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THESIS
PLAN B OPTION

WRITTEN BY:
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MICHIGAN STATE UNIVERSITY
URBAN & REGIONAL PLANNING PROGRAM
MINE LAND RECLAMATION SPECIALIZATION

SPRING 1996

-PROJECT SITE-
SAND & GRAVEL OPERATION
OWNED AND OPERATED BY AMERICAN AGGREGATES CORPORATION

OXFORD, MICHIGAN

ABSTRACT

Aggregate mining is an essential activity in every urban metropolitan area. Most forms of growth and development require construction materials, which come from below the earth's surface. As a result of the history of the mining industry, all of its activities in general, have the image of being a negative impact on the environment. With proper planning and reclamation involved, there is potential for positive impacts to the environment.

Regulations on issues such as wetlands, erosion control, safety, and water quality, are apparent in the majority of aggregate mining operations, and thus, require operators to directly deal with each of them.

The site ~~for~~ on which this study is based ~~upon~~ is owned by American Aggregates Corporation, based in Dayton, Ohio. It is located in Oxford Township, Michigan and is 440+ acres. Oxford Township, which is part of Oakland County, has historically had heavy aggregate mining activity. As a result, Oxford Township has developed their own set of standards for issues such as reclamation.

The site is currently being mined and has approximately 15-20 years left at current market rate. This study will consist of two distinct operation and development plan options, with the significant difference being the type of equipment used. Reclamation procedures shown in a phasing sequence will be a part of both options.

Because mining activities involve taking material from the earth, mining companies are generally regarded as having no concern or forethought for the future of the mined property. This is not always the case. This study will show specific examples of how a mining operation can be used as a sculptor of the land. Mining operations, particularly aggregate, should be done in a sequence of phases, allowing reclamation to be completed as the operation progresses. This allows for the least amount of disturbed land and creates usable land before mining is complete. Because of the nature of mining activities, heavy earth moving equipment is already available and should be utilized in an efficient manner for reclamation. Overburden material has to be stripped and moved as part of the operation, and if planned, that material is what will be utilized to build usable land at minimal expense. This study will look at relevant regulatory issues, regional conditions for future land uses, and site characteristics to shape and develop an operational sequence of activities.

INTRODUCTION

INTRODUCTION

American Aggregates Corporation (AAC) is an aggregate mining company based out of Dayton, Ohio, but with some of its operations in the metropolitan Detroit area. The particular AAC operation for this study is a 440+ acre property just north of the Village of Oxford, in Oakland County, Michigan.

Oakland County has a very long history of sand & gravel mining. AAC has been a significant part of that history and would like to continue being a significance in its future. Because there has been such heavy mining activity in the county, and especially in Oxford Township, the township has developed its own set of standards for mining and reclamation issues. AAC has properties ranging from depleted reserves and ready for development, to actively mining, to virgin woodlands and farm fields. Because of all of the properties AAC owns in the area, it is extremely important that they develop and continue a good relationship with the community. The key to maintaining a good relationship for AAC and other mining companies, is to be responsible to the environment and to look at their operations, and properties in general, with a long-term vision in mind. This vision should include operation plans and sequences, reclamation plans, and potential post mine development plans.

This area of Michigan is continually growing in population, and thus, development follows. The mining industry has a unique situation. With any growing area, first there is a continual need for aggregate materials, and second, mined-out properties, which are diverse landscapes and water in many cases, are in high demand for development. If dealt with properly and following a long-range plan, AAC, as well as other mining companies, has an opportunity to extract sand & gravel, while at the same time, make the property more valuable.

AAC's Oxford property is currently being mined and has close to twenty years of reserve left. The operation has consisted of two pits, both dry bank, but there is potential for a wet operation. The processing plant is located on a separate, yet adjacent AAC property, just south of the active operation. A conveyor system is used to transport the material to the plant, but it will soon be replaced with a trucking operation, as a result of issues discussed later.

This study will consist of the following:

PART I

REGULATORY, ZONING, AND TOWNSHIP PLANNING ISSUES

Part I includes those issues related to sand & gravel mining operations such as wetlands, development, safety, water quality, drainage, erosion and sediment control, and zoning.

PART II

INVENTORY AND ANALYSIS

Part II includes both the regional setting in terms of growth and development patterns, and the site itself, in terms of surface conditions, the deposit, and the operations.

PART III

MINING AND RECLAMATION PROGRAM

Part III will include two distinct operation and reclamation plans, the major difference being the type of equipment used.

Also included in the study will be eleven drawings, which visualize the key components of the project. The goal of this study is to use a specific mining operation, with all of its supporting data, to show a visualization of how mining should be approached from a planning perspective and the potential rewards that can come about as a result. To achieve maximum efficiency, in terms of the life of the property, mining has to be approached in a broad, yet comprehensive manner.

It is not the goal of this study to determine the exact layout of the property twenty years down the road, but it is rather, to develop a procedure that will maximize the deposit resources and characteristics, while at the same time, demonstrate how utilizing that deposit most efficiently can lead to the development of very valuable land once mining is complete.

PART I

REGULATORY, ZONING, AND TOWNSHIP PLANNING ISSUES

PART I

In simple terms, mining is the extraction of natural materials below the earth's surface. Many mining companies have become very efficient at procedures of extraction, but mining, particularly aggregate mining has become much more complex than just the extraction of material. With a continual growth in population, and society's increasing awareness to the protection of its environment, regulations related to sand & gravel mining operations are becoming increasingly stringent.

Federal and state regulations specifically involving mining operations generally pertain to coal mining. Regulations for aggregate mining come from either the state, or in most cases, the local government. With this situation, there are inconsistencies that have to be dealt with, and thus, the permitting process becomes drawn out.

Along with zoning, there are other issues that can become related to sand & gravel mining depending on the specific situation. This section will deal with some of the key issues related to sand & gravel mining, and how they are regulated.

Wetland Protection and Development

Issues of wetland protection and development have become as significant as any in terms of our environment. It is also a very common issue in relation to sand & gravel mining, though not all operations. With population growth and development, much of our country's natural wetlands have been filled in or dredged out. This loss has also been, in part, a result of mining operations. But, the significant issue is that with mining operations, there is also the opportunity to build wetlands.

In terms of the federal government, the EPA and the Army Corps of Engineers set up the Clean Water Act, section 404, initially as a result of highway construction. Section 404 permits require mitigation, which the creation of new wetlands, or the restoration of existing wetlands to replace those that have been disturbed.

Michigan has a unique geology. Because of the Ice Age and the creation of the great lakes, Michigan was once almost entirely wetland. The majority of the wetlands have been lost to growth and development. To protect what remains, the state set up the Wetland Protection Act in 1979. Michigan is the only state that has been delegated wetland protection authority under section 404 because if its actions. The Wetland Protection Act is set up as a "no net loss" policy, which means mitigation is required where wetlands have been filled. In each case, a ratio of mitigated wetlands to disturbed natural wetlands is determined, and a permit is granted with condition that mitigation be done and followed through.

The State of Michigan Department of Natural Resources regulates wetlands on the basis of delineating wetlands in terms of vegetation, hydric soils, and standing water. A protected wetland is either five acres or larger, or contiguous to a water body, though the DNR can protect smaller ones if they feel necessary.

Wetland mitigation is a very significant and unique issue in terms of the mining industry. First, much like other activities, mining operations disturb wetlands if they are present of the property. But, what is unique to most other activities, is that, as a result of the nature of the operation and the geology, wetlands can also be created as part of the mining procedure. This brings about another related topic, which is mitigation banking. Wetlands can obviously be created where they have been disturbed. But, in some cases, wetlands may also be created where there were none before, as a result of the excavation. The issue in debate is whether or not mining companies should be given credit for created wetlands, where mitigation was not forced upon them. And, if no credit is granted, should they be regulated.

Michigan's wetland law is a very strong law, but the problem is that it is sporadically enforced. It is largely dependent on the general public being proactive and taking responsibility for their own actions. The mining industry needs to continue to pay special attention to the wetland issues because of its unique relationship to them.

Not only are wetlands a legal issue in terms of mining, but they are also aesthetic and functional. Both during active mining, as well as post mining, wetlands can offer a protective fringe around water bodies, they can offer flood protection, and they help water that can be too sterile by adding nutrients. Mined-out lakes can often times be very deep with little organic life, and wetlands at water's edge can improve the quality of it, as well as the groundwater. It will also encourage wildlife habitat and a more diverse ecosystem.

Land Development

Much of the cost of development is the property itself, the preparation of the land for a particular development, and the proximity of the land to a populated area. Sand & gravel mining operators have an ideal opportunity to not only maximize mining activities, but also develop their land to create valuable property. The key issue is that, from the beginning, long range plans should be a critical part of the mining process.

In many cases, operators own the land in which they mine. It is to their advantage to be responsible in how their land will be left when mining is complete, in order to capitalize on potential end-use opportunities. Second, with available equipment from mining activities, and because overburden materials have to be moved and stored as part of the mining process, operators have an opportunity to shape their own landscape at a minimal extra cost. And third, aggregate materials are very bulky and low cost. The expense is in transportation. As a result, sand & gravel mines are necessary to be located near populated, urban areas where construction materials are needed. This makes the post-mined land more valuable, being in close proximity to urban areas.

One of the opportunities that sand & gravel operators should take advantage of is that, many times they excavate material below water. These activities create lakes and wetland areas. Waterfront property has a very high demand, and there is no cost to dig the lakes, it is an operational cost. In shaping the land adjoining lakes, the key issue for operators is to make the land safe and usable. Generally, shapes need to be, at a minimum, a ratio of 3:1. Also, mining operations usually last for many years. In growing areas, changes take place and they cannot always be predicted. Long range plans for reclamation should not necessarily be designed for specific end-uses, but more for usable land.

When planning for the future, existing land uses, as well as land use plans developed by the community, should be considered, though not necessarily taken as final decisions. Because of the nature of the operation and the potential it brings for creative land development, viable options should be looked at. The best approach is to develop alternatives, including that which fits existing plans, and from those, work with the community to determine what is most desirable for all involved. In many cases, if a mining company works with a community, the existing operation will become the focal point to future developments because of the potential to shape it to the needs of that specific community.

WATER QUALITY

In many cases, the end result of aggregate mining operations, is a lake. Ground water levels vary, but sand & gravel deposits often extend below those levels, and the operations then expose the ground water. As long as the area is not a wetland, there are no direct regulations against creating a lake. However, water quality is a critical issue.

There are two possibilities that need to be addressed. First, there is contamination. With the exposure of groundwater, there is potential for contamination. To the general public, there is a natural perception that, with mining comes contamination. However, in terms of sand & gravel, it is a natural process. Material is just being dug out from the earth. There are no chemicals or other additives involved with the mining process. The only possibilities are through fuel and oil spills, or natural drainage of pollutants into the water. This potential has resulted in an upgrade in methods of fuel and oil containment and the awareness of its importance. With the potential value of waterfront property after the completion of mining, it only makes sense that mining companies would want to be proactive in preventing contamination.

The second issue that may arise is water being too sterile. If the deposit continues and the material is of quality, mined-out lakes can get to be very deep. These deep lakes stay very cold and thus have a very difficult time supporting plant life or wildlife. This then results in a very sterile lake. The creation of gentler slopes and/or wetlands at the edge of lakes, and diversity beneath the surface of lakes through overburden and plant material, can be methods of bringing nutrients to the water.

DRAINAGE

Sand & gravel mines can completely change the topography of the landscape. The critical issue is that, as a result of the mining operation, there shall be no change in the level of off-site drainage.

Because of increased concern over wetland issues, drainage often has to be a critical issue and can best be handled if long-range plans are in place. Drainage issues should not only be considered as preventative to problems, but also as tools to create wetlands.

EROSION & SEDIMENT CONTROL

Erosion and sediment control are directly related to drainage issues. Because of the steeper slopes created from sand and gravel pits, erosion can become a problem. To minimize erosion from drainage, one of the controls is seeding, or plant material in general. Seeding or various plant materials slow drainage, as well as spread it out. Retaining walls with material such as stone, brick, or wood can also be a method to control erosion. Most state and local mining permits require seeding of slopes at a minimum for erosion control.

In many sand & gravel operations, a flume or waste sand is produced as a non-salable product. As a result, it needs to be distributed. The most efficient method of disposing of the sand is to let if flow back into a water area as it comes out of the processing plant. It is not very feasible to use the sand as buildable land, but it can be useful for the creation of wetland or natural habitat areas.

As a state, Michigan has historically had a problem, and spent many tax dollars on the removal of sediment from its waters. Soil erosion is the removal or loss of soil by the action of water, ice, gravity, or wind. Sediment can become a pollutant if enough is built up to degrade the quality, interfere with uses, or destroy natural plant growth. Because of the significant changes in topography and the exposure of erodable material, mining operations can cause major erosion problems. Clay and topsoil act as binders and can be used like adhesive, while silt, and sand have much greater erodability.

In 1972, the Michigan Department of Natural Resources (MDNR), Bureau of water management, set up Act 347 of the Public Acts, called Soil Erosion and Sedimentation Control Act. The act was to set guidelines for those who change the earth, so as to control erosion and sedimentation issues.

Basic Principles of Act 347

The act for erosion and sedimentation control consists of five basic principles set by the state. **First**, disturbed areas should be kept as small as possible. If there is a long range plan for a mining operation, reclamation should be completed in succession with the mining and the exposed area will then be kept to a minimum. **Second**, disturbed areas should be stabilized and protected as soon as possible. This principle, again, stresses the importance of having an overall mining and reclamation plan from the beginning. The operator has to know, where material will come from to stabilize the disturbed area, and how to build the final landform in terms of a final plan.

Third, storm water runoff velocities should be kept low. **Fourth**, disturbed areas should be protected from storm water runoff. And **fifth**, sediment should be retained on site. With all of these principles, the only way to effectively achieve them is to understand the life of the project as much as possible, so as to develop a plan for the control of erosion and sediment.

There are various methods of stabilizing and protecting against erosion, and one of the advantages for mining operations is that those same activities are also controls for other issues. Plant material is a very effective control against erosion, particularly because it slows the velocity of runoff, as well as spreads it out. Operations also have other issues for plant material, such as screening, beautification, and increasing the value of the land. Because of this, the direct cost of erosion control is much less significant.

Enforcement

Enforcement is always one of the key issues in state-wide policies such as Act 347, because, first, without enforcement, the policy will not be followed effectively. And second, it is very difficult to have effective enforcement simply because the state does not have the resources available to cover every single site and set this up for each earth changer.

There are specific requirements before a permit to change the topography of a site is given. First, phase one requires maps showing a site inventory, and a preliminary site plan of the potential disturbed areas. Those maps will be reviewed by the state and approved before moving forward. And second, a design/engineer site plan will be submitted, showing the plan for the control of erosion and sediment. The permit will be granted once phase two has been approved.

Along with the plan requirements, site inspections will then continue for the remainder of the project. There will be scheduled inspections, generally once a year, as well as random inspections. It is a great advantage if the operator can develop a working relationship with the inspectors. When an operator demonstrates that they are intent on following their plan, there will be more flexibility in terms of being creative and trying new methods of control. If there is a working relationship, the possibility of changes to the plan, as a result of desired changes to mine plan, can be made much more informally and efficiently.

Counties and/or townships can enact their own policy towards erosion and sedimentation control, as long as they meet the requirements of the state, at a minimum.

Township Planning & Zoning Issues

The State of Michigan does not have any regulations for sand & gravel mining. They are enforced at the township or local level. Because of Oxford Township's long history of mining activity, a fairly extensive program has been set up. One of the problems with local authority is the inconsistency in enforcement. A township is allowed to set their own requirements for a mining operation, however, if those requirements are unreasonable or inconsistent with others in the same township, the mining company has a right to take legal action.

Those operations that have been around before Oxford Township set their program up, have a grandfather clause allowing them to continue to operate. Any new areas need to follow set guidelines. For a new operation or a rezoning, the following information must be provided by the operator. First, is the location and size of the site. Second, is a general description of the extraction material, processing plant, and equipment to be used. Third, is the estimated time for the life of the operation, and finally, a plan of reclamation. Reclamation plans can be done at a variety of levels, but the more time spent planning, the more efficient the operation will be.

Some of the other issues that the township determines for each operation are: setback limits, screening with earth berms and vegetation, dust control, truck haul routes and possibly the number of trucks per day, and standards for reclamation. The standards for reclamation will include sloping, planting of vegetation, removal of equipment and structures upon completion, and timing considerations.

In terms of mining and zoning issues, Oxford Township is ahead of many others simply because they have had continual activity for many years. The township has set up a Gravel and Sand Overlay District, which allows the extraction of the aggregate, and upon completion of the operation, the property will automatically be changed to a different zoning code. The classification for the AAC's Oxford property upon completion of mining is Suburban Farm, which is single-family five acre lots.

The Gravel and Sand Overlay District first sets up the permitted principle uses, as well as the special land uses allowable in the district. The permitted principle uses include: mining sand, gravel, and/or stone; processing and transportation of that material, along the necessary buildings and structures; storage and stockpiling of the mined material; and, outdoor recreational uses. The allowable special land uses include: private aircraft landing strips; temporary, open-air uses of an industrial character; shooting ranges and gun clubs; and, yard waste composting facilities.

Oxford Township has set standards for mining and reclamation. First, in terms of operations, the following will be a summary of the critical issues and how they relate to the AAC site.

1. Setbacks are set at 50' from abutting property lines, and 75' from a Right-of-way of an adjacent road. There is also a 150' setback for any buildings or structures from an abutting property line. The township reserves the right to increase or decrease these limits where they deem necessary. These circumstances would potentially involve meeting up with existing elevations, or a special circumstance with a particular abutting land use.

2. All active excavation shall be screened from the view of an adjoining residential district. That can be done either with a earth berm, being at least six feet in height at its center from the elevation of the property line, or the screen can be built with coniferous plant material, having a minimum caliper of three inches. All constructed berms must be planted with seed, trees, and similar vegetation. Tree screens shall be planted using a staggering of rows to ensure significant coverage. The significant residential district near the AAC site is to its north. There is currently a natural tree screen that has not been disturbed along the north property line, and the operation plan will show where alternate berms will be created, both in terms of screening from the major transportation route, and in terms of storage of overburden.

3. If public roads are to be used as haul roads, first, they have to get approval, and second, they have to be maintained. The main haul road leaving the AAC property is Dunlap Rd., which is public, and it is also a gravel road. Dunlap Rd. is continually graded and maintained for proper drainage. There may be alternate haul routes in the future and if so, considerations such as truck and/or tire washers may be necessary.

4. Upon completion of excavation, the site shall be reclaimed to standards set by the township, and all operations equipment and structures shall be removed from the site and not buried.

<u>Standards for Reclamation</u>

1. The banks of all sand & gravel operations shall not be less than 3:1 slope, and in areas excavated to permanent water bodies the 3:1 slope shall continue to the five foot below the low water mark.

2. Vegetation shall be restored with the use of sufficient soil and overburden, and adequate seeding. The vegetation shall consist of grasses, trees, and shrubs, and should cover all of the mined areas except that which is submerged under water.

3. Upon completion of mining, rehabilitation shall begin and all equipment and structures shall be removed within one year. Rehabilitation shall be completed within two years. The completed rehabilitation shall be consistent with the approved reclamation plan. The township can extend the time-frame for reclamation in necessary circumstances.

Also a part of the mining permit process is a bond requirement. Each operation is required to put up a bond that would financially cover rehabilitation of the total disturbed area in the case where the operator left the site without reclaiming. The township sets the amount of the bond, though it can be very beneficial for the operator to do a cost estimate so as to only put up the necessary amount.

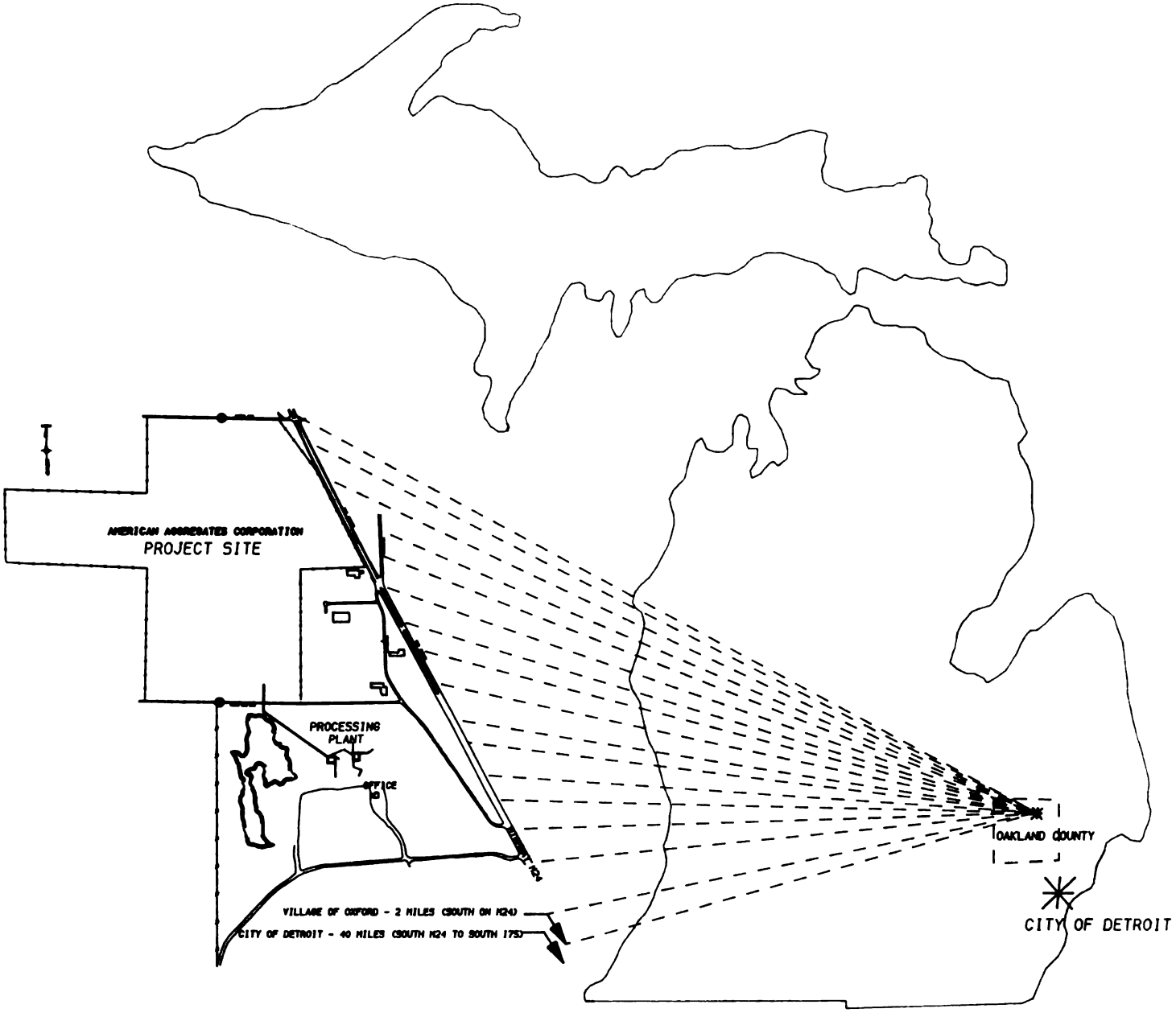
With the growth trends as they are and the length of time before mining is complete for AAC, reclamation plans should not necessarily follow the Suburban Farms (5-acre lots) classification for potential end use. First of all, the property, with its lakes, will be very valuable, and second, the zoning may change again within the life of the operation. Long range reclamation and development plans should be designed for the optimum end use for its particular setting, with the idea that things may change, and they should make sense, in terms of efficiency in the movement of overburden.

PART II

INVENTORY AND ANALYSIS

REGIONAL MAP

AMERICAN AGGREGATES CORPORATION - OXFORD, MICHIGAN



PART II

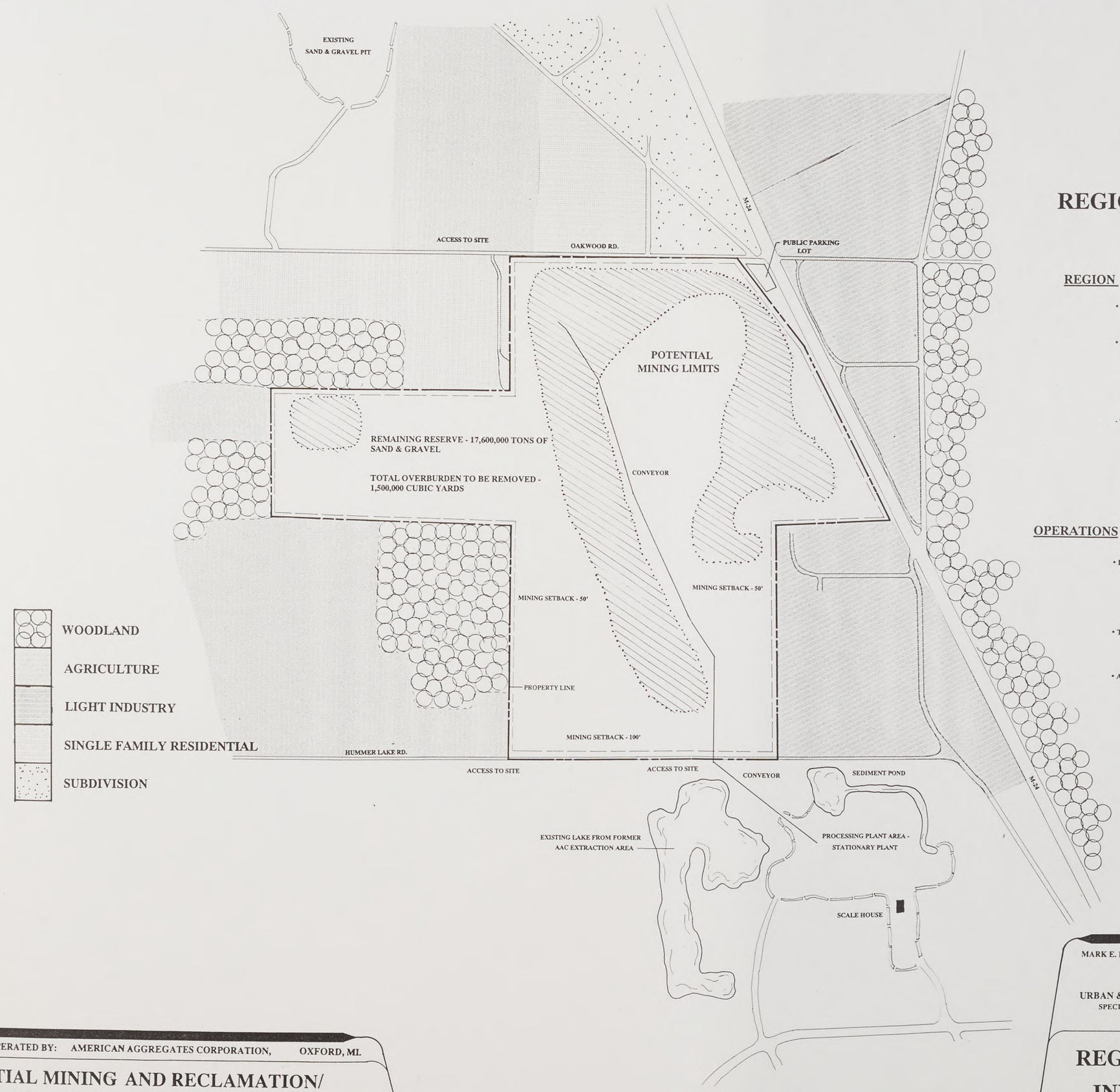
Sand & gravel mining is essential to all growing urban areas. However, this does not mean that the process of mining is easy to be involved with or is highly supported. It is an industry whose history has attached itself with a negative image, mostly in terms of being responsible to the environment.

Mining has become so much more than just excavating aggregate material from the earth. In order to run an efficient operation, many issues need to be addressed and thorough collection of data is critical. One of the unique characteristics of mining is that no two operations are alike. Each situation has its own set of issues, and because of this factor, a thorough inventory and analysis needs to be done. The information cannot simply be handed over from another operation.

Because of their proximity to populated areas, sand & gravel operators have to consider much more than just excavating material out of the ground. With the operations in the heart of metropolitan areas, the properties are of a much higher demand than those in the outlying rural areas. There is a relatively shorter lifespan for aggregate mines, and thus development is very feasible to consider. Aggregate mines are often times controlled and monitored at the local level, which can bring about more scrutiny. And finally, sand & gravel has no consistency, each deposit is unique and has to be tested to be efficient. The variations in deposit also bring about a need for flexibility in equipment and method of excavation.

It is because of these factors that a thorough inventory and analysis of the regional setting, the site's surface features, the deposit, and the operations is crucial to be successful. If information relating to these issues is obtained, it will increase the return on investment for the property, it will allow zoning and planning issues to be carried through with more success in less time, and most of all it will allow the operation to run as efficiently as possible.

Throughout PART II there will be detailed maps showing inventory and analysis issues for site and regional context, the deposit, and the operations. It is through the following maps that a visionary picture begins to develop and those issues need to be carried through the life of the project. Mining is going to occur on the AAC site, and if the mining activities are used as the sculptor of property with a vision in mind, the successive development can end up being the most valuable product of the operation. In a sense, mining is simply a method of getting paid to sculpt the land to a desired use and asset for the community.



REGIONAL / OPERATIONS I & A NOTES:

REGION

- 440-ACRE SITE IS JUST PART OF AMERICAN AGGREGATES' PROPERTIES IN OAKLAND COUNTY.
- OAKLAND COUNTY HAS BEEN GROWING AND WILL CONTINUE TO GROW, THUS MAKING THIS PROPERTY VALUABLE. DEVELOPMENT ON THIS PROPERTY CAN BENEFIT BOTH, AMERICAN AGGREGATES FINANCIALLY, AS WELL AS, OAKLAND COUNTY IN CONTROLLING THE RATE OF ITS GROWTH WITH A SEQUENTIAL DEVELOPMENT PLAN.
- THE SITE IS WITHIN THE DETROIT METROPOLITAN AREA, LOCATED DIRECTLY NORTH OF DETROIT CITY, AND SOUTHEAST OF FLINT. IT IS JUST NORTH OF THE VILLAGE OF OXFORD ALONG HIGHWAY M-24.

OPERATIONS

- IN THE SUMMER OF 1995, THE CONVEYOR SYSTEM WILL BE REPLACED WITH TRUCKS. A HOPPER AT THE SOUTH END OF THE SITE WILL FEED ONTO THE CONVEYOR AND TO THE PLANT. BEFORE COMPLETION OF THE MINING, THE STATIONARY PLANT WILL BE REMOVED AND A PORTABLE PLANT WILL BE BROUGHT IN.
- THE OPERATION HAS BEEN ALL DRY BANK MINING TO THIS POINT. THERE WILL BE WET MINING THUS CREATING LAKES ON THE SITE.
- AT THE CURRENT AVERAGE PRODUCTION RATE OF ABOUT 1 MILLION TONS PER YEAR, THE EXPECTED LIFE OF THIS OPERATION IS ALMOST 18 YEARS.

SCALE: 0' 400' 1200'

NORTH

MARK E. PETERSON GRADUATE PROJECT
MICHIGAN STATE UNIVERSITY
URBAN & REGIONAL PLANNING PROGRAM
SPECIALIZATION IN MINE LAND RECLAMATION

SPRING 1995

SITE OWNED AND OPERATED BY: AMERICAN AGGREGATES CORPORATION, OXFORD, MI.

SEQUENTIAL MINING AND RECLAMATION/
LAND DEVELOPMENT STUDY

REGIONAL / OPERATIONS
INVENTORY & ANALYSIS

REGIONAL SETTING

It is inevitable that every mining operation will be an impact on the environment. The question is, how can the impact be minimized? It starts with gathering data and planning.

While most environmental impact issues can be minimized at the control of the mining company, the most difficult issue to control is the haul trucks. The problem is that most mining companies do not own the trucks, and thus do not have control over them. Gravel trucks pollute the air, they spill bits of material while traveling, and they put wear and tear on roads. They can also present safety problems. In the Oxford area, there is fairly heavy truck traffic due to the amount of mining activity. It is up to mining companies to make an effort at developing policies and programs for truck safety and the enforcement of them.

Metropolitan Detroit is continually growing. Oxford lies about 40 miles directly north of the city and is seeing signs that that growth is moving to its area. The village of Oxford itself is not very large, only about 6,000 people. But, the village, along with its outlying area, has seen continual growth since the 1970's and has developed plans to support a much greater growth because of the trend of the Metro Detroit Area. For example, the township has developed a micro plan covering the majority of its area. American Aggregates owns a large amount of property in the township, so it will continue to be an important factor in the plan. One of AAC's tracts of land, which is located just north of the village and just south of the active mining area, is part of the micro plan. The tract is 1150 acres and is planned for high to medium density housing. Preliminary plans have been developed and show the potential of 2600 to 3200 lots. Oxford Township has shown that they understand the direction that they are heading. And, having these large tracts of land owned by AAC, with the opportunity for input on its future use, the township is potentially in the position to control the growth, in terms of its distribution. From a planning perspective, if the tracts of land owned and mined by AAC were to be developed and used as focus areas for growth in the community, the township would then have a situation where they could support its growth, while at the same time, preserve much of its natural open space and maintain its current attraction.

Oxford is located along Highway M-24, which is a main corridor down to Detroit. The proximity to M-24 would allow development on the AAC site to be very feasible. Since the site is adjacent to the highway, increased traffic would be concentrated on the main corridor. Maintenance costs would be significantly higher if increased traffic was spread much more throughout the township.

SITE I & A NOTES:

- THE SITE IS 440 ACRES AND OWNED BY AMERICAN AGGREGATES CORPORATION.
- THE CHARACTER OF THE PROPERTY SHOULD BE PRESERVED AS MUCH AS POSSIBLE IN THE NON MINING AREAS.
- THE CURRENT PROCESSING PLANT IS STATIONARY AND LOCATED JUST SOUTH OF THE PROPERTY. MATERIAL IS SENT ON A CONVEYOR SYSTEM TO THE PLANT. THAT SYSTEM IS GOING TO BE REPLACED IN THE SUMMER OF 1995. THE NEW SYSTEM WILL BE TRUCKS HAULING THE MATERIAL, ON SITE, TO A HOPPER AT THE SOUTH ACCESS POINT OF THE PROPERTY, AND THEN TO THE PLANT. THE PLANT WILL BE REPLACED BEFORE THE COMPLETION OF MINING.
- THE SITE IS SCREENED FROM THE PUBLIC, MAINLY WITH THE USE OF PLANT MATERIAL.
- WITH A SEQUENTIAL DEVELOPMENT PLAN, PORTIONS OF THE SITE CAN BE DEVELOPED PRIOR TO THE COMPLETION OF MINING.
- THE BEST AREAS FOR LAND FORMING ARE THOSE ADJACENT TO THE MINING LIMITS. PLANS FOR THE PLACEMENT OF OVERBURDEN WILL CONSIDER ACCESS TO ALL NECESSARY AREAS OF THE SITE.

DEVELOPABLE LAND

BEST POTENTIAL- CHARACTERISTICS INCLUDE: OPEN FIELD AREAS, NON-MINABLE, AND LOCATION IN RELATION TO FUTURE LAKE AREAS.

MARGINAL POTENTIAL- CHARACTERISTICS INCLUDE: WOODED AREAS, NON-MINABLE, AND EXISTING WETLANDS.

POOR POTENTIAL- CHARACTERISTICS INCLUDE: MINABLE AREAS, AND POTENTIAL FUTURE LAKE AREAS.

SCALE: 0' 200' 600'

NORTH

SITE OWNED AND OPERATED BY: AMERICAN AGGREGATES CORPORATION, OXFORD, MI.

SEQUENTIAL MINING AND RECLAMATION/ LAND DEVELOPMENT STUDY

MARK E. PETERSON GRADUATE PROJECT
MICHIGAN STATE UNIVERSITY
URBAN & REGIONAL PLANNING PROGRAM
SPECIALIZATION IN MINE LAND RECLAMATION

SPRING 1995

SITE INVENTORY & ANALYSIS

The AAC site is 440 acres, and if taken advantage of, it can become an attractive development for the township. One of the advantages of having a long range development is sequence with mining, is that, not only can a development plan, including landforms, be shaped as needed, but it can also control the rate of growth in the area. As mining is completed in sections of the property, development can follow, creating usable land while operations are still in progress.

Growth is moving out as far as areas like Oxford because people are looking for something new and different. The potential that a mining operation can add to a development, by creating unique landforms and diversity, makes AAC's oxford property even more valuable. Mining companies have to have the vision that is necessary to make these potentially unique developments come true. In terms of Metropolitan Detroit, Oxford Township has unique quality in its rural character. If growth and development can be controlled and concentrated, that character can potentially be maintained.

SITE- SURFACE CONDITIONS

Surface conditions vary for each and every site. From topography to vegetation to access points, no two sites are similar. There are two crucial reasons to having a clear understanding for these features. First, from an operational point if view, the processing plant and truck routes have to be easily accessible. Also, existing natural features should be utilized along with planned features such as earth berms to screen the operation most effectively. And second, from an environmental and future land use point of view, natural features such as wetland and woodland should be protected, as they will add value to a final landscape.

AAC's 440-acre property also has an adjoining property to the south which is where the processing plant and scale house are located. The properties are separated by Hummer Lake Rd., which is a gravel road. Highway M-24, the main corridor south to Detroit is on the east side of the properties, and Oakwood Rd. is the north boundary of the site. There are four access points to the property. There is a back entrance coming off Oakwood Rd., an emergency access point off M-24, and two access points off Hummer Lake Rd., with the furthest east being the main entrance. Because of the probable future development on the property, direct access to M-24 would be of a great advantage. This can also be considered in the scheme of future operations. With a site of this size and the potential it brings the area for the future, it will likely be a very significant feature within the community. This gives AAC a very strong argument for considering a main entrance off M-24.

The site is relatively flat topography with the west end having the most variation. The west end has some areas as much as 70' difference. AAC does still lease some of the flat areas to farmers, which maintains some usable soil. However, as those areas are considered for mining, topsoil is not separated from the clay, they are stripped off together as overburden. There are two existing piles of overburden creating high points on the property.

Besides farmland, there is a significant amount of woodland on the site. The character of the woodlands is predominantly medium density hardwoods. There is also some areas of wetland. These features add value to the property and thus, are taken into account with the deposit to determine overall minability. To this point, AAC is currently mining in two separate pits, both dry, and they have a very effective screen of evergreen trees along M-24. As the operation is expanded and moves to the east, it will be advantageous for AAC to also use overburden to create berms as well. The earth berms act as visual barriers, and at the same time they keep surface drainage on site.

There is a housing subdivision to the north and there are single family lots, mostly multi-acre throughout the area. But, for the most part, this region has a lot of natural woodlands and farmland. There is also commercial development along M-24.

Being located along M-24, the AAC site is easily accessible to utilities. It is up to AAC whether they want to take reclamation and land development as far as putting in infrastructure, or if they want to just sell the property as usable land. Generally, there are mining setbacks which are determined in each permit. The setbacks on the site, as permitted are 50', but to ease cost of reclamation and to maximize options for development, it may be advantageous to AAC to leave more virgin land if possible. From a development stand point, it can be more economically viable to leave an extra 100' to 200' of material to maximize buildable land. The development has to offset the lost reserves to be feasible.

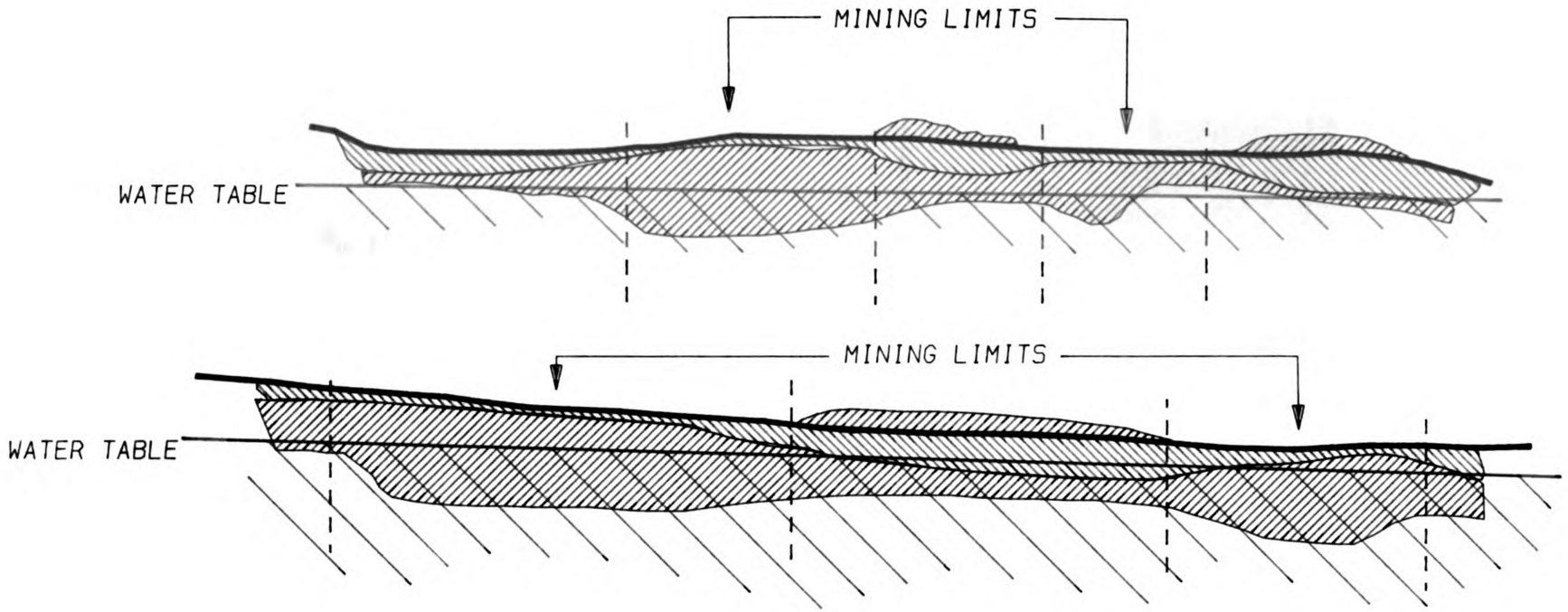
DEPOSIT

One of the crucial steps in the mining process is drilling test holes to check the deposit structure. Without drilling, a sand & gravel mining operation cannot be efficient. Sand & gravel deposits are a result of the Ice Age and the glaciers and are not uniform in structure. Drilling, either with an auger or core drill, can determine depth of overburden, depth of the deposit, and the depth of the ground water.

Not only does drilling help make the operation more efficient, but it is also very helpful to the environment. Understanding where to mine and where not to mine will protect surface features on those no-mine areas. Also, if an operator understands where mining can potentially be, and where it definitely will not be, those no-mine areas can be utilized in development schemes while the mining is still in progress. This way, development does not have to be put off until mining is complete.

Drawings #1-#4 illustrate the depth and distribution of the deposit as well as overburden. From those drawings, a picture of potentially minable areas are depicted. These are also overlaid with the site surface features and an outline of minable area is determined. On this particular site, the deposit is feasible for both wet and dry bank mining. Potential final lake areas are also determined from drawing #3 which shows sand & gravel below the water table. It is important to keep in mind that the required 3:1 slopes must maintain to five feet below water. At that point, the slope can be much greater, resulting in a gain on the capture of the deposit as it goes deeper.

Drawing #1 shows overburden depth and distribution. As depicted by the map, there is a heavy clay seam in the north central region of the site. This area will be concentrated on as an overburden placement area, and possibly the future site of the processing plant because of the centralized location. Drawing #2 shows the deposit depth and distribution. This map shows that the deepest and best material is in the north end of the property, along Oakwood Rd. The deposit reaches beyond 100' in this area. Drawing #3 shows the deposit depth and distribution below water. Again the most significant area below water is the north end, reaching deeper than 80'. Drawing #4 shows the overburden/deposit ratio. There is no set depth of overburden that can be stripped, it depends on the depth of deposit below. The combination of these maps visualizes the potential limits of the mining. They are also overlaid with drawings #5 and #6, which show the surface and operational features. The following page shows two cross-sections illustrating the characteristics of the deposit in relation to overburden and the water table.



DEPOSIT/OVERBURDEN ANALYSIS
CROSS-SECTIONS

These cross-sections follow the section lines for drawing #9 (A1-A1' and B1-B1'). The overall character of the deposit in relation to overburden and the water table is illustrated.

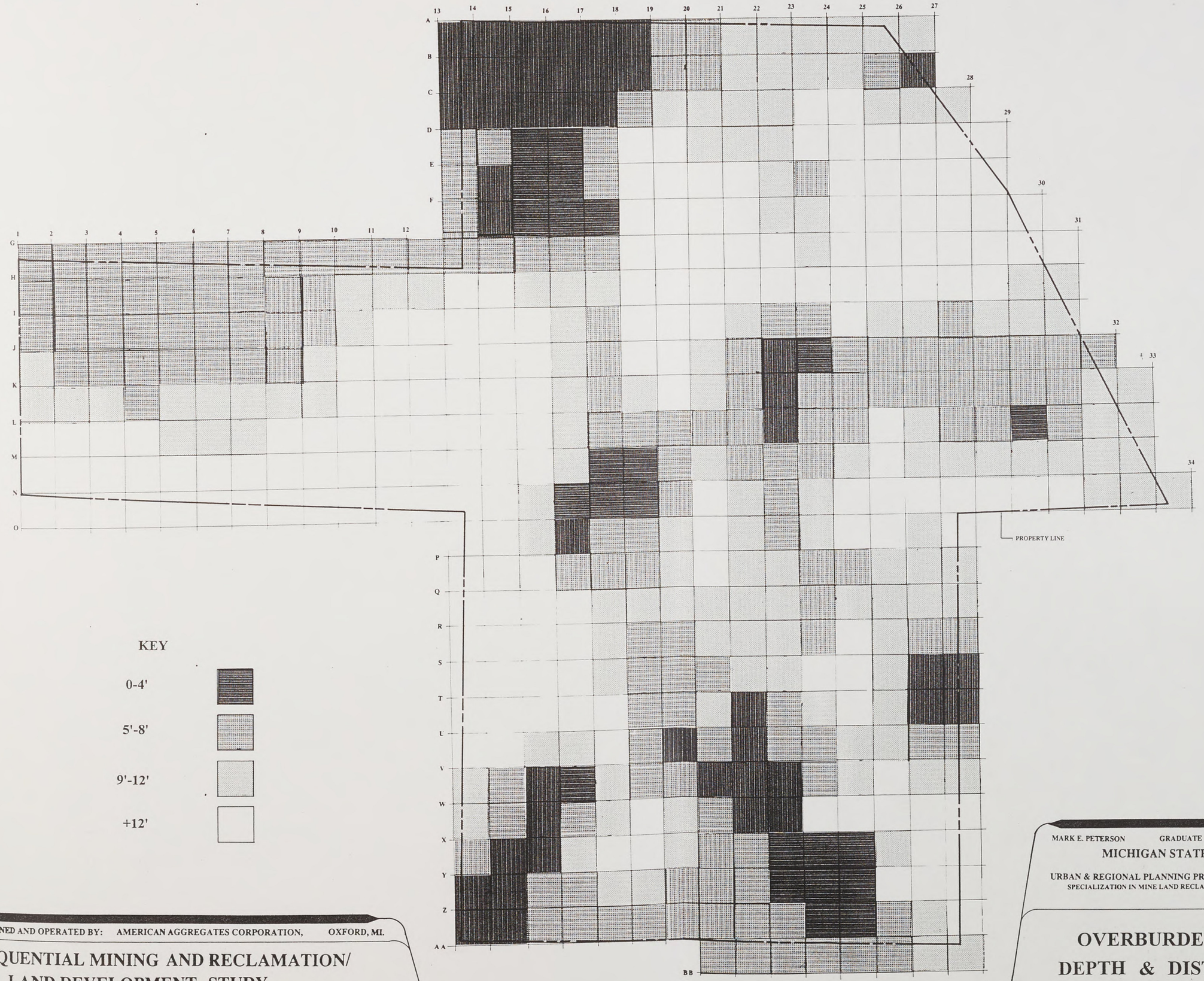
Also illustrated is overburden placement, showing the fill areas as being adjacent to the mining limits, but on top of no-mine areas so the fill will not be moved again.

FILL AREA

OVERBURDEN

SAND & GRAVEL

WATER TABLE



KEY

0-4'

5'-8'

9'-12'

+12'

SCALE: 0' 200' 600'

NORTH

MARK E. PETERSON GRADUATE PROJECT

MICHIGAN STATE UNIVERSITY

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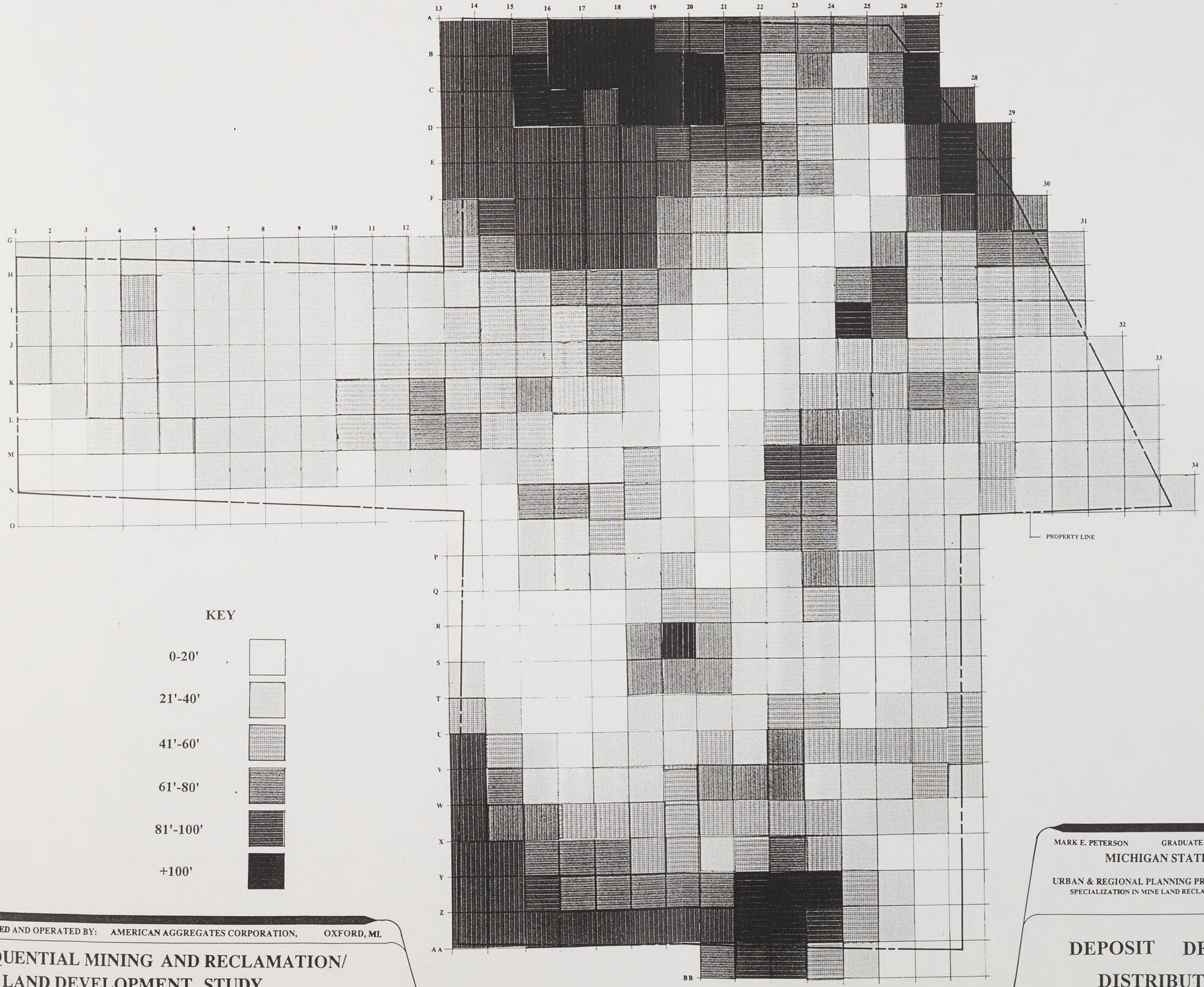
SPRING 1995

SITE OWNED AND OPERATED BY: AMERICAN AGGREGATES CORPORATION, OXFORD, MI.

SEQUENTIAL MINING AND RECLAMATION/ LAND DEVELOPMENT STUDY

OVERBURDEN DEPTH & DISTRIBUTION

1



KEY

0-20'

21'-40'

41'-60'

61'-80'

81'-100'

+100'

SCALE: 0' 200' 600'

NORTH

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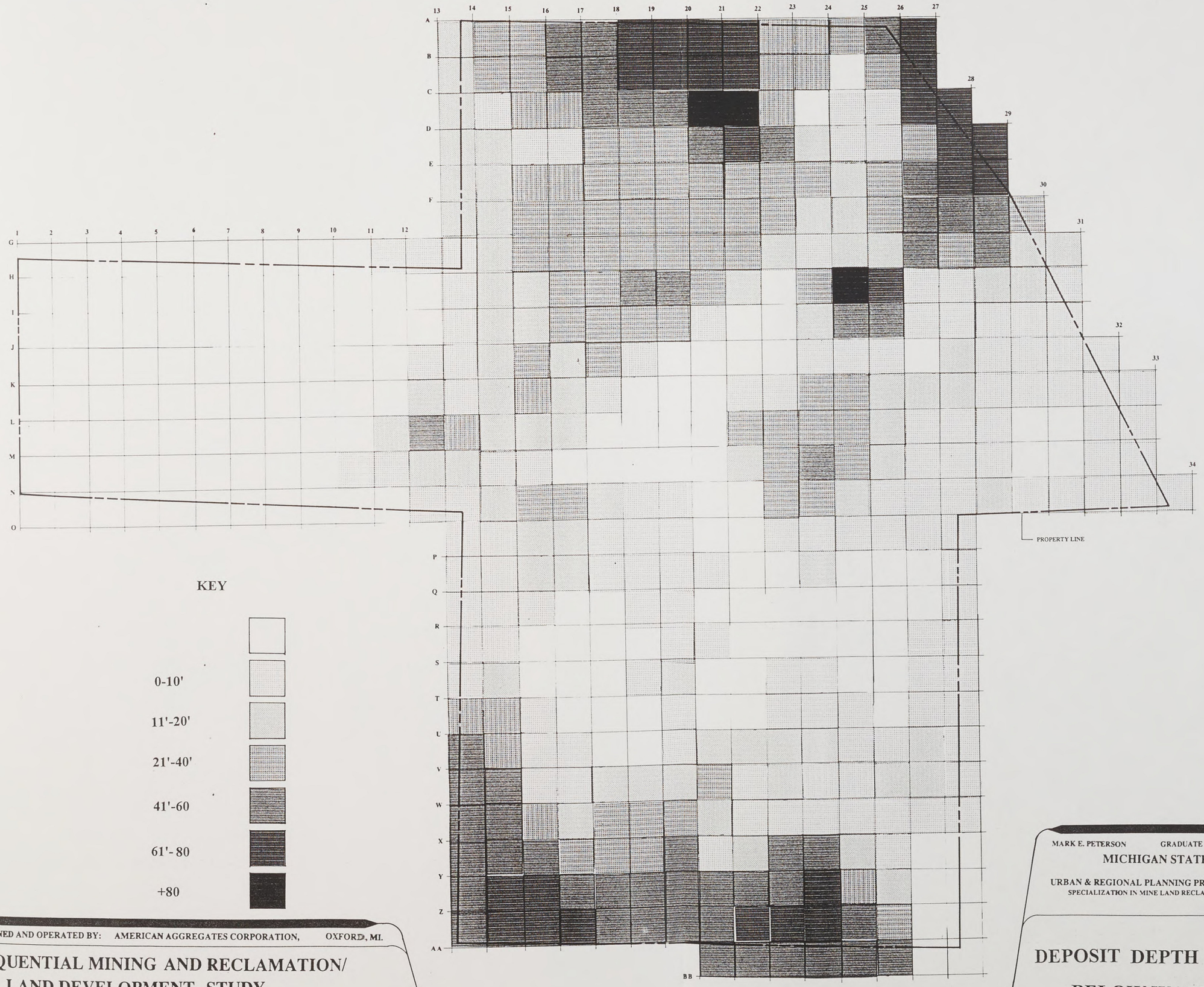
DEPOSIT DEPTH & DISTRIBUTION

2



KEY

0-10'

11'-20'

21'-40'

41'-60

61'- 80

+80

SCALE: 0' 200' 600'

NORTH

SITE OWNED AND OPERATED BY: AMERICAN AGGREGATES CORPORATION, OXFORD, MI.

SEQUENTIAL MINING AND RECLAMATION/ LAND DEVELOPMENT STUDY

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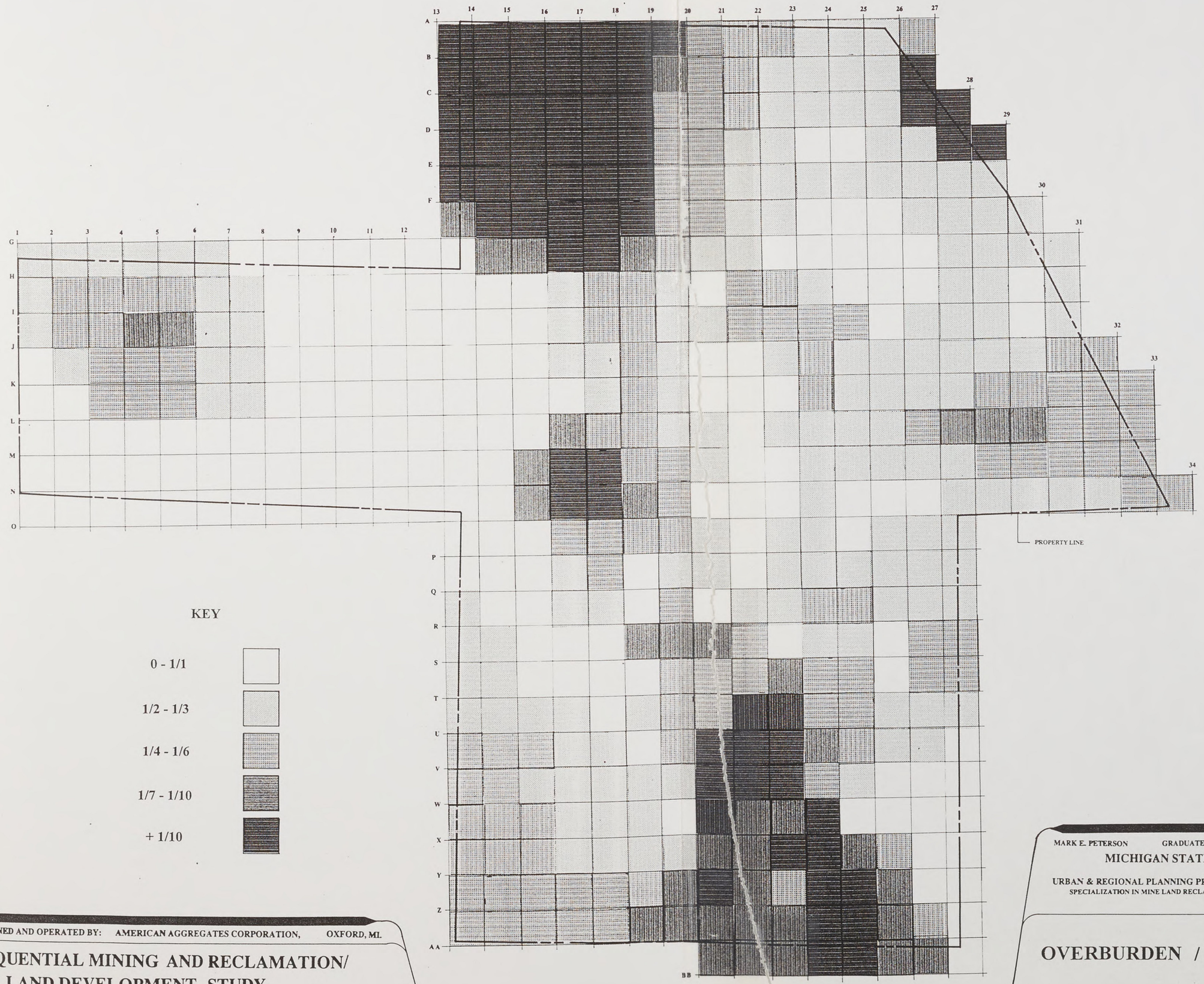
SPRING 1995

DEPOSIT DEPTH & DISTRIBUTION BELOW WATER

3



KEY

0 - 1/1

1/2 - 1/3

1/4 - 1/6

1/7 - 1/10

+ 1/10

SCALE: 0' 200' 600'

NORTH

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SPRING 1995

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SEQUENTIAL MINING AND RECLAMATION/ LAND DEVELOPMENT STUDY

OVERBURDEN / DEPOSIT RATIO

4

From the analysis, potential mining limits were determined (drawing #6) and the calculated remaining reserves for the site is 17.6 million tons. Also calculated was the overburden to be moved, totaling 1.5 million cubic yards. In terms of mining, the site has a variety of options, both in terms of equipment and sequencing. But, even more significant to this operation is the potential for development. Because of the structure and distribution of the deposit, the potential to make the site one big lake is not an option. Therefore, this is an example of a situation where the development should use the character of the operation and the mining and placement of overburden should specifically shape the final landform.

OPERATIONS

There are three basic types of sand & gravel operations. First, there is dry bank, using front end loaders to excavate the material. Second, there is a wet operation using a dragline, which in simple terms is a crane with a bucket scooping out material from the water. And third, there is a dredge, which is another wet operation. A dredge is a boat that sits on the water, with a tube acting like a vacuum under water. A dredge is used when it is required to go beyond about 40' below water. The AAC property has the potential to use any and\or all of these methods. In terms of reclamation, dry bank operations have an advantage because there is access for working at the pit floor, as well as the top of the banks. If a deposit is only as deep as 40', it is much more efficient and cheaper to use a dragline. The dragline, however, cannot maximize a particular deposit because it has to maintain a ledge to work from. On the other hand, if the deposit is below 40', a dragline should be used. The dragline sits in the water so it can mine as close to the edges as the setbacks and restraints on reclamation will allow. The dredge can also be efficient in reclamation by using its pumps to backfill material in specific areas and potentially create compact, usable land.

Before getting into the excavation of the sand & gravel, the overburden needs to be stripped and moved. Stripping is done with scrapers and if needed bulldozers. The key to any successful reclamation and development plan is the movement of overburden. Once potential mine areas and no-mine areas are determined, reclamation plans can use those no-mine areas as overburden or land shaping areas. If overburden has to be moved more than one time, the operation is not running at maximum efficiency. Overburden has to be initially moved at an operational expense, thus creating a minimal reclamation expense if it is no longer moved.

At the present time, the Oxford site has 6200 ft. of conveyor, which transports the material from the pit to the processing plant. Because the deposit is an irregular configuration, and different grades of material have to be mixed together from different areas of the site, the conveyor is no longer going to be efficient, and the operation will change to using haul trucks. The trucks will give more flexibility to the operation.

The processing plant is located on AAC's adjoining property to the south. The current plant is very old and as the operation continues in the future, AAC may consider bringing in a portable plant to replace it. A portable plant will also give more flexibility to the operation.

Oxford's annual production rate is approximately 1 million tons per year. And, at 17.6 million tons of reserves left, the life of the operation will be just under 18 years if the current market rate holds up. One of the advantages that AAC has is that they also have other operations in the area, and this gives opportunities for flexibility in equipment. If costs can be shared or equipment itself, the operation can be much more successful.

In terms of sequencing and direction of movement for the operation, there are two key points to keep in mind. First, the processing plant is currently located to the south of the site, with the likelihood of it moving on site and towards the north end in the future. The most efficient use of the location of the plant, then, would be to concentrate on the south end and move north. This would create the shortest haul to the current plant, and create a very close proximity for the deep deposit on the north end to utilize the future location of the plant. And second, this deposit is varied enough to use any and/or all of the three mining methods. The actual selection of equipment will play a major factor in the sequence of the mining. PART III will illustrate two different options for operations.

PART III

MINING AND RECLAMATION PROGRAM

PART III

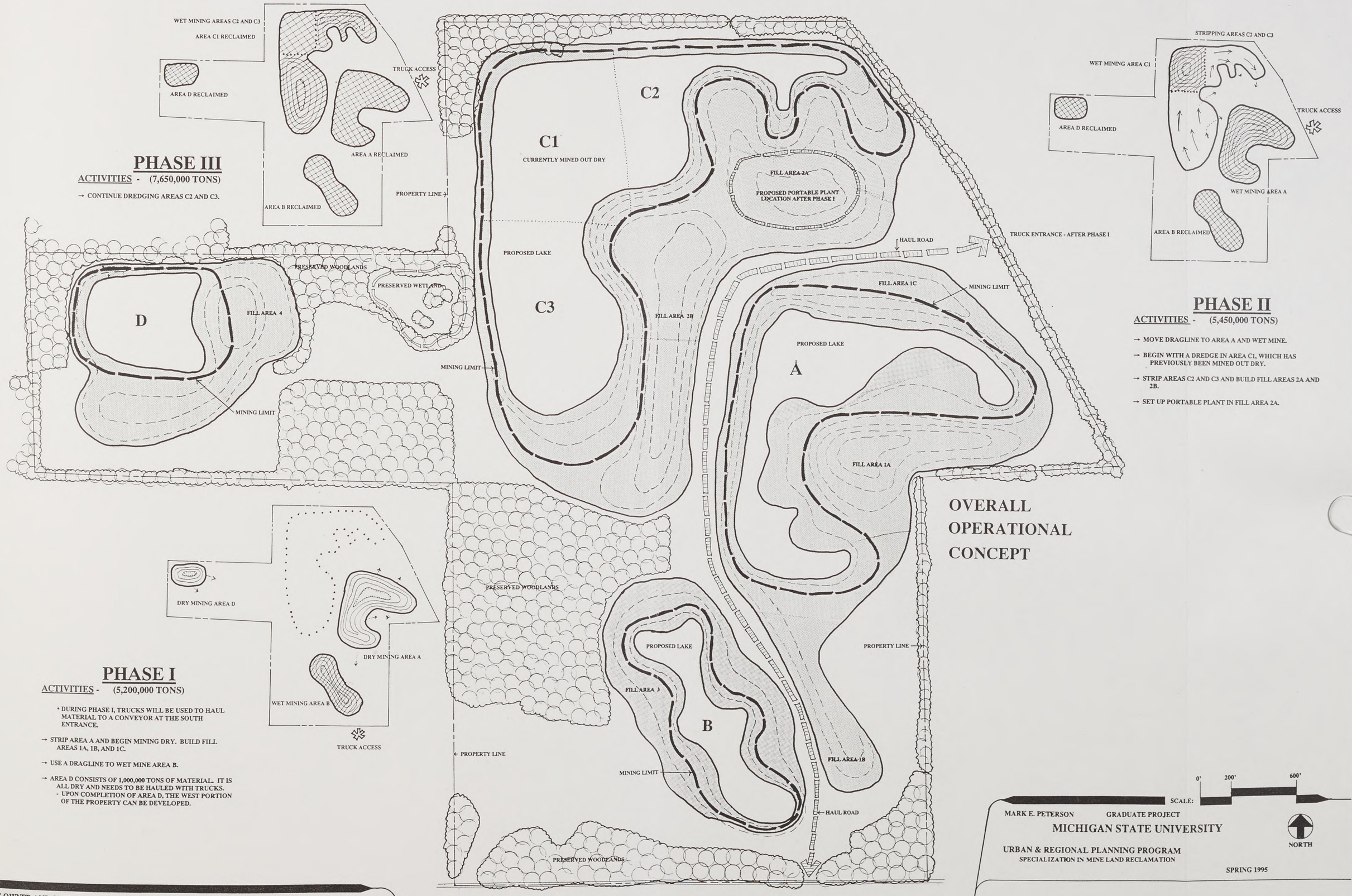
The mining and reclamation program is the long range plan showing sequence of mining and how reclamation follows. From the inventory and analysis, and with the continuing growth in the area, this particular site looks to be very valuable to the community in terms of development. AAC would be very smart to do their part in preparing the land for a future end use, while keeping in mind they need to maximize their deposit.

With a 20-year operation and development that far down the road, specific land use plans should not be counted on. Over 20 years, many things may change, such a zoning and growth. It is the development of usable land that AAC needs to keep in mind throughout the life of the operation.

In terms of mining operations and the equipment used for them, the conveyor system currently on site is already scheduled to be removed and subsequently, haul trucks will be the operational procedure for the transporting of material. As will be shown in the mining program, conveyor systems are generally most efficient in operations where the material is coming from one main area. The Oxford site needs to blend material with different gradations from different areas of the property and the use of trucks to haul material will be more efficient and create more flexibility.

The mining and reclamation program will consist of two distinct options, with the major difference being the type of equipment used for excavation. In each option, a complete description of the overall mining and reclamation sequence will be given. Each option has a sequence of phases that allows mining to be maximized at the same time that the land is being reclaimed behind the mining. Also a part of the mining and reclamation program will be a description of final development characteristics and issues.

The phasing sequence and labeled areas of the site will follow drawings #7-#10. The two options for mining sequences are based on the characteristics of the deposit, the location and potential future movement of the processing plant, and the equipment available.



PHASE III

ACTIVITIES - (7,650,000 TONS)

→ CONTINUE DREDGING AREAS C2 AND C3.

PHASE II

ACTIVITIES - (5,450,000 TONS)

→ MOVE DRAGLINE TO AREA A AND WET MINE.

→ BEGIN WITH A DREDGE IN AREA C1, WHICH HAS PREVIOUSLY BEEN MINED OUT DRY.

→ STRIP AREAS C2 AND C3 AND BUILD FILL AREAS 2A AND 2B.

→ SET UP PORTABLE PLANT IN FILL AREA 2A.

PHASE I

ACTIVITIES - (5,200,000 TONS)

* DURING PHASE I, TRUCKS WILL BE USED TO HAUL MATERIAL TO A CONVEYOR AT THE SOUTH ENTRANCE.

→ STRIP AREA A AND BEGIN MINING DRY. BUILD FILL AREAS 1A, 1B, AND 1C.

→ USE A DRAGLINE TO WET MINE AREA B.

→ AREA D CONSISTS OF 1,000,000 TONS OF MATERIAL. IT IS ALL DRY AND NEEDS TO BE HAULED WITH TRUCKS.
- UPON COMPLETION OF AREA D, THE WEST PORTION OF THE PROPERTY CAN BE DEVELOPED.

OVERALL OPERATIONAL CONCEPT

SCALE: 0' 200' 600'

NORTH

MARK E. PETERSON GRADUATE PROJECT

MICHIGAN STATE UNIVERSITY

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SPRING 1995

SITE OWNED AND OPERATED BY: AMERICAN AGGREGATES CORPORATION, OXFORD, MI.

SEQUENTIAL MINING AND RECLAMATION/ LAND DEVELOPMENT STUDY

OPERATIONS PLAN OPTION #1

OPTION #1

Option #1 follows drawing #7, and is an operation using all three types of excavation methods throughout its life. From the drawing, Area A is the east pit, Area B is the south pit, Area C is the north pit, and Area D is the west pit. Areas B and C are where the current dry pits are started. The shaded areas on drawings #7 and #8 are the overburden storage or land shaping areas.

One of the crucial differences between options #1 and #2, is that, the particular makeup of the gravel, or coarseness, is widely varied on this site. Since option #1 has the situation of active mining going on in different areas of the property at the same time, AAC will be able to take advantage of mixing material to specification. Whereas, option #2 creates a situation where material is being extracted from only one area at a time with the dredge.

The concept of option #1 is utilize the equipment already on site, which includes trucks, front end loaders for dry bank mining, and a dragline. Option #1 also makes the best efficient use of the plant location with the idea of moving in a new plant towards the north end in the future. One of the main factors of this operation is that a dredge will eventually be necessary to maximize the deposit. This option gives flexibility and time in locating and bringing in the dredge.

Phase I

Activities in Phase I total 5.2 million tons of sand & gravel.

The current processing plant will be used throughout phase I. The conveyor system will be removed and trucks will be used to transport the material within the site. Trucks will haul material to the entrance at Hummer Lake Rd., and there they will dump the raw material into a hopper which feeds a conveyor to transport to the plant. It is likely that in the future a portable plant will be used. Because the current plant is located to the south and a portable can be moved where needed, it is important to take advantage of the furthest south pits for
phase I. This will keep truck hauling distances down to a minimum.

Area B has been mined out dry, and at this point a dragline should be brought in to dig out the lake. Area B has 900,000 tons of material under water.

At the same time, Area A should be stripped and fill areas 1A, 1B, and 1C should be developed. Once Area A is stripped, dry bank mining can start and move in a northerly direction. Area A's dry reserve is 3.3 million tons. Using a dry bank operation first allows the dragline to be utilized in Area B.

Area D is also part of phase I. The deposit on the west side of the site is not very good, however there is 1 million tons available where Area D sits. It is all dry and will not create a lake. This part of the site can be utilized as developed land before mining is complete.

The current processing plant will be utilized throughout phase I and into phase II. Once the portable plant replaces the existing one, the main entrance to the site will be off M-24.

Phase II

Activities in Phase II total 5.45 million tons of sand & gravel.

During phase II, Area's B and D will be reclaimed to completion. As phase II begins, the dragline will be moved to Area A and the wet operation will follow the direction that the dry bank moved.

At the same time, Area C1 will begin with a dredge operation because of the depth of material. Area C1 is mined out dry and the dredge can begin in the pit. The deposit in Area C is as much as 100' which requires a dredge to reach it. Area C2 will first be stripped so that fill area 2A can be completed. This will be where the new plant will locate because it is centralized to the remaining reserves. Area C3 will also be stripped as part of phase II.

Phase III

Activities in Phase III total 7.65 million tons of sand & gravel.

Phase III involves reclaiming Area A to completion, and continuing the dredge operation in Area C. The nature of the dredge type of operation allows C2 and C3 to be excavated with the dredge without taking the material above water level first. As the dredge continues to mine the material under water, the dry banks collapse and the material is then taken wet.

· KEY ·

MULTI-FAMILY UNITS

1/2-ACRE LOT - SINGLE-FAMILY

1-ACRE LOT - SINGLE-FAMILY

0' 200' 600'

SCALE:

NORTH

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FINAL MASTER PLAN OPTION #1

The depth of the lake in Area C brings about a decision of how far to extend the lake to the north and if enough area should be left for development. With the amount of material that can be extracted, and better access to the rest of the site for development, it is probably most feasible to mine to the limit and leave the north lake edge and natural area with possibly a system of trails to have walking access around the lake.

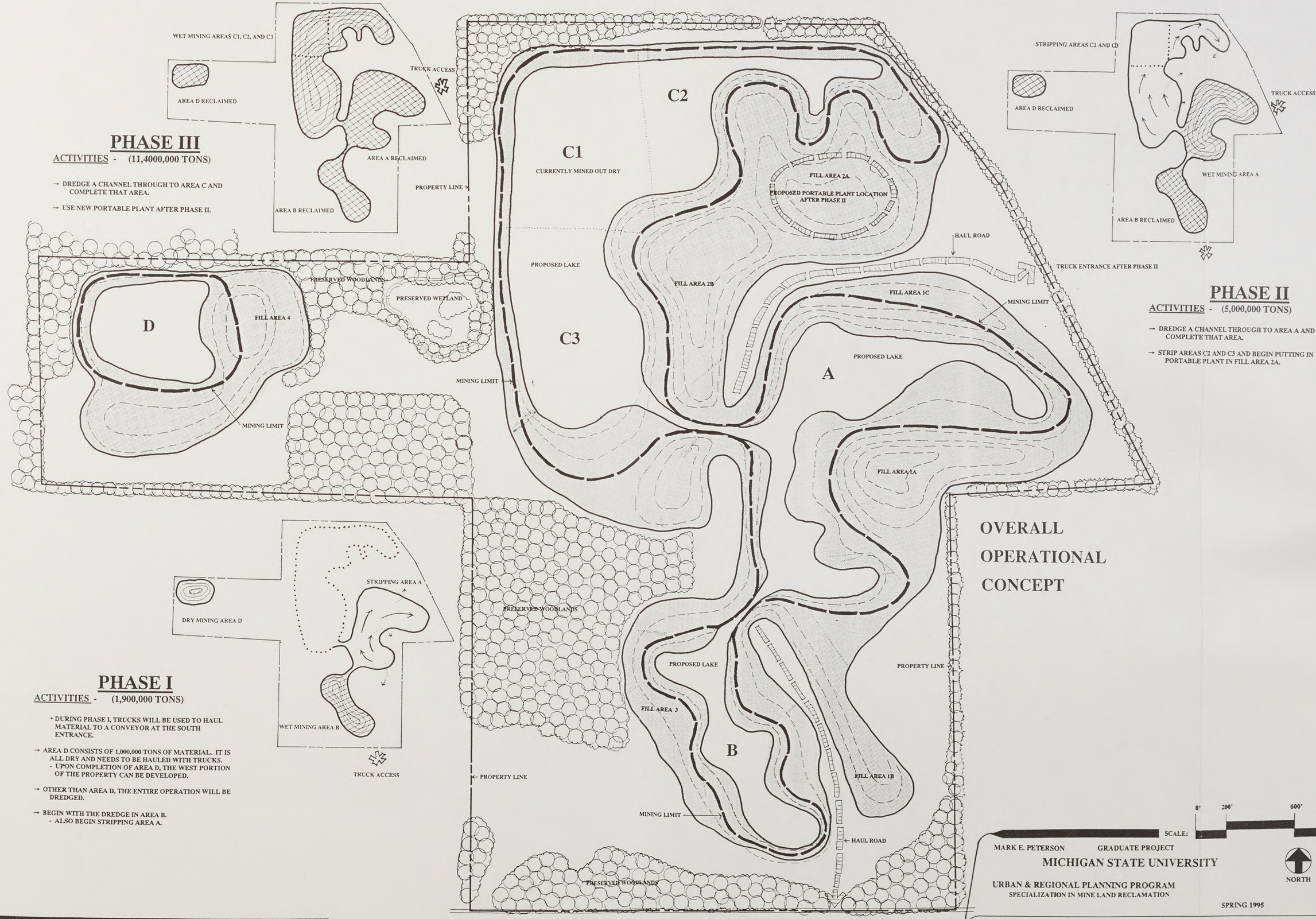
Development - Option #1

In the span of 20 years, many things will change, both with the operation and the region. But, in terms of a sand & gravel operation, if there is a long range plan put together that makes sense, the property will be worth much more at the completion of mining. Understanding that there may be changes in zoning and the marketability of development for the area, if a long range plan is followed, and usable land is the end result, the property will not lose value.

Once the main entrance for the operation has been established off M-24, it is natural that it should also be used as the entrance for the development. To be most cost effective, the development will take advantage of many of the characteristics and features from the mining operation. These features are what will give the development its uniqueness and attractiveness.

Option #1 development will consist of three separate lakes, with the proposed lake in Area C being the largest and deepest. Waterfront property is very attractive to people and will significantly increase its value. But, on the other hand, if a lake is overdeveloped or overcrowded with people, it will lose some of its attraction. Open space can enhance the overall value of the development to offset the loss of units.

The development is a mixed unit housing project, including single family lots, condominium units, and apartment units. The design also includes a town center area, with public parking and shopping. For single family lots, the plan includes 86 1/2-acre lots, mostly on the west side of the property, and 118 1/4-acre lots, with many of them either waterfront lots of with viewing access to the lakes. The higher density units take more advantage of the operation and utilize the landforms shaped by AAC. Their relationship to the lakes establish their value and attractiveness. The design has approximately 800 total units, which is about four per acre. And, the town center area is in the location where the portable processing plant was set up.



PHASE III

ACTIVITIES - (11,4000,000 TONS)

→ DREDGE A CHANNEL THROUGH TO AREA C AND COMPLETE THAT AREA.

→ USE NEW PORTABLE PLANT AFTER PHASE II.

PHASE II

ACTIVITIES - (5,000,000 TONS)

→ DREDGE A CHANNEL THROUGH TO AREA A AND COMPLETE THAT AREA.

→ STRIP AREAS C2 AND C3 AND BEGIN PUTTING IN PORTABLE PLANT IN FILL AREA 2A.

PHASE I

ACTIVITIES - (1,900,000 TONS)

* DURING PHASE I, TRUCKS WILL BE USED TO HAUL MATERIAL TO A CONVEYOR AT THE SOUTH ENTRANCE.

→ AREA D CONSISTS OF 1,000,000 TONS OF MATERIAL. IT IS ALL DRY AND NEEDS TO BE HAULED WITH TRUCKS.
- UPON COMPLETION OF AREA D, THE WEST PORTION OF THE PROPERTY CAN BE DEVELOPED.

→ OTHER THAN AREA D, THE ENTIRE OPERATION WILL BE DREDGED.

→ BEGIN WITH THE DREDGE IN AREA B.
- ALSO BEGIN STRIPPING AREA A.

OVERALL OPERATIONAL CONCEPT

0' 200' 600'

SCALE:

NORTH

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OPERATIONS PLAN OPTION #2

To take maximum advantage of the lakes, the land shaping was done in a method to create a terrace effect and give as many units as possible a view of the water. This is made possible simply because the plans were done prior to the overburden being moved and thus, it was moved with a vision in mind. The cross sections on drawing #11 illustrate how the land shaping methods capitalized on maximizing both the number of units per acre, as well as their value. There are also two separate access points to the large lake, which is where recreational activities will take place.

OPTION #2

Option #2 offers a completely different plan in sequence of excavation and equipment. The deposit obviously does not change from option #1, and thus the final configuration and development will be relatively similar. The difference comes in reaching the final plan. In order to maintain consistency, the mining areas will be labeled the same as option #1.

Option #2 is almost entirely a dredge operation, thus creating just one large lake. While the final configuration of the land and lakes will be very similar, it is the equipment used in the sequences that creates the difference between options #1 and #2.

The concept for option #2 is, except for Area D, to use a dredge for the entire operation. The use of a dredge creates a very efficient operation if the deposit analysis holds true. The risk of a dredge operation is that material is only being excavated from one area, and if the mix of material does not meet specifications, the operation does not have as much flexibility. An alternative, if needed, may be to do some dry bank mining ahead of the dredge, which would be viable in this situation because there already exists dry bank pits.

Phase I

Activities in Phase I total 1.9 million tons of sand & gravel.

The current processing plant located south of the property will be utilized throughout phases I and II. Area D will be the only dry bank mining for this option. It will produce 1 million tons and again be part of phase I.

Besides Area D, the entire operation will be a dredge. Since Area B has already been mined out dry and it is the closest access to the current processing plant, the dredge will start there. As the dredge begins in Area B, stripping will begin in Area A.

Phase II

Activities in Phase II total 5 million tons of sand & gravel.

Phase II begins with dredging a channel from Area B to Area A. The lakes will be connected, so to have access across the channel, a bridge will be built. At the same time Area A is being dredged, Areas C2 and C3 will be stripped. C1 is already mined out dry so no stripping is required. The overburden from C2 will be used to build fill area 2A for the portable processing plant location. Area's B and D will be reclaimed to completion during phase II.

Phase III

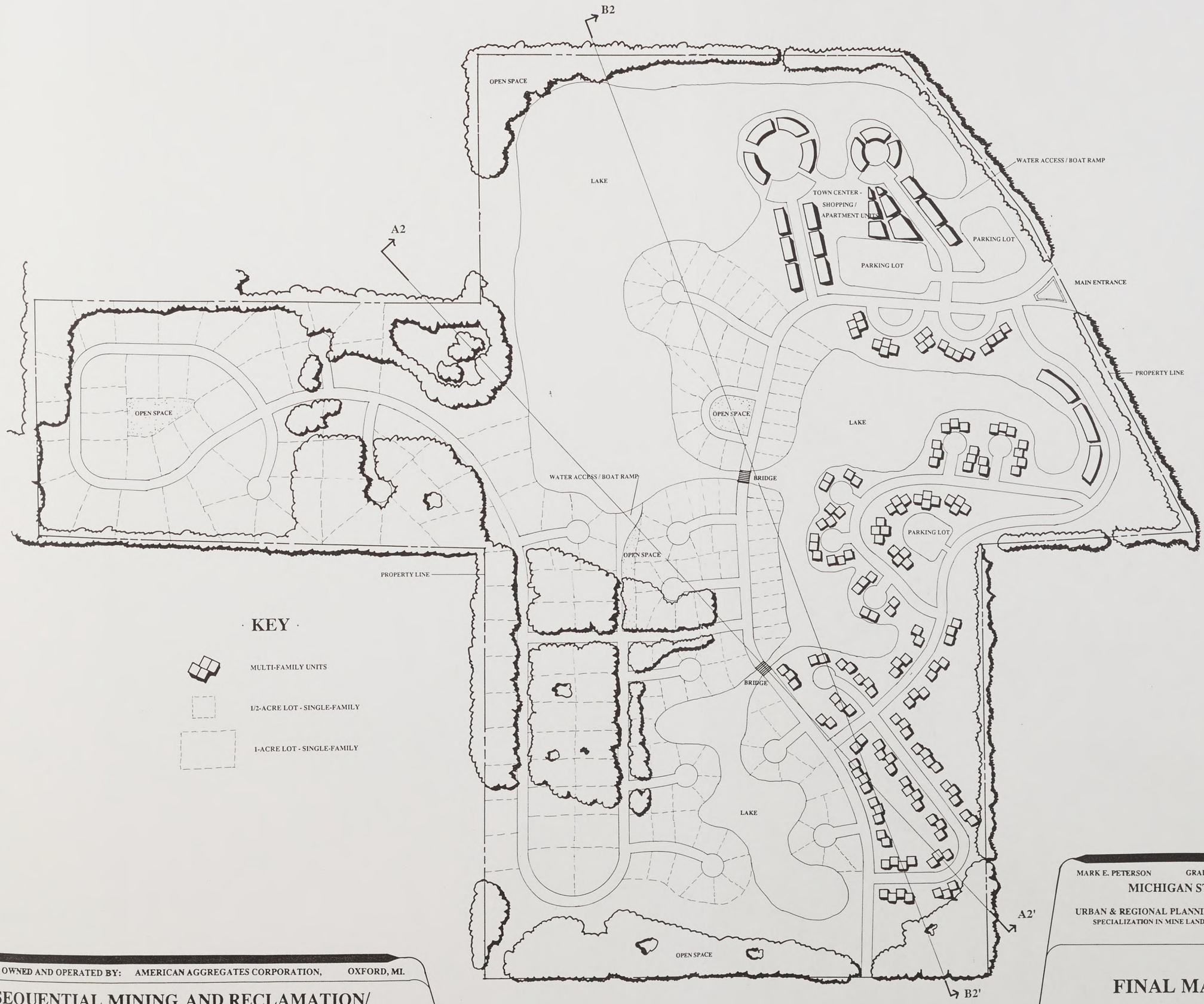
Activities in Phase III total 11.4 million tons of sand & gravel.

To begin phase III a channel will be dredged from Area A to Area C. And again, to have access over the channel, a bridge will be built. Phase III will begin to use the portable processing plant. During phase III, Area A will be reclaimed to completion.

Development - Option #2

The final development plan for option #2 is very similar to that of option #1. The major difference is that there is just one large lake instead of three separate ones. The only changes to the layout of the final design is near the areas where the channels are connecting the lake. The 1/4-acre lot design is done with a different layout to take the optimum advantage of the connected lake.

Bridges will need to be built for access across the two channel areas. The design layout of the two development plans is left very similar because of two main reasons. First, within a twenty year operation, many things will change in terms of mining. It may be a situation where these two options are done in combination with each other. And second, the market for the area may change. To say that things won't change in the market over twenty years is not being realistic. The key point is that the layout for the development is what shapes the mining operation and it makes sense in terms of mining and reclamation. Whatever the final design layout, the building of usable land and reclamation for the operation in general, makes good sense, both for land value and operational efficiency.



· KEY ·

MULTI-FAMILY UNITS

1/2-ACRE LOT - SINGLE-FAMILY

1-ACRE LOT - SINGLE-FAMILY

SCALE: 0' 200' 600'

NORTH

MARK E. PETERSON GRADUATE PROJECT

MICHIGAN STATE UNIVERSITY

URBAN & REGIONAL PLANNING PROGRAM
SPECIALIZATION IN MINE LAND RECLAMATION

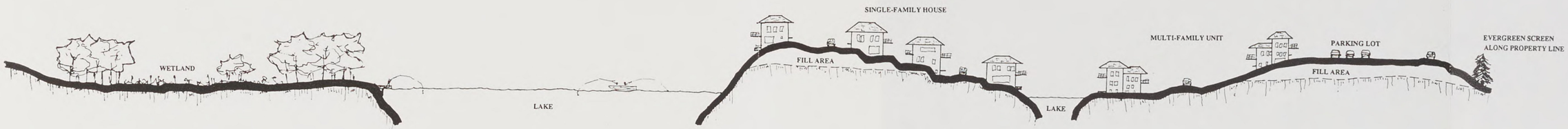
SPRING 1995

SITE OWNED AND OPERATED BY: AMERICAN AGGREGATES CORPORATION, OXFORD, MI.

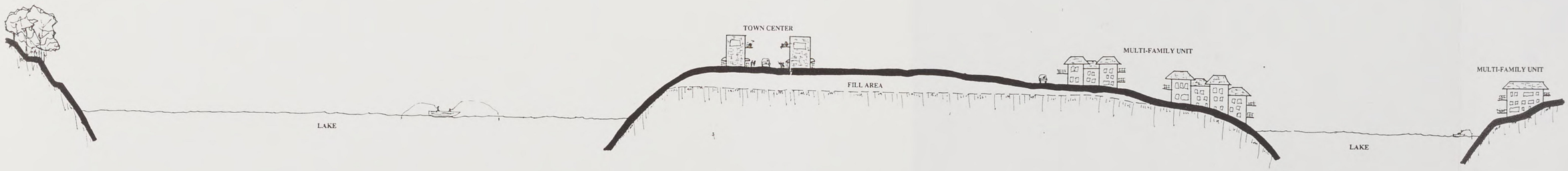
SEQUENTIAL MINING AND RECLAMATION/ LAND DEVELOPMENT STUDY

FINAL MASTER PLAN OPTION #2

OPTION #1



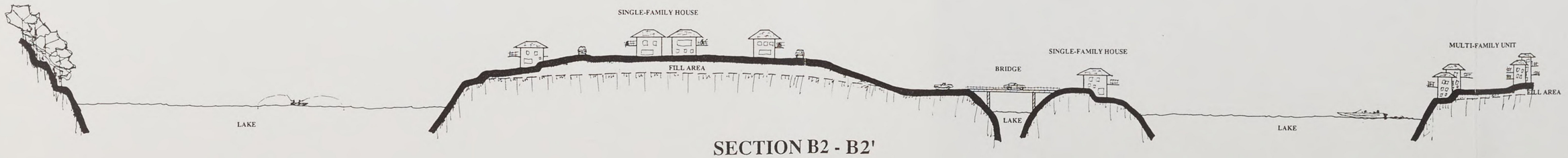
SECTION A1 - A1'



SECTION B1 - B1'

OPTION #2

SECTION A2 - A2'



SECTION B2 - B2'

SCALE: VERTICAL - 1" = 40'
HORIZONTAL - 1" = 100'

SCALE:

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FINAL DEVELOPMENT / LANDFORM SKETCHES

CONCLUSION

CONCLUSION

Vision is that of being able to see the potential of the future, with an understanding that the future is shaped by how we act today. Having vision is very important in the mining industry because of two points. First, mining operations make very drastic changes to the natural landscape over its active life. And second, the life of the operation can outlast a generation, in terms of people. The critical idea of a mine plan is not that an operation directly follow it without question or alteration, but that it provide guidelines to what is possible and what makes sense.

An effective mine plan is not possible without very thorough data collection and analysis of it. Regulatory issues, regional and surface conditions, deposit structure, and operations must be understood to create a usable plan.

A mine plan serves a variety of purposes. First, it obviously allows an operation to run much more efficiently than one without a plan. And second, a plan can be used as a tool for zoning or township planning issues. A potential operation with a plan will much more effectively be accepted than one without. The plan shows actions to be responsible, and once an operation is active and it can be shown that the plan is being used, the image of the operator is greatly improved.

This particular study shows a mine plan for a sand & gravel operation that does not count on the fact that it will be carried out step by step, but rather it is a plan that makes good sense. In either of two scenarios, overburden is never moved twice, and when it is moved, it is never more than 1500'. And also, whether the end use of the property is a mixed type of development or anything else, the idea is that through this plan, usable land will be the end result.

The key point to keep in mind is that the inventory & analysis has to be done to gain the full potential of any operation. Once there is an understanding of the deposit, the site features, and the regional market, it is at that point that the potential end use development should be the guiding factor in the sequencing and shaping of the mining and reclamation program. In this particular situation, the deposit occurs in pockets, instead of one contiguous mining area. This presents both restraints and opportunities for AAC.

First, in terms of restraints, because the deposit is not one contiguous pit, the sequence and equipment for the mining will be more spread out and require more planning. Another restraint is the fact that at the current time, the processing plant is located south of the property and puts AAC in a situation to begin mining on the south side to be most efficient.

Second, in terms of opportunities, because the property is not going to be one big lake, there is much greater potential for unique and creative development. The development becomes that much more important simply from the fact that there will be a good deal of land left after mining is complete.

As a result of the mining operation, the 440+ acre property will be left with about 96 acres of lake. The biggest lake area, being mining area C, will be 62 acres and will also be the deepest, reaching as deep as 90 feet. To take the greatest advantage of the lakes from a development standpoint, the placement of the overburden was done in such a way as to create usable land. The fill areas were planned to be lower acreage, with building land higher to create views of the lakes. The land is to built in a terraced fashion in many cases to create levels of land, all with views of the lakes.

The approach to this project was done in such a way to plan a creative development, while at the same time, maximize a current mining deposit. The final design layout calls for close to 900 housing units, both single family and multi-family. The design would be from 3 to 4 units per acre. Since the current zoning calls for 5-acre lots, there may be a situation to contend with down the road. But, because of the expected growth of Oxford Township and the potential this site brings to the community, the higher density development makes good sense. At the same time, with short distances for hauling of overburden and because the deposit is maximized, the plan also makes good sense for the operation. This plan and the approach to it illustrates the point that the aggregate mining industry has a unique potential to create very valuable community developments, while continuing to maximize their operations.

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