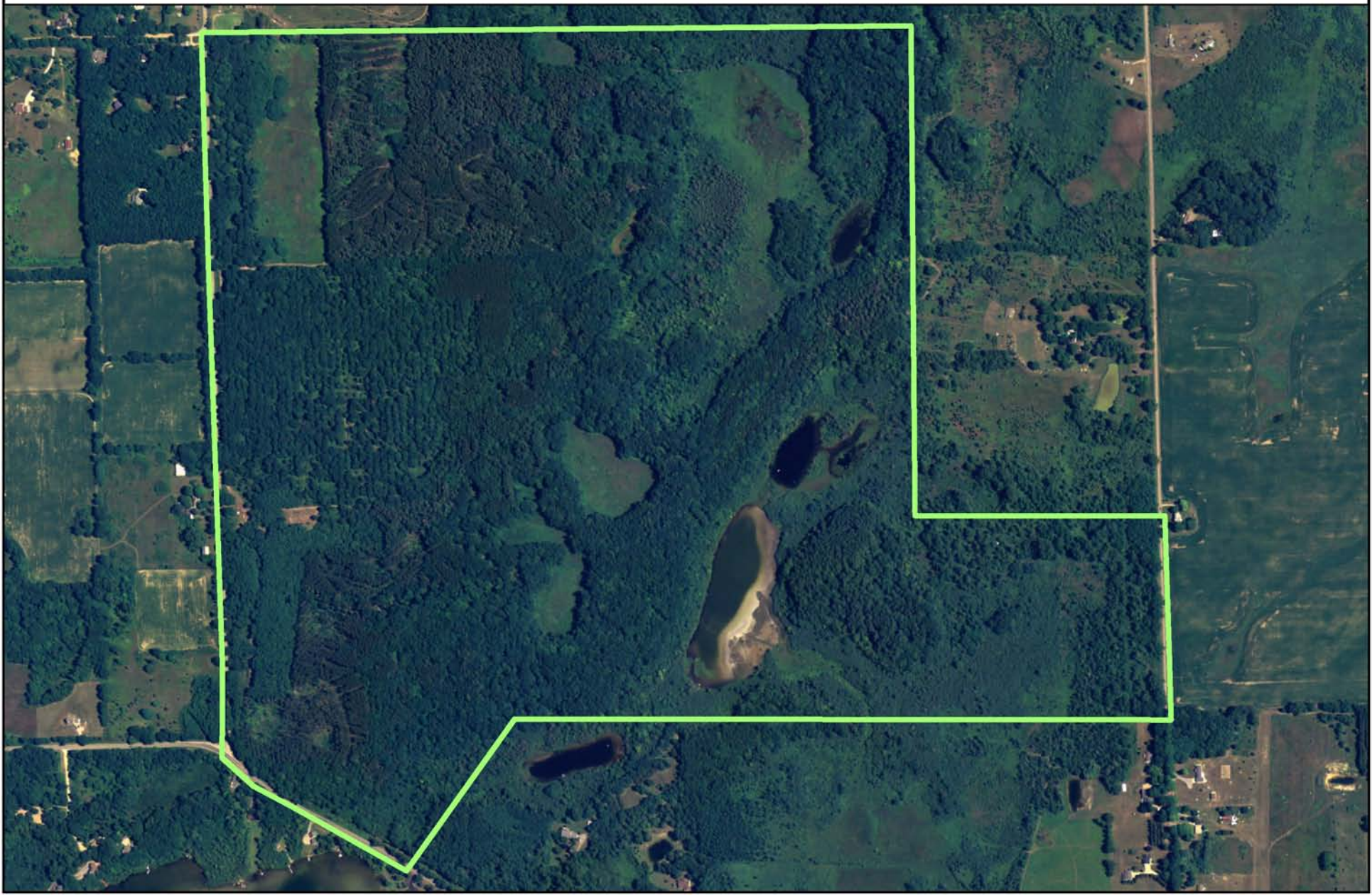
Leelanau County

Image Year: 2005

MacCready Reserve

Jackson County

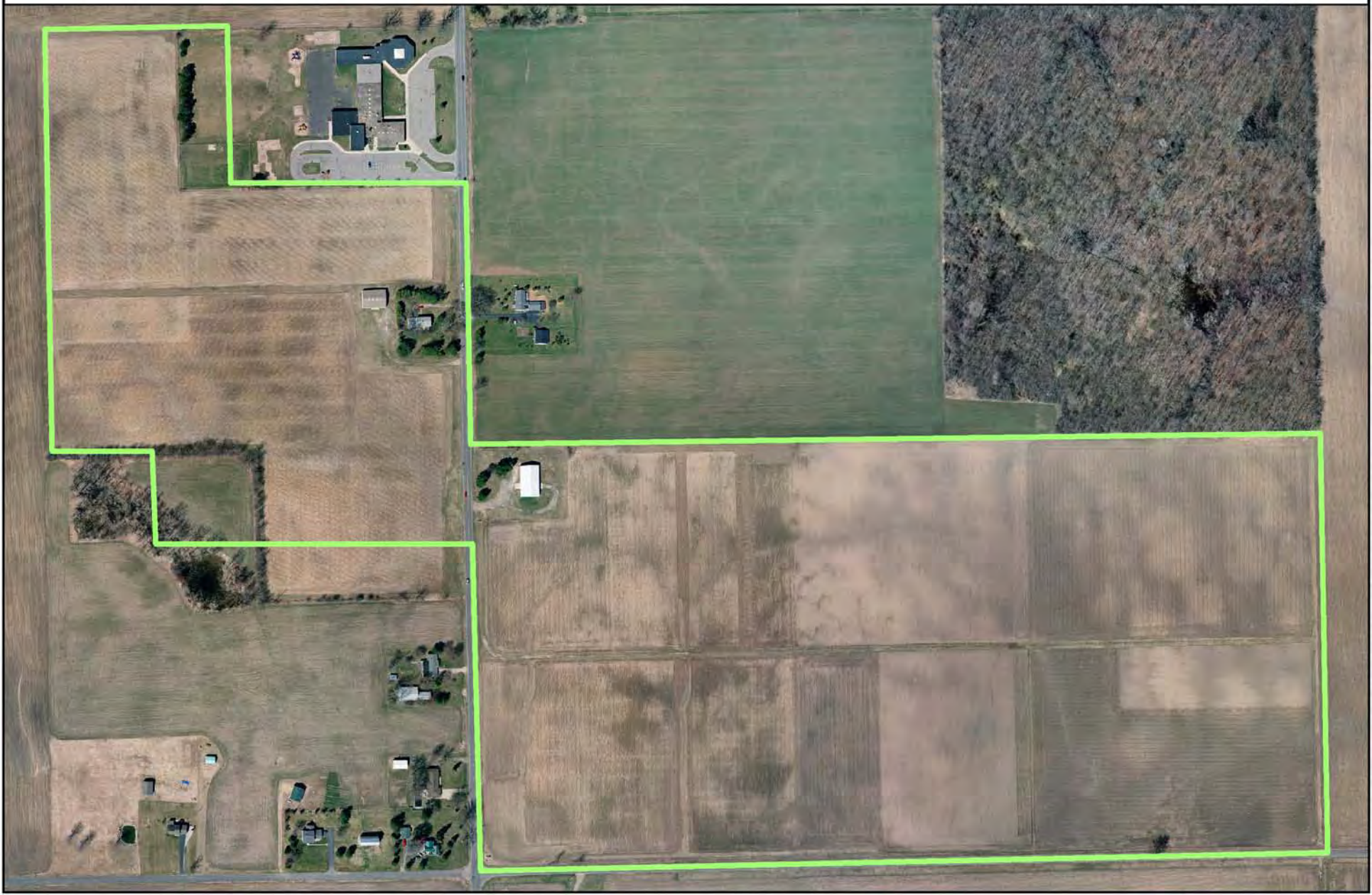
Image Year: 2005



Mason Research Farm

Ingham County

Image Year: 2005



Montcalm Research Farm

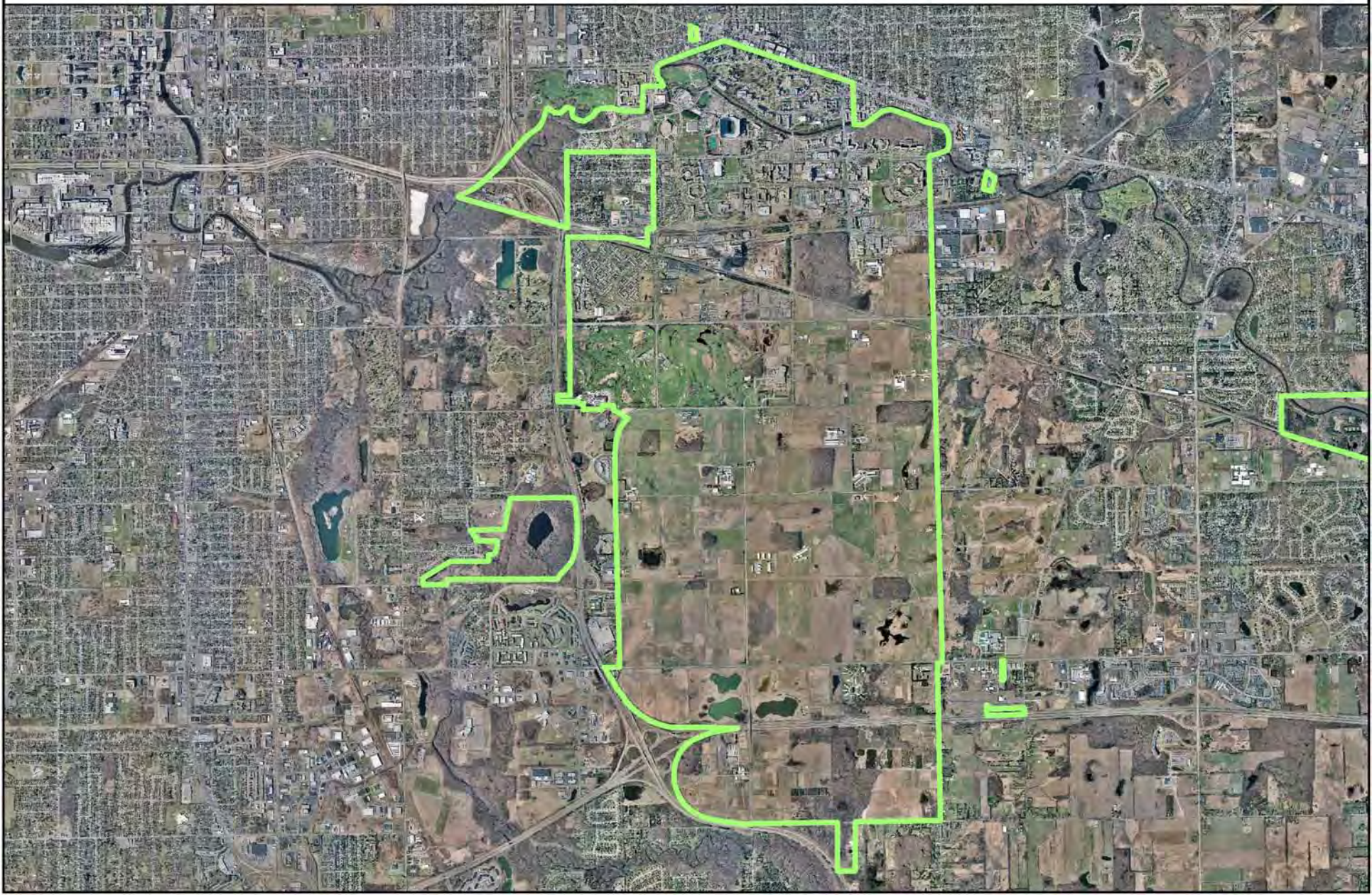
Montcalm County

Image Year: 2006

MSU Campus, East Lansing

Ingham County

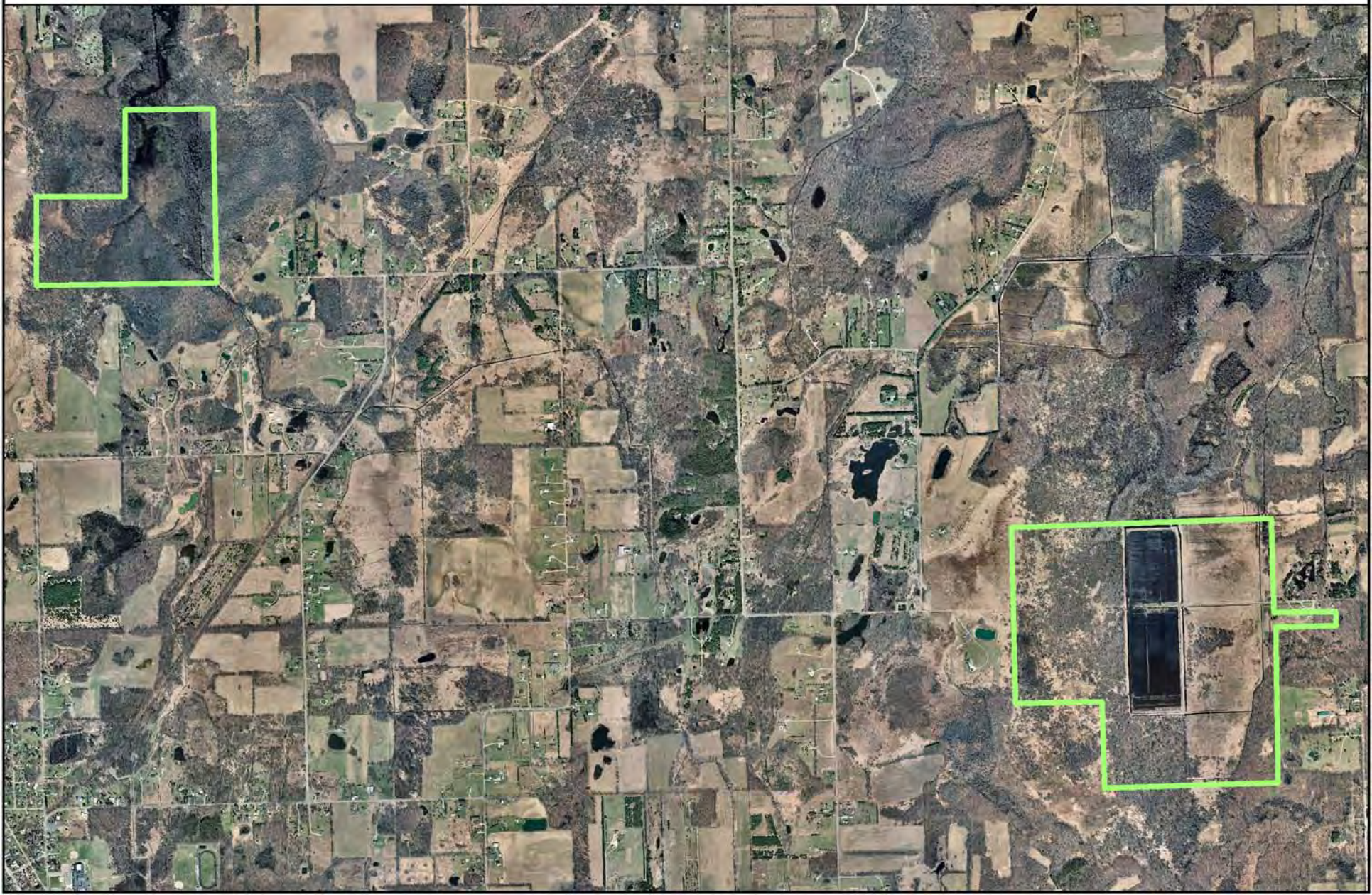
Image Year: 2005



Muck Soils Research Farm

Clinton County

Image Year: 2005



Northwest Michigan Horticultural Research Station

Leelanau County

Image Year: 2005

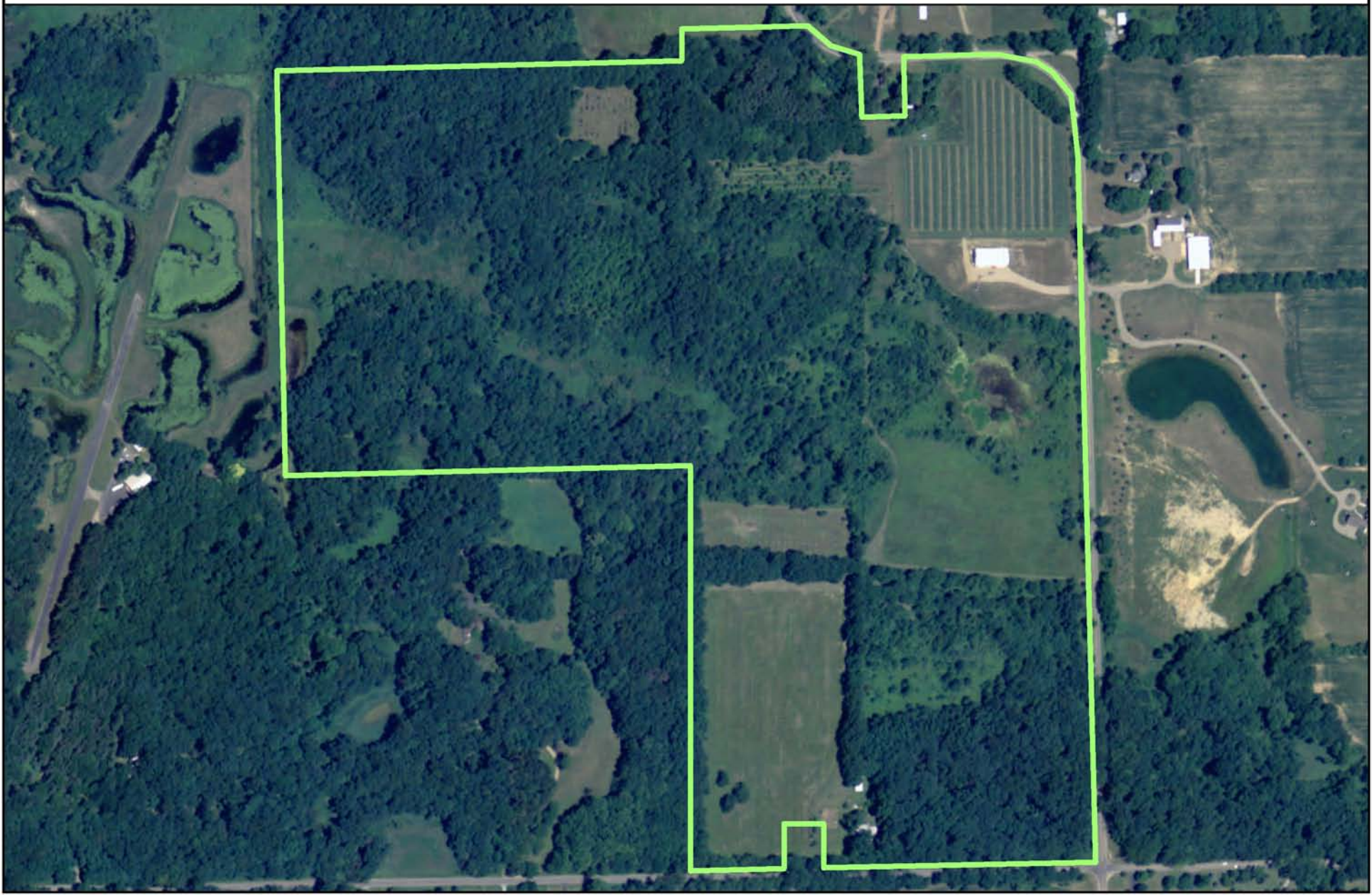
River Terrace Property

Ingham County

Image Year: 2005

Rogers Reserve
Jackson County

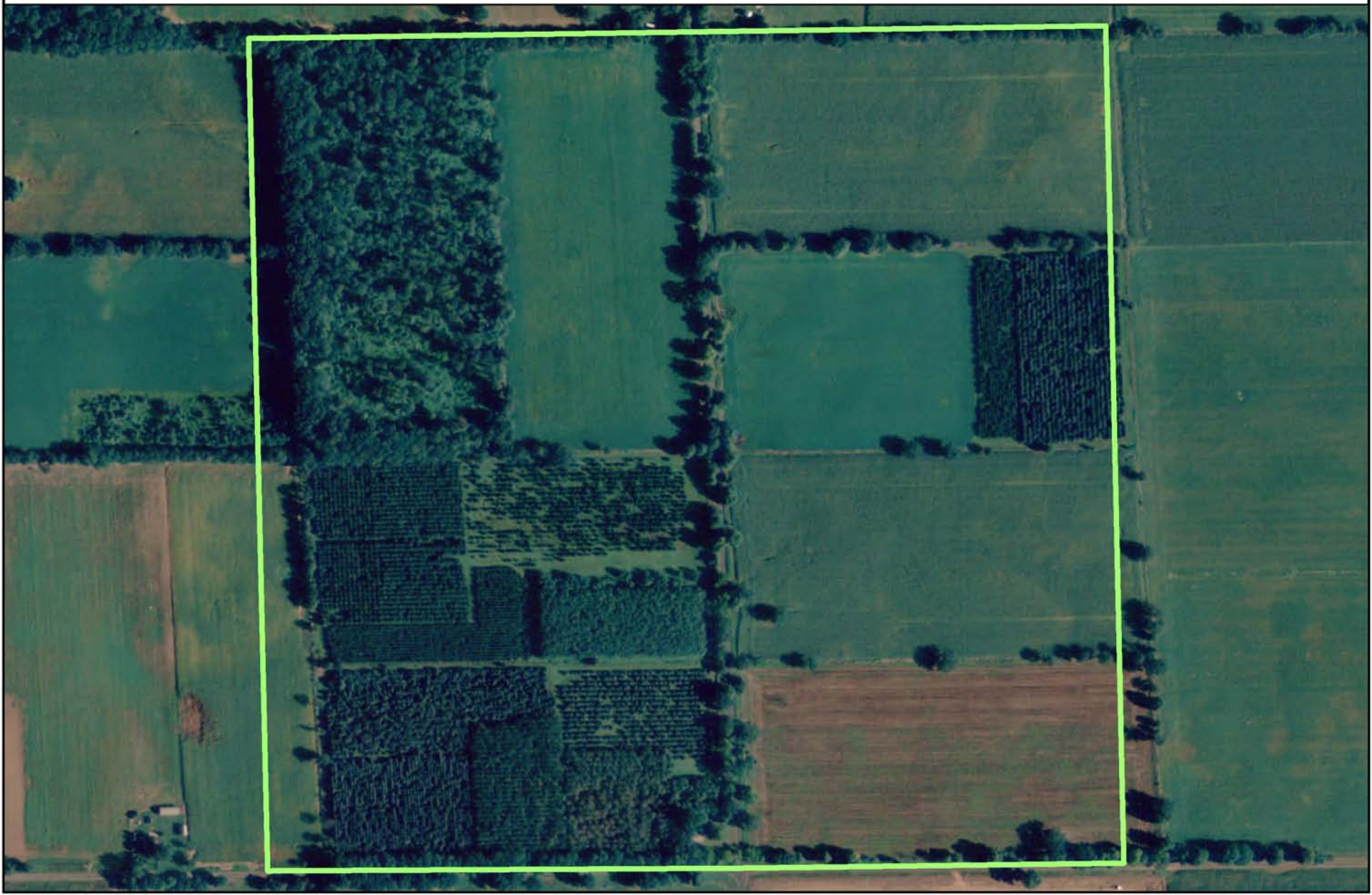
Image Year: 2005



Rose-Dell Seed Orchard Research Facility

Calhoun County

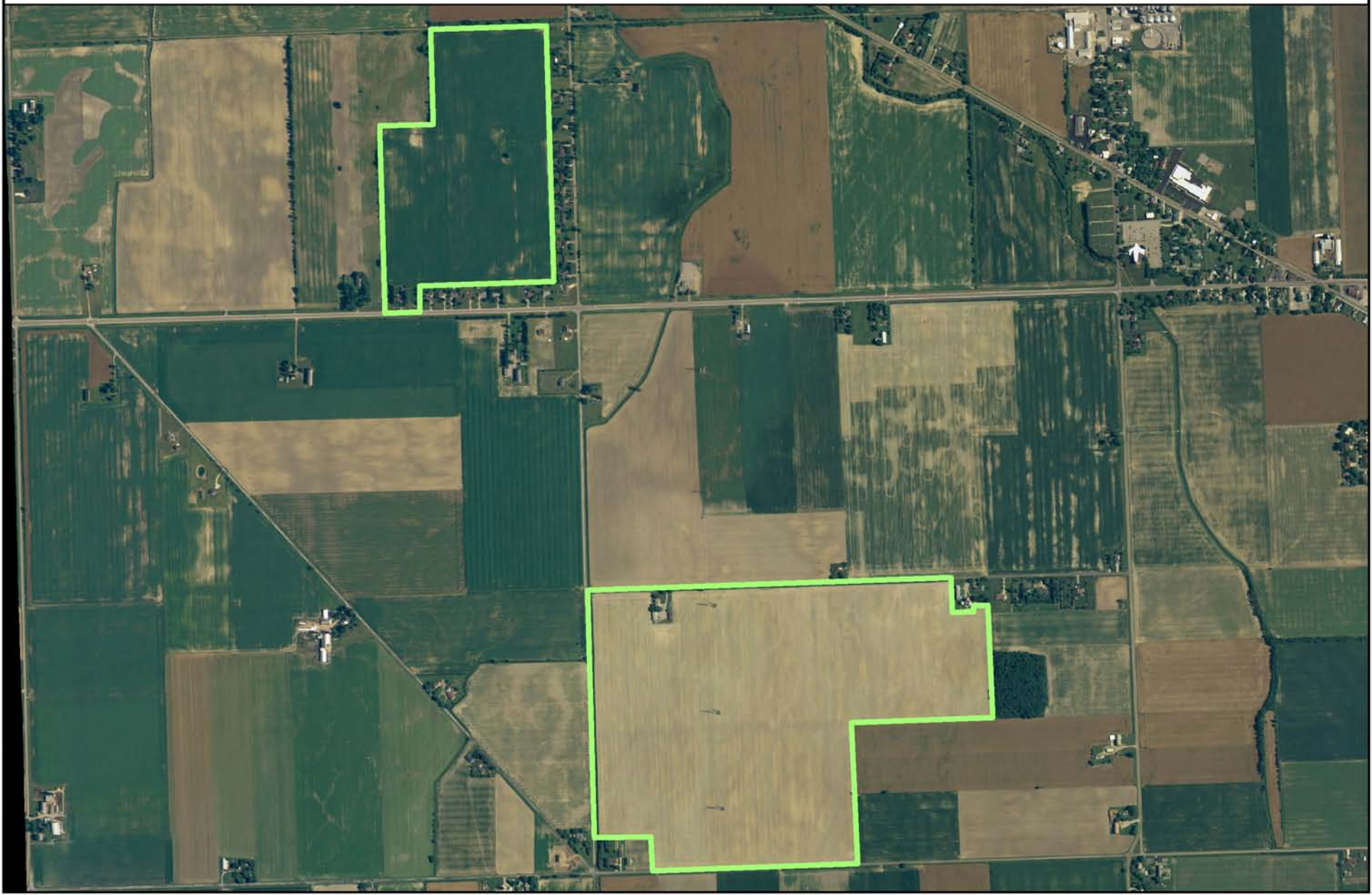
Image Year: 2005



Saginaw Valley Bean and Sugar Beet Research Farm (Leased)

Saginaw & Tuscola County

Image Year: 2005



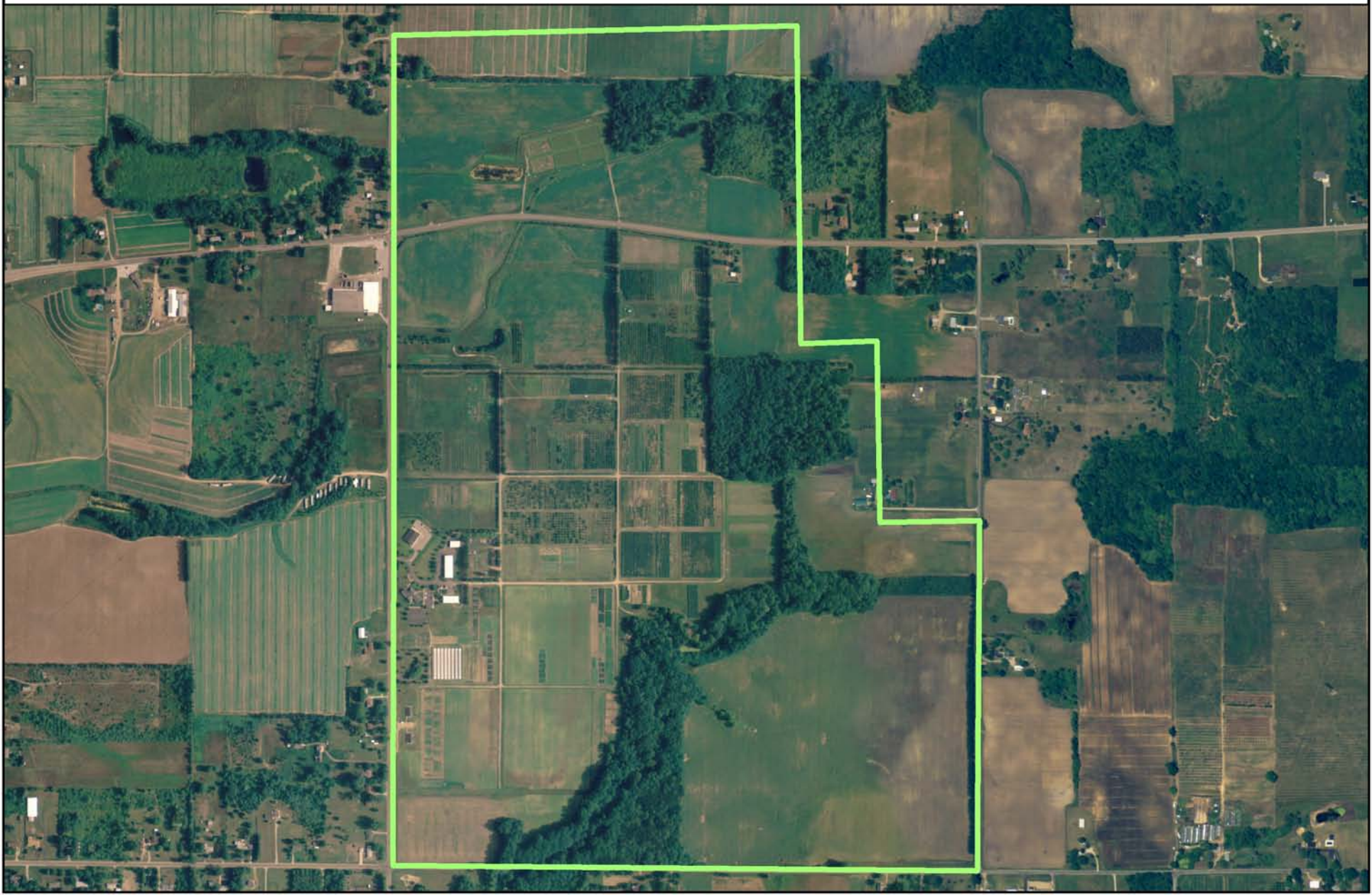
Sailing Club
Ingham County

Image Year: 2005

Southwest Michigan Research and Extension Center

Berrien County

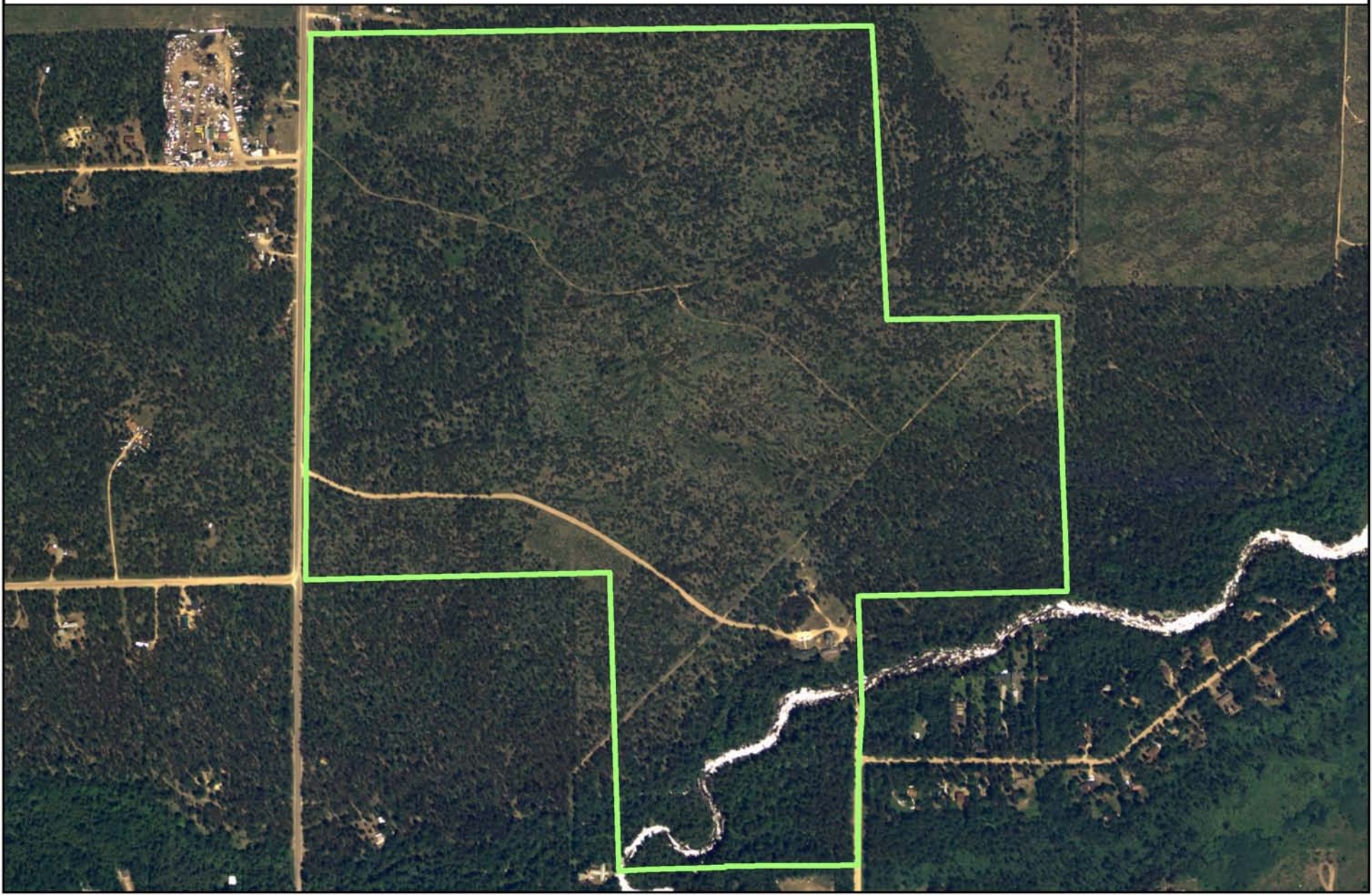
Image Year: 2005



Stranahan-Bell Property (Wa Wa Sum)

Crawford County

Image Year: 2005



Sycamore Creek Property

Ingham County

Image Year: 2005

Tollgate Education Center and Americana Foundation Property

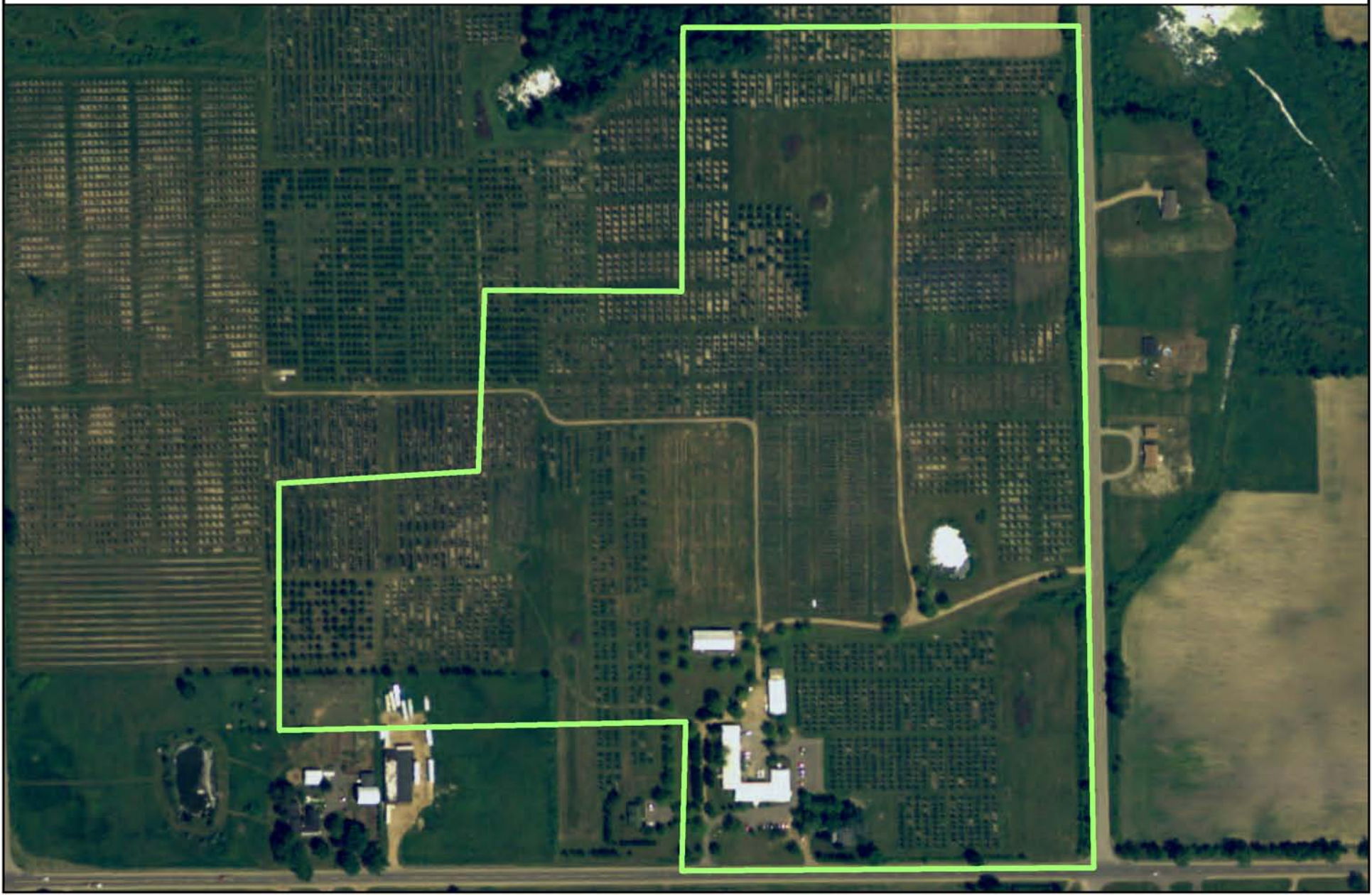
Oakland County

Image Year: 2005

Trevor Nichols Research Complex

Allegan County

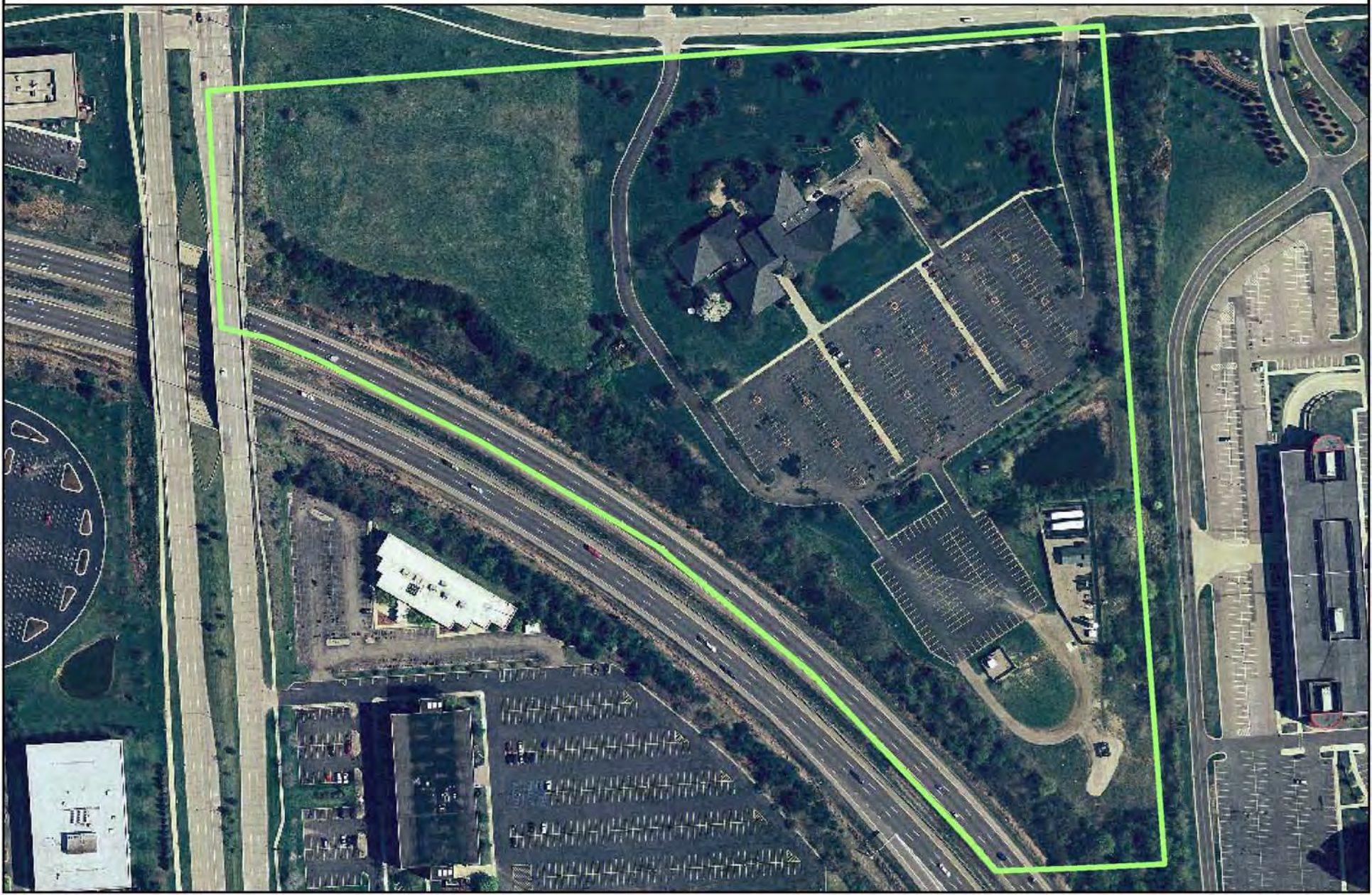
Image Year: 2005



Troy Management Education Center

Oakland County

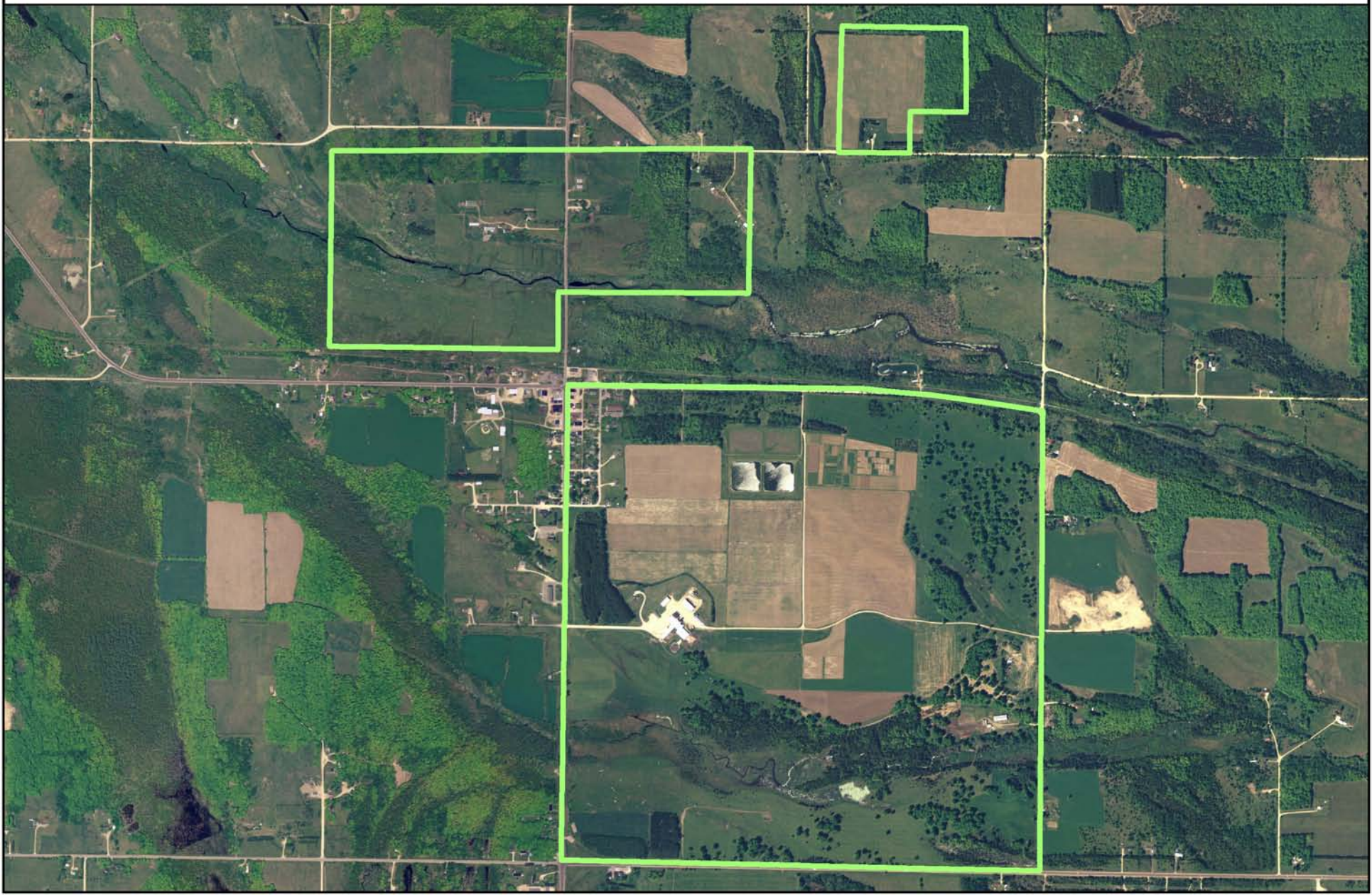
Image Year: 2005



Upper Peninsula Experiment Station

Alger County

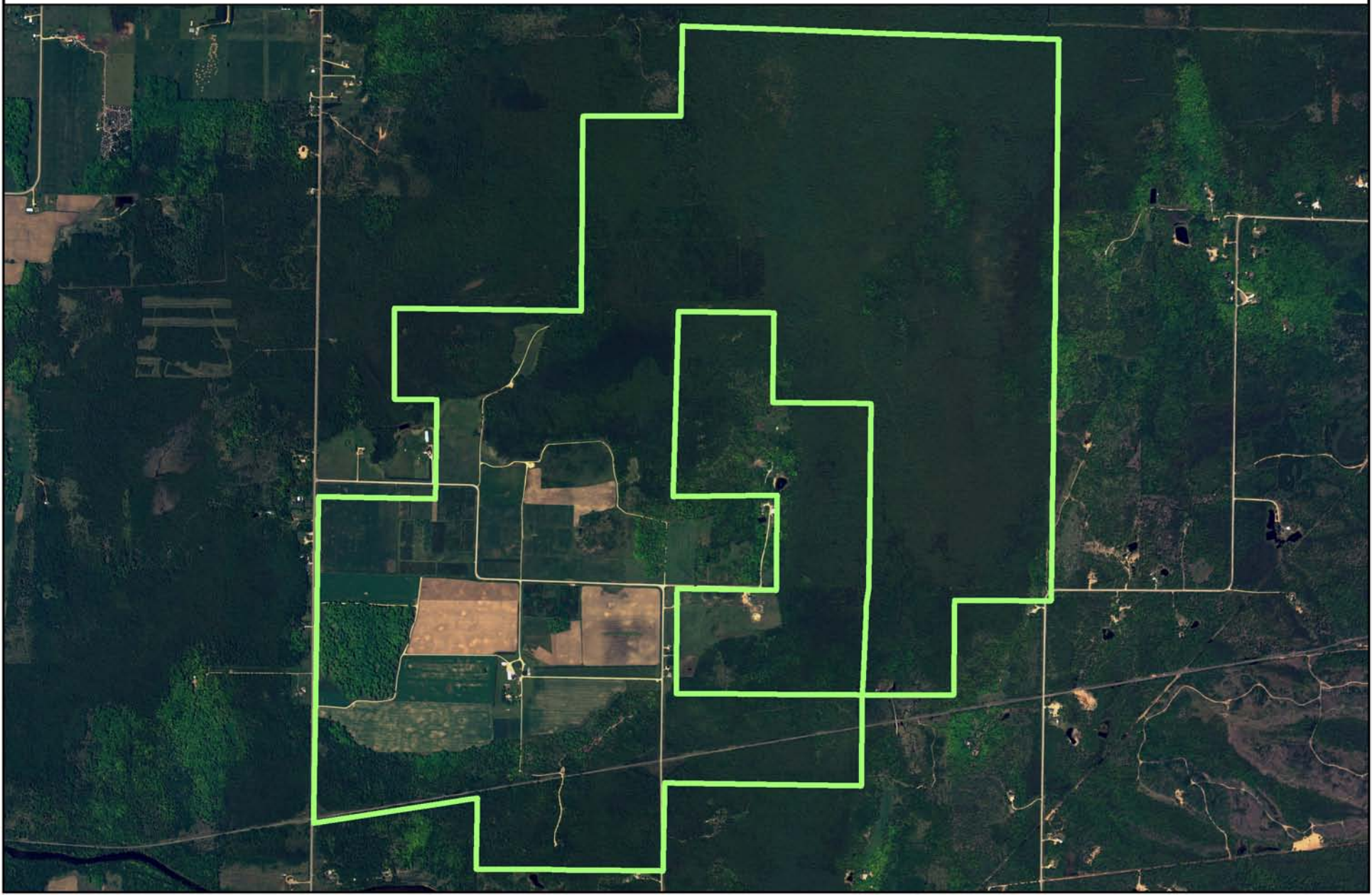
Image Year: 2005



Upper Peninsula Tree Improvement Center

Delta County

Image Year: 2005



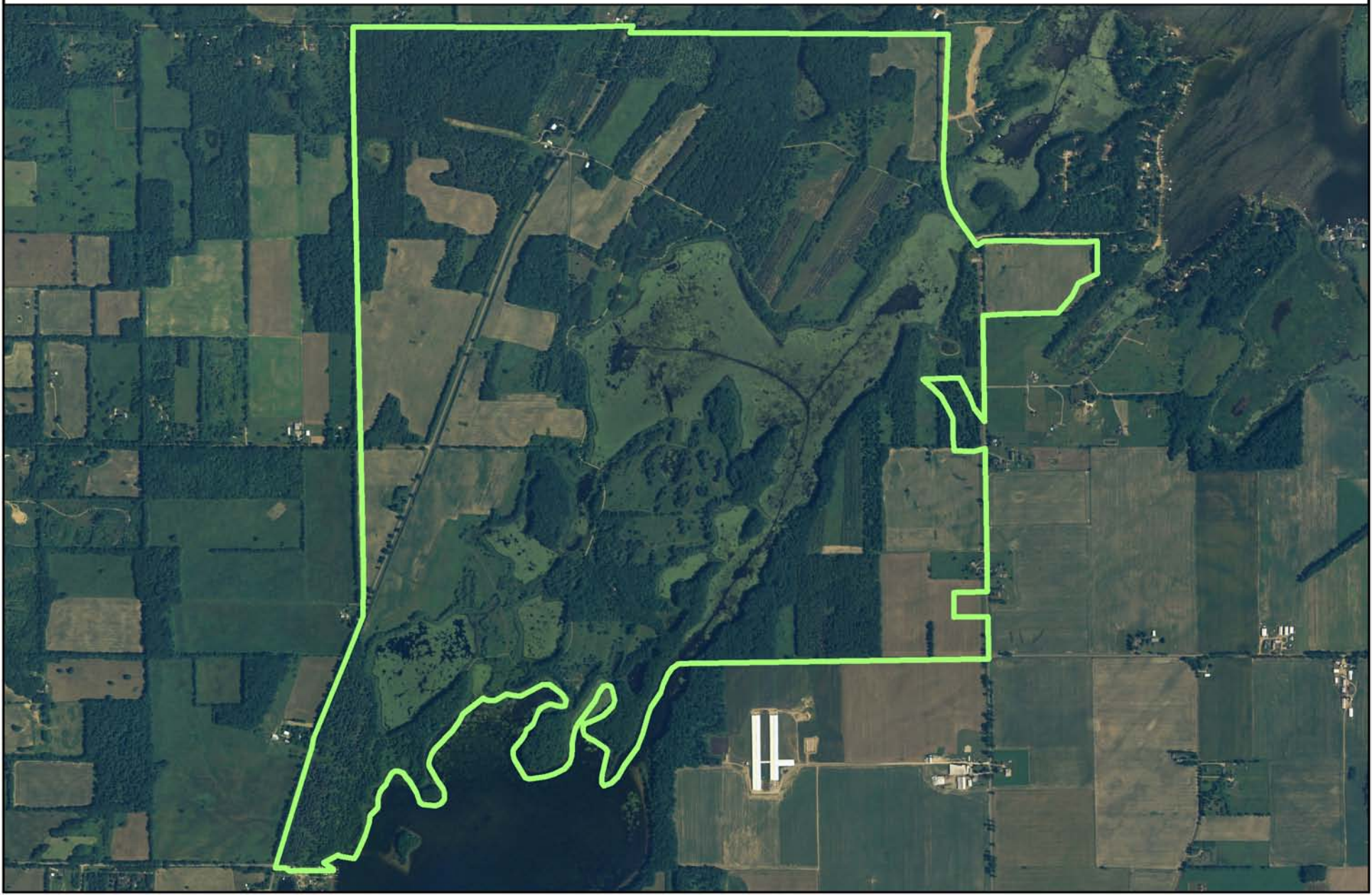
Van Hoosen Property
Oakland County

Image Year: 2005

W.K. Kellogg Biological Station (Lux Arbor Reserve)

Barry County

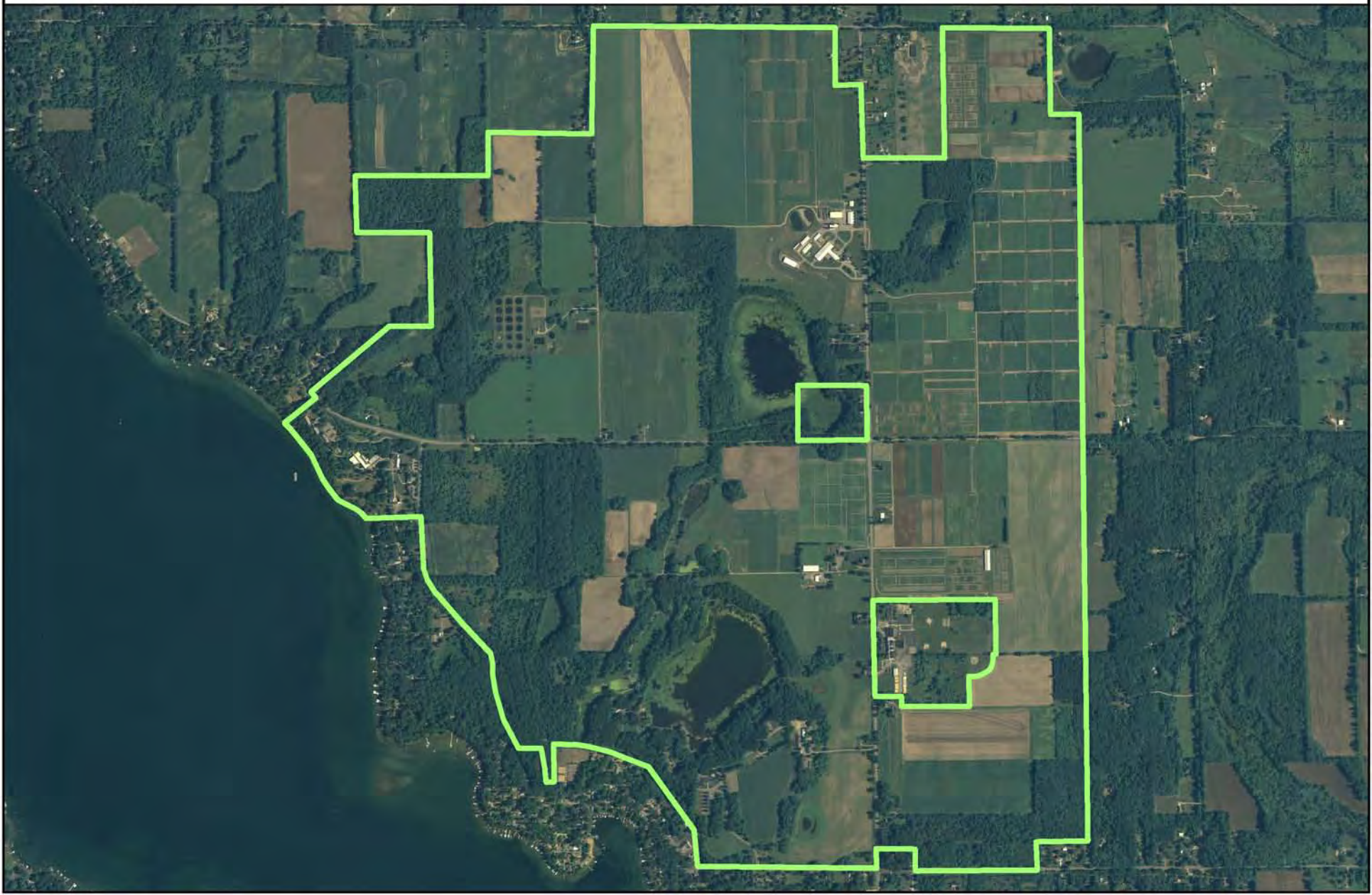
Image Year: 2005



W.K. Kellogg Biological Station, Bird Sanctuary, and Farm

Kalamazoo County

Image Year: 2005



W.K. Kellogg Experimental Forest

Kalamazoo County

Image Year: 2005