ENVIRONMENTAL COMMISSION MEETING

Thursday, July 26, 2012
7:00 p.m.

Inver Grove Heights City Hall, Council Chambers

A G E N D A

1. **CALL TO ORDER**

2. **PLEDGE OF ALLEGIENCE**

3. **ROLL CALL**

4. **APPROVAL OF AGENDA**

5. **APPROVAL OF MINUTES**

   A. Februrary 23, 2012

6. **OLD BUSINESS**

7. **NEW BUSINESS**

   A. Consider a Sand and Gravel Overlay District designation five year renewal for the Bituminous Roadways asphalt plant located at 112th Street and Rich Valley Boulevard.

8. **CITIZEN COMMENTS**

9. **REPORTS AND UPDATES**

10. **ADJOURN**

Draft

ENVIRONMENTAL COMMISSION MEETING

Inver Grove Heights City Hall – Council Chambers
February 23, 2012

---

1. Call to Order

Meeting called to order at 7:00 PM by Chair Groenjes

2. Pledge of Allegiance

3. Roll Call

Commissioners Present: Chair Greg Groenjes, Ted Trenzeluk, Stephanie Schmid, Dustin Bower, and Susan Burke
Commissioners Absent: Mike Flaherty, Bob Pohlman, Robert Heidenreich, and Sarah Brass
Others Present: Heather Botten, Associate Planner
Allan Hunting, City Planner
Scott Thureen, City Engineer

4. Approval of Agenda

Agenda approved.

5. Approval of Minutes

Mr. Bower moved to approve the minutes from October 27, 2011 and Ms. Schmid seconded the motion. Motion to approve carried unanimously.

6. Old Business

7. New Business

A. Update on a Vacation of unimproved road right-of-way generally located east of Conrad Avenue and north of 102nd Street, owned by Macalester College.

Allan Hunting, City Planner stated that Macalester College is in negotiations with Dakota County to protect a large portion of a Natural History Area with permanent conservation easement. The applicant is requesting to vacate all of the public right-of-way within the plat of Dorr's Third Inver Grove Addition. Mr. Trenzeluk asked what it meant to vacate a property. Mr. Hunting replied that a vacation means to take away government rights typically from an easement or right-of-way and turn it back to private ownership.

From a planning perspective, since the land is part of the college property and used as a natural area, it would be logical to support the vacation request as the land could not be developed in the pattern is was platted and since it appears no streets would ever be built.

The Engineering Department during their review, found a document prepared in 2000 prepared by an engineering firm relating to future storm water routing and improvements. The plan was prepared to address specific issues for a pond between Concord Boulevard and Inver Grove Trail. To relieve pressure from an existing pond that was experiencing high water levels, three possible storm water outlet alignments to the river were studied. All three are in the vicinity of the vacation request. Engineering determined that some public means of access must be retained if the right-of-way was to be vacated.

Mr. Hunting continued stating that staff supports the vacation provided there are dedication of easements and agreements as listed in the staff report. Planning Commission also supports the vacation. The City Council tabled the request in order for the applicant and the City to finalize documents and for staff to update the Environmental Commission on the request. No formal action is required from the Environmental Commission.

Mr. Bower asked if the land was in the DNR scenic area. Mr. Hunting replied that it was not in a designated scenic area but was located in the critical area of the Mississippi River.

Mr. Bower asked what Macalester College was going to do with the land. Mr. Hunting replied that the vacation would provide a cleaner deed with the conservation easement and there would be no changes to the existing use of a nature center and open space.

Mr. Trenzeluk asked what the Planning Commission recommendation was. Mr. Hunting replied that they recommended approval with a change to the wording in condition #3 and to eliminate condition #4.

Mr. Bower stated he watched the City Council meeting and felt there was a disconnect between the City and Dakota County; he was curious to what the concerns were. Mr. Hunting replied there was confusion on the requested easements and access to the property.

Ms. Burke asked staff to explain Figure 8. Mr. Thureen, City Engineer replied the routes in Figure 8 reference different alternatives for potential future stormsewer outfall to the Mississippi River based on the study done in the year 2000. This study demonstrated high water levels at Pond KP-34. A plan was prepared showing three possible storm water outlet alignments to the river to address scenarios to relieve pressure from an existing landlocked pond with high water levels. The City Engineering Department did some further review on the three possible alignments; it was determined that the most cost effective route would be what is known as the northern alignment (Route C). Mr. Thureen continued saying that the College was asking the City to vacate City rights-of-way; it is common for the City to trade needs to acquire different easements.

Mr. Jerald Dosch, Macalester College stated the college is in the process of selling a conservation easement to the County. The college would be giving up the right to develop the land. The County was interested because of the green space initiative. The college benefits because the money is poured back into the land. The college is requesting the City to vacate the rights-of-way so the County can have all of the land and never have to worry about a road going through it.

Mr. Trenzeluk asked if not vacating the easement would void the deal between the County and the college. Mr. Dosch replied that if they are not allowed to vacate the City could access the right-of-way in the future. If the request continued without the new easement asked for by the City the County owns the development rights and the City could not condemn the land from the County; the City could not use eminent domain over the County land. Mr. Thureen commented that all of the interested parties have not met together at the same time to discuss the easements and access.

Mr. Trenzeluk asked if the property around KP34 was still developing. Mr. Thureen replied that it was and the City was trying to protect the pond and the landowners since it is a landlocked system.

Mr. Bower asked if the County was interested in agreeing to the easement. Mr. Dosch stated that the request started with a street vacation and the City added in the easement conditions; the requested easement does not benefit the County or Macalester. Mr. Dosch continued stating it was all theoretical, it may or may not be built and no one knows what would be built, if it did happen. The College and the County sent a letter to the City saying they are willing to work with the City but would like more specifics on the requested easement. Mr. Groenjes asked if the college was ok with the drainage easement and if they were concerned with the access. Mr. Dosch replied that access was part of it, overall they were unclear what the easement will be used for; they are not comfortable with the uncertainty. Mr. Dosch continued stating the mission for Macalester is research, education, public outreach, and sustainability. Stormwater from other land across the college property is not part of that mission.

Ms. Burke asked if the College had an alternative plan that would satisfy the City, College, and the County. Mr. Dosch replied that the President of Macalester recently sent a letter to the City to start negotiations.

Mr. Trenzeluk commented that he feels making a recommendation on the request would be premature. He continued stating he would prefer the Environmental Commission table the request until the City talks with the County or he would recommend to vacate the rights-of-way with no conditions. Mr. Bower stated he agreed with Mr. Trenzeluk's comments. He also wanted to know what the potential future cost and impact would be for to the City if a drainage easement is not granted. Ms. Schmid and Ms. Burke also commented they wish to table to request until more information is available.

Mr. Hunting stated that due to scheduling the request will be heard at the City Council meeting on March 12. In the meantime the parties will be meeting to work out the language for the requested documents.

Mr. Bower stated he would recommend the approval of the vacation of right-of-way without conditions. Mr. Trenzeluk seconded the motion. Motion passed unanimously (5-0).

B. Update on the 65th Street clean up near the "rubbish ranch" (65th Street and Buckley Way) as part of project 2012-09D.

Mr. Thureen presented the update on the 65th Street clean up. He stated the street reconstruction is schedule for 2012. The City Council has opened the public hearing until April 9, 2012. Mr. Thureen stated that a Phase I and II Environmental review were done on the property. The borings for the Phase II Environmental Site Assessment found levels of diesel range organics (DRO's) and low levels of lead contaminated soil requiring an approved disposal plan. The City met with the MPCA and Dakota County Environmental staff regarding the areas of contamination. A consulting firm has been hired to put together a response action plan. This item is being brought to the Environmental Commission for informational purposes.

Chair Groenjes asked if the soil was going to be removed from the road right-of-way and the contaminated soil outside of the right-of-way was going to be left alone. Mr. Thureen replied in the affirmative.

Mr. Bower asked if a liner was required, similar to what was used in the Landfills. Mr. Thureen replied that a liner was not required because it goes on top of existing contaminated material. The material used for capping is clay soil which minimizes the chance of it leeching downward.

Ms. Burke stated she had concerns about the contamination damaging the ponds to the north and south. Mr. Thureen replied that the City would follow the guidelines set forth by the Pollution Control Agency.

Mr. Trenzeluk asked who was responsible for paying for the street reconstruction. Mr. Thureen replied that there are five sources of funding because of all the different types of improvements being done. 65th Street is in the State aid system therefore the road will be brought up to state aid standards, additionally there would be stormsewer, minor watermain, and sanitary sewer work being done. Funding for the project is coming from state aid funds, pavement management funds, water fund, sewer fund, and special assessments.

Mr. Trenzeluk asked if there have been any reports of people getting sick in the area because of the contamination. Mr. Thureen replied he was not aware of any such claims.

Mr. Groenjes asked if Dakota County was in concurrence with the response action plan. Mr. Thureen responded in the affirmative.

Mr. Groenjes thanked Mr. Thureen for the update.

8. Citizen Comments

9. Reports and Updates

10. Adjourn

Mr. Bower moved to adjourn at 7:40. Ms. Burke seconded the motion. Motion approved unanimously.

PLANNING REPORT
CITY OF INVER GROVE HEIGHTS

REPORT DATE: July 16, 2012 **CASE NO:** 12-17CZA

APPLICANT: Bituminous Roadways

PROPERTY OWNER: Bituminous Roadways

REQUEST: Sand and Gravel Zoning District designation five (5) year renewal

LOCATION: 112th Street and Rich Valley Boulevard **HEARING DATE:**
Planning Commission 8/9/12
Environmental Commission: 7/26/12

COMPREHENSIVE PLAN: IOS, Industrial
Open Space **ZONING:** A, Agricultural

REVIEWING DIVISIONS: Planning
Engineering
Barr Engineering **PREPARED BY:** Allan Hunting
City Planner

BACKGROUND

Bituminous Roadways, Inc. has submitted an application for an extension of their five year Sand and Gravel Overlay Zoning District designation for their approximately 200 acre site. The operations at the existing site include the mining and removal, crushing, screening, washing and stockpiling of aggregate for the asphalt plant, and the recycling and stockpiling of concrete and rock products. The main processing activities will include, crushing, screening and washing. Over the life of the facility, mining is proposed to occur on approximately 141 acres of the site and the remaining 60 acres is designated as a buffer area.

Approvals of any Sand and Gravel Overlay Districts require renewal every five years. The current Sand and Gravel approval was granted on July 23, 2007 and expires on July 23, 2012. The site also operates under a Conditional Use Permit to allow for the asphalt plant, processing of sand and gravel and a contractor's yard with open storage. The conditional use permit does not require renewals.

The applicant has submitted a narrative describing the operation and has provided maps showing existing conditions and a final development plan for the gravel pit. The applicant is not proposing any changes to the operation of the site or the location of any equipment or buildings. Bituminous Roadways is requesting to add a single on-site groundwater well to supply makeup water for the wash plant operation.

Staff has submitted the plans to Barr Engineering for their review and asked them to respond to specific conditions of approval relating to the request for the additional well. Barr's report is attached to the staff report.

EVALUATION OF THE REQUEST

The site is surrounded by the following uses:
North - Vacant land; zoned A; guided IOS
East - Open space, west 100 acres/agricultural; zoned A and I-1; guided Limited Industrial
West - Open space/agricultural; zoned A; guided RDR
South - Residential, Open space/agricultural; zoned A; guided IOS

History

The City granted the original Sand and Gravel zoning of the property on May 13, 1974 for a period of 15 years. On December, 26, 1979, the City approved a conditional use permit for the asphalt plant. This permit was initially granted for a period of five years but was extended by the City, at the owners request in 1984. On April 24, 1989, the City approved the next five year extension and a CUP for the asphalt plant and for a contractors yard for the painting contractor that also operates out of the site. The City Council again approved an extension on March 28, 1994 for both the Sand and Gravel Overlay and for the CUP extension.

The City Council approved a five year extension for the Sand and Gravel Overlay and CUP for sand and gravel processing, asphalt plant and contractor's yard in April 2001 at the existing 70 acre site.

In 2002, the City Council approved a 130 acre expansion of the sand and gravel operation. That expansion required that an EAW be prepared for the site. This was done and was reviewed by the Environmental Commission and was approved by the City Council with a negative declaration that an environmental impact statement was not needed. Since that time, the City has approved two additional 5-year permits. The current sand and gravel approval expires July 23, 2012.

ANALYSIS

Since no changes are being proposed for the operation, the analysis of this report consists of a review of each of the conditions of approval for both the Sand and Gravel Overlay and Conditional Use Permit. The existing condition will be listed followed by a response on the status of that condition.

A. Sand and Gravel Temporary Zoning District

1. The Temporary Sand and Gravel (S&G) Zoning shall remain in place on the property for a period of five (5) years to expire on July 23, 2012.

   The application was submitted in time by the applicant to receive the new approval before July 23. Staff has had to extend the application process time in order to complete our review of the request. The item would be heard by the Council in August.

2. The operation of the sand and gravel operation approved herein shall comply with all provisions of Inver Grove Heights City Code, Section 515.19, Sand and Gravel Zoning District, except as specifically modified herein.

   No issues found with this condition. Staff is not aware of any non-compliance with this condition.

3. The following plans, on file with the Planning Division, shall constitute the "approved plans" referenced therein:
   Existing conditions dated 1/8/07
   Phasing Plan dated 1/8/07
   Final Land Use Plan dated 4/25/02
   Reclamation Plan dated 1/8/07
   Final Land Use Plan dated 4/26/02
   Landscaping Plan – east property line dated 11/28/01
   Landscape Plan – south property line dated 11/28/01
   All aspects of the operation of the site shall comply with the approved plans.

   The site has been operating in accordance with the approved plans since the expansion was approved in 2002. The current Comp Plan guides the area as IOP, Industrial Open Space. This category was created to serve as a buffer between heavier industrial uses (land fill, gravel pit and refinery) and residential uses. Industrial uses that are currently operating within this area would be allowed to continue operating under existing permits without further restrictions. The final land use plan shows large lot residential with a public street extending from Rich Valley Boulevard. No sewer is expected on the west side of Rich Valley and therefore the lots would be served by their own well and septic system. No other issues existing with this condition.

4. The washing operation shall use only water obtained from storm water ponds and shall not use any ground water from wells unless this sand and gravel ordinance is amended.

   The applicant is requesting a new well be allowed to supplement storm water collection for the washing part of the operation. Part of the process requires the aggregate to be washed

to remove the fine particles so it is clean to use in the asphalt mix. Bituminous Roadways has created some storm ponds on site to catch water that they use for the washing operation. In the last few years, there has not been enough rain to keep the storm ponds full for wash water. A new well is proposed so they may pump in the spring to fill three new storm ponds to utilize throughout the season. The city had Barr Engineering review the request to see what issues or concerns may arise with this request. Their report is attached. There are two wells in the area that have the potential to be impacted by the new well. On is the Wicker well that is on the residential property surrounded by the gravel pit along Rich Valley Boulevard. The other is a monitoring well on Pine Bend Owned land on the east side of Rich Valley. Barr concluded the proposed pumping is predicted to have a negligible impact on the groundwater flow in the area. The spring pumping would have a draw down effect on the two wells. The setting of the pump on the Wicker property is sufficiently deep enough that the water draw would not be deep enough to impact this well. The monitoring well could go dry for a short period of time (less than a day) before water is recharged in the area. Barr recommends that if a new well is allowed it should operate with the higher spring-time pumping rate rather than a slow draw during the summer. Barr does not find any negative impacts to any other wells or ground water impacts with this request. Based on this information, staff would support the request to allow a new well for wash water purposes. The new well would require a DNR appropriations permit.

5. The location of the asphalt plant shall remain in its existing position and shall not be relocated unless this sand and gravel ordinance is amended.

No changes proposed. No issues with this condition.

6. "Operation" as it relates to hours of operation, shall include, but is not limited to, all mining and grading operations, crushing and screening of rock, washing, the operation of the asphalt plant on the site, and movement of vehicles and equipment in and out of the site. Hours of operation on the site shall be limited to 7:00 a.m. to 7:00 p.m., Monday through Friday, 9:00 a.m. to 6:00 p.m. Saturday, except the asphalt plant may run 7:00 a.m. to 7:00 p.m., Saturday. The crushing of concrete and asphalt shall be regulated by condition #7.

The applicant is requesting some language be included which allows for some temporary expansion of night shift hours to address the bidding of a project that are done during evening hours. Night shift hours are required with certain jobs, including state highway work. The request would be to add a maximum of 30 total night shift hours per season to the asphalt plant operation schedule. Over the years, the applicant has requested additional night time hours and the Council has approved all those requests. Bituminous Roadways has always contacted the nearest neighbor to let them know of the night hours. They would continue this policy if the extended hours were approved. Staff, has always supported the requests to Council for any extended hours and supports this request. With the additional hours established by condition, the extra time and work is avoided through staff review and

council review of the requests. Staff would recommend that Bituminous provide the city with written notice prior to each event, including confirmation of contact with the nearest neighbor so a record can be kept to monitor total hours used each season.

7. Crushing of concrete on site shall be permitted provided the following conditions are met:

    1. All crushing operations shall be conducted in the current location in the existing site as of 6/4/02.
    2. The stockpile of concrete to be crushed and the stockpile of already crushed concrete shall not in the aggregate exceed a total of 50,000 cubic yards.
    3. The height of the stockpiles shall not exceed 25 feet.
    4. Crushing shall occur on not more than 12 weeks during the calendar year. No crushing shall occur on Sunday; crushing shall only occur between the hours of 7:00 a.m. and 7:00 p.m. Monday - Friday and 9:00 a.m. to 6:00 p.m., Saturday.

    No issues with this condition. To our knowledge, the site operates under these conditions. Staff has not received any complaints that the operator is working outside of the approved hours.

8. Bituminous Roadways may temporarily store Manufactured Organic Shingle Scrap (MOSS) in open storage areas provided the areas in the aggregate do not exceed one (1) acre in size and provided the location and storage configuration is approved by the Fire Marshal and Director of Community Development. MOSS storage areas may be relocated as operations on the site change subject to the approval of the Fire Marshal and the Director of Community Development. The City may impose reasonable conditions relating to dust control, fire prevention and size, height and configuration of the storage piles.

    Bituminous Roadways does temporarily store MOSS on site in the area identified as shingle storage on the site plan. The stock pile is located in the same area as the previous approval (typically in the northern portion of the site). No issues with this condition.

9. The final disposal of MOSS on the site shall be prohibited.

    Operational condition.

10. As part of the approval granted herein, the applicant may use used concrete and asphalt products as a part of the operation. Stockpiling area for these materials shall be as noted on the approved plans.

The proposed plans show the location of the product stockpiles. The stockpiles are generally located in the same location as previous approvals. No issues with this condition.

11. Bituminous Roadways shall prohibit all drivers of trucks from using Rich Valley Boulevard north of Cliff Road except in those instances where materials are being taken to a project located within the City's regulatory authority. Bituminous Roadways shall post an advisory to all drivers to the same effect at exits from the site.

No issues with this condition. To our Knowledge, the site operates under these conditions.

12. The site shall be kept clear, at all times, of windblown debris.

No issues with this condition. To our Knowledge, the site operates under these conditions.

13. The foundry sand in the southeast berm shall be left undisturbed.

The southeast foundry sand berm had been undisturbed and contained a vegetative cover. This condition has been satisfied.

14. Bituminous Roadways shall bring no additional foundry sand onto the site.

Operational condition. No additional foundry sand has been found on the site.

15. The berms which cover the foundry sand shall be maintained in vegetative cover to control erosion of the foundry sand.

This condition has been satisfied.

16. The stockpiled MOSS, shingle scrap, recycled asphalt, and concrete pavement will not be disposed at the site.

No issues with this condition. To our Knowledge, the site operates under these conditions.

17. Stock piles of recycled asphalt, MOSS, shingles, and concrete shall be limited in size to amount that will be used that year.

No issues with this condition. To our Knowledge, the site operates under these conditions.

18. Backfill material shall be either clean fill material that was stripped off the site or other clean fill material which is brought in from offsite.

Operational condition.

19. Spent bag house bags will be disposed of in a lined landfill permitted or approved to accept such materials.

Bituminous Roadways indicates the spent bags are disposed of at a landfill.

20. A restoration bond shall be in an amount to cover the costs of restoration of the site, as determined by the City Engineer, prior to City Council approval.

The City does have a restoration bond from Bituminous Roadways to cover the costs of restoration. The City Engineer indicates no changes are needed.

21. Bituminous Roadways shall obtain and maintain the necessary licenses and approvals from Dakota County and Minnesota Department of Natural Resources. Terms and conditions of the license and approval shall be hereby incorporated into this City approval.

Bituminous Roadways has provided the city with copies of all necessary permits from other agencies. The site is in compliance with this condition.

22. Bituminous Roadways shall obtain and maintain the necessary Minnesota Pollution Control Agency permits including two air quality permits and one industrial storm water permit. The terms and conditions of those permits shall be hereby incorporated into this City approval.

Bituminous Roadways has provided the city with copies of all of the required permits. No notices of violation have ever been issued by the MPCA. The site is in compliance with this condition.

23. All reports which are required to be submitted to Dakota County under the single Hazardous Waste Generators License and the one Processing License shall also be submitted to the City, including the required annual and quarterly reports.

Barr Engineering reviewed this condition for compliance. Barr found out from Dakota County that as of 2003, the facility was no longer a hazardous waste generator and no reports were required. Condition wording to be modified with this renewal.

24. All reports which are required to be submitted to the Minnesota Pollution Control Agency shall also be submitted to the City, including annual emissions inventory report, semi-annual deviations report, annual compliance certification report, and annual report.

Bituminous Roadways has provided to the city copies of their reports submitted to the MPCA. The site is in compliance with this condition.

25. Monitoring shall be conducted at the single ground water well that consists of arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, DRO, GRO, phenol, pH, electric conductivity and alkalinity. The monitoring should occur with half the wells every other year. Parameters and protocols shall be as agreed to by Dakota County, the City and Bituminous Roadways.

Staff has received copies of the well tests. According to the project narrative, the sample concentrations show the levels below limits.

26. Monitoring of the storm water ponds used for the washing operation shall be conducted every other year and shall be tested for the same elements as listed in condition #25.

Monitoring information on the storm water ponds was not yet available at the time this report was written. Response will be provided at the meeting.

27. All buildings shall be removed from the site within three (3) months of the closure of the facility.

Operational Condition.

28. Bituminous Roadways shall enter into a Host Community Agreement with the City of Inver Grove Heights including the payment of host community fees, within three (3) months of the State Legislature providing the City with the Authority to enter into such an agreement.

The Legislature has not approved any regulations providing cities the authority to collect host community fees for sand and gravel extraction. This condition should remain for future action.

29. Restoration shall be conducted in phases at the site. As portions of the mining area are completed, the areas will be backfilled, graded, topsoil applied and vegetation established.

Operational condition. Engineering would review the backfilling operation to make sure the work is in compliance with the approved plans.

B. Conditional Use Permit

1. Resolutions No. 02-107 and the conditions therein shall become null and void.

   Condition would be modified to reflect the latest Resolution number.

2. All terms and conditions of the approval of the temporary Sand and Gravel Zoning District for the property shall apply to all the operations on the site specifically stated herein, except where said terms and conditions may be modified by the conditions below, then the conditions of this permit shall prevail.

   Conditions and terms were discussed above.

3. Approval of this conditional use permit shall be valid for the duration of the Temporary Sand and Gravel Zoning or until such time that the sand and gravel operation on site shall cease to continue if such time frame is shorter. The sand and gravel operation and the approval granted herein shall terminate concurrently.

   Operational condition.

4. Where violations of the conditions of this permit are noted, the City is authorized to immediately terminate all operations on the site and resumption of operation will not be permitted until such violation is rectified.

   Operational condition. No violations have been noted.

5. The processing of the sand and gravel shall include, but not limited to; mining, crushing, screening, washing, sorting and blending into and stockpiling a variety of aggregates, and the recycling and stockpiling of concrete and rock products.

   Operational condition. Clarifies what processing is allowed.

6. The contractor's yard shall be used in substantial conformance with the plan entitled "Existing Conditions" dated 1/8/07, on file with the Planning Division.

   This condition reflects the Rainbow Painting Company that rents space in the metal building. The conditional use permit was for storage of vehicles associated with this use. No issues with this condition. To our knowledge, the site operates under these conditions.

7. The washing operation shall use only water obtained from storm water ponds and shall not use any ground water from wells.

The applicant is requesting to allow a new well for the washing operation. See the discussion in the Sand and Gravel review.

8. The location of the asphalt plant shall remain in its existing position and shall not be relocated.

No issues with this condition. The asphalt plant is in the same location.

9. All buildings shall be removed from the site within three (3) months of the closure of the facility.

Operational condition.

10. The area on the site plan identified as woods on the west side that is not being excavated shall be preserved and no cutting of trees shall occur as a result of the mining operation. A restrictive covenant shall be placed over this portion of the site to insure its protection.

This condition has been completed and satisfied and should be removed with this renewal.

11. Storage of equipment and vehicles for Rainbow Painting shall be limited to the building designated "garage" on the approved site plan and the adjacent area located south of the metal building.

No issues with this condition. To our Knowledge, the site operates under these conditions. The area is identified on the existing conditions plan.

12. All plans submitted by the applicant shall be subject to the review and recommendations made by the City Engineer and Director of Public Works.

Engineering is still in the process of reviewing the plans. Engineering has reviewed and approved previous plan sets and since no changes are being proposed, no issues are expected.

13. Monitoring shall be conducted at the single ground water well on the site known as the "Rainbow well" and on the Todd Wicker and Robert Plan property, that consists of arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, DRO, GRO, phenol, pH, electric conductivity and alkalinity. The monitoring shall occur at half the wells one year and the other half the next year. Parameters and protocols shall be as agreed to by Dakota County, the City and Bituminous Roadways.

Monitoring reports have been submitted for testing of the 3 wells. See condition #25 above.

ALTERNATIVES

The Planning Commission has the following actions available on the proposed project:

A. Approval: If the proposed request is found to be acceptable, approval of the applicable following actions should be taken:

- Approval of the **Temporary Sand and Gravel Zoning** Renewal for a period of five (5) years subject to the following conditions:

1. The Temporary Sand and Gravel (S&G) Zoning shall remain in place on the property for a period of five (5) years to expire on (council approval date), 2017.

2. The operation of the sand and gravel operation approved herein shall comply with all provisions of Inver Grove Heights City Code, Title 10-13G, Sand and Gravel Overlay District, except as specifically modified herein.

3. The following plans, on file with the Planning Division, shall constitute the "approved plans" referenced therein:

   Existing conditions dated 7/21/12
   Phasing Plan dated 7/21/12
   Final Land Use Plan dated 4/25/02
   Reclamation Plan dated 7/21/12
   Landscaping Plan – east property line dated 2012
   Landscape Plan – south property line dated 2012

   All aspects of the operation of the site shall comply with the approved plans.

4. The location of the asphalt plant shall remain in its existing position and shall not be relocated unless this sand and gravel ordinance is amended.

5. "Operation" as it relates to hours of operation, shall include, but is not limited to, all mining and grading operations, washing, the operation of the asphalt plant on the site, and movement of vehicles and equipment in and out of the site. Hours of operation on the site shall be limited to 7:00 a.m. to 7:00 p.m., Monday through Saturday, except for the crushing of concrete which shall be regulated by Condition #7. The asphalt plant shall be allowed to operate a maximum of 30 night shifts (7:00 p.m. to 7:00 a.m.) during the construction season each year. Bituminous Roadways shall provide the city with written notice prior to each event, including confirmation of contact with the nearest neighbor so a record can be kept to monitor total hours used each season.

6. Crushing of concrete on site shall be permitted provided the following conditions are met:

    1. All crushing operations shall be conducted in the current location in the existing site.
    2. The stockpile of concrete to be crushed and the stockpile of already crushed concrete shall not in the aggregate exceed a total of 50,000 cubic yards.
    3. The height of the stockpiles shall not exceed 25 feet.
    4. Crushing shall occur on not more than 12 weeks during the calendar year. No crushing shall occur on Sunday; crushing shall only occur between the hours of 7:00 a.m. and 7:00 p.m. Monday – Friday and 9:00 a.m. to 6:00 p.m., Saturday.

7. Bituminous Roadways may temporarily store Manufactured Organic Shingle Scrap (MOSS) in open storage areas provided the areas in the aggregate do not exceed one (1) acre in size and provided the location and storage configuration is approved by the Fire Marshal and Director of Community Development. MOSS storage areas may be relocated as operations on the site change subject to the approval of the Fire Marshal and the Director of Community Development. The City may impose reasonable conditions relating to dust control, fire prevention and size, height and configuration of the storage piles.

8. The final disposal of MOSS on the site shall be prohibited.

9. As part of the approval granted herein, the applicant may use used concrete and asphalt products as a part of the operation. Stockpiling area for these materials shall be as noted on the approved plans.

10. Bituminous Roadways shall prohibit all drivers of trucks from using Rich Valley Boulevard north of Cliff Road except in those instances where materials are being taken to a project located within the City's regulatory authority. Bituminous Roadways shall post an advisory to all drivers to the same effect at exits from the site.

11. The site shall be kept clear, at all times, of windblown debris.

12. The foundry sand in the southeast berm shall be left undisturbed.

13. Bituminous Roadways shall bring no additional foundry sand onto the site.

14. The berms which cover the foundry sand shall be maintained in vegetative cover to control erosion of the foundry sand.

15. The stockpiled MOSS, shingle scrap, recycled asphalt, and concrete pavement will not be disposed at the site.

16. Stock piles of recycled asphalt, MOSS, shingles, and concrete shall be limited in size to amount that will be used that year.

17. Backfill material shall be either clean fill material that was stripped off the site or other clean fill material which is brought in from offsite.

18. Spent bag house bags will be disposed of in a lined landfill permitted or approved to accept such materials.

19. A restoration bond shall be in an amount to cover the costs of restoration of the site, as determined by the City Engineer, prior to City Council approval.

20. Bituminous Roadways shall obtain and maintain the necessary licenses and approvals from Dakota County and Minnesota Department of Natural Resources. Terms and conditions of the license and approval shall be hereby incorporated into this City approval.

21. Bituminous Roadways shall obtain and maintain the necessary Minnesota Pollution Control Agency permits including two air quality permits and one industrial storm water permit. The terms and conditions of those permits shall be hereby incorporated into this City approval.

22. All reports which are required to be submitted to Dakota County under a Hazardous Waste Generators License and a Processing License shall also be submitted to the City, including the required annual and quarterly reports.

23. All reports which are required to be submitted to the Minnesota Pollution Control Agency shall also be submitted to the City, including annual emissions inventory report, semi-annual deviations report, annual compliance certification report, and annual report.

24. Monitoring shall be conducted at the single water well that consists of arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, DRO, GRO, phenol, pH, electric conductivity and alkalinity. The monitoring shall occur with half the wells every other year. Parameters and protocols shall be as agreed to by Dakota County, the City and Bituminous Roadways.

25. Monitoring of the storm water ponds used for the washing operation shall be conducted every other year and shall be tested for the same elements as listed in condition #24.

26. All buildings shall be removed from the site within three (3) months of the closure of the facility.

27. Bituminous Roadways shall enter into a Host Community Agreement with the City of Inver Grove Heights including the payment of host community fees, within three (3) months of the State Legislature providing the City with the Authority to enter into such an agreement.

28. Restoration shall be conducted in phases at the site. As portions of the mining area are completed, the areas will be backfilled, graded, topsoil applied and vegetation established.

o Approval of the **Conditional Use Permit Amendment** for the processing of sand and gravel, an asphalt plant and contractor's yard with open storage subject to the following conditions:

1. Resolutions No. 07-122 and the conditions therein shall become null and void.

2. All terms and conditions of the approval of the temporary Sand and Gravel Zoning District for the property shall apply to all the operations on the site specifically stated herein, except where said terms and conditions may be modified by the conditions below, then the conditions of this permit shall prevail.

3. Approval of this conditional use permit shall be valid for the duration of the Temporary Sand and Gravel Zoning or until such time that the sand and gravel operation on site shall cease to continue if such time frame is shorter. The sand and gravel operation and the approval granted herein shall terminate concurrently.

4. Where violations of the conditions of this permit are noted, the City is authorized to immediately terminate all operations on the site and resumption of operation will not be permitted until such violation is rectified.

5. The processing of the sand and gravel shall include, but not limited to; mining, crushing, screening, washing, sorting and blending into and stockpiling a variety of aggregates, and the recycling and stockpiling of concrete and rock products.

6. The contractor's yard shall be used in substantial conformance with the plan entitled "Existing Conditions" dated 1/8/07, on file with the Planning Division.

7. The location of the asphalt plant shall remain in its existing position and shall not be relocated.

8. All buildings shall be removed from the site within three (3) months of the closure of the facility.

9. Storage of equipment and vehicles for Rainbow Painting shall be limited to the building designated "garage" on the approved site plan and the adjacent area located south of the metal building.

10. All plans submitted by the applicant shall be subject to the review and recommendations made by the City Engineer and Director of Public Works.

11. Monitoring shall be conducted every other year at the single ground water well on site known as the "Rainbow well" and on the Todd Wicker and Robert Plan property, that consists of arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, DRO, GRO, phenol, pH, electric conductivity and alkalinity. The monitoring shall occur at half the wells one year and the other half the next year. Parameters and protocols shall be as agreed to by Dakota County, the City and Bituminous Roadways.

12. The owner shall provide the City Engineering Division full access to the property for an annual storm water maintenance, erosion control, and sediment control inspections.

B. Denial: Should the proposed request, or portions thereof, not be found to be acceptable, the appropriate requests described above should be denied. The basis for denial must be stated in any such motion.

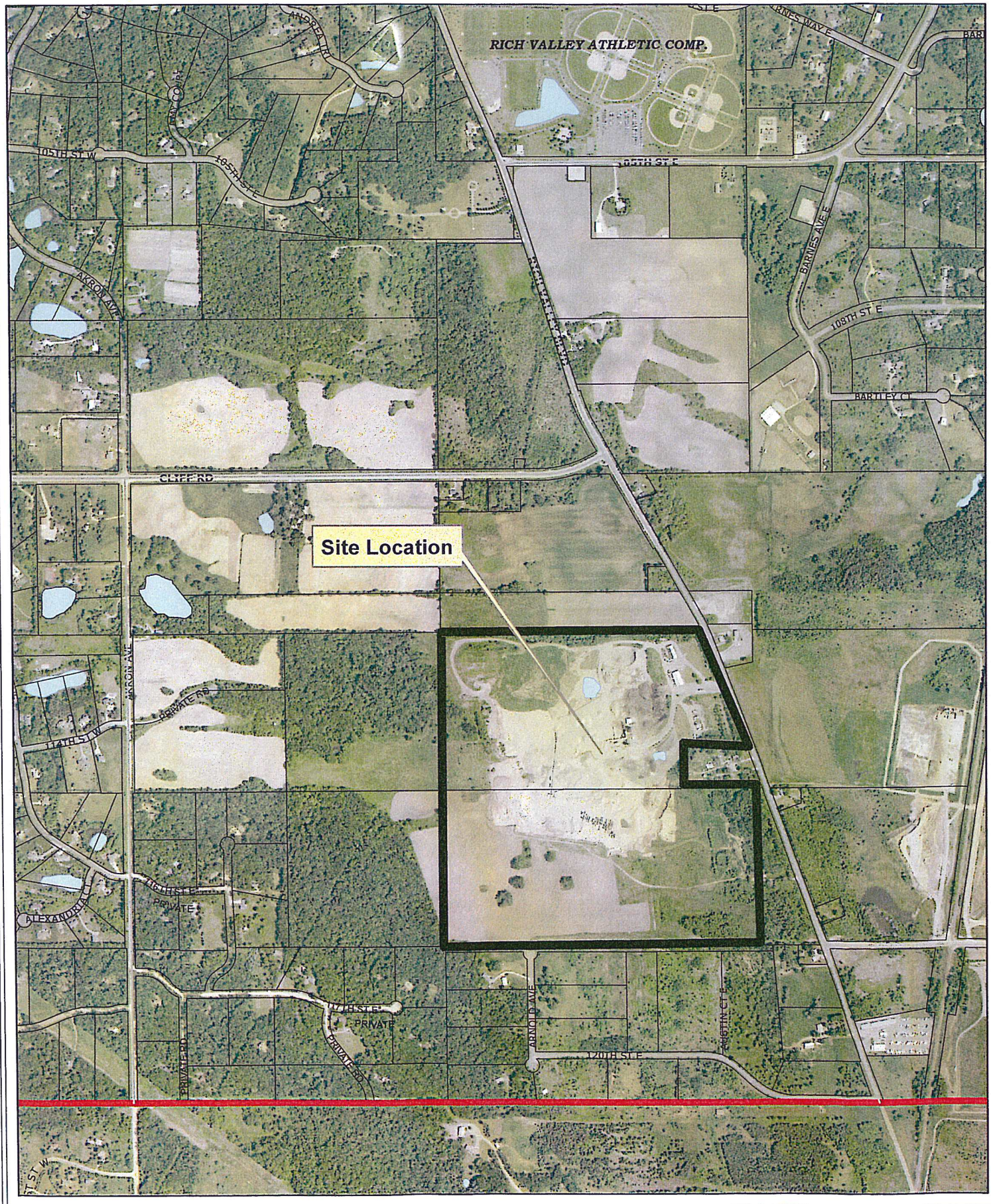
RECOMMENDATION

Staff and Barr Engineering do not find any issues with the five year renewal and conditional use permit amendment. Staff also concurs with Barr 's analysis on the proposed well finds no issue with allowing the well. As such, Staff recommends **Alternative A**, approval of the request with the conditions listed.

Attachments: Site Location
Application Packet including Plans
Barr Engineering Report

Inver Grove Heights

Location Map
Case No. 12-17CZA



~~April 2012~~
Revised July 2, 2012

REPORT TO:

BITUMINOUS ROADWAYS, INC.

APPLICATION FOR REISSUANCE OF CONDITIONAL USE PERMIT 07-11C FOR THE MINING AND PROCESSING OF SAND AND GRAVEL, AN ASPHALT PLANT AND CONTRACTOR'S YARD WITH OPEN STORAGE AND FIVE YEAR SAND AND GRAVEL OVERLAY DISTRICT

INVER GROVE HEIGHTS, MINNESOTA

Consulting Civil Engineers

Sunde Engineering, PLLC.
10830 Nesbitt Avenue South• Bloomington, Minnesota 55437-3100
Phone: (952) 881-3344 • Fax: (952) 881-1913 • E-Mail: info@sundecivil.com

REPORT TO:

BITUMINOUS ROADWAYS, INC.

APPLICATION FOR REISSUANCE OF CONDITIONAL USE PERMIT 07-11C FOR THE MINING AND PROCESSING OF SAND AND GRAVEL, AN ASPHALT PLANT AND CONTRACTOR'S YARD WITH OPEN STORAGE AND FIVE YEAR SAND AND GRAVEL OVERLAY DISTRICT

INVER GROVE HEIGHTS, MINNESOTA

I HEREBY CERTIFY THAT THIS REPORT WAS PEPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER AND A DULY LICENSESD PROFESSIONAL GEOLOGIST UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kirsten Pauly, P.E. P.G.

DATE 7/2/12 REG. NO. 21842

SUBMITTED BY:

SUNDE ENGINEERING, PLLC
10830 Nesbitt Avenue South
Bloomington, MN 55437

Table of Contents

LIST OF FIGURES:

LIST OF PLANS:

LIST OF APPENDICES

I. INTRODUCTION

Bituminous Roadways, Inc. (BRI) currently operates a sand and gravel mining facility located in the southern portion of Inver Grove Heights (Site). This application pertains to a five year permit renewal of the Conditional Use Permit associated with the facility.

The Site includes both the original mining operation and asphalt production plant which has been permitted since 1963 and the southern portion of the current mining operation which was originally permitted in 2002 after completion of an Environmental Assessment Worksheet (EAW). During the 2002 permitting process, both areas were combined into one permit to facilitate the five year permit review and renewal process.

The Site is operating in accordance with Conditional Use Permit 07-11C. Activities allowed under the permit include mining and processing, (crushing screening and washing) stockpiling, loading and hauling, reclamation, and operation of an asphalt plant and a contractors yard. In addition, the Site operates under a National Pollutant Discharge Elimination System (NPDES) Stormwater Permit and Air Emissions Permit issued by the Minnesota Pollution Control Agency (MPCA), a Minnesota Department of Natural Resources (DNR) Water Appropriations Permit, and a Dakota County Hazardous Waste Generators License and Processing License. Environmental Review was completed for this Site on April 8, 2002 in accordance with the Minnesota Environmental Quality Board Rules with the City of Inver Grove Heights as the Responsible Government Unit (RGU).

This report and accompanying plan set provides information regarding the mining operation.

II. SITE INFORMATION

1. General Site Information

The Site is located in a portion of Section 32, Township 27 North, Range 22 W, in the City of Inver Grove Heights in Dakota County. The Site is situated just west of County Road 71 (Rich Valley Boulevard). The general location of the Site is illustrated on Figure 1.

The entire property encompasses a total of approximately 201 acres. Over the entire life of the facility, mining is proposed to occur on approximately 141 acres of the Site and the remaining 60 acres is designated buffer area. Mining has been completed over the majority of the northern portion of the site and is progressing to the south. Reclamation activity has begun and will continue throughout the next five year permit term on the northern portion of the Site in areas where mining has been completed.

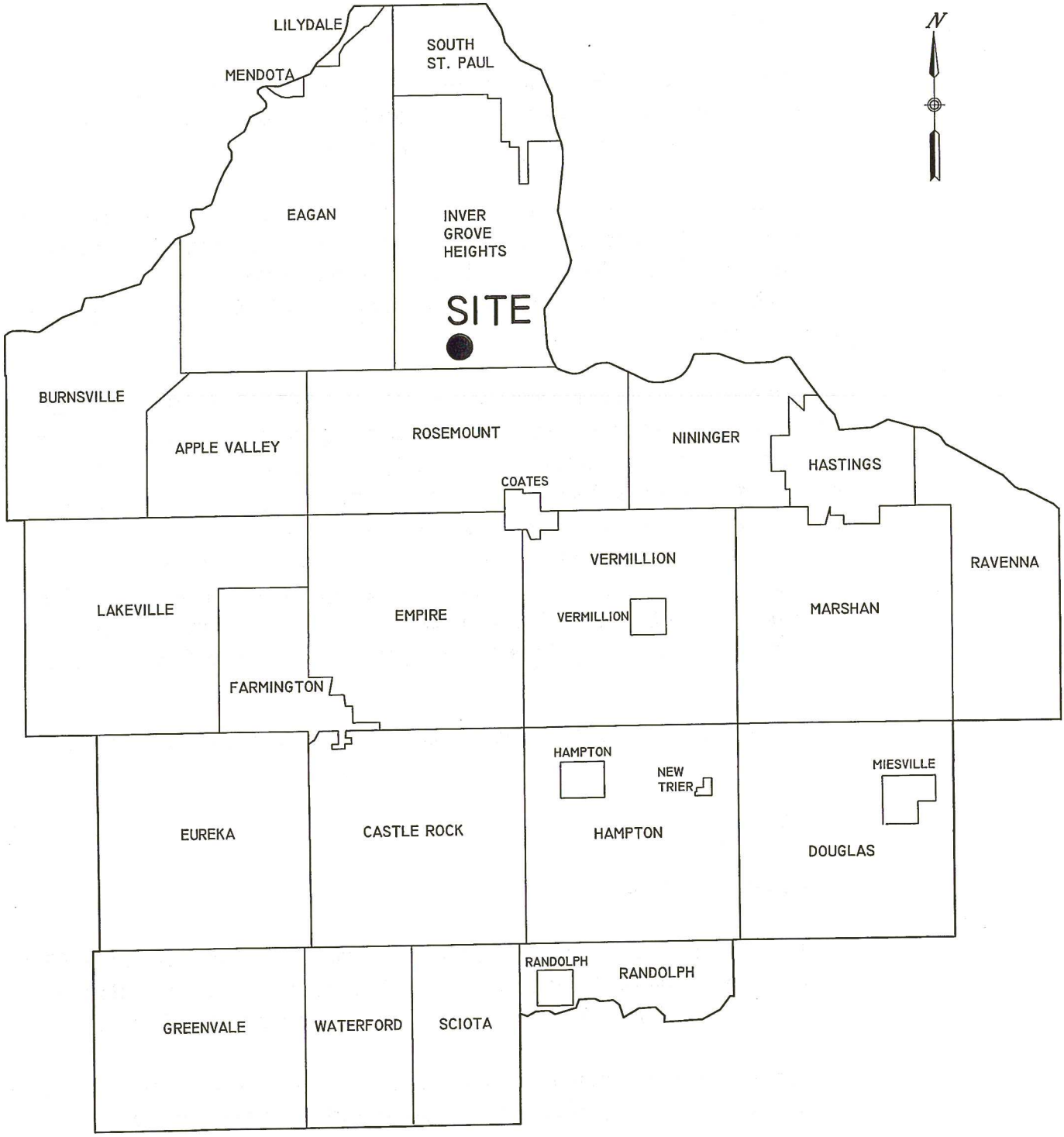


FIGURE 1
GENERAL LOCATION MAP

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

The majority of the current mining activity takes place in the southern portion of the Site. Portions of this area have been stripped in preparation for the progression of mining. A screening berm was constructed and seeded along the southwest corner of the Wicker property and along the southern property line during the fall of 2006. Inactive phases of the Site continue to be used for agricultural production and open space/wooded areas. A gas pipeline runs along a portion of the southern boundary of the Site and transects the western portion of the Site. The pipeline will not be disturbed as part of the mining operations.

Surrounding land uses include agricultural production to the north (under the control of Flint Hills Resources), rural residential to the south and west, and agricultural and industrial to the east and southeast. The Site with respect to adjacent features is indicated on Figure 2, USGS Quadrangle Map Excerpt.

Specific Site features are indicated on the Existing Conditions Plan, Sheet C-1 located in the back of this report.

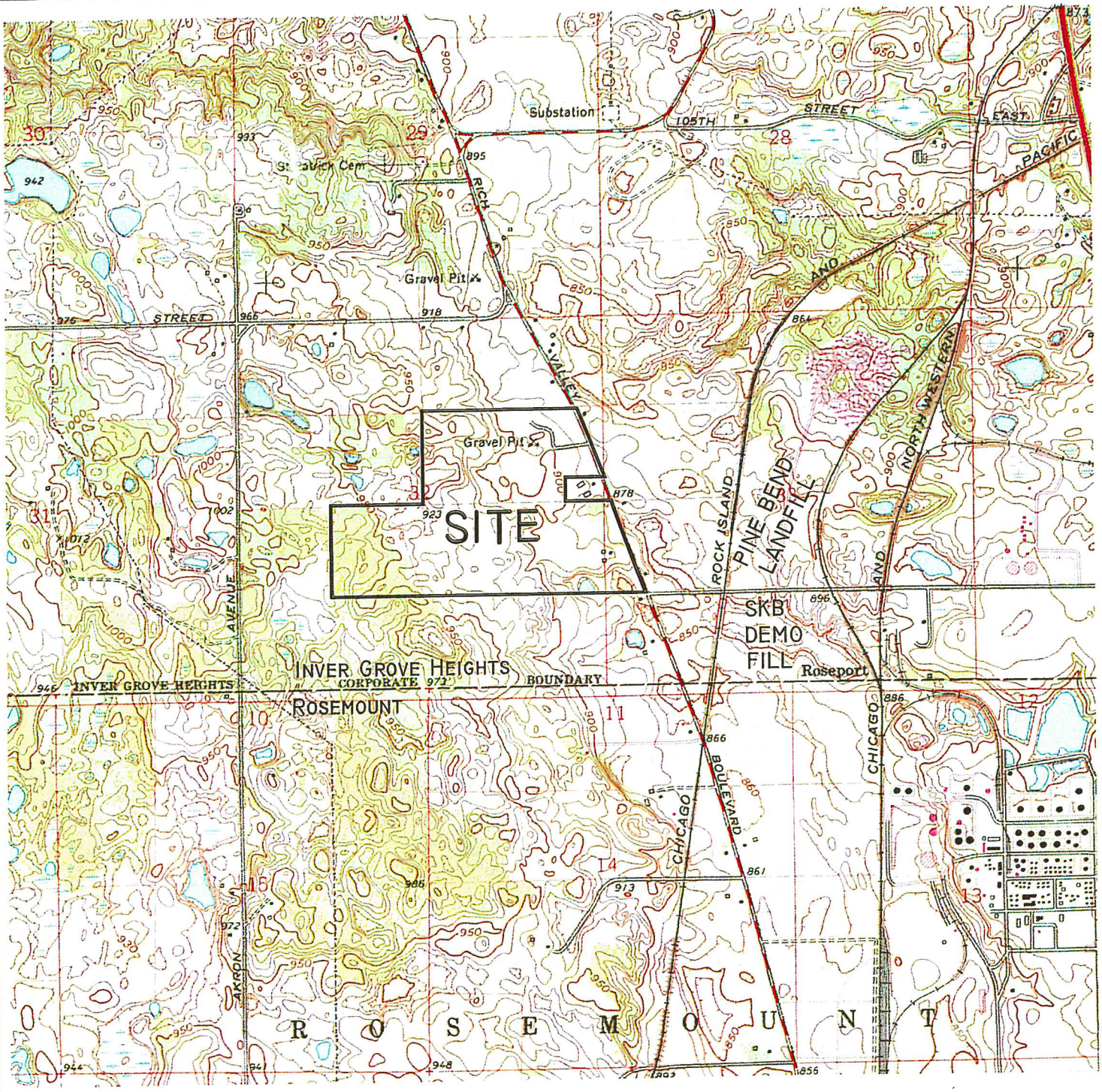
2. Site Ownership

The northern parcel is owned by:
Gerda Limited Partnership
c/o Debra Lacount
13907 Dublin Road
Apple Valley, MN 55124
(952) 322-2214

The southern parcel is owned by:
Bituminous Roadways, Inc.
1520 Commerce Drive
Mendota Heights, MN 55120
(651) 686-7001

3. Site Operator

The Site is operated by:
Bituminous Roadways, Inc.
1520 Commerce Drive
Mendota Heights, MN 55120



Source: USGS 7.5 MINUTE SERIES
TOPOGRAPHIC QUADRANGLE 1967
INVER GROVE HEIGHTS, MINNESOTA

FIGURE 2
USGS QUADRANGLE MAP EXCERPT

N

0 1000 2000
SCALE IN FEET

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

4. Legal Description

The legal description of the site is as follows:

That part of the S ½ of the NE ¼ of Section 32, Township 27, Range 22, W, lying Westerly of Rich Valley Boulevard; except that part described as follows: Commencing at the SE corner of said S ½ of the NE ¼; thence West along the South line thereof, a distance of 592.43 feet; thence North 344.9 feet; thence East 570 feet to the centerline of Rich Valley Boulevard; thence Southeasterly along said centerline, a distance of 67 feet to the East line of said S ½ of the NE ¼; thence South 281.85 feet to the point of beginning. PID No. 20-03200-05-011.

And

The Northeast Quarter (NE¼) of the Southwest Quarter (SW ¼) and the North One-Half (N½) of the Southeast Quarter (SE¼), Section thirty-two (32), Township twenty-seven (27), Range twenty-two (22) AND All of that tract of land lying West of Highway Number Five (5) in the Northwest Quarter (NW ¼) of the Southwest Quarter (SW ¼), Section thirty–three (33), Township twenty-seven (27), Range twenty-two (22); subject to an easement to Minnesota Northern Natural Gas Company, as described in Deed recorded in Book 193 of Deeds, page 374. PID No. 20-03200-75-010, 20-03300-05-020, 20-03200-51-010.

5. Neighboring Properties

A property owner's list within 1000 feet of the Site is included in Appendix A.

III. OPERATIONS

1. Mineral Extraction

Site operations consist of stripping overburden from areas to be mined. The overburden is used to create screening berms along the perimeter of the property. The depth of overburden varies across the site from one to seven feet in thickness based on soil borings drilled over the project area. Overburden remains on Site and is later used during the reclamation process.

Aggregate is removed from the bank using a front end loader. Excavation will occur to a maximum depth of 840 feet above mean sea level (msl). Areas around the perimeter of the Site may be mined to 840 feet above msl and subsequently backfilled with on-site sand or clean soil fill to achieve the proposed reclamation grades.

Excavation will proceed in phases as illustrated on the Phasing Plan, Sheet C-2. Each phase is estimated to represent approximately five years worth of mining activity. The expected duration of mining is an additional twenty to twenty five years, although the actual life of the Site will depend upon market demand. Cross Section A-A', B-B' and C-C' Sheets C-3 through C-5 illustrate the sand and gravel deposit, maximum mining depth, reclamation grades, and existing grades.

2. Processing

Excavated material is screened and crushed at the active face and then transported to the northern portion of the Site for additional processing. The screening and crushing units are portable and move with the movement of the active face. Material is transported from the active face to the processing area using conveyors and/or off road haul trucks. Additional processing includes crushing, washing screening, sorting and blending into a variety of aggregate products. The majority of the material is used to produce hot mix asphalt at the on-site plant.

Recycling of concrete and asphalt occurs in the northern portion of the Site. The material is hauled to the Site and stockpiled. The concrete is periodically crushed and blended into specific aggregate products. The combined volume of concrete material to be crushed and the crushed concrete stockpile is not allowed to exceed 50,000 cubic yards. Asphalt is crushed and added directly into the asphalt plant to produce various hot mixes. Crushing associated with the recycling operation is restricted to no more than 12 weeks of operation during the calendar year and is subject to the same hours of operation of the remainder of the facility operations (item 4 below).

Manufactured organic shingle scrap (MOSS) are also recycled in the northern portion of the Site. These materials are put through a grinder and then added to the asphalt plant process.

A wash plant is operated periodically on the site. A wash plant is simply a structure that is composed of a series of screens and spray bars. As aggregate is passed through the plant it is sprayed with water to remove fine sand and silt from the aggregate. The washwater contains no chemicals or additives. After the washwater passes through the plant, it is discharged into a series of sedimentation ponds. The sedimentation ponds allow for the fine sediment to settle out of the washwater. Clarified washwater is recycled back to the wash plant from the final sedimentation pond for reuse.

Washwater has been obtained from an on-site pond in the past. The pond collects stormwater runoff from the adjacent area, but has not been able to provide a continual or reliable supply of water sufficient to operate the wash plant. BRI is planning to add a single

on-site groundwater well to supply makeup water to the system. The proposed new well will supply up to 450 gallons per minute (gpm) for approximately 1,584 hours per year or 42.8 million gallons per year. Initially water from the on-site well will be pumped into a series of sedimentation ponds to fill the ponds and then to supply makeup water as needed. These ponds will be used to supply water to the wash plant. After the washwater passes through the plant, it will be discharged into the sedimentation ponds. Water from the final sedimentation pond is recycled back to the wash plant for reuse.

The Site is located west of the Pine Bend Landfill, a known source of groundwater contamination. The Minnesota Pollution Control Agency (MPCA), including the MPCA's hydrogeologist assigned to the site, was contacted to review the proposed placement of the well. Past studies at the Landfill and continued monitoring of the facility have included the establishment of a designated special well construction area. The proposed well is located outside of this district and almost one mile from the current limits of the groundwater contamination plume. Figure 3, Proposed Well Location, illustrates the location of the landfill, the special well construction area, approximate groundwater plume limits and the proposed location of the Bituminous Roadways well.

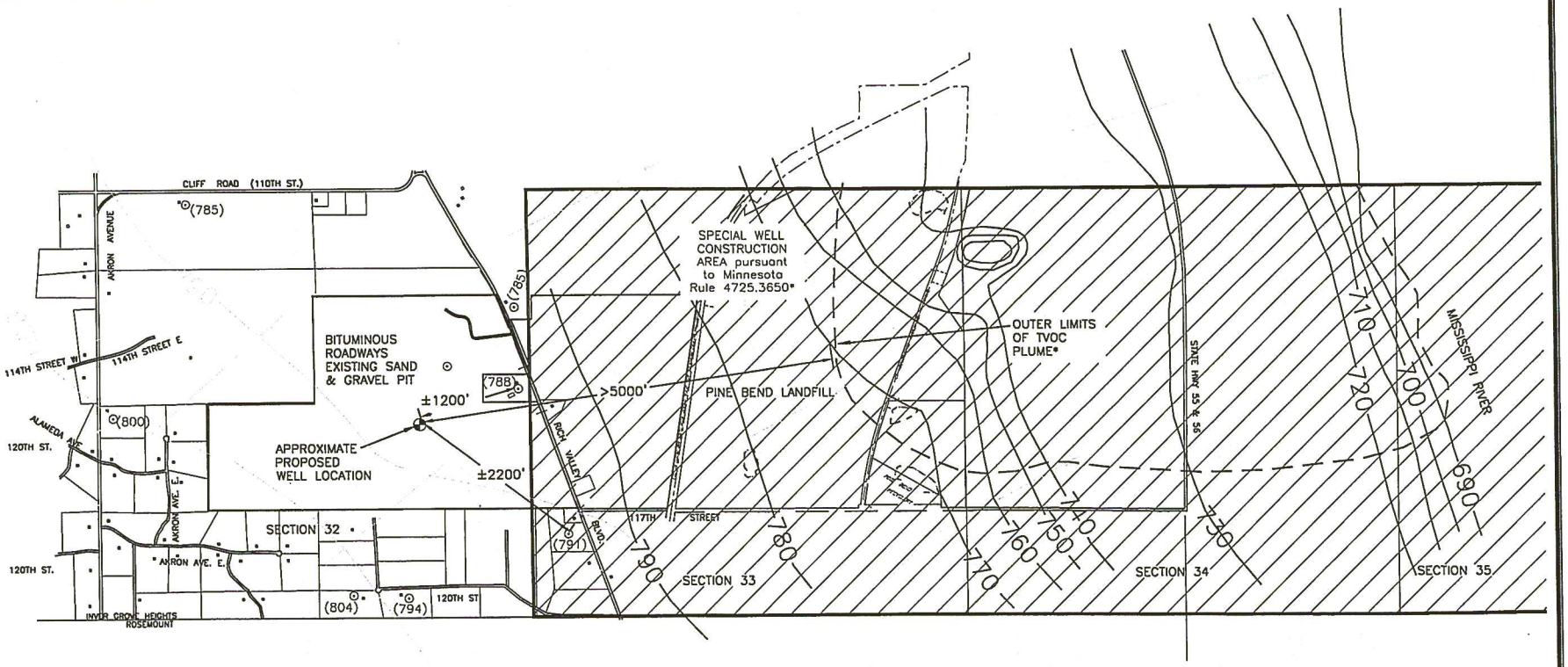
The use of the well will be seasonal and limited to pumping no more than 12 hours a day, 5 days per week, and then only when needed to fill the ponds up at the start of the washing season and then to provide make up water, (to replace water lost to the product and through evaporation) during washing. The limited duration of pumping will allow the groundwater table to rebound during the 12 hours of no pumping each day. Averaging the water use over the course of the washing season (26 weeks) amounts to an effective withdrawal rate of 155 gpm which is unlikely to have any impact on the direction of groundwater flow within the impacted area of the landfill. The current water appropriations permit will be amended, prior to using well water. The appropriate permits will be applied for prior to installing the well and the appropriate construction procedures will be followed.

3. Fencing

Portions of the site adjacent to steep slopes are fenced with six foot high chain link fencing. Fencing is illustrated on the Existing Conditions Plan C-1.

4. Hours of Operation

The Site operates between the hours of 7 a.m. and 7 p.m. Monday through Friday and 9 a.m. and 6 p.m. Saturday, for all activities except the asphalt plant which may operate from 7 a.m. – 7 p.m. on Saturdays.



*Source: Third Five-Year Review Report for Pine Bend Sanitary Landfill SW-45, dated February 2010, by US EPA

LEGEND

780 — GROUNDWATER CONTOUR (SOURCE: Figure 3 of 2011 Summer Water Quality and Natural Attenuation Monitoring Report by GES, dated Sept. 27, 2011)

790 GROUNDWATER CONTOUR (Interpreted from local well and boring log data.)

(791) GROUNDWATER ELEVATION

⊙ EXISTING WELL

PROPOSED WELL

DIRECTION OF GROUNDWATER FLOW

N

0 1000 2000

SCALE IN FEET

FIGURE 3

PROPOSED WELL LOCATION

BITUMINOUS ROADWAYS INC.

INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

Bituminous Roadways would like to add a maximum of 30 total night shifts per season to the asphalt plant operation schedule. Night shifts are required with certain jobs, especially State Highway work. BRI currently operates periodic night shifts with prior verbal permission from the nearest resident, Todd Wicker, and the City. Mr. Wicker's house is approximately 600 feet from the plant's driveway and approximately 800 feet from the asphalt plant itself. The next nearest occupied residence is approximately 2,000 feet from the plant. In the past years of night shift operations, Bituminous Roadways has never received any noise or disruption complaints from neighbors. Bituminous Roadways will continue to verbally request permission from Mr. Wicker prior to scheduling a night shift, but would like to incorporate night shift work into the 2012 CUP.

5. Setbacks

Stripping, excavation, processing, stockpiling and sedimentation ponds are setback a minimum of 50 feet from all property lines and gas pipelines, a minimum of 75 feet from the right-of-way line of County Road 71 (Rich Valley Boulevard) and a minimum of 300 feet from adjacent residential structures. Setbacks are indicated on the Phasing Plan, Sheet C-2.

6. Site Access

The Site is accessed off of County Road 71 (Rich Valley Boulevard). The entrance to the Site is paved for at least 75 feet. The haul routes are currently Rich Valley Boulevard north to Cliff Road and Rich Valley Boulevard south to 117th Street. Average daily traffic generated from the Site is approximately 150 truck trips per day. Levels of production are expected to remain fairly consistent over the course of the next permitting period.

7. Landscaping

The setback areas on the Site will be landscaped in accordance with the approved landscape plans (see Figures 4, 4A and 4B). Landscaping includes the establishment of berms along Rich Valley Boulevard and along portions of the southern setback area of the Site. A portion of the berm along the southern setback area has been constructed.

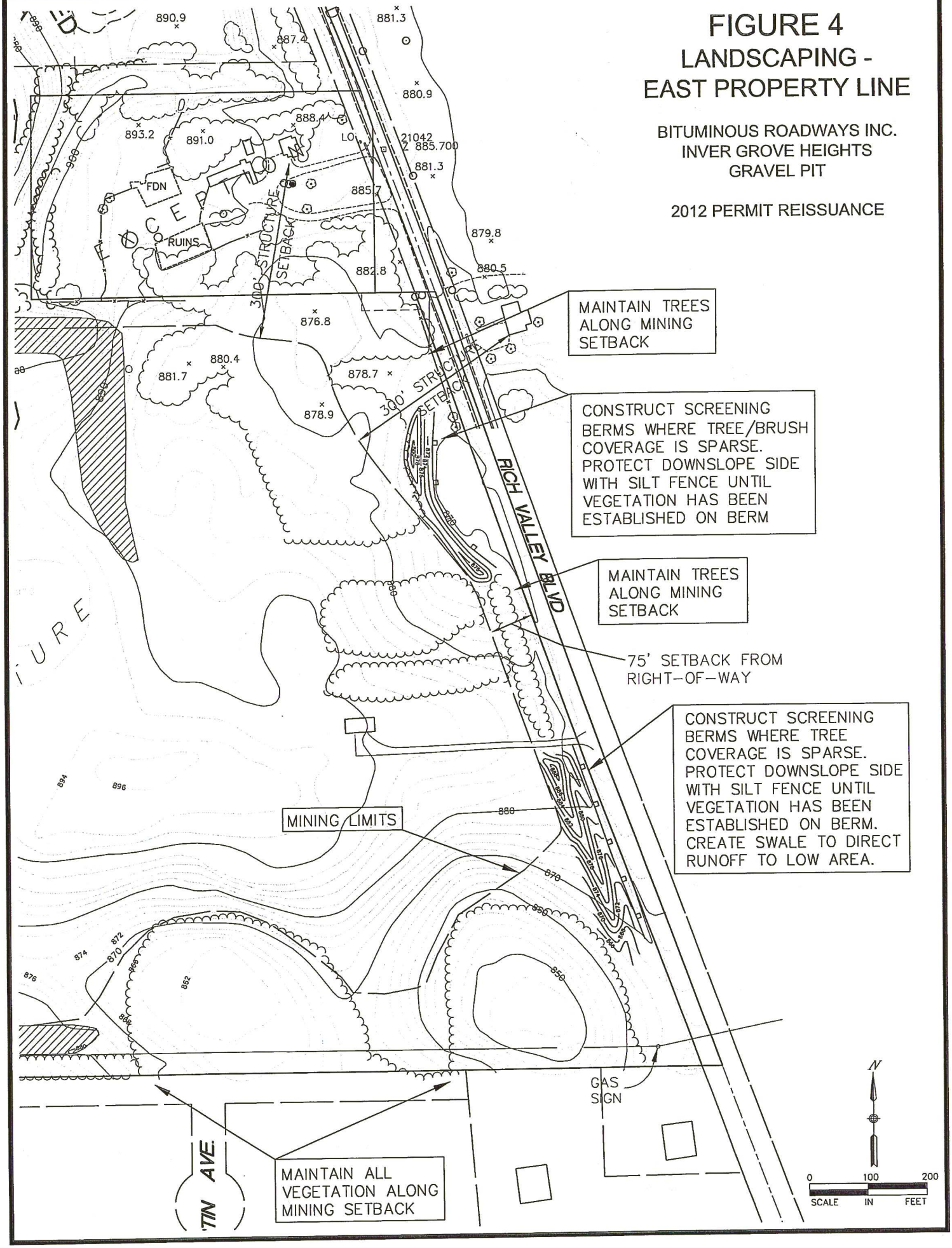
8. Weed Control

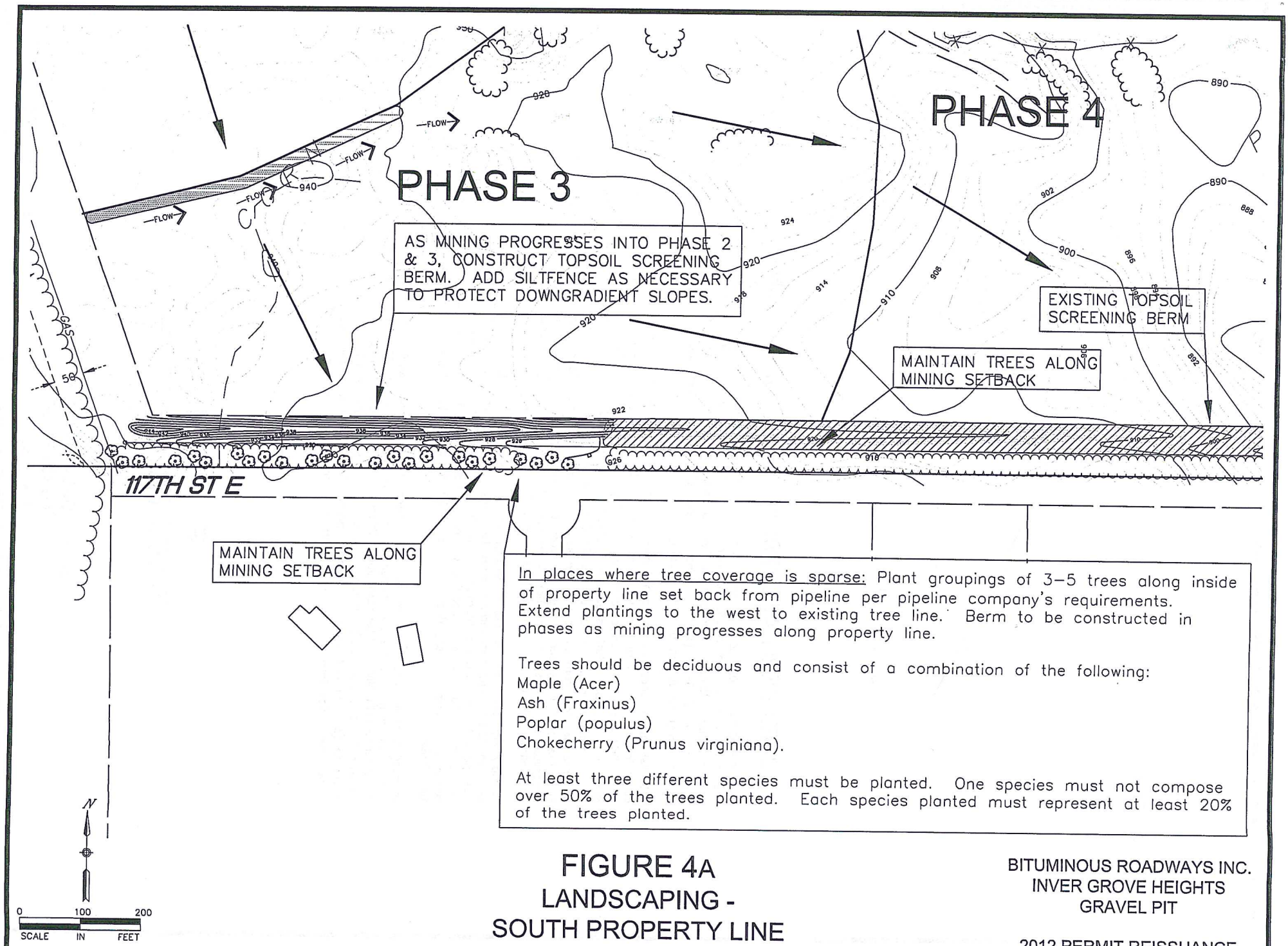
Weeds or other unsightly or noxious vegetation shall be controlled as necessary to maintain a neat appearance of the Site.

FIGURE 4
LANDSCAPING - EAST PROPERTY LINE

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS
GRAVEL PIT

2012 PERMIT REISSUANCE





In places where tree coverage is sparse: Plant groupings of 3–5 trees along inside of property line set back from pipeline per pipeline company's requirements. Extend plantings to the west to existing tree line. Berm to be constructed in phases as mining progresses along property line.

Trees should be deciduous and consist of a combination of the following:
Maple (Acer)
Ash (Fraxinus)
Poplar (populus)
Chokecherry (Prunus virginiana).

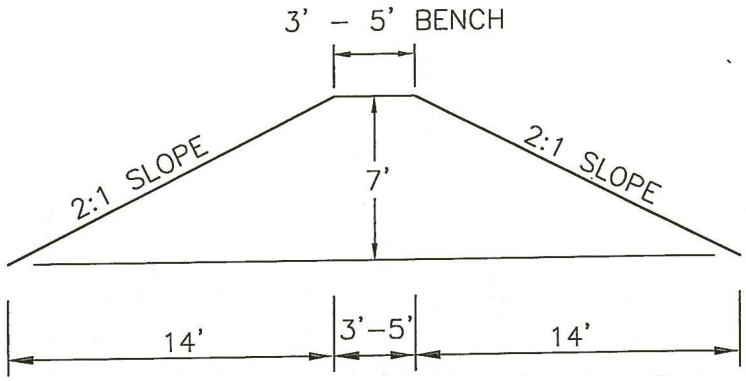
At least three different species must be planted. One species must not compose over 50% of the trees planted. Each species planted must represent at least 20% of the trees planted.

FIGURE 4A
LANDSCAPING - SOUTH PROPERTY LINE

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS
GRAVEL PIT

2012 PERMIT REISSUANCE

NO SCALE



SEED BERM ACCORDING TO SPECIFICATIONS:

In areas to be permanently seeded, use native seed mixture equivalent to MNDOT No. 350. Apply seed mixture at a rate of 94.7 kg per hectare (84.5 lbs per acre) in accordance with MNDOT Standard Spec. 2575. Incorporate a Type 3 fertilizer (slow release type with 10 week residual) consisting of 22–5–10 (%N–P–K) into the soil at an application rate of 392 kg per hectare (350 lbs per acre) by disking prior to seeding.

Establish native seed mix in accordance with MNDOT Standard Spec. 2575.3. Use a Truax type, or equal interseeder drill with at least two seed boxes: a small/fine seed box and a large/fluffy seed box. Drill large/fluffy seeds to a final planting depth of 10 mm (1/2 inch) to 25 mm (1 inch) deep from the large/fluffy seed box. Split the drill rates in half and make two passes over the site in order to decrease competition in drill rows. Scatter small/fine seeds over the soil surface by drop–seeding from the small/fine seed box, or broadcast. Coordinate with the seed vendor to keep the large/fluffy seeds separate from the small/fine seeds so that they may be installed from separate seed boxes. Lightly harrow or rake the site following the seeding operation. Pack the site following harrowing in order to ensure a firm seed–bed.

Comply with the requirements of MNDOT Standard Spec. Table 2575–1 for season of planting native seed mixtures. The appropriate dates for spring seeding are from April 15 through July 20. Fall seeding dates are from September 20 to October 20. Dormant seeding dates are from October 20 to November 15. Dormant seeding will only be allowed if the maximum soil temperature at a depth of 25 mm (1 inch) does not exceed 10 degrees C (50 degrees F) in order to prevent germination.

In seeded areas with slopes equal to or flatter than 3:1, apply MNDOT Standard Spec. 3882 Type 1 mulch uniformly over the soil surface by hand or machine within 24 hours after seeding in accordance with MNDOT Standard Spec. 2575.3. Apply mulch at a rate of 4.5 metric tons per hectare (2 tons per acre). Immediately after placement, anchor all mulch material into the soil by crimping (straight disking) in a direction perpendicular to that of the overland storm water flow. Punch the mulch into the soil to a depth of 2 to 3 inches with a disk spacing of 8" or less.

FIGURE 4B
SCREENING BERMS

9. Wetlands

There are two low areas on the southern portion of the Site that were indicated as wetland basins on the National Wetland Inventory map. A field delineation of the wetland basins was performed by SEH and presented their results in a May 20, 2002 report. They concluded that neither area meets the criteria for a jurisdictional wetland determination. A copy of the SEH report is included as Appendix B.

10. Storm Water Management

Storm Water Calculations for the 2, 10, and 100 year events from pre and post mining conditions, as well as a long term yield model for the site using precipitation data from the last thirty years to establish high water levels for the proposed future ponding areas, were submitted as part of the past permitting applications. These studies are still applicable and are provided in Appendix C.

11. Tree Preservation

The existing woods located west of the gas pipeline will not be impacted by mining or reclamation grading. Trees and vegetation within the 300 foot setback from existing structures will also remain undisturbed. Existing trees in the setback area along the southern portion of the Site have been undisturbed and provide additional screening. Additional trees may be planted as the proposed topsoil screening berm along the south property line is expanded to the west in accordance with the approved landscaping plans (see Figures 4, 4A and 4B, Landscaping).

12. Dust Control

Dust is controlled at the Site by utilizing the existing paved site entrance. Interior haul roads are watered as needed in order to minimize dust from vehicular travel within the site. Screening berms are vegetated.

13. Noise Control

The Site must operate in compliance with State noise standards. Vehicles and equipment are operated with standard noise reduction features such as mufflers. Perimeter berms and operation of equipment in the recessed portion of the site also help to reduce noise emissions from the site.

During the original permitting phase of the southern portion of the site, Barr Engineering modeled anticipated noise generation from the site based on topography, equipment to be operated and location of adjacent residences or receptors. The modeling results and applicable noise standards were discussed in detail in the EAW. The noise analysis predicted that the site will operate below noise standards established by the Minnesota Pollution Control Agency for residential areas both during stripping operations which occur at grade and during mining operations when equipment is recessed on the floor of the mining operation and the active bank provides noise mitigation.

Barr's analysis also noted that back up alarms will likely be audible at the nearest residences particularly when there is a light northern wind and little other background noise. Although the noise may be audible, it does not represent a predicted exceedence of state standards. Back up alarms are a requirement of MSHA – Mining Safety and Health Administration. Back up alarms are intentionally loud and audible and are required in order to ensure the protection of on-site workers.

14. Lighting

There is no lighting within the active mining area. There are a total of six exterior lights associated with security for the asphalt plant and contractors yard. Exterior lights are located as follows:

1 - Rainbow shop
1 - Old scale house
1- Top of oil tanks at plant
3- Top of silos at plant.

15. Groundwater Monitoring

In accordance with the permit, groundwater monitoring is conducted every other year at the on-site well (known as the "Rainbow well") and at the Todd Wicker and Robert Plan properties. Samples are analyzed for both diesel range organics (DRO) and gasoline range organics (GRO) and for arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, phenol, pH, electric conductivity and alkalinity. Results are submitted to the City. The results from the last five years show that sample concentrations for both GRO and DRO have been below the reporting limit. The results also show that the concentrations of barium, cadmium, chromium, nickel, selenium, silver, zinc, and phenol were all below the Health Risk Limit (HRL) established by the Minnesota Department of Health. The sample concentrations of arsenic and mercury were below the Maximum Contaminate Level (MCL) (HRLs have not been established for arsenic or mercury), which is a federal standard for the

lowest concentration at which a particular contaminant is believed to be a potential health concern. The sample concentrations for lead and copper were both below the "action level" (HRLs or MCLs have not been established for lead or copper).

There is an existing well associated with the farmstead on the Site. This well will be abandoned in accordance with Dakota County Ordinance No. 114 and the Minnesota Department of Health, once mining has progressed to the point the demolition of the homestead will be required.

16. Volumes

The gross volume of in-place material to be removed from the Site is approximately 8 million cubic yards. Approximately 1.2 million cubic yards have been removed from the Site as part of Phase 1 mining. The life expectancy of the site will depend upon the future economy and aggregate demand in the metropolitan area. Reports by the Metropolitan Council, Minnesota Geologic Survey and Minnesota Department of Natural Resources indicate that the supply of aggregate materials in the metropolitan area is rapidly being depleted. However, the vitality of the economy and the construction industry impact market demand which varies from year to year. The remaining life of this Site is estimated to be 20-25 years.

17. Permits

In addition to the local permits required by the City of Inver Grove Heights, which include the Conditional Use Permit and Land Alteration Permit the Site must operate in compliance with other state and federal regulations. The site operates under a NPDES Stormwater Permit and Air Emissions Permit issued by the MPCA, a Minnesota DNR Water Appropriations Permit, and a Dakota County Hazardous Waste Generators License and Processing License. The existing Water Appropriations Permit will be amended prior to using well water and all reports which are required to be submitted to the MN DNR for the Water Appropriations Permit will also be submitted to the City, including water usage reports (water usage in 2010 and 2011 was zero). The Site also operates under a Spill Prevention Control and Countermeasures (SPCC) Plan.

All reports which are required to be submitted to Dakota County under the Hazardous Waste Generators License and the Processing License will also be submitted to the City, including the required annual and quarterly reports. All reports which are required to be submitted to the MPCA will also be submitted to the City, including annual emissions inventory report, semi-annual deviations report, annual compliance certification report, and annual report.

IV. RECLAMATION

1. Phasing

Reclamation is conducted in phases at the site. As portions of the mining area are completed, the areas are backfilled, graded, topsoil applied and vegetation established. During the past five year permit period, substantial reclamation activity has been completed in the northern portion of the site. The Reclamation Plan, Sheet C-6 illustrates the reclamation grades that will be established at the Site upon conclusion of mining. The Phasing Plan, Sheet C-2 illustrates areas where reclamation has been completed. Reclamation activities will leave the Site in a state that will prepare it for final development.

2. Grades

Areas within the northern portion of the Site have been backfilled and sloped and they were seeded and mulched in the fall of 2011. Reclamation activities will continue in areas where mining has been completed. Reclamation activities in these areas will include continued backfilling and sloping of the excavated areas with materials unsuitable for sale or use in asphalt mix. Clean backfill soil may also be brought to the site to be used for establishment of reclamation grades. All backfill used in reclamation activities is clean, compactable, natural earthen material free of debris or contamination.

Along the perimeter of the excavation limits, backfilling will be required to achieve a maximum 4:1 final slope previously approved by the City of Inver Grove Heights. The processing and stockpile area will remain open and active.

Reclamation grades for the southern portion of the Site will be graded to a maximum slope of 10:1 as indicated on the Reclamation Plan, Sheet C-6.

3. Topsoil

Topsoil capable of establishing and supporting vegetation, will be placed as areas are reclaimed. Topsoil will be replaced to a minimum depth of six inches. Backfilled and graded areas will be seeded and mulched to establish vegetation, stabilize slopes and minimize erosion.

4. Removal of buildings

Within three months after completion of the sand and gravel mining operation any buildings or structures which have been established on the site as an accessory to the mining operation

will be removed. Permanent structures which conform to the permanent zoning district requirements in which they are located, may remain on Site.

5. Bond

A reclamation bond has been posted with the City of Inver Grove Heights to insure that the Site is properly restored upon completion of mining activity.

Final Use of the property upon reclamation will be consistent with the zoning and subdivision ordinances in effect at the time of final development. According to the City of Inver Grove Heights Comprehensive Plan dated March 2010 the site is designated rural residential. The next Comprehensive Plan update will be available in 2020 and that designation is subject to change. It is possible that this area will be serviced by sanitary sewer at the time of final development. Even if this area is not within the Metropolitan Urban Service Area (MUSA) at the time of final development, previous drain field design and percolation testing within Inver Grove Heights have shown that septic systems and drain fields can be properly designed in areas previously disturbed by grading and earth moving activities in areas with permeable sand and gravel soils. Another option would be to provide a community drain field design in an undisturbed portion of the Site. In this situation individual septic tanks could be pumped up to a larger drain field serving all of the residential uses on the site.

V. PLAN SET

Operations are described in detail within this report. The following plans have been prepared which help to illustrate the Site operations.

1. Existing Conditions: **C-1**

This plan illustrates pertinent Site features including the site boundary, existing topography, utilities, easements, wooded areas, wetlands, and existing on-site and adjacent buildings.

2. Phasing Plan: **C-2**

The Phasing Plan illustrates the sequence of mining and reclamation activities which are proposed to occur on the Site.

3. Cross-Sections: **C-3, C-4, C-5**

Cross Sections have been prepared for the site and are included as Figures C-3, C-4 and C-5. These cross sections illustrate the existing elevation, proposed reclamation grades, depth of topsoil, maximum mining elevation and extent of sand and gravel deposit on Site.

4. Reclamation Plan: **C-6**

This plan illustrates the end use grades for the site, limits of mining, and setbacks. Final grades have been designed at a maximum 10:1 slope for the southern portion of the site and a maximum 4:1 slope as previously approved for the northern portion of the Site.

APPENDIX C

STORM WATER MANAGEMENT CALCULATIONS

LONG-TERM WATERSHED YIELD MODEL
FOR BITUMINOUS ROADWAYS
INVERGROVE HEIGHTS, MN

INTRODUCTION:

The City of Inver Grove Heights engineering department requested from Bituminous Roadways a long-term watershed yield model for the future development of their Inver Grove Heights site. The future development will consist of 2.5-5 acre parcels developed according to rural residential uses. The 200.3-acre site was modeled using XP-SWMM 2000 continuous simulation along with 30 years, 1970-2000, of hourly precipitation data. The runoff from the 30 years of hourly precipitation data was routed through the site and into the respective holding basins. These holding basins are land-locked and the only outflow is evaporation and seepage. Evaporation from each basin was modeled in XP-SWMM based on actual pan evaporation data from P.W. Manson, G.M. Schwarz, E.R. Allred, "Some Aspects of the Hydrology of Ponds and Small Lakes", Agricultural Experiment Station—University of Minnesota, Technical Bulletin 257, 1968. Seepage from each basin was modeled using a rating curve and the soil characteristics. The critical event for a land-locked basin is the spring 10-day snowmelt. This was modeled using 7.2" of runoff over the entire site (assuming 100% impervious – frozen ground). This volume was then added to an average high water elevation from the XP-SWMM output over the 30 years to obtain the 10-day snowmelt HWL.

SUMMARY:

The ultimate design of the holding ponds for the future development of the Bituminous Roadways site in Inver Grove Heights was determined using the long-term watershed yield model. XP-SWMM was used to route 30 years of precipitation data through the site and each pond. The pond for the 71.33-acre North site was designed with an approximate normal water level of 820. The series of ponds for the 129.01-acre south site were designed with approximate NWL's of 830. The water levels of these ponds bounced with time (see stage-time graph in snowmelt section). From the graph an average high water level in the beginning of spring was interpolated for each pond. This average high water level was used as the starting elevation for the 10-day spring snowmelt simulation. The 7.2" of runoff volume was added to the average high water level of each pond and the 10-day snowmelt HWL was determined. The SWMM output shows three major storm events (August 1977, July 1987 and July 1997) all of which occur in the summer months. The 10-day snowmelt simulation shows HWLs similar to the event of July 1987.

	August 1977	July 1987	July 1997	10-day snowmelt	Low Point in Street
North Pond	839±	843.9	829.5±	844±	848
South Pond	848.5±	853.2	840±	854±	855

Therefore, a HWL of about 844 for the north pond and 854 for the south pond seems to be critical. The street elevation for each site is designed above this critical elevation.

Bituminous Roadways #82-185
Inver Grove Heights, MN

Date: 4/24/02
By: MAO

Long Term Yield Model (30-Year)

XP-SWMM 2000 Continuous Modeling

Tributary Drainage Areas:

North (1) = 71.33 acres

South (2) = 129.01 acres

(1) Routing Method:
SWMM Runoff Non-linear Reservoir Method

Subcatchment Area #	Area (ac)	Impervious* Fraction (%)	Slope (ft/ft)	Width (ft)
North (1)	71.33	12	0.05	2220
South (1)	129.01	12	0.03	2440

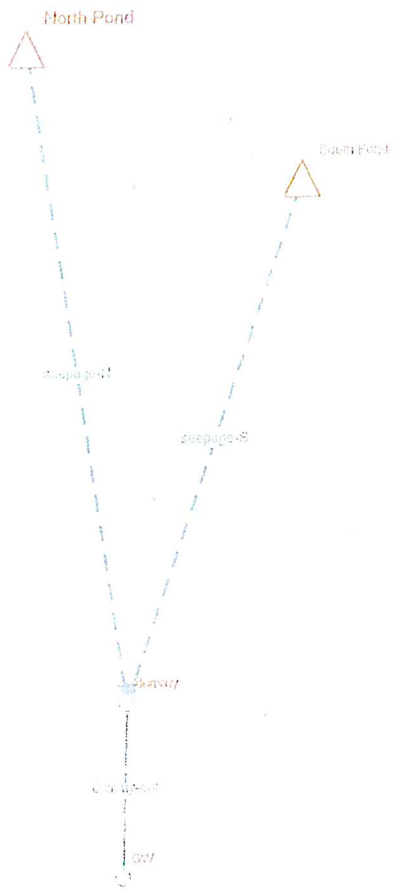
* 2.5-5 acre lots

(2) Runoff Infiltration: SCS Type B Horton

Max. Infiltration Rate ≅ 3 in/hr
(loam soils)

Min. Asymptotic Infiltration Rate ≅ 0.2 in/hr
(Type B)

Decay Rate of Infiltration ≅ 0.001 /sec


North Pond
South Pond
seepage-N
seepage-S
Junction
Outfall
SW

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

(3) Storage - Stepwise Linear Method

Stage Storage Table: North Pond

Elevation	Area (ac)	Incremental Volume (ac-ft)	Σ Vol (ac-ft)
820	0.791		0.00
		12.23	
830	1.656		11.97
		21.59	
840	2.704		33.55
		48.68	
850	7.420		82.23

Stage Storage Table: South Ponds

Elevation	Area (Total) (ac)	Incremental Volume (ac-ft)	Σ Vol (ac-ft)
830	1.25		0.00
		20.32	
840	2.94		20.32
		39.50	
850	5.06		59.82
		116.43	
860	19.85		176.24

(4) Seepage

$Q = KiA$

K = hydraulic Conductivity (Ft/sec)

i = hydraulic gradient = 1.0

A = Sectional Area (Ft^2)

Soil Characteristics

411A + 411B Waukegan (See Attachment 'A')

Depth 28-60 in ~ k = 6.0-20 in/hr

Use k = 6.0 in/hr = 1.4×10^{-4} Ft/sec

Rating Curve - Seepage North

$Q = Ki(L-H)$

Elevation	(L) Average Circumference (Ft)	H (Ft)	Q (cfs)	ΣQ (cfs)
820			0	0
821	1057	1	0.14	0.14
822	1025	1	0.14	0.28
822	1048	1	0.15	0.43
830	1124	7	1.10	1.53
840	1526	10	2.14	3.68
850	1711	10	2.40	6.08

$K = 1.4 \times 10^{-4}$ ft/sec

Rating Curve - Seepage South

$Q = kiA(LH)$

Elevation	(L) Average Circumference (ft)	(H) (ft)	Q (cfs)	ΣQ (cfs)
830			0	0.00
	1923	1		
831			0.27	0.27
	1975	1		
832			0.28	0.55
	2000	1		
833			0.28	0.83
	2275	7		
840			2.23	3.06
	3044	10		
850			4.26	7.32
	3034	10		
860			5.08	12.4

(5) Evaporation

Pan evaporation data from "Hydrology of Ponds and Small Lakes" by Manson, Schwartz, Allred (Agricultural Experiment Station - University of Minnesota) Technical Bulletin 257 - 1968 (See Attachment '8')

Pan Evaporation - Farmington (in.)

	1962	1963	1964	Average
May	7.85	7.29	9.29	8.14
June	7.76	10.11	10.11	9.33
July	5.59	8.68	10.18	8.15
Aug.	7.38	7.69	8.36	7.78
Sept.	4.55	5.46	4.78	4.93
Oct	3.15	—	—	1.08

(6) Rainfall Data

30-years Hourly Precipitation Data TD-3240
years (1970-1999)
Obtained in NWS Fixed length Format
from National Climatic Data Center
for Station # 215435 (Mpls-St. Paul Airport)

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

(7) Snowmelt Simulation

10-Day snowmelt = 7.2 inches Runoff

North Site

Runoff Volume = (71.33 acres)(7.2 inches)

V = 42.8 ac-ft

@ Elevation 822* Volume Storage = 1.72 ac-ft

add Snowmelt Volume = 44.52 ac-ft

10-Day Snowmelt HWL = ± 844

South Site

Runoff Volume = (129.01 ac)(7.2 inches)

V = 77.4 ac-ft

@ Elevation 833* Volume Storage = 4.34 ac-ft

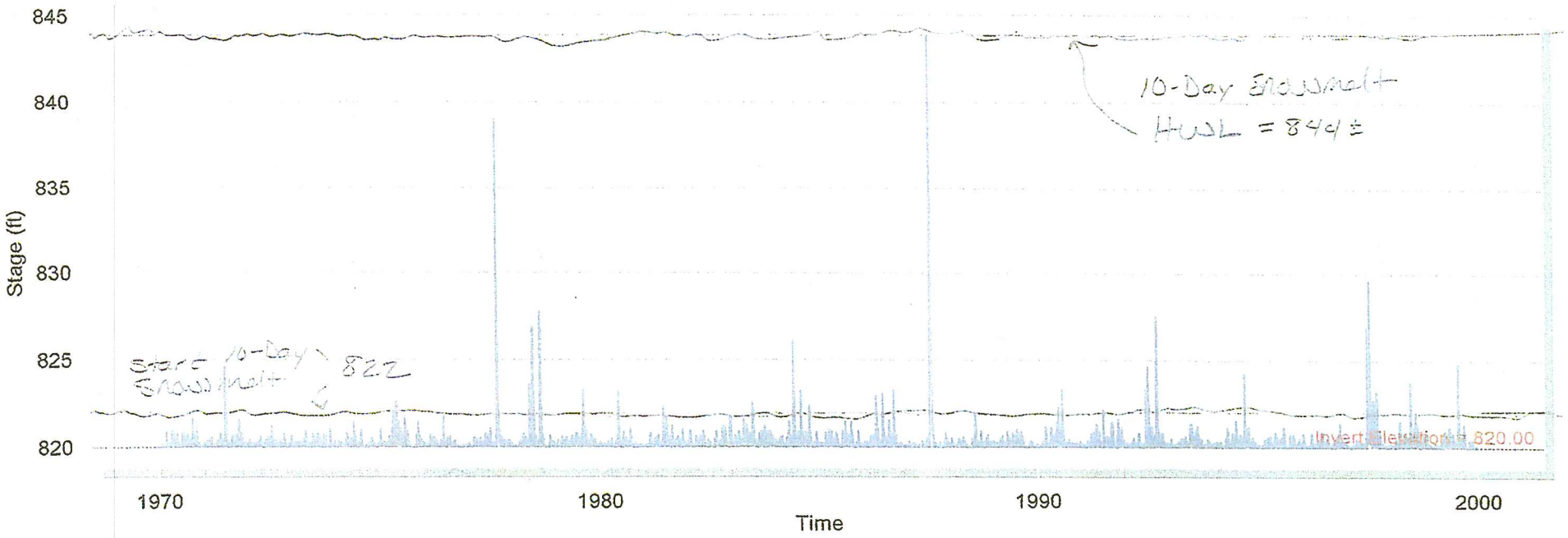
add Snowmelt runoff Volume = 81.74 ac-ft

10-Day Snowmelt HWL = ± 854

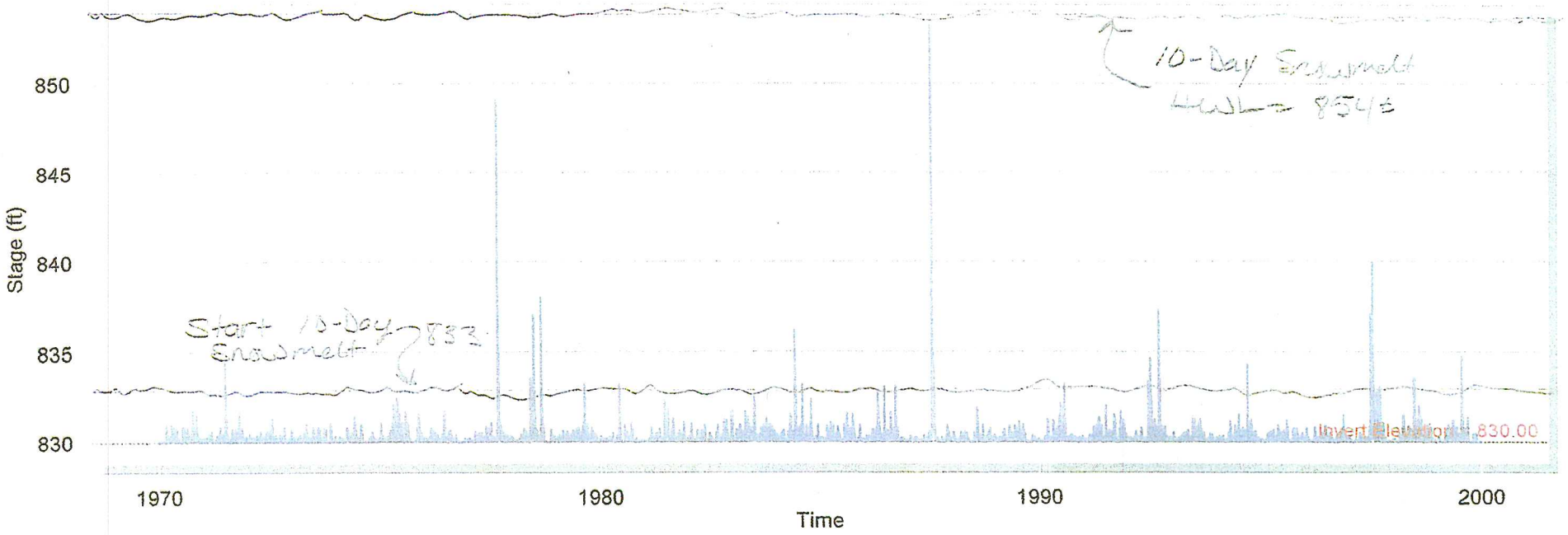
* Approximate elevation of ponds at Springtime Snowmelt (See following graph)

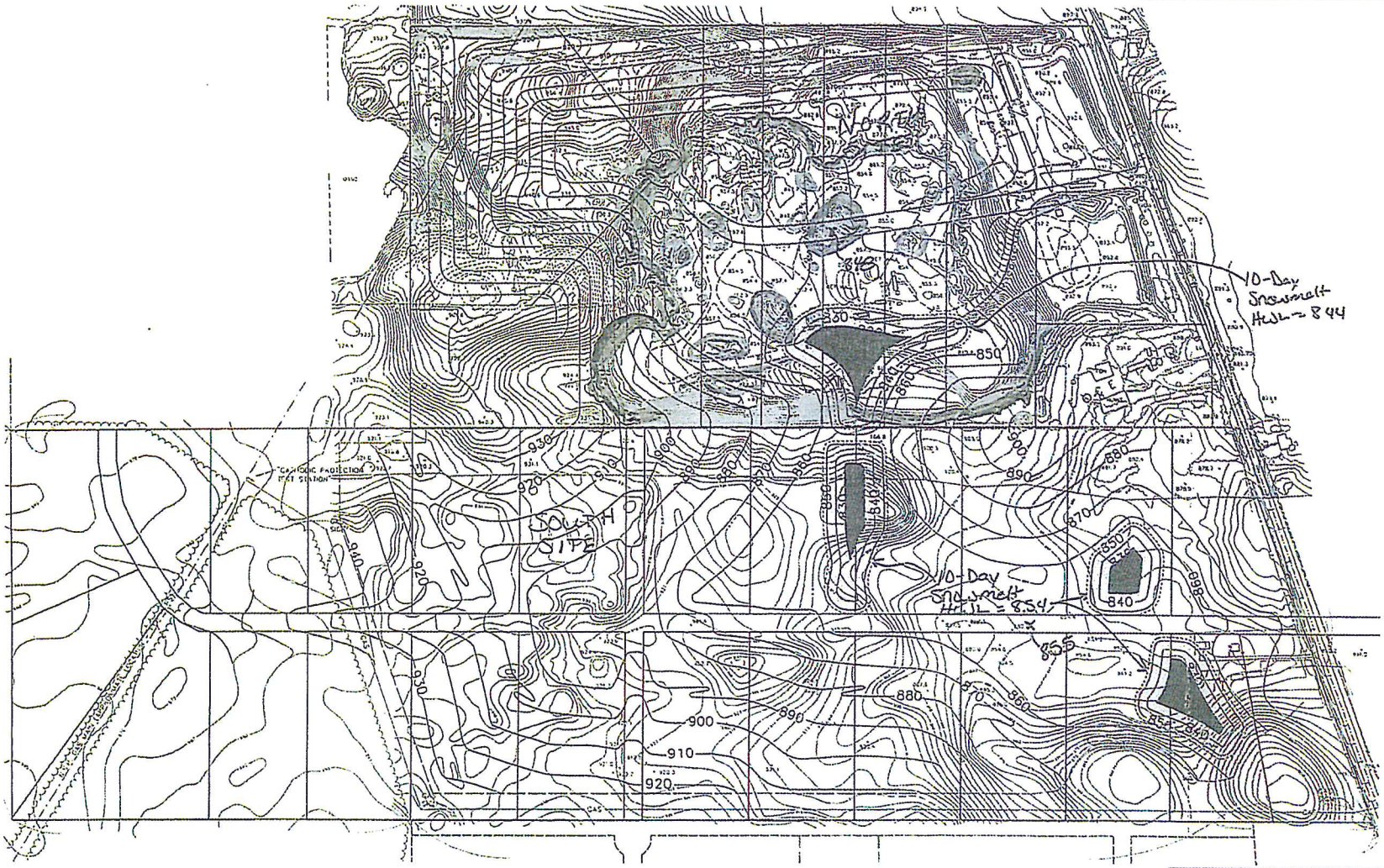
22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Node - North Pond



Node - South Pond





DATE	REVISION

BITUMINOUS ROADWAYS, INC.
INVER GROVE HEIGHTS GRAVEL PIT

Sunde Engineering, Inc.

POND SCHEMATIC

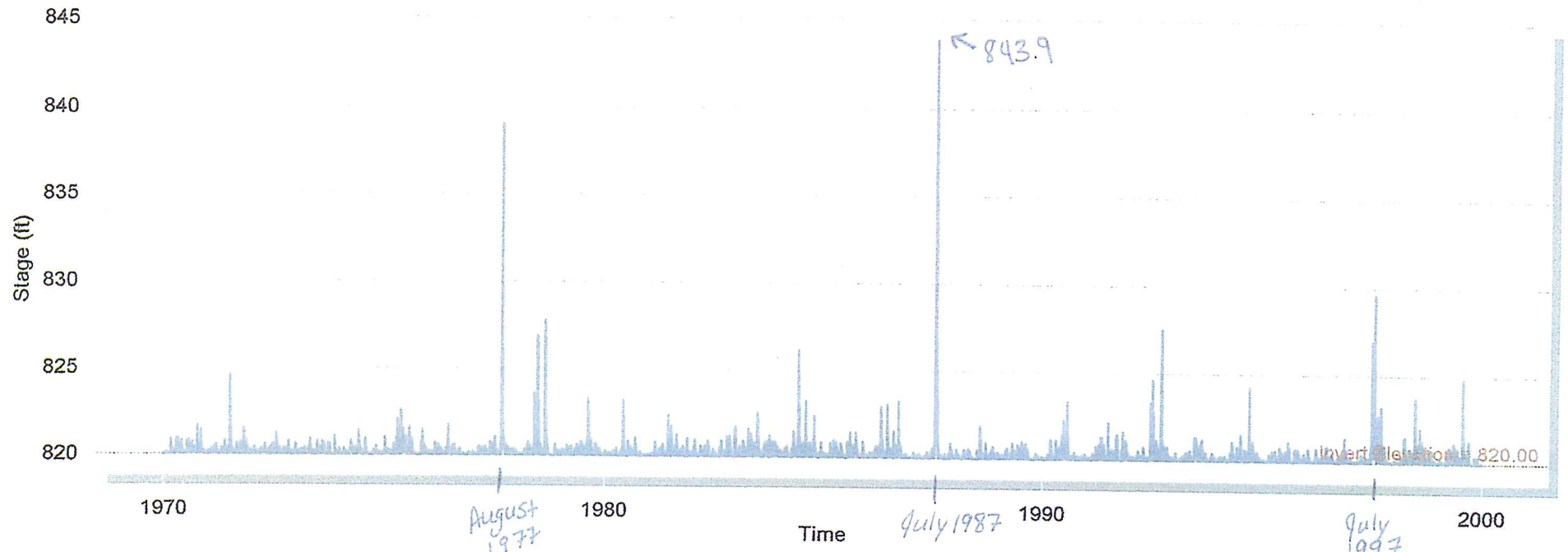
P-1

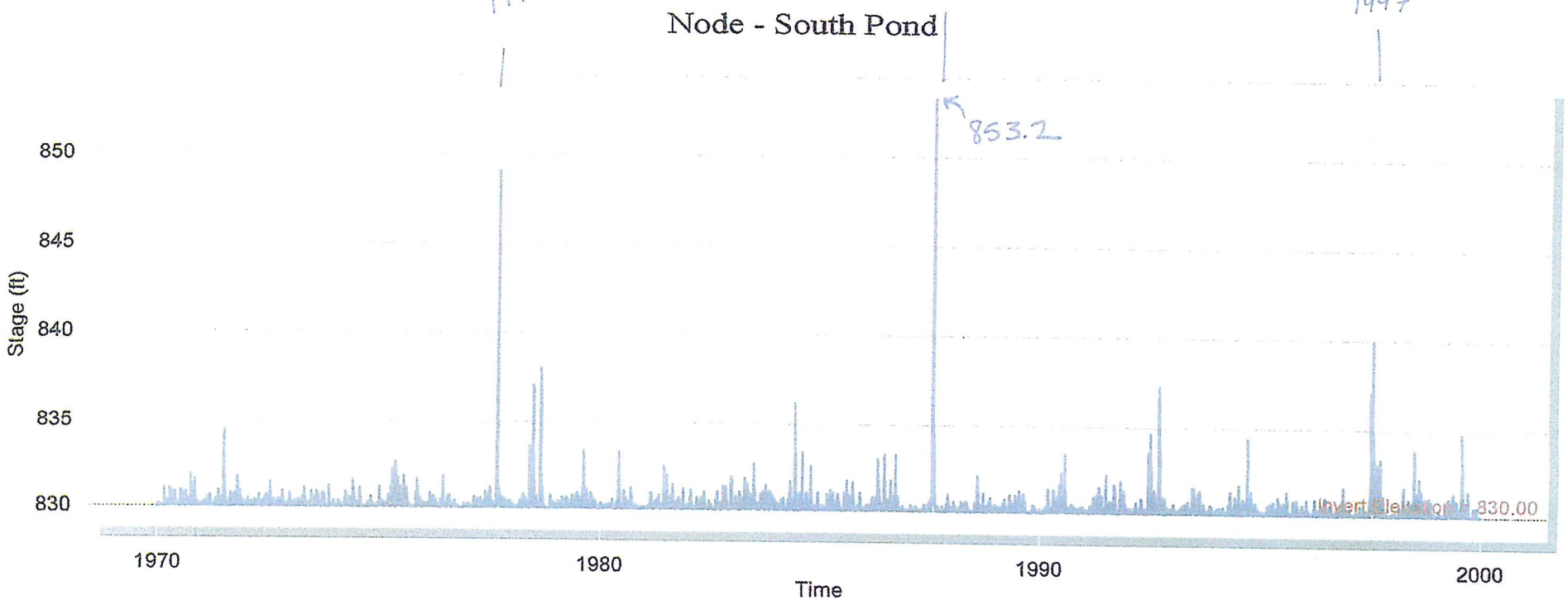
22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

(8) Results

	HWL (Aug. 1977	HWL (July 1987)	HWL (July 1997)	10-Day Snowmelt	Low Point in Street
North Pond	839±	843.9	829.5±	844±	848
South Pond	848.5±	853.2	840±	854±	855

See BH2.OUT for XP-SWMM output (attachment 'C').


Node - North Pond
845
840
835
830
825
820
Stage (ft)
843.9
Invert Elevation = 820.00
1970
August 1977
1980
July 1987
1990
July 1997
2000
Time


Node - South Pond
850
845
840
835
830
Stage (ft)
853.2
Invert Elevation = 830.00
1970
1980
1990
2000
Time

A

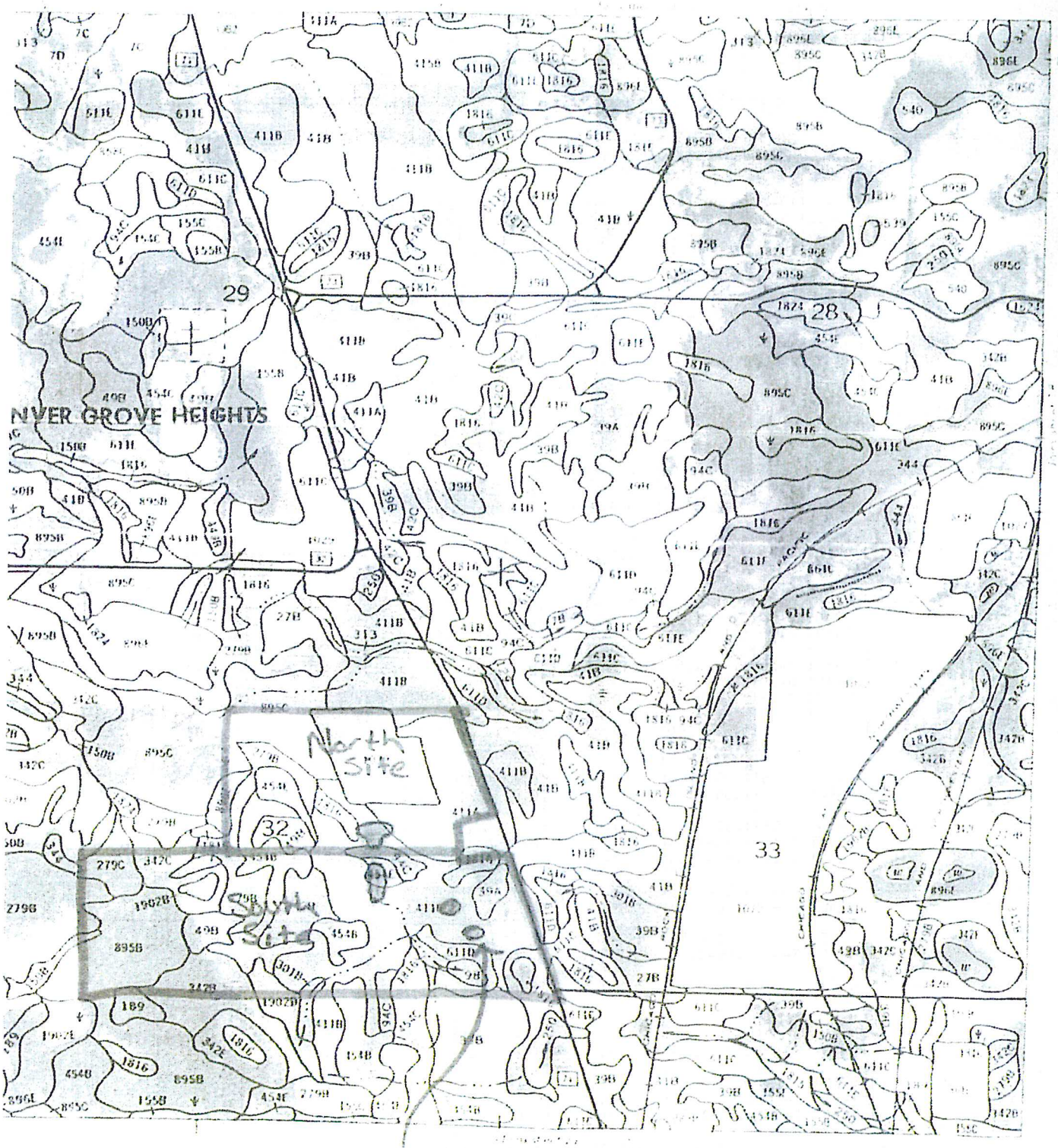

29
28
32
33
North Site
South Site
NVER GROVE HEIGHTS
Approximate Location of proposed ponds

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
378----------	0-21	30-35	1.35-1.40	0.6-2.0	0.21-0.23	6.6-7.3	High----------	0.24	5	6	6-7
Maxfield	21-27	25-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.3	High----------	0.32			
	27-60	20-26	1.65-1.85	0.6-2.0	0.17-0.19	6.1-7.8	Low-----------	0.32			
382B----------	0-9	18-27	1.30-1.45	0.6-2.0	0.24-0.30	5.6-6.5	Moderate------	0.32	5	6	2-4
Blooming	9-21	24-32	1.35-1.50	0.6-2.0	0.18-0.22	5.6-6.5	Moderate------	0.32			
	21-48	20-30	1.50-1.65	0.6-2.0	0.16-0.19	5.1-7.3	Moderate------	0.32			
	48-60	18-27	1.50-1.75	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.32			
408----------	0-28	28-35	1.20-1.40	0.6-2.0	0.17-0.22	6.6-7.8	Moderate------	0.28	4	6	5-15
Faxon	28-37	18-30	1.40-1.60	0.6-2.0	0.12-0.19	6.6-7.8	Moderate------	0.28			
	37	---	---	---	---	---	----------	----			
409B, 409C--------	0-7	8-15	1.30-1.50	2.0-6.0	0.16-0.18	5.6-7.3	Low-----------	0.20	4	3	1-2
Etter	7-21	10-18	1.35-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Low-----------	0.20			
	21-60	1-5	1.50-1.70	6.0-20	0.05-0.07	5.1-6.0	Low-----------	0.15			
411A, 411B, 411C-	0-13	18-27	1.35-1.55	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	4	6	2-5
Waukegan	13-28	18-27	1.35-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.43			
	28-60	1-10	1.50-1.70	6.0-20	0.02-0.04	5.6-7.8	Low-----------	0.10			
414----------	0-16	20-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.28	5	6	5-7
Hamel	16-40	24-35	1.45-1.60	0.2-0.6	0.16-0.19	5.6-7.3	Moderate------	0.28			
	40-60	20-30	1.55-1.75	0.6-2.0	0.14-0.18	7.4-7.8	Moderate------	0.28			
415A, 415B, 415C-	0-9	18-32	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	4	6	2-5
Kanaranzi	9-19	18-32	1.35-1.50	0.6-2.0	0.17-0.22	5.6-7.8	Low-----------	0.28			
	19-60	0-5	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low-----------	0.10			
449B----------	0-9	8-20	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low-----------	0.37	5	5	2-4
Crystal Lake	9-40	18-30	1.50-1.60	0.6-2.0	0.18-0.22	5.1-6.0	Moderate------	0.37			
	40-60	8-20	1.45-1.55	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.37			
454B, 454C, 454E-	0-5	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----------	0.15	5	2	<1
Mahtomedi	5-35	0-10	1.45-1.70	6.0-20	0.05-0.07	5.1-6.5	Low-----------	0.10			
	35-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----------	0.10			
463----------	0-8	10-27	1.30-1.40	2.0-6.0	0.20-0.22	7.4-8.4	Low-----------	0.28	5	5	2-5
Minneiska	8-60	5-18	1.40-1.60	2.0-6.0	0.13-0.18	7.4-8.4	Low-----------	0.28			
465----------	0-42	8-15	1.35-1.50	2.0-6.0	0.13-0.18	6.6-7.8	Low-----------	0.20	5	3	2-4
Kalmarville	42-60	2-5	1.55-1.65	6.0-20	0.06-0.09	6.6-7.8	Low-----------	0.10			
495----------	0-18	5-18	1.35-1.45	2.0-6.0	0.13-0.16	5.6-7.8	Low-----------	0.17	5	3	2-4
Zumbro	18-56	2-10	1.45-1.55	6.0-20	0.10-0.12	5.6-7.8	Low-----------	0.17			
	56-60	0-10	1.45-1.60	6.0-20	0.05-0.12	6.1-7.8	Low-----------	0.17			
522----------	0-5	---	0.16-0.45	0.2-6.0	0.35-0.45	6.6-7.8	----------	----	---	3	60-80
Boots	5-60	---	0.16-0.28	0.6-6.0	0.35-0.45	6.6-7.8	----------	----			
539----------	0-45	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	----------	----	2	3	>75
Palms	45-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low-----------	----			
540----------	0-60	---	0.10-0.25	0.2-6.0	0.35-0.45	5.6-7.3	----------	----	---	3	>25
Seelyeville											
545----------	0-45	0-10	0.10-0.25	0.2-6.0	0.35-0.48	5.1-7.8	----------	----	---	2	>25
Rondeau	45-60	5-15	0.05-0.20	<0.2	0.20-0.22	7.4-7.8	----------	----			
611C, 611D--------	0-11	5-15	1.35-1.55	2.0-6.0	0.13-0.15	6.1-7.8	Low-----------	0.17	3	3	1-4
Hawick	11-21	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low-----------	0.17			
	21-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			
611E, 611F--------	0-9	2-10	1.40-1.60	6.0-20	0.10-0.12	6.1-7.8	Low-----------	0.17	3	2	1-3
Hawick	9-21	1-10	1.50-1.65	>6.0	0.03-0.10	6.1-7.8	Low-----------	0.17			
	21-60	1-5	1.55-1.65	>20	0.02-0.06	7.4-8.4	Low-----------	0.10			

COUNTY

SOIL LEGEND

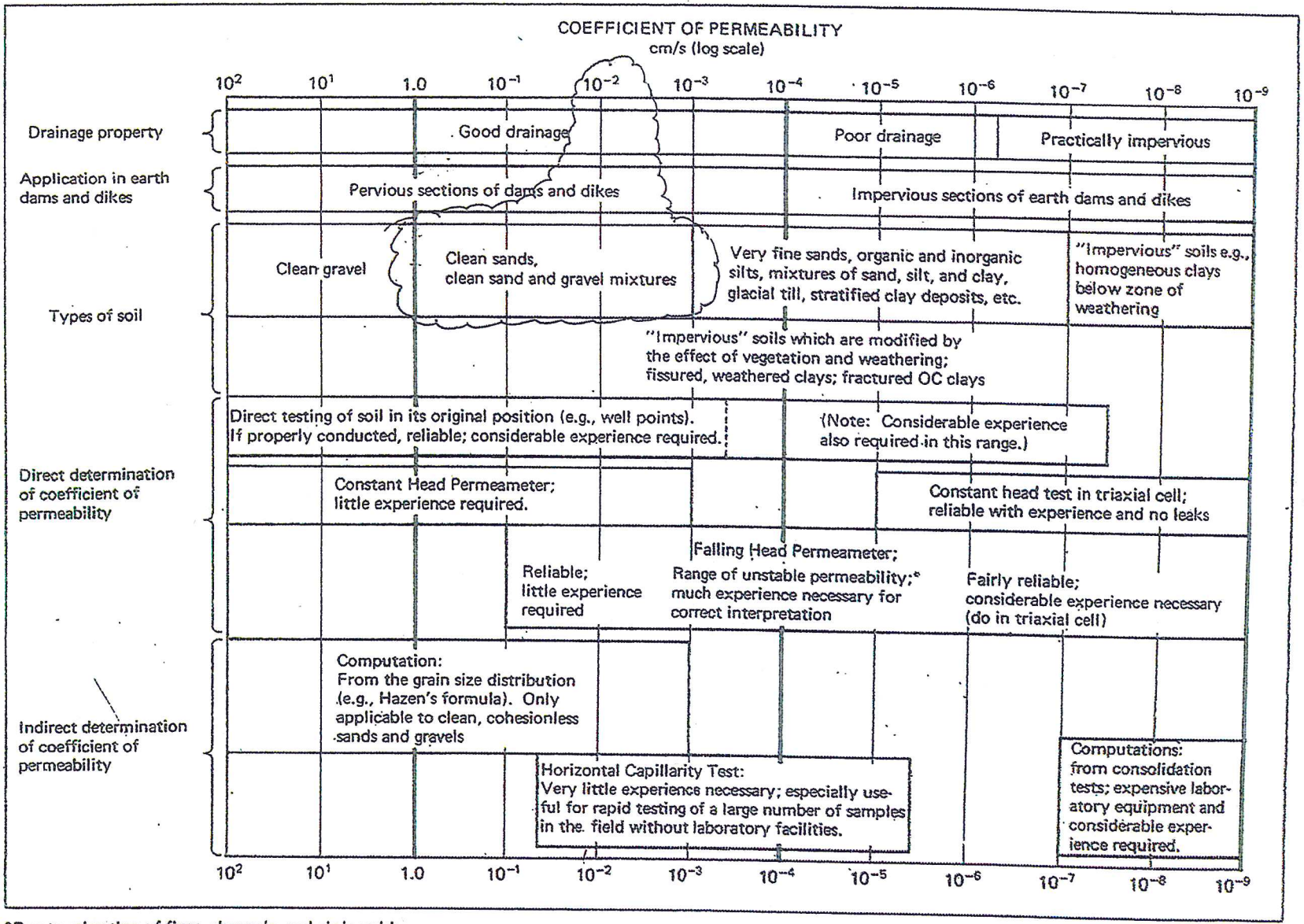
Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is eroded.

SYMBOL	NAME
2B	Ostrander loam, 1 to 6 percent slopes
2C	Ostrander loam, 6 to 12 percent slopes
7A	Hubbard loamy sand, 0 to 1 percent slopes
7B	Hubbard loamy sand, 1 to 6 percent slopes
7C	Hubbard loamy sand, 6 to 12 percent slopes
7D	Hubbard loamy sand, 12 to 18 percent slopes
8A	Sparta loamy fine sand, 0 to 1 percent slopes
8B	Sparta loamy fine sand, 1 to 6 percent slopes
12C	Emmert very gravelly sandy loam, 3 to 15 percent slopes
27A	Dickinson sandy loam, 0 to 2 percent slopes
27B	Dickinson sandy loam, 2 to 6 percent slopes
39A	Wadena loam, 0 to 2 percent slopes
39B	Wadena loam, 2 to 6 percent slopes
39B2	Wadena loam, 2 to 6 percent slopes, eroded
39C	Wadena loam, 6 to 12 percent slopes
39C2	Wadena loam, 6 to 12 percent slopes, eroded
39D	Wadena loam, 12 to 18 percent slopes
41A	Estherville sandy loam, 0 to 2 percent slopes
41B	Estherville sandy loam, 2 to 6 percent slopes
42C	Solida gravelly coarse sandy loam, 2 to 12 percent slopes
49B	Antigo silt loam, 1 to 3 percent slopes
81B	Boone loamy fine sand, 2 to 6 percent slopes
81C	Boone loamy fine sand, 6 to 12 percent slopes
81E	Boone loamy fine sand, 12 to 40 percent slopes
91C	Terril loam, 4 to 12 percent slopes
98	Colo silt loam, occasionally flooded
100A	Copaston loam, 0 to 2 percent slopes
100B	Copaston loam, 2 to 6 percent slopes
100C	Copaston loam, 6 to 12 percent slopes
106B	Lester loam, 2 to 6 percent slopes
106C	Lester loam, 6 to 12 percent slopes
106C2	Lester loam, 6 to 12 percent slopes, eroded
106D2	Lester loam, 12 to 18 percent slopes, eroded
109	Cordova silty clay loam
113	Webster clay loam
114	Glencoe silty clay loam
129	Cylinder loam
150B	Spencer silt loam, 2 to 6 percent slopes
151C	Burkhardt sandy loam, 6 to 12 percent slopes
151D	Burkhardt sandy loam, 12 to 18 percent slopes
155B	Chetek sandy loam, 3 to 8 percent slopes
155C	Chetek sandy loam, 8 to 15 percent slopes
155E	Chetek sandy loam, 15 to 25 percent slopes
173F	Frontenac loam, 25 to 40 percent slopes
176	Garwin silty clay loam
177A	Gotham loamy fine sand, 0 to 2 percent slopes
177B	Gotham loamy fine sand, 2 to 6 percent slopes
177C	Gotham loamy fine sand, 6 to 12 percent slopes
189	Auburndale silt loam
203B	Joy silt loam, 1 to 5 percent slopes
208	Kato silty clay loam
213B	Klinger silt loam, 1 to 5 percent slopes
226	Lawson silt loam
239	Le Sueur loam
250	Kennebec silt loam
251D	Mazeppa loam, 12 to 18 percent slopes
251E	Mazeppa loam, 18 to 25 percent slopes
252	Marshan silty clay loam
253	Meadcreek silty clay loam
255	Mayer silt loam
279B	Otterholt silt loam, 1 to 6 percent slopes
279C	Otterholt silt loam, 6 to 15 percent slopes
283A	Plainfield loamy sand, 0 to 2 percent slopes
283B	Plainfield loamy sand, 2 to 6 percent slopes
283D	Plainfield loamy sand, 6 to 18 percent slopes
285A	Port Byron silt loam, 0 to 2 percent slopes
285B	Port Byron silt loam, 2 to 6 percent slopes
285C	Port Byron silt loam, 6 to 12 percent slopes
299A	Rockton loam, 0 to 2 percent slopes
299B	Rockton loam, 2 to 6 percent slopes
299C	Rockton loam, 6 to 12 percent slopes
301B	Lindstrom silt loam, 1 to 4 percent slopes
313	Spillville loam, occasionally flooded
317	Oshawa silty clay loam
318	Mayer loam, swales
320B	Tallula silt loam, 2 to 6 percent slopes
320C2	Tallula silt loam, 6 to 12 percent slopes, eroded
342B	Kingsley sandy loam, 3 to 8 percent slopes
342C	Kingsley sandy loam, 8 to 15 percent slopes
342E	Kingsley sandy loam, 15 to 25 percent slopes
342F	Kingsley sandy loam, 25 to 40 percent slopes
344	Quam silt loam
377B	Merton silt loam, 1 to 6 percent slopes
378	Maxfield silty clay loam
382B	Blooming silt loam, 1 to 6 percent slopes
408	Faxon silty clay loam
409B	Elter fine sandy loam, 2 to 6 percent slopes
409C	Elter fine sandy loam, 6 to 12 percent slopes
411A	Waukegan silt loam, 0 to 1 percent slopes
411B	Waukegan silt loam, 1 to 6 percent slopes
411C	Waukegan silt loam, 6 to 12 percent slopes
414	Hamel silt loam
415A	Kanaranzi loam, 0 to 2 percent slopes
415B	Kanaranzi loam, 2 to 6 percent slopes
415C	Kanaranzi loam, 6 to 12 percent slopes
449B	Crystal Lake silt loam, 1 to 8 percent slopes
454B	Mahtomedi loamy sand, 3 to 8 percent slopes
454C	Mahtomedi loamy sand, 8 to 15 percent slopes
454E	Mahtomedi loamy sand, 15 to 25 percent slopes
463	Minneiska loam, occasionally flooded
465	Kalmarville sandy loam, frequently flooded
495	Zumbro fine sandy loam
522	Houghton muck
539	Palms muck
540	Seelyeville muck
545	Rondeau muck
611C	Hawick coarse sandy loam, 6 to 12 percent slopes
611D	Hawick coarse sandy loam, 12 to 18 percent slopes
611E	Hawick loamy sand, 18 to 25 percent slopes
611F	Hawick loamy sand, 25 to 50 percent slopes
857A	Urban land-Waukegan complex, 0 to 1 percent slopes
857B	Urban land-Waukegan complex, 1 to 8 percent slopes
858C	Urban land-Chetek complex, 1 to 15 percent slopes
860C	Urban land-Lester complex, 3 to 15 percent slopes
861C	Urban land-Kingsley complex, 3 to 15 percent slopes
861E	Urban land-Kingsley complex, 15 to 25 percent slopes
865B	Urban land-Hubbard complex, 0 to 6 percent slopes
880f	Brodale-Rock outcrop complex, 18 to 45 percent slopes
888B	Kingsley-Lester complex, 2 to 6 percent slopes
888C	Kingsley-Lester complex, 6 to 12 percent slopes
888D	Kingsley-Lester complex, 12 to 18 percent slopes
889B	Wadena-Hawick complex, 2 to 6 percent slopes
889C	Wadena-Hawick complex, 6 to 12 percent slopes
889D	Wadena-Hawick complex, 12 to 18 percent slopes
895B	Kingsley-Mahtomedi-Spencer complex, 3 to 8 percent slopes
895C	Kingsley-Mahtomedi-Spencer complex, 8 to 15 percent slopes
895E	Kingsley-Mahtomedi complex, 15 to 25 percent slopes
895F	Kingsley-Mahtomedi complex, 25 to 40 percent slopes
963C2	Timula-Bold silt loams, 6 to 12 percent slopes, eroded
963D2	Timula-Bold silt loams, 12 to 18 percent slopes, eroded
963E2	Timula-Bold silt loams, 18 to 25 percent slopes, eroded
1013	Pits, quarry
1027	Udorthents, wet
1029	Pits, gravel
1039	Urban land
1055	Aquolls and Histosols, ponded
1072	Udorthents, moderately shallow
1815	Zumbro loamy fine sand
1816	Kennebec Variant silt loam
1821	Algansee sandy loam, occasionally flooded
1824	Quam silt loam, ponded
1825C	Seelyeville muck, sloping
1827A	Waukegan silt loam, bedrock substratum, 0 to 2 percent slopes
1827B	Waukegan silt loam, bedrock substratum, 2 to 6 percent slopes
1827C	Waukegan silt loam, bedrock substratum, 6 to 12 percent slopes
1848B	Sparta loamy sand, bedrock substratum, 2 to 8 percent slopes
1894B	Winnebago loam, 2 to 6 percent slopes
1895B	Cormi loam, 2 to 8 percent slopes
1896B	Ostrander-Cormi loams, 2 to 6 percent slopes
1898F	Elter-Brodale complex, 25 to 60 percent slopes
1902B	Jewett silt loam, 1 to 6 percent slopes

Exhibit A-1, continued: Hydrologic soil groups for United States soils

WARM SPRINGS, DRAINED, ALKALI	C	WAUPECAN	B	WELD	C	WETTERHORN	C	WIBAUX	B
WARM SPRINGS, DRAINED	C	WAUQUIE	B	WELDA	C	WETZEL	D	WICHITA	C
WARM SPRINGS, COOL	C	WAURIKA	D	WELLER	C	WEVERTON	B	WICHUP	D
WARMAN	B/D	WAUSEON	B/D	WELLINGTON	D	WEWELA	B	WICKAHONEY	D
WARMAN, GRAVELLY SUBSOIL	A/D	WAUTOMA	B/D	WELLMAN	B	WEWOKA	C	WICKENBURG	D
WARNEKE	D	WAVELAND	B/D	WELLS	B	WEYERS	C/D	WICKERSHAM	B
WARNERS	C/D	WAVELAND, DEPRESSIONAL	D	WELLSBORO	C	WEYHOUTH	B	WICKETT	C
WARNOCK	B	WAVERLY		WELLSCREEK	B	WHAKANA	B	WICKHAM	B
WARRENTON	D	WAWASEE	B/D	WELLSED	C	WHALAN	B	WICKIUP	C
WARSAW	B	WAWINA	B	WELLSTON	B	WHALEY	D	WICKSBURG	B
WARSING	B	WAX	A	WELLSVILLE	B	WHARTON	C	WICUP	C
WARWICK	A	WAXPOOL	C	WELLTON	B	WHATCOM	C	WIDEMAN	A
WASA	D	WAYAH	D	WELOY	C	WHATELY	D	WIDEN	C
WASATCH	A	WAYBE	B	WELRING	D	WHEATLEY	A/D	WIDTSOE	B
WASCO	B	WAYCUP	D	WELSUM	D	WHEATRIDGE	B	WIEHL	C
WASDA	B	WAYDEN	B	WELTER	D	WHEATVILLE	B	WIELAND	C
WASEPI	B/D	WAYLAND	D	WEMPLE	B	WHEELER	B	WIERGATE	D
WASHBURN	B	WAYMOR	C/D	WENAS	D	WHEELERVILLE	B	WIFFO	B
WASHINGTON	D	WAYNECO	B	WENAS, DRAINED	C	WHEELING	B	WIGGLER	D
WASHINGTON, WET SUBSTRATUM	B	WAYNESBORO	D	WENATCHEE	C	WHEELON	D	WIGGLETON	B
WASHOE	C	WAYNETOWN	B	WENDANE	C	WHETROCK	C	WIGTON	A
WASHOUGAL	B	WEA	C	WENDANE, DRAINED	B	WHETSTONE	C	WILAHA	B
WASHTENAW	B	WEASH	B	WENDOVER	D	WHICHMAN	B	WILBANKS	D
WASILLA	C/D	WEATHERFORD	C	WENDTE	D	WHIDBEY	C	WILBRAHAM	C
WASIOJA	D	WEAVER	B	WENONA	C	WHILPHANG	D	WILBUR	B
WASKISH	B	WEAVERVILLE	C	WENTWORTH	B	WHIPPANY	C	WILBURTON	B
WASKOM	D	WEBB	B	WEOGUFKA	C	WHIPPLE	D	WILCO	C
WASPO	C	WEBBRIDGE	C	WEPO	C	WHIPSTOCK	C	WILCOX	D
WASSAIC	D	WEBBTOWN	B	WERELD	B	WHIRLO	B	WILCOXSON	C
WASSIT	B	WEBER	C	WERLOG	C	WHISKEYDICK	C	WILDALE	C
WATAB	D	WEBILE	B	WERNER	C	WHISPERING	C	WILDCAT	D
WATAMA	C	WEBSTER	C	WERNOCK	D	WHISTLE	B	WILDERNESS	C
WATAUGA	C	WEDEKIND	B/D	WESCONNETT	B	WHIT	D	WILDGEN	B
WATCHABOB	B	WEDERTZ	D	WESDY	C	WHITAKER	B	WILDHORSE	A
WATCHAUG	C	WEDGE	B	WESFIL	C	WHITE HOUSE	C	WILDORS	C
WATCHUNG	B	WEDLAR	D	WESIX	D	WHITE STORE	D	WILDWOOD	D
WATERBURY	D	WEDOWEE	A	WESKA	D	WHITE SWAN	D	WILE	C
WATERCANYON	D	WEED	C	WESLEY	D	WHITECAP	D	WILEY	B
WATEREE	B	WEEDING	B	WESO	B	WHITECLOUD	B	WILHITE	C/D
WATERMAN	B	WEEDMARK	D	WESPAC	B	WHITECOW	B	WILHOIT	B
WATERTOWN	D	WEEKIWACHEE	B	WESPAC, SANDY SUBSTRATUM	D	WHITECROSS	D	WILKES	C
WATERVILLE	D	WEEKS	D	WESSEL	B	WHITEFISH	B	WILKESON	B
WATKINS	A	WEEKSVILLE	C	WESTBROOK	C	WHITEFORD	B	WILKINS	B
WATKINS RIDGE	B	WEENA	B/D	WESTBURY	D	WHITEHALL	B	WILL	D
WATO	B	WEEPAH	D	WESTBUTTE	C	WHITEHILLS	B	WILLABY	B/D
WATONGA	B	WEESATCHE	C	WESTCAMP	C	WHITEHORN	C	WILLACY	C
WATOOPAH	D	WEGA	B	WESTCREEK	C	WHITEHORSE	D	WILLAKENZIE	B
WATROUS	B	WEHADKEE	B	WESTE	B	WHITEKNOB	B	WILLAMAR	C
WATSEKA	B	WEIGANG	D	WESTERVILLE	C	WHITELAKE	B	WILLAMETTE	B
WATSON	B	WEIGLE	C	WESTFORK	B	WHITEMAN	C	WILLAMETTE, WET	B
WATSONIA	C	WEIKERT	D	WESTHAVEN	D	WHITEPEAK	D	WILLANCH	C
WATSONVILLE	D	WEIMER	C/D	WESTHAVEN, SALINE-ALKALI	D	WHITERIVER	D	WILLAPA	D
WATT	D	WEINBACH	D	WESTINDIAN	C	WHITEROCK	C	WILLARD	C
WATTON	D	WEINGART	C	WESTLAKE	D	WHITESBORO	D	WILLETTE	B
WATUSI	C	WEINGARTEN	D	WESTLAND	C	WHITESBURG	C	WILLHILL	A/D
WAUBAY	C	WEIR	C	WESTMORE	D	WHITESON	C	WILLHO	C
WAUBEEK	B	WEIRMAN	D	WESTMORELAND	B/D	WHITESTONE	D	WILLIAMS	D
WAUBERG	B	WEIRMAN, WET	A	WESTON	C	WHITETHORN	B	WILLIAMSBURG	B
WAUBONSIE	D	WEIRMAN, NONFLOODED		WESTOVER	B	WHITEWATER	D	WILLIAMSON	D
WAUCEDAH	B/D	WEISBURG	C	WESTPHALIA	D	WHITEWOLF	A	WILLIAMSPORT	C
WAUCHULA	D	WEISER	B	WESTPLAIN	A	WHITEWOOD	C/D	WILLIAMSTOWN	C
WAUCHULA, DEPRESSIONAL		WEISHAUPT	D	WESTPORT	B	WHITEWOOD, NONFLOODED	B/D	WILLIAMSVILLE	C
WAUCOBA	D	WEISSENFELS	C	WESTPORT, THIN SURFACE	D	WHITEWRIGHT	A	WILLIHAN	B/D
WAUCONA	B	WEITAS	B	WESTSHORE	C	WHITING	B	WILLIS	C
WAUCONDA	B	WEITCHPEC	C	WESTYACO	D	WHITINGER	C	WILLISTON	C
WAUKEE	B	WEKODA	D	WESTVIEW	C	WHITLEY	B	WILLOW CREEK	C
WAUKEGAN	B	WELAKA	A	WESTVILLE	B	WHITLOCK	B	WILLOWDALE	B
WAUKENA	B	WELBY	B	WESTWEGO	B	WHITMAN	C	WILLOWEMOC	B
WAUKON	D	WELCH	D	WESWIND	D	WHITNEY	B	WILLOWMAN	C
WAULD	B	WELCH, GRAVELLY SUBSTRATUM, DRAINED	B	WESWOOD	D	WHITORE	B	WILLOWS	D
WAUMAC	C	WELCH, RARELY FLOODED, DRAINED		WETA	C	WHITSOL	D	WILLWOOD	B
WAUMBEK	B	WELCH, DRAINED	B	WETHERSFIELD	B	WHITSON	B	WILMA	A
WAUNA	B	WELCHLAND	C	WETHEY	D	WHITTIER	D	WILMER	B
WAUPACA	C	WELCOME	C	WETHEY, DRAINED	C	WHITWELL	B	WILMINGTON	C
	B/D		B	WETMORE	C	WHOBREY	C	WILMONT	D
			B	WETSAW	A	WHOLAN	C	WILMONTON	B
					D	WHORLED	B	WILPAR	B
					C	WHY	C	WILPOINT	C
							B	WILSHIRE	D
									A

NOTES: TWO HYDROLOGIC SOIL GROUPS SUCH AS B/C INDICATES THE DRAINED/UNDRAINED SITUATION.
MODIFIERS SHOWN, E.G., BEDROCK SUBSTRATUM, REFER TO A SPECIFIC SOIL SERIES PHASE FOUND IN SOIL MAP LEGEND.



*Due to migration of fines, channels, and air in voids.

Fig. 7.6 Permeability, drainage, soil type, and methods to determine the coefficient of permeability (after A. Casagrande, 1938, with minor additions).

Excerpt from "Hydrology of Ponds and Small Lakes"

(B)

The different clay minerals significantly affect the permeability of the clay as emphasized by Grim (p. 240, 1962). Clay tends to fill the voids between grains of silt, sand, and gravel, and there is definite correlation between clay mineral compositon and the order of magnitude of permeability.

Grim (p. 241, 1962) cites a table by Endell *et al* giving permeability K in cm/min at 65 kg/sq. cm for various mixtures of sand and clay minerals, including pure clay. Comparisons from the cited table are pertinent to the analysis shown in table 3. It is noted that quartz sand, mica, kaolinite, and ca-montmorillonite have a permeability (K) value of 1×10^{-3}, 4.9×10^{-4}, 3.0×10^{-6} and 2.0×10^{-7}, respectively.

Na-montmorillonite is impermeable. It should be explained that the X-ray method used in obtaining the analyses given in table 3 gives the dominant montmorillonite, but some Na-montmorillonite is doubtless present, as is common where ion-exchange is involved. The presence of much montmorillonite in the clays of the bottom sediments of ponds and lakes in Minnesota is important in reducing permeability.

Organic matter in the bottom sediments has been briefly noted above, but further description is desirable. The muck (and clay-silt sediment below) ranges in color from black to light gray both in bulk and under the microscope. When organic matter is abundant, its appearance under the microscope in plain polarized light ranged from black to brown to tan, depending primarily on its abundance and particle size. The prevailing characteristic of this material is that the organic matter, clay minerals, and silt particles from aggregates in which the grains of silt, mainly quartz, are clearly enclosed in aggregates. Ju what effect, if any, the aggregates have on the grain siz determinations in the laboratory process remains to b determined. It seems possible that aggregation or floccul tion of the organic matter and fine particles makes th sediment more impervious.

Table 4. Comparison of evaporation and precipitation

	70% of Pan Evaporation (in inches) Farmington	Precipitation (in inches) Minneapolis	Excess or Deficiency Evaporatio (in inches)
1962.....	25.47 (May-October only)	28.83	−3.46
1963.....	27.40 (May-September only)	19.57	+7.83
1964.....	29.90 (May-September only)	25.97	+3.93

Precipitation and Evaporation

That precipitation and evaporation are by far the mos important factors in determining water levels in isolate bodies of water is verified by the results of the presen studies. Since Minnesota has a continental climate, th weather is subject to wide fluctuations, not only throughou the year but from year to year and the effects of this ar shown in the levels of the ponds and lakes included i this investigation.

It was not practical to establish rain gages at the 4 locations investigated. Instead it was necessary to us the climatological data of the Weather Bureau, U. S. De partment of Commerce. Fortunately several of the site for regular observations of precipitation were reasonably

Table 5. Precipitation in 1962 at selected locations. U.S. Weather Bureau records. (Precipitation in inches.)

	Minneapolis		Forest Lake	St. Peter		Redwood Falls		Willmar		Morris		Little Falls
Jan.	.55	—.15	34	.25	—.60	.41	—.13	.65	.07	.51	—.06	.55
Feb.	2.07	1.29	1.18	1.82	.94	1.26	.94	1.75	1.09	1.55	.87	1.22
March	1.87	.34	1.73	1.45	—.17	1.02	—.36	1.06	—.10	.79	—.35	.86
April	1.32	—.54	.98	1.22	—.94	1.79	—.18	1.60	—.44	1.60	—.69	1.00
May	8.03	4.84	5.73	6.79	3.16	4.05	.78	5.61	2.39	6.43	3.47	7.18
June	1.48	—2.52	3.00	2.15	—3.19	3.64	—.64	2.84	1.64	3.89	—.05	2.37
July	5.12	1.85	4.63	7.24	4.05	8.27	5.43	5.82	3.01	9.09	5.91	7.93
August	3.47	.29	5.90	4.19	.41	3.62	.41	1.77	—1.83	1.76	1.27	3.08
Sept.	2.46	.03	2.85	.164	—1.12	2.06	—.09	3.58	.91	3.93	2.04	2.69
October	1.69	.10	1.49	1.40	—.15	2.80	1.44	1.44	.09	.51	—.94	.65
Nov.	.52	—.98	.63	.23	—1.31	.31	—.87	.66	—.49	.46	—.55	.47
Dec.	.26	—.60	.25	.12	.81	.17	—.47	.09	—.48	.07	—.54	.10
TOTAL	28.83	4.05	28.71	38.50	.34	28.40	5.81	26.87	2.400	30.42	7.84	28.08

EVAPORATION

	Farmington	Stewart
May	7.85	6.89
June	7.76	7.05
July	5.59	6.02
Aug.	7.38	7.26
Sept.	4.55	4.29
Oct.	3.25	3.57
Total	36.38	35.08

Minus sign indicates below normal.

Table 6. Precipitation and class A pan evaporation for 1963 at selected locations

	Minneapolis		Forest Lake	St. Peter		Redwood Falls		Willmar		Morris		Little Falls
Jan.	.46	—.24	.18	.34	—.52	.62	+.08	.59	+.01	.34	—.23	.23
Feb.	.41	—.37	.20	.39	—.49	.60	—.17	.34	—.32	.68	+.02	.48
March	1.18	—.35	1.04	1.07	—.55	.88	—.50	2.03	+87.00	1.73	+.59	1.11
April	2.07	+.22	1.91	2.29	+.07	2.62	+.44	4.84	+2.80	2.70	+.56	3.44
May	5.06	+1.87	4.10	2.88	—.75	5.68	+2.41	5.38	+2.16	3.16	+.20	5.04
June	1.91	—2.09	2.94	4.92	+.36	3.39	—.89	5.46	+.98	4.33	+.39	3.08
July	1.53	—1.74	3.35	6.36	+3.17	8.52	+5.68	3.05	+.24	4.41	+1.23	4.02
Aug.	1.55	—1.63	1.91	2.67	—1.12	3.48	+.27	2.78	—.82	3.00	+.03	4.35
Sept.	3.46	+1.04	3.15	2.56	—.19	3.72	1.57	5.36	+2.59	2.56	+.67	2.25
Oct.	.81	—.78	.38	1.85	+.30	1.44	.08	2.49	+.96	2.22	+.77	1.51
Nov.	.52	—.88	.49	.29	—1.31	.29	—.89	.45	—.70	.53	—.48	.99
Dec.	.60	—.26	.77	.36	—.57	.24	—.40	1.09	+.52	.63	+.02	1.26
Total	19.21	—5.21	20.42	25.86	—2.30	31.27	+4.38	33.86	+9.39	26.29	+3.71	27.76

Class A Pan Evaporation

	Farmington	Stewart
May	7.29	7.30
June	10.11	9.74
July	8.68	7.91
Aug.	7.60	6.49
Sept.	5.46	4.81
Total	39.14	36.25

Table 7. Precipitation and class A pan evaporation for 1964 at selected locations, U.S. Weather Bureau records (Precipitation in inches)

	Minneapolis		Forest Lake	St. Peter		Redwood Falls		Willmar		Morris		Little Falls
Jan.	.67	—.23	.65	.14	—.71	.25	—.29	.24	—.34	1.21	—.34	.19
Feb.	.06	—.72	.02	Tr	—.88	.08	—.69	.20	—.46	.17	—.49	Tr
March	1.35	—.18	.98	.95	—.67	.88	—.50	1.64	+.41	1.39	+.25	1.27
April	2.98	+1.13	3.63	3.34	+1.15	2.84	—.87	4.02	+1.98	3.64	+1.50	2.52
May	3.44	+.25	4.13	4.46	+.83	2.89	—.38	2.28	—.94	.28	—2.68	1.88
June	2.18	—1.82	1.61	2.05	—3.23	1.30	—2.98	2.49	—1.99	2.75	—1.19	2.35
July	2.02	—1.25	1.44	3.63	+.44	1.71	—1.13	2.35	—.46	2.21	—.97	3.91
Aug.	5.42	2.24	4.70	6.90	+3.12	3.61	.40	6.68	+3.08	6.01	+2.98	7.83
Sept.	5.21	2.78	3.40	5.80	+3.05	2.81	—.66	1.98	—.69	1.53	—.36	2.69
Oct.	.57	—1.02	.49	.37	—1.18	.49	—.87	.02	—1.51	.06	—1.39	.23
Nov.	1.19	—.21	1.14	1.36	—.18	.30	—.88	.74	—.41	.35	—.66	1.05
Dec.	1.08	+.22	1.53	.86	—.07	.37	—.27	.57	.00	.29	—.32	.44
Total	25.97	+1.19	23.16	29.86	+1.70	17.53	—6.06	23.14	—1.33	18.89	—3.67	24.36

Class A Pan Evaporation

	Farmington	Waseca
May	9.29	8.24
June	10.11	8.46
July	10.18	9.10
Aug.	8.36	6.92
Sept.	4.78	3.71
Total	42.72	37.61

Table 8. Examples of the rise in water level in spring 1965

Pothole No.	From	To	Rise Feet
B 1	12-31-1964	4-22-1965	4.24
In 1	12-31-1964	4-22-1965	7.06
In 2	12-31-1964	4-22-1965	3.87
In 3	12-31-1964	4-22-1965	5.69
In 4	12-31-1964	4-22-1965	8.31
In 5	12-31-1964	4-22-1965	8.23
In 7	12-31-1964	4-22-1965	7.92
LE 3	12-31-1964	4-29-1965	7.18
LE 4	1- 9-1965	4-22-1965	5.84
M 1	1- 9-1965	5- 4-1965	8.69
M 2	1- 5-1965	4-29-1965	5.66
M 3	1- 9-1965	4-29-1965	5.54
N 1	1-22-1965	5- 4-1965	11.46
S.P. 1	12-31-1964	5-27-1965	4.84
S.P. 2	12-31-1964	5-27-1965	5.76
S.P. 3	12-31-1964	5-27-1965	7.57

for above normal.
for below normal.

Bituminous Roadways, Inc.
Inver Grove Heights, MN

4/25/02

Stormwater Calculations: 2, 10, & 100-yr Storms

(1) Existing Conditions

Drainage Area Tributary to existing on-site wetland

A_1 = 44.77 acres = 0.0699 sq mi

100% pervious → CN = 61

Time of Concentration

1st 300 feet Sheet Flow

$$t_1 = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} S^{0.4}}$$

where: $n = 0.24$, $L = 300'$, $P_2 = 2.75$, $S = 0.01$

$t_1 \cong 0.813$ hrs

After Max. 300 feet — Shallow Concentrated Flow

$$t_2 = \frac{L}{3600V}$$

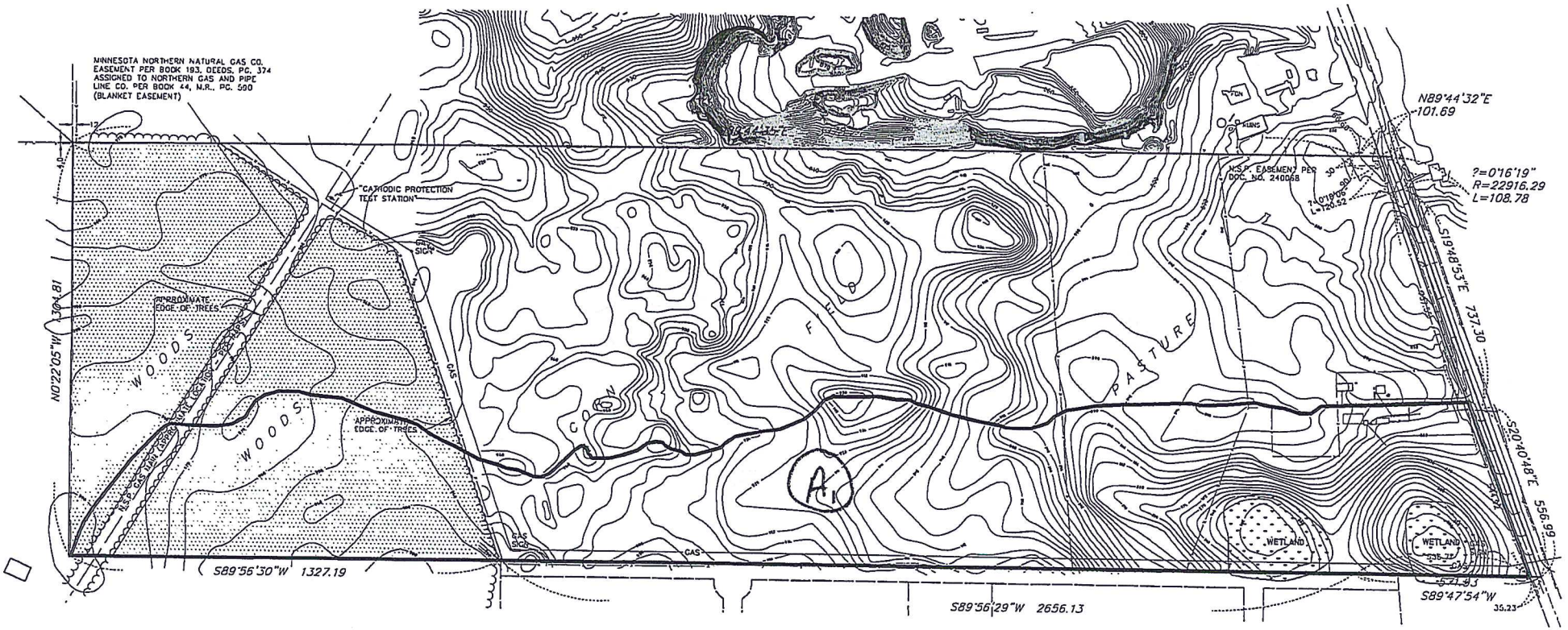
where: $L = 1720$ ft, $V = 2.8$ ft/sec

$t_2 \cong 0.17$ hrs.

$t_c = t_1 + t_2 \cong 0.98$ hrs

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

Existing Conditions Tributary Drainage Area Map



22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

(2) Proposed Conditions

Drainage Area Tributary to existing on-site wetland $A_2 = 63.05 ac = 0.0985 sq mi$

100% Pervious → CN = 61

Time of Concentration:

1st 300 ft Sheet Flow

$$t_1 = \frac{0.007 (nL)^{0.8}}{(P_2)^{0.5} S^{0.4}}$$

where: $n = 0.24$, $L = 300'$, $P_2 = 2.75$, $S = 0.02$

$t_1 \cong 0.62$ hrs

After Max 300 feet - Shallow Concentrated Flow

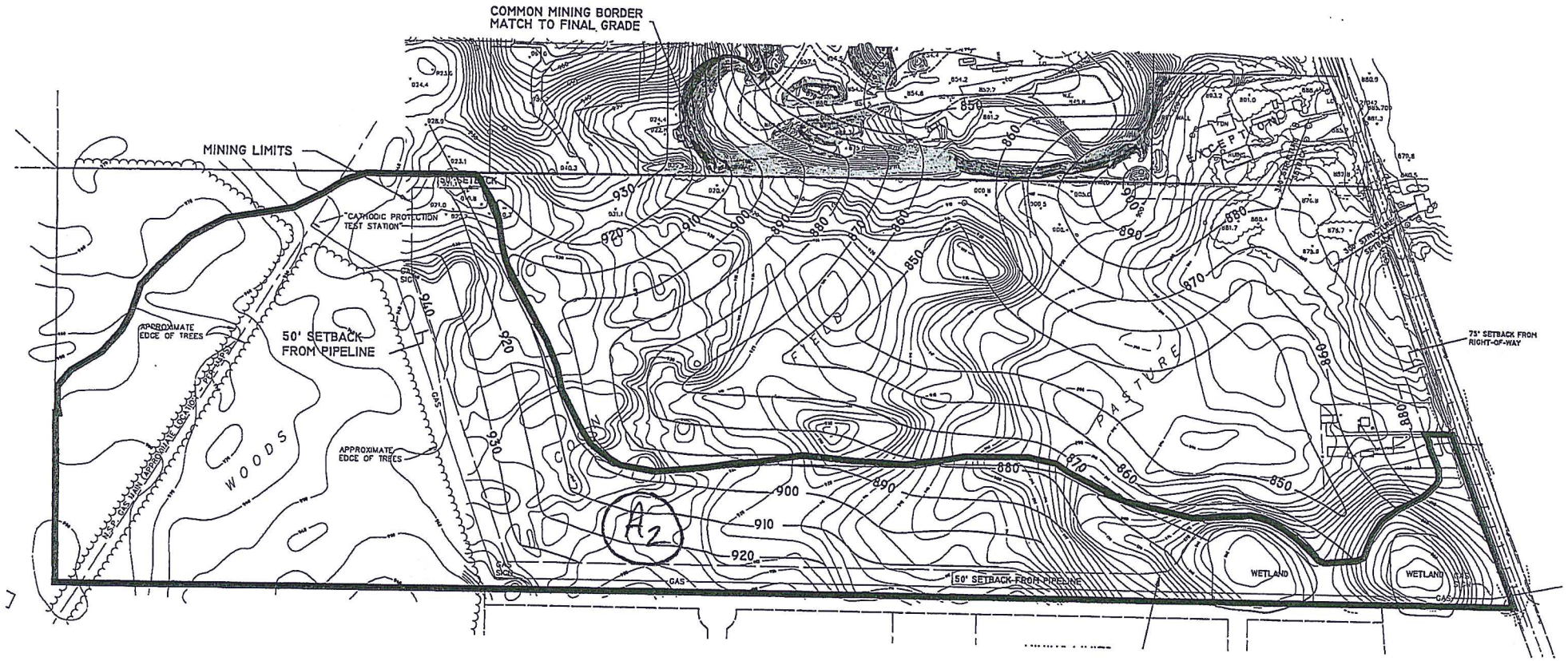
$$t_2 = \frac{L}{3600 V}$$

where: $L = 2840$ ft, $V = 2.3$ ft/sec

$t_2 \cong 0.34$ hrs

$t_c \cong 0.62 + 0.34 = 0.96$ hrs.

Proposed Conditions Tributary Drainage Area Map



AMPAD
22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

(3) TR-20 Results

Storm Event	Rainfall (in.)	Existing Conditions Peak Flow Rate (cfs)	Proposed Conditions Peak Flow Rate (cfs)
2-YR	2.75	3.53	5.04
10-YR	4.20	17.78	25.43
100-YR	5.90	42.91	61.38

1

**********80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY**********

```
JOB TR-20                    FULLPRINT          SUMMARY
TITLE     Bituminous Roadways, Inver Grove Heights, MN Existing Conditions
TITLE     (04/26/02)  2-YR, 10-YR & 100-YR/24-HR/TYPE II STORM EVENT
 6 RUNOFF 1 001       1 .06996      61.         0.98        1 1   1   1
   ENDATA
 7 INCREM 6             0.05
 7 COMPUT 7 001   001              2.75        1.0         2 2  01  01
   ENDCMP 1
 7 INCREM 6             0.05
 7 COMPUT 7 001   001              4.20        1.0         2 2  01  01
   ENDCMP 1
 7 INCREM 6             0.05
 7 COMPUT 7 001   001              5.90        1.0         2 2  01  01
   ENDCMP 1
   ENDJOB 2
0*****************************END OF 80-80 LIST*********************************
1
```


EXECUTIVE CONTROL OPERATION INCREM
\+ MAIN TIME INCREMENT = .05 HOURS RECORD ID

EXECUTIVE CONTROL OPERATION COMPUT
\+ FROM XSECTION 1 RECORD ID
\+ TO XSECTION 1
STARTING TIME = .00 RAIN DEPTH = 2.75 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .05 HOURS

OPERATION RUNOFF CROSS SECTION 1
OUTPUT HYDROGRAPH= 1
AREA= .07 SQ MI INPUT RUNOFF CURVE= 61. TIME OF CONCENTRATION= .98 HOURS
INTERNAL HYDROGRAPH TIME INCREMENT= .0503 HOURS

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET) (RUNOFF)
12.77	3.53	

TIME(HRS)		FIRST HYDROGRAPH POINT = .00 HOURS				TIME INCREMENT = .05 HOURS			DRAINAGE AREA =		.07 SQ.MI.
11.50	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.02	.05
12.00	DISCHG	.14	.26	.43	.65	.93	1.26	1.63	2.01	2.36	2.67
12.50	DISCHG	2.93	3.15	3.31	3.43	3.50	3.53	3.52	3.48	3.41	3.30
13.00	DISCHG	3.19	3.08	2.98	2.89	2.80	2.71	2.63	2.56	2.48	2.40
13.50	DISCHG	2.33	2.26	2.19	2.13	2.07	2.01	1.95	1.90	1.85	1.80
14.00	DISCHG	1.75	1.70	1.66	1.62	1.58	1.54	1.51	1.47	1.44	1.41
14.50	DISCHG	1.38	1.35	1.32	1.30	1.27	1.25	1.22	1.20	1.17	1.15

RUNOFF VOLUME ABOVE BASEFLOW = .14 WATERSHED INCHES, 6.10 CFS-HRS, .50 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP
\+ COMPUTATIONS COMPLETED FOR PASS 1 RECORD ID

1

EXECUTIVE CONTROL OPERATION INCREM
\+ MAIN TIME INCREMENT = .05 HOURS RECORD ID

```
 EXECUTIVE CONTROL OPERATION COMPUT                                                                    RECORD ID
+                                FROM XSECTION   1
+                                                TO XSECTION   1
        STARTING TIME =   .00    RAIN DEPTH =  4.20    RAIN DURATION=  1.00    RAIN TABLE NO.= 2    ANT. MOIST. COND= 2
        ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .05 HOURS


 OPERATION RUNOFF   CROSS SECTION   1
           OUTPUT HYDROGRAPH= 1
           AREA=    .07 SQ MI   INPUT RUNOFF CURVE= 61.    TIME OF CONCENTRATION=   .98 HOURS
           INTERNAL HYDROGRAPH TIME INCREMENT=  .0503 HOURS

           PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
              12.62                          17.78                       (RUNOFF)

 TIME(HRS)          FIRST HYDROGRAPH POINT =   .00 HOURS      TIME INCREMENT =  .05 HOURS      DRAINAGE AREA =    .07 SQ.MI.
   11.50    DISCHG        .00       .00       .00       .01       .03       .07       .16       .35       .70      1.26
   12.00    DISCHG       2.08      3.17      4.52      6.13      7.94      9.88     11.79     13.54     15.01     16.16
   12.50    DISCHG      17.00     17.52     17.75     17.73     17.47     17.01     16.40     15.66     14.82     13.95
   13.00    DISCHG      13.12     12.37     11.71     11.10     10.54     10.02      9.54      9.10      8.67      8.27
   13.50    DISCHG       7.90      7.56      7.24      6.94      6.65      6.39      6.14      5.91      5.69      5.49
   14.00    DISCHG       5.30      5.12      4.95      4.80      4.65      4.51      4.38      4.25      4.14      4.03
   14.50    DISCHG       3.92      3.82      3.73      3.64      3.55      3.47      3.38      3.30      3.23      3.15

   RUNOFF VOLUME ABOVE BASEFLOW =   .56 WATERSHED INCHES,     25.41 CFS-HRS,     2.10 ACRE-FEET;   BASEFLOW =    .00 CFS

 EXECUTIVE CONTROL OPERATION ENDCMP                                                                    RECORD ID
+                                COMPUTATIONS COMPLETED FOR PASS   2


1


 TR20 XEQ 04-26-02  09:50       Bituminous Roadways, Inver Grove Heights, MN Existing Conditions                  JOB  1   PASS   3
      REV PC 09/83(.2)          (04/26/02)  2-YR, 10-YR & 100-YR/24-HR/TYPE II STORM EVENT                       PAGE   3


 EXECUTIVE CONTROL OPERATION INCREM                                                                    RECORD ID
+                                MAIN TIME INCREMENT =   .05 HOURS

 EXECUTIVE CONTROL OPERATION COMPUT                                                                    RECORD ID
+                                FROM XSECTION   1
+                                                TO XSECTION   1
        STARTING TIME =   .00    RAIN DEPTH =  5.90    RAIN DURATION=  1.00    RAIN TABLE NO.= 2    ANT. MOIST. COND= 2
        ALTERNATE NO.= 1         STORM NO.= 1    MAIN TIME INCREMENT =   .05 HOURS


 OPERATION RUNOFF   CROSS SECTION   1
           OUTPUT HYDROGRAPH= 1
           AREA=    .07 SQ MI   INPUT RUNOFF CURVE= 61.    TIME OF CONCENTRATION=   .98 HOURS
           INTERNAL HYDROGRAPH TIME INCREMENT=  .0503 HOURS

           PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
              12.57                          42.91                       (RUNOFF)

 TIME(HRS)          FIRST HYDROGRAPH POINT =   .00 HOURS      TIME INCREMENT =  .05 HOURS      DRAINAGE AREA =    .07 SQ.MI.
   10.50    DISCHG        .00       .00       .00       .00       .00       .00       .00       .00       .00       .01
   11.00    DISCHG        .01       .02       .03       .05       .07       .10       .14       .19       .25       .32
   11.50    DISCHG        .41       .52       .68       .90      1.20      1.62      2.24      3.17      4.52      6.39
   12.00    DISCHG       8.84     11.86     15.40     19.39     23.70     28.10     32.28     35.93     38.85     40.96
   12.50    DISCHG      42.28     42.86     42.78     42.13     40.98     39.43     37.57     35.47     33.24     31.01
   13.00    DISCHG      28.92     27.05     25.40     23.90     22.53     21.27     20.11     19.04     18.03     17.09
   13.50    DISCHG      16.23     15.43     14.70     14.01     13.37     12.77     12.22     11.71     11.23     10.79
   14.00    DISCHG      10.38      9.99      9.63      9.30      8.98      8.69      8.41      8.15      7.91      7.68
   14.50    DISCHG       7.46      7.26      7.07      6.88      6.70      6.53      6.36      6.20      6.04      5.89

   RUNOFF VOLUME ABOVE BASEFLOW =  1.30 WATERSHED INCHES,     58.71 CFS-HRS,     4.85 ACRE-FEET;   BASEFLOW =    .00 CFS

 EXECUTIVE CONTROL OPERATION ENDCMP                                                                    RECORD ID
+                                COMPUTATIONS COMPLETED FOR PASS   3


 EXECUTIVE CONTROL OPERATION ENDJOB                                                                    RECORD ID
```

1

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
+													
XSECTION 1	RUNOFF	.07	2	2	.05	.0	2.75	24.00	.14	---	12.77	3.53	50.5
XSECTION 1	RUNOFF	.07	2	2	.05	.0	4.20	24.00	.56	---	12.62	17.78	254.1
XSECTION 1	RUNOFF	.07	2	2	.05	.0	5.90	24.00	1.30	---	12.57	42.91	613.4

1

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1
0 XSECTION 1	.07	
+		
ALTERNATE 1		42.91

1END OF 1 JOBS IN THIS RUN

1

```
  ******************80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY******************

  JOB TR-20                    FULLPRINT          SUMMARY
  TITLE     Bituminous Roadways, Inver Grove Heights, MN Proposed Conditions
  TITLE     (04/26/02)  2-YR, 10-YR & 100-YR/24-HR/TYPE II STORM EVENT
   6 RUNOFF 1 002       1 .09851      61.         0.96        1 1   1   1
    ENDATA
   7 INCREM 6            0.05
   7 COMPUT 7 002   002              2.75        1.0         2 2  01  01
    ENDCMP 1
   7 INCREM 6            0.05
   7 COMPUT 7 002   002              4.20        1.0         2 2  01  01
    ENDCMP 1
   7 INCREM 6            0.05
   7 COMPUT 7 002   002              5.90        1.0         2 2  01  01
    ENDCMP 1
    ENDJOB 2
0*******************************END OF 80-80 LIST*********************************
1
```



```
  EXECUTIVE CONTROL OPERATION INCREM                                    RECORD ID
+                                  MAIN TIME INCREMENT =    .05 HOURS

  EXECUTIVE CONTROL OPERATION COMPUT                                    RECORD ID
+                                  FROM XSECTION    2
+                                                TO XSECTION    2
         STARTING TIME =    .00    RAIN DEPTH =  2.75    RAIN DURATION=  1.00    RAIN TABLE NO.= 2    ANT. MOIST. COND= 2
         ALTERNATE NO.= 1          STORM NO.= 1    MAIN TIME INCREMENT =    .05 HOURS


  OPERATION RUNOFF   CROSS SECTION   2
            OUTPUT HYDROGRAPH=  1
            AREA=     .10 SQ MI   INPUT RUNOFF CURVE= 61.    TIME OF CONCENTRATION=    .96 HOURS
            INTERNAL HYDROGRAPH TIME INCREMENT=  .0492 HOURS

            PEAK TIME(HRS)              PEAK DISCHARGE(CFS)          PEAK ELEVATION(FEET)
              12.75                            5.04                       (RUNOFF)

  TIME(HRS)          FIRST HYDROGRAPH POINT =    .00 HOURS      TIME INCREMENT =  .05 HOURS      DRAINAGE AREA =    .10 SQ.MI.
    11.50     DISCHG          .00       .00       .00       .00       .00       .00       .00       .00       .02       .08
    12.00     DISCHG          .20       .39       .64       .96      1.37      1.87      2.41      2.96      3.46      3.90
    12.50     DISCHG         4.27      4.56      4.79      4.93      5.01      5.04      5.01      4.93      4.80      4.63
    13.00     DISCHG         4.47      4.32      4.18      4.05      3.92      3.80      3.69      3.57      3.46      3.35
    13.50     DISCHG         3.25      3.16      3.06      2.97      2.88      2.80      2.72      2.65      2.57      2.51
    14.00     DISCHG         2.44      2.38      2.32      2.26      2.21      2.15      2.10      2.06      2.01      1.97
    14.50     DISCHG         1.93      1.89      1.85      1.81      1.78      1.74      1.71      1.67      1.64      1.60

    RUNOFF VOLUME ABOVE BASEFLOW =    .14 WATERSHED INCHES,       8.62 CFS-HRS,       .71 ACRE-FEET;   BASEFLOW =    .00 CFS

  EXECUTIVE CONTROL OPERATION ENDCMP                                    RECORD ID
+                                  COMPUTATIONS COMPLETED FOR PASS   1

1
```



```
  EXECUTIVE CONTROL OPERATION INCREM                                    RECORD ID
+                                  MAIN TIME INCREMENT =    .05 HOURS
```

EXECUTIVE CONTROL OPERATION COMPUT
+ FROM XSECTION 2 RECORD ID
+ TO XSECTION 2
STARTING TIME = .00 RAIN DEPTH = 4.20 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .05 HOURS

OPERATION RUNOFF CROSS SECTION 2
OUTPUT HYDROGRAPH= 1
AREA= .10 SQ MI INPUT RUNOFF CURVE= 61. TIME OF CONCENTRATION= .96 HOURS
INTERNAL HYDROGRAPH TIME INCREMENT= .0492 HOURS

PEAK TIME(HRS) PEAK DISCHARGE(CFS) PEAK ELEVATION(FEET)
12.60 25.43 (RUNOFF)

TIME(HRS)		FIRST HYDROGRAPH POINT = .00 HOURS				TIME INCREMENT = .05 HOURS			DRAINAGE AREA =		.10 SQ.MI.
11.50	DISCHG	.00	.00	.00	.01	.04	.10	.24	.53	1.04	1.86
12.00	DISCHG	3.08	4.70	6.71	9.08	11.75	14.57	17.34	19.83	21.89	23.46
12.50	DISCHG	24.56	25.20	25.43	25.28	24.79	24.03	23.06	21.90	20.64	19.37
13.00	DISCHG	18.20	17.17	16.26	15.41	14.62	13.90	13.24	12.61	12.01	11.45
13.50	DISCHG	10.94	10.47	10.02	9.60	9.21	8.85	8.51	8.19	7.89	7.61
14.00	DISCHG	7.35	7.10	6.87	6.66	6.45	6.26	6.08	5.91	5.75	5.60
14.50	DISCHG	5.46	5.32	5.19	5.07	4.95	4.83	4.71	4.60	4.49	4.38

RUNOFF VOLUME ABOVE BASEFLOW = .56 WATERSHED INCHES, 35.88 CFS-HRS, 2.96 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP
+ COMPUTATIONS COMPLETED FOR PASS 2 RECORD ID

1

TR20 XEQ 04-26-02 09:57 Bituminous Roadways, Inver Grove Heights, MN Proposed Conditions JOB 1 PASS 3
REV PC 09/83(.2) (04/26/02) 2-YR, 10-YR & 100-YR/24-HR/TYPE II STORM EVENT PAGE 3

EXECUTIVE CONTROL OPERATION INCREM
+ MAIN TIME INCREMENT = .05 HOURS RECORD ID

EXECUTIVE CONTROL OPERATION COMPUT
+ FROM XSECTION 2 RECORD ID
+ TO XSECTION 2
STARTING TIME = .00 RAIN DEPTH = 5.90 RAIN DURATION= 1.00 RAIN TABLE NO.= 2 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .05 HOURS

OPERATION RUNOFF CROSS SECTION 2
OUTPUT HYDROGRAPH= 1
AREA= .10 SQ MI INPUT RUNOFF CURVE= 61. TIME OF CONCENTRATION= .96 HOURS
INTERNAL HYDROGRAPH TIME INCREMENT= .0492 HOURS

PEAK TIME(HRS) PEAK DISCHARGE(CFS) PEAK ELEVATION(FEET)
12.55 61.38 (RUNOFF)

TIME(HRS)		FIRST HYDROGRAPH POINT = .00 HOURS				TIME INCREMENT = .05 HOURS			DRAINAGE AREA =		.10 SQ.MI.
10.50	DISCHG	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
11.00	DISCHG	.02	.03	.04	.07	.11	.15	.21	.28	.37	.48
11.50	DISCHG	.61	.77	1.00	1.33	1.77	2.39	3.30	4.68	6.67	9.42
12.00	DISCHG	13.03	17.48	22.69	28.55	34.85	41.22	47.20	52.35	56.36	59.16
12.50	DISCHG	60.81	61.38	60.99	59.80	57.90	55.45	52.58	49.41	46.12	42.91
13.00	DISCHG	39.99	37.42	35.15	33.06	31.15	29.40	27.79	26.29	24.88	23.58
13.50	DISCHG	22.40	21.31	20.29	19.34	18.45	17.64	16.88	16.18	15.53	14.92
14.00	DISCHG	14.35	13.83	13.33	12.87	12.44	12.04	11.66	11.31	10.97	10.66
14.50	DISCHG	10.36	10.09	9.82	9.57	9.32	9.08	8.84	8.62	8.39	8.18

RUNOFF VOLUME ABOVE BASEFLOW = 1.30 WATERSHED INCHES, 82.86 CFS-HRS, 6.85 ACRE-FEET; BASEFLOW = .00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP
+ COMPUTATIONS COMPLETED FOR PASS 3 RECORD ID

EXECUTIVE CONTROL OPERATION ENDJOB
RECORD ID

1

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION 2	RUNOFF	.10	2	2	.05	.0	2.75	24.00	.14	---	12.75	5.04	51.1
XSECTION 2	RUNOFF	.10	2	2	.05	.0	4.20	24.00	.56	---	12.60	25.43	258.1
XSECTION 2	RUNOFF	.10	2	2	.05	.0	5.90	24.00	1.30	---	12.55	61.38	623.1

1

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1
0 XSECTION 2	.10	
ALTERNATE 1		61.38

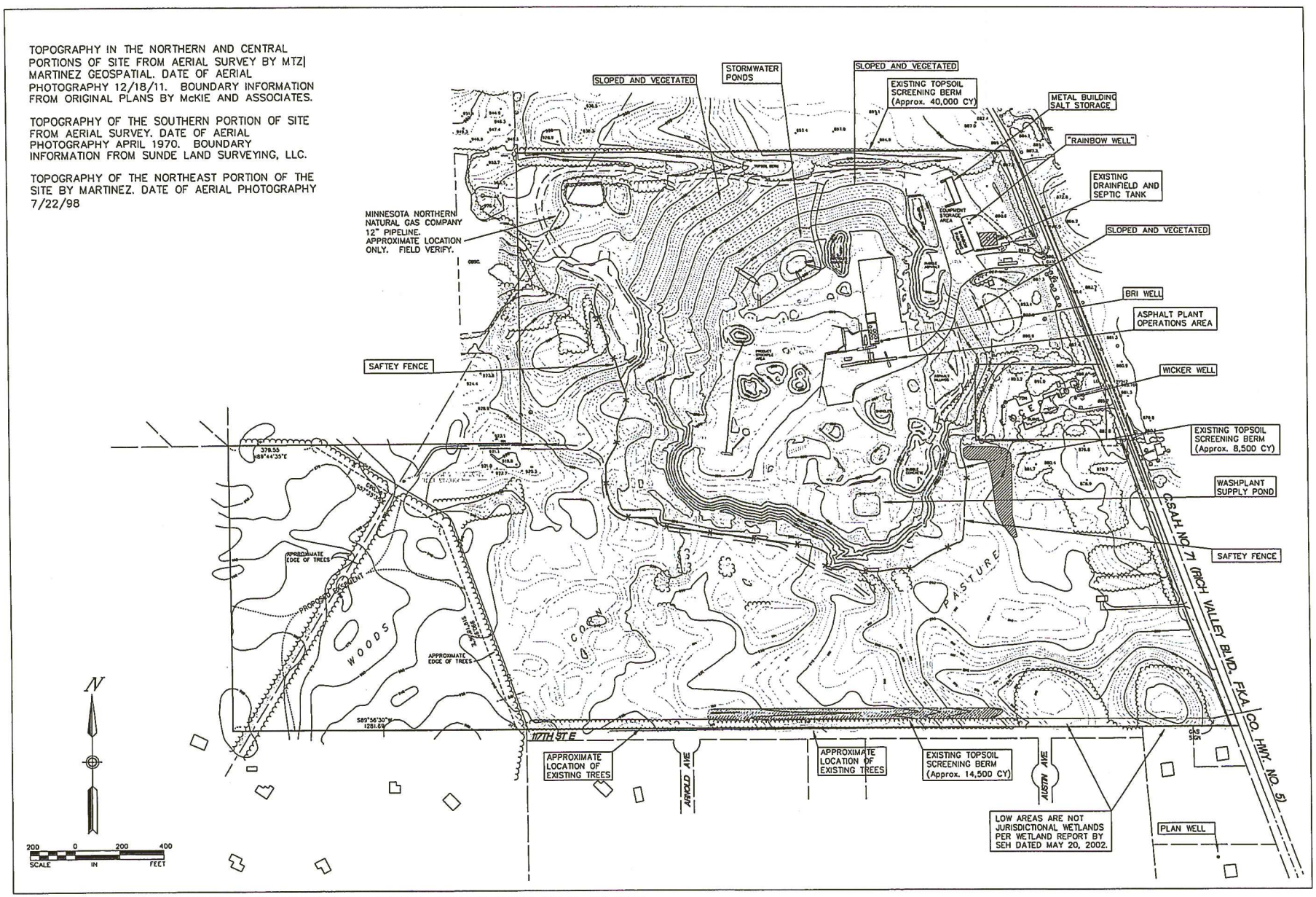
1END OF 1 JOBS IN THIS RUN

PLANS

TOPOGRAPHY IN THE NORTHERN AND CENTRAL PORTIONS OF SITE FROM AERIAL SURVEY BY MTZ| MARTINEZ GEOSPATIAL. DATE OF AERIAL PHOTOGRAPHY 12/18/11. BOUNDARY INFORMATION FROM ORIGINAL PLANS BY McKIE AND ASSOCIATES.

TOPOGRAPHY OF THE SOUTHERN PORTION OF SITE FROM AERIAL SURVEY. DATE OF AERIAL PHOTOGRAPHY APRIL 1970. BOUNDARY INFORMATION FROM SUNDE LAND SURVEYING, LLC.

TOPOGRAPHY OF THE NORTHEAST PORTION OF THE SITE BY MARTINEZ. DATE OF AERIAL PHOTOGRAPHY 7/22/98



T. , R. , S.

DRAWING: \\Kirstenspc\dwgs\Bituminous Roadways\2012 Permit Reissuance\2012 Revisions & Additions\C1 - Existing Conditions.dwg LAYOUT: C1 XREF: SLS-easement

Sunde Engineering, PLLC.
CONSULTING CIVIL ENGINEERS
10830 NESBITT AVENUE SOUTH
BLOOMINGTON, MINNESOTA 55437
(952) 881-3344 TELEPHONE
(952) 881-1913 FAX
www.sundecivil.com

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

DATE	REVISION
7/2/12	REVISED PER CITY COMMENTS

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kirsten Pauly
DATE: 7/2/12 REG. NO.: 21842

INFORMATION:

PROJECT NO.: 97-185
DRAWN BY: mm
CHECKED BY: kp
APPROVED BY: kp
SCALE: as noted
DATE: 04/24/12

DESCRIPTION:

EXISTING CONDITIONS

SHEET NO:

C-1

NOTES:

1. TOPOGRAPHY IN THE NORTHERN AND CENTRAL PORTIONS OF SITE BY MTZ| MARTINEZ GEOSPATIAL. DATE OF AERIAL PHOTOGRAPHY 12/18/11.

2. TOPOGRAPHY IN THE SOUTHERN PORTION OF SITE FROM AERIAL SURVEY. DATE OF AERIAL PHOTOGRAPHY April 1970.

3. TOPOGRAPHY OF THE NORTHEAST PORTION OF THE SITE BY MARTINEZ. DATE OF AERIAL PHOTOGRAPHY 7/22/98.

4. PHASING: FUTURE MINING ACTIVITY WILL PROCEED IN THE SEQUENCE INDICATED ON THIS PLAN. MINING IS CURRENTLY ACTIVE IN PHASE 1 AND WILL PROGRESS TO PHASE 2 WITHIN THE NEXT FIVE YEARS. EACH PHASE REPRESENTS APPROXIMATELY FIVE YEARS OF MINING ACTIVITY. ACTUAL LENGTH OF A PHASE WILL DEPEND UPON MARKET DEMAND AND THE QUALITY OF AGGREGATES ENCOUNTERED.

5. DIVERSION BERMS:

   DIVERSION BERMS WILL BE CONSTRUCTED AROUND ACTIVE PHASES TO PREVENT AGRICULTURAL RUN-ON INTO ACTIVE MINING AREAS. PHASES TO BE IMPACTED INCLUDE PHASE 1 AND PHASE 2, DESCRIBED BELOW:

   PHASE 1 – A DIVERSION BERM WILL BE PLACED ALONG THE WEST SIDE OF PHASE 1 IN ORDER TO KEEP AGRICULTURAL RUNOFF FROM ENTERING THE MINE. SEE ABOVE FOR LOCATION.

   PHASE 2 – A DIVERSION BERM WILL BE PLACED ALONG PART OF THE SOUTH BOUNDARY OF PHASE 2 IN ORDER TO KEEP AGRICULTURAL RUNOFF FROM ENTERING THE MINE. SEE ABOVE FOR LOCATION.

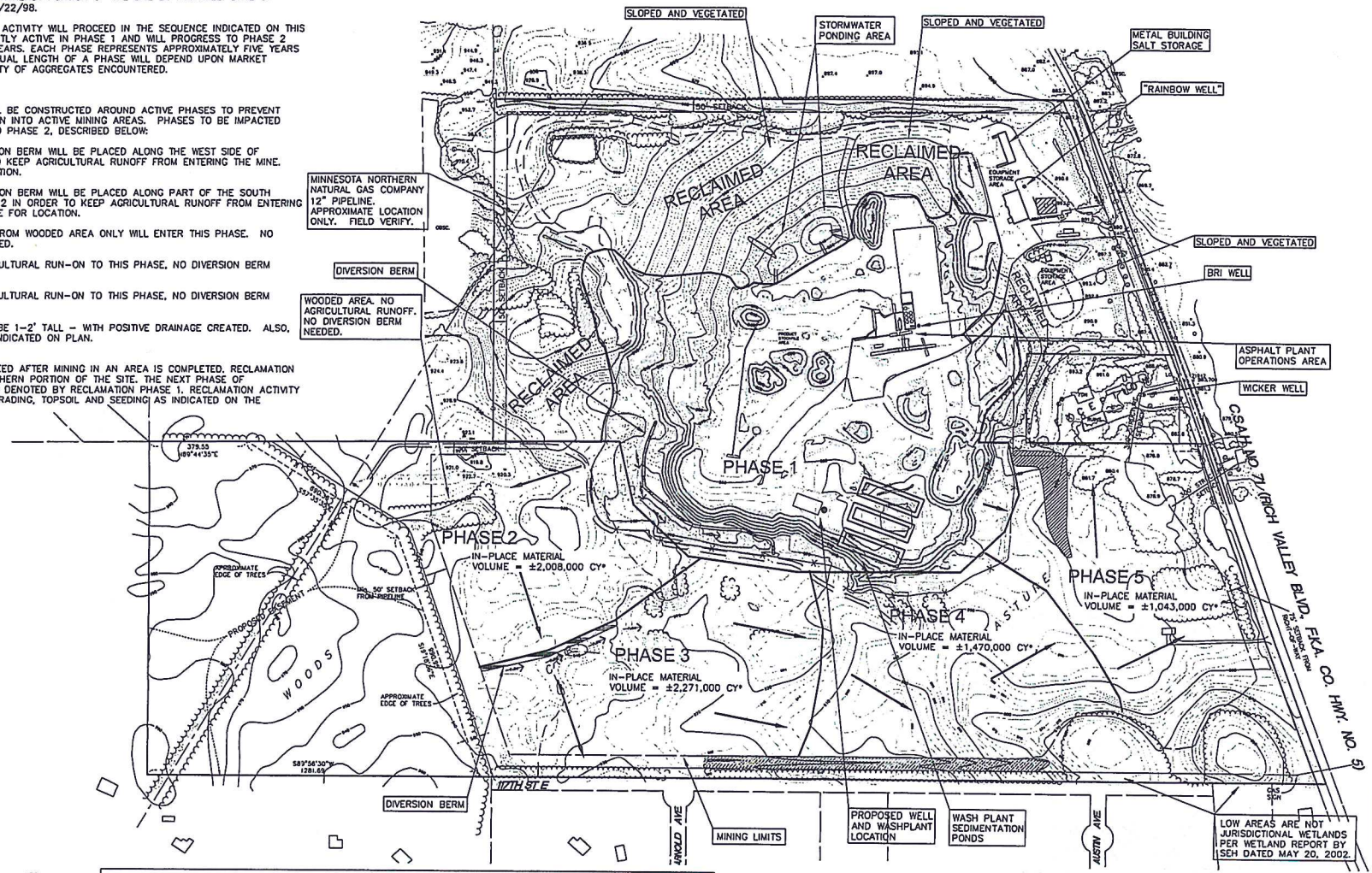
   PHASE 3 – RUNOFF FROM WOODED AREA ONLY WILL ENTER THIS PHASE. NO DIVERSION BERM NEEDED.

   PHASE 4 – NO AGRICULTURAL RUN-ON TO THIS PHASE, NO DIVERSION BERM NEEDED.

   PHASE 5 – NO AGRICULTURAL RUN-ON TO THIS PHASE, NO DIVERSION BERM NEEDED.

   DIVERSION BERMS TO BE 1-2' TALL – WITH POSITIVE DRAINAGE CREATED. ALSO, PERIMETER OF BERM INDICATED ON PLAN.

6. RECLAMATION WILL PROCEED AFTER MINING IN AN AREA IS COMPLETED. RECLAMATION HAS BEGUN IN THE NORTHERN PORTION OF THE SITE. THE NEXT PHASE OF RECLAMATION ACTIVITY IS DENOTED BY RECLAMATION PHASE 1. RECLAMATION ACTIVITY INCLUDES BACKFILLING, GRADING, TOPSOIL AND SEEDING AS INDICATED ON THE RECLAMATION PLAN.



*These are approximate gross volumes of in-place material from the existing ground elevation (less 3' of topsoil and overburden) to the maximum excavation elevation. Only a portion of the material will be used as construction aggregate as this depends on the gradation and the market demand. This volume assumes vertical walls at the phase limits.

DRAWING: \\Gratesnpc\dwgs\Bituminous Roadways\2012 Permit Reissuance\2012 Revisions & Additions\C2 – Phasing Plan.dwg LAYOUT: C2 XREF: SLS-easement

Sunde Engineering, PLLC.
CONSULTING CIVIL ENGINEERS
10630 NESBITT AVENUE SOUTH
BLOOMINGTON, MINNESOTA 55437
(952) 881-3344 TELEPHONE
(952) 881-1913 FAX
www.sundecivil.com

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

DATE	REVISION
7/12	REVISIONS PER CITY COMMENTS

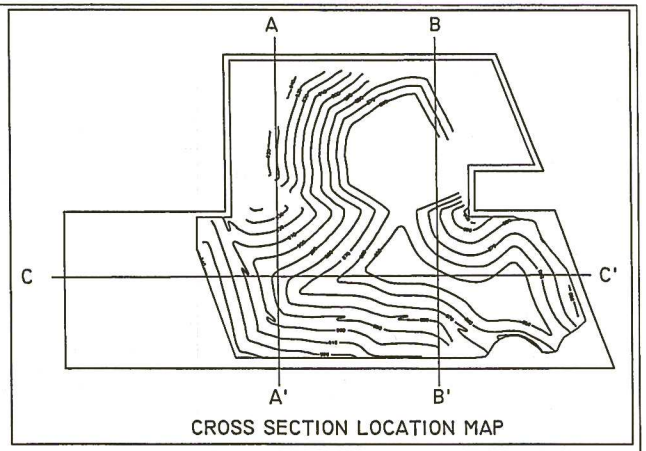
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kirsten Pauly
DATE: 7/2/12 REG. NO.: 21642

INFORMATION:
PROJECT NO.: 87-185
DRAWN BY: mm
CHECKED BY: kp
APPROVED BY: kp
SCALE: graphic
DATE: 06/26/12

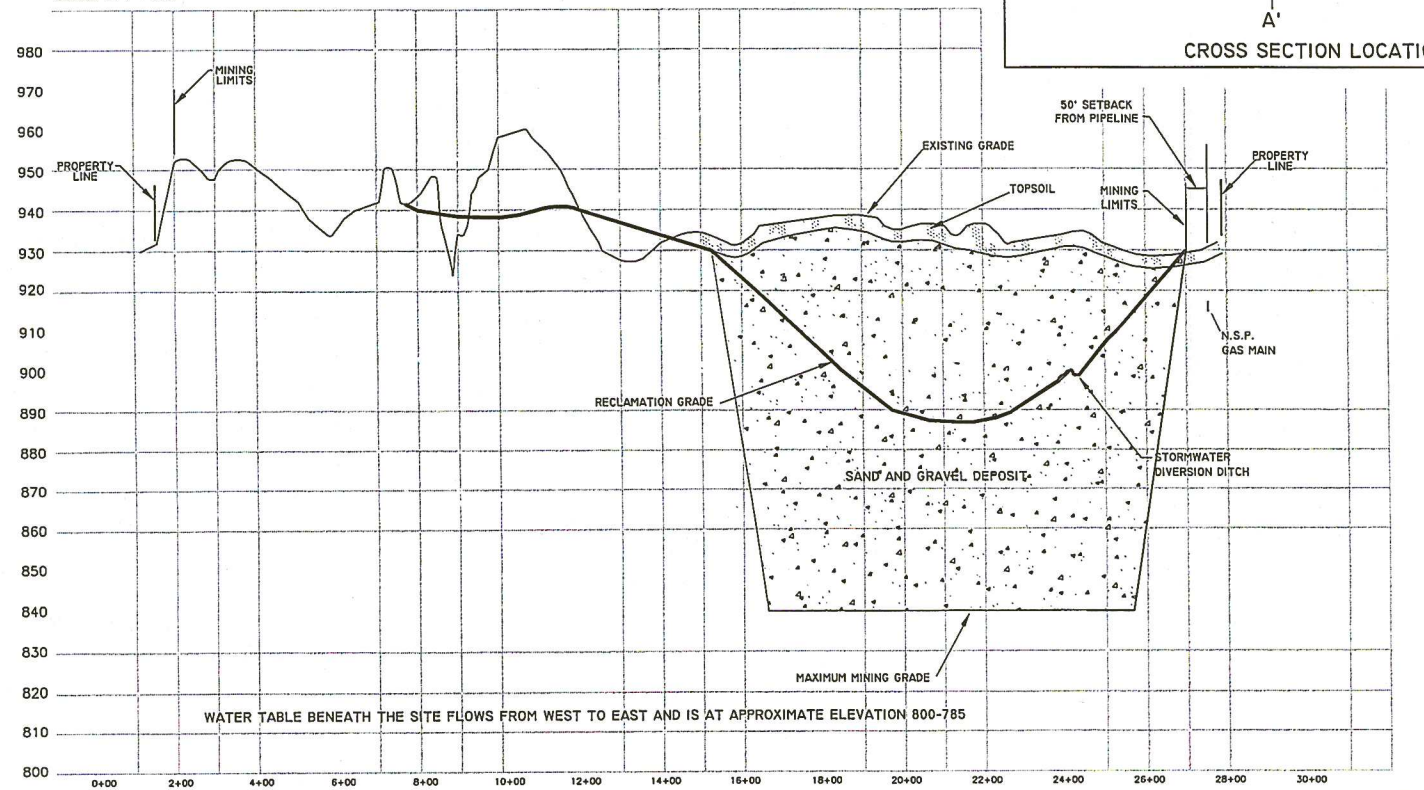
DESCRIPTION:
PHASING PLAN

SHEET NO:
C-2



CROSS SECTION LOCATION MAP

SCALE X: 1" = 30'
SCALE Y: 1" = 300'



NORTH-SOUTH CROSS SECTION A-A'

T. . R. . S.

DRAWING: \\Gratempe\dwgs\Bituminous Roadways\2012 Permit Reissuance\2012 Revisions & Additions\Cross Sections.dwg LAYOUT: 2012

Sunde Engineering, PLLC.
CONSULTING CIVIL ENGINEERS
4200 WEST OLD SHAKOPEE ROAD / SUITE 230
BLOOMINGTON, MINNESOTA 55437
(952) 881-3344 TELEPHONE
(952) 881-1013 FAX
www.sundecivil.com

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

DATE	REVISION
7/2/12	REVISIONS PER CITY COMMENTS

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kirsten Pauly
DATE: 7/2/12 REG. NO.: 21842

INFORMATION:

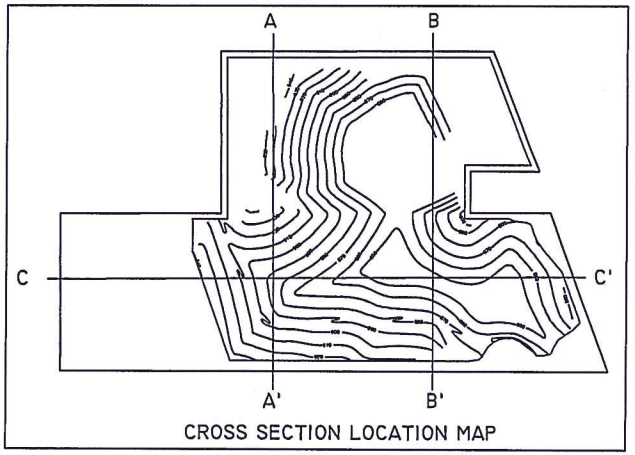
PROJECT NO.: 87-185
DRAWN BY: mm
CHECKED BY: kp
APPROVED BY: kp
SCALE: graphic
DATE: 06/14/12

DESCRIPTION:

CROSS-SECTION A-A'

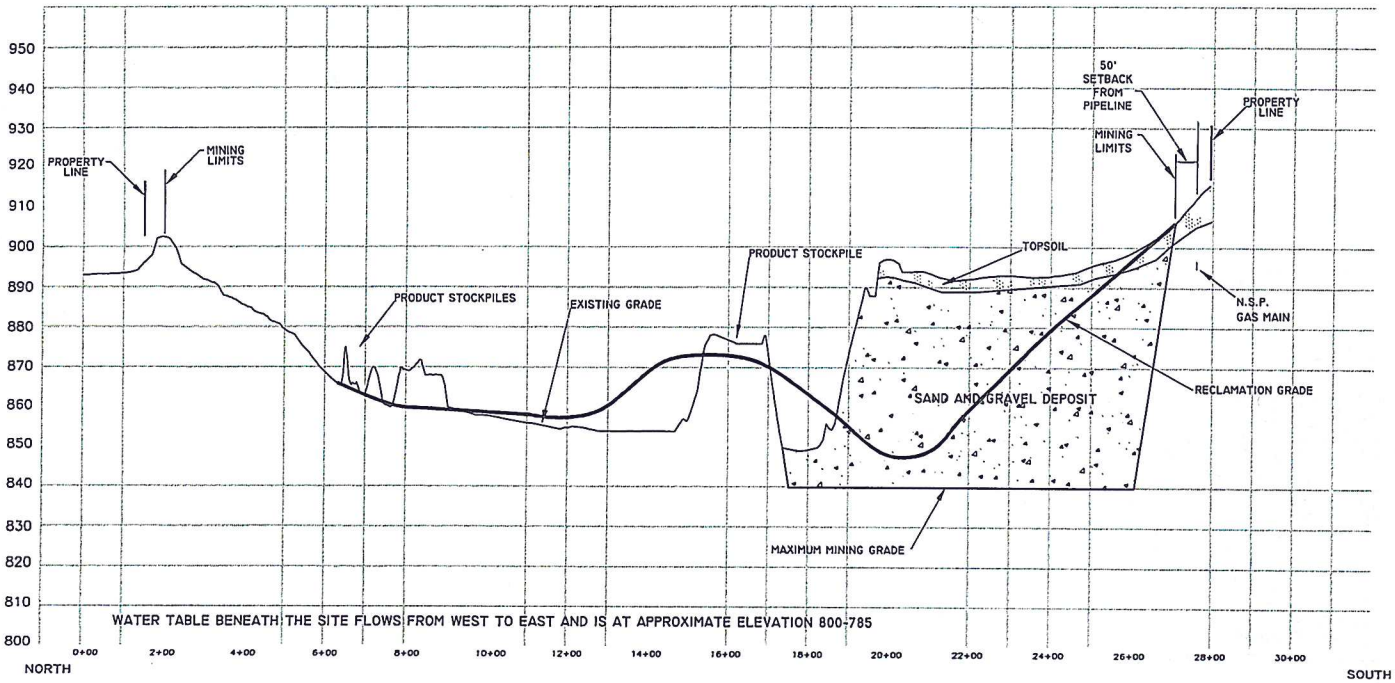
SHEET NO:

C-3



CROSS SECTION LOCATION MAP

SCALE X: 1" = 30'
SCALE Y: 1" = 300'



NORTH-SOUTH CROSS SECTION B-B'

T. , R. , S.

DRAWING: \\Cratenapt\dwgs\Bituminous Roadways\2012 Permit Reissuance\2012 Revisions & Additions\Cross Sections.dwg LAYOUT: 2012

Sunde Engineering, PLLC.
CONSULTING CIVIL ENGINEERS
4200 WEST OLD SHAKOPEE ROAD / SUITE 230
BLOOMINGTON, MINNESOTA 55437
(952) 881-3344 TELEPHONE
(952) 881-1913 FAX
www.sundecivil.com

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

DATE	REVISION
7/2/12	REVISIONS PER CITY COMMENTS

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kirsten Pauly
DATE: 7/2/12 REG. NO.: 21642

INFORMATION:

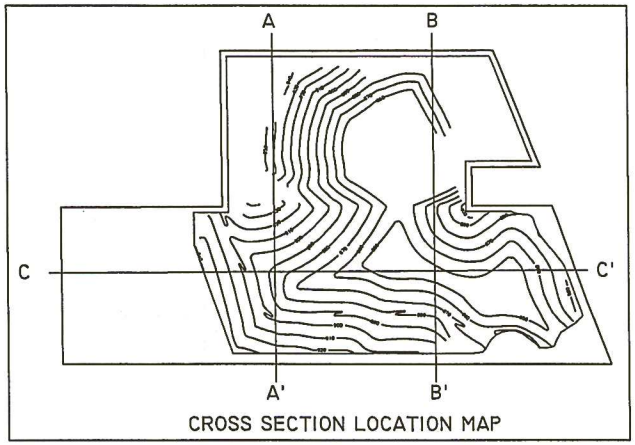
PROJECT NO.:	87-185
DRAWN BY:	mo
CHECKED BY:	kp
APPROVED BY:	kp
SCALE:	graphic
DATE:	04/20/12

DESCRIPTION:

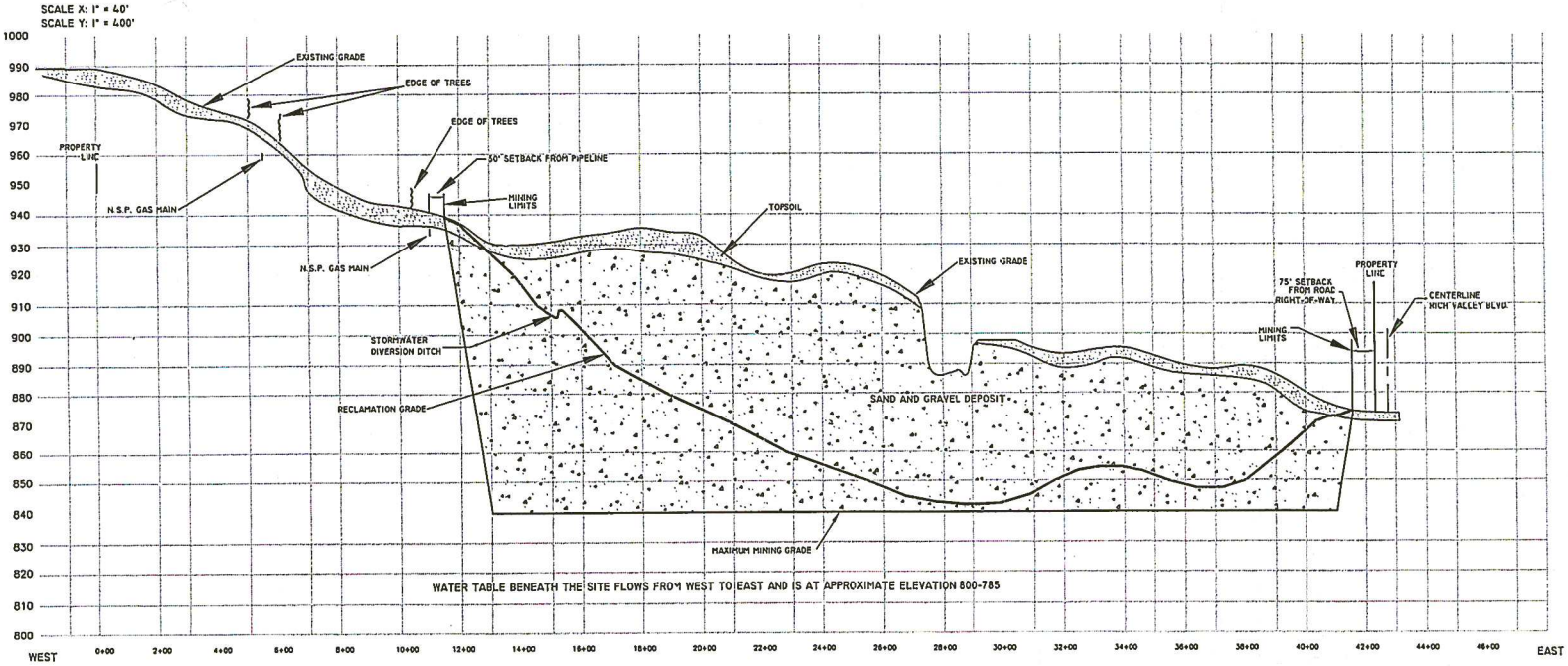
CROSS-SECTION B-B'

SHEET NO:

C-4



CROSS SECTION LOCATION MAP



WEST-EAST CROSS SECTION C - C'

T. , R. , S.

DRAWING: \\Grstenspe\dwgs\Bituminous Roadways\2012 Permit Reissuance\2012 Revisions & Additions\Cross Sections.dwg LAYOUT: 2012

Sunde Engineering, PLLC.
CONSULTING CIVIL ENGINEERS
4200 WEST OLD SHAKOPEE ROAD / SUITE 230
BLOOMINGTON, MINNESOTA 55437
(952) 881-3344 TELEPHONE
(952) 881-1913 FAX
www.sundecivil.com

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

DATE	REVISION
7/2/12	REVISIONS PER CITY COMMENTS

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kirsten Pauly
DATE: 7/2/12 REG. NO.: 21642

INFORMATION:

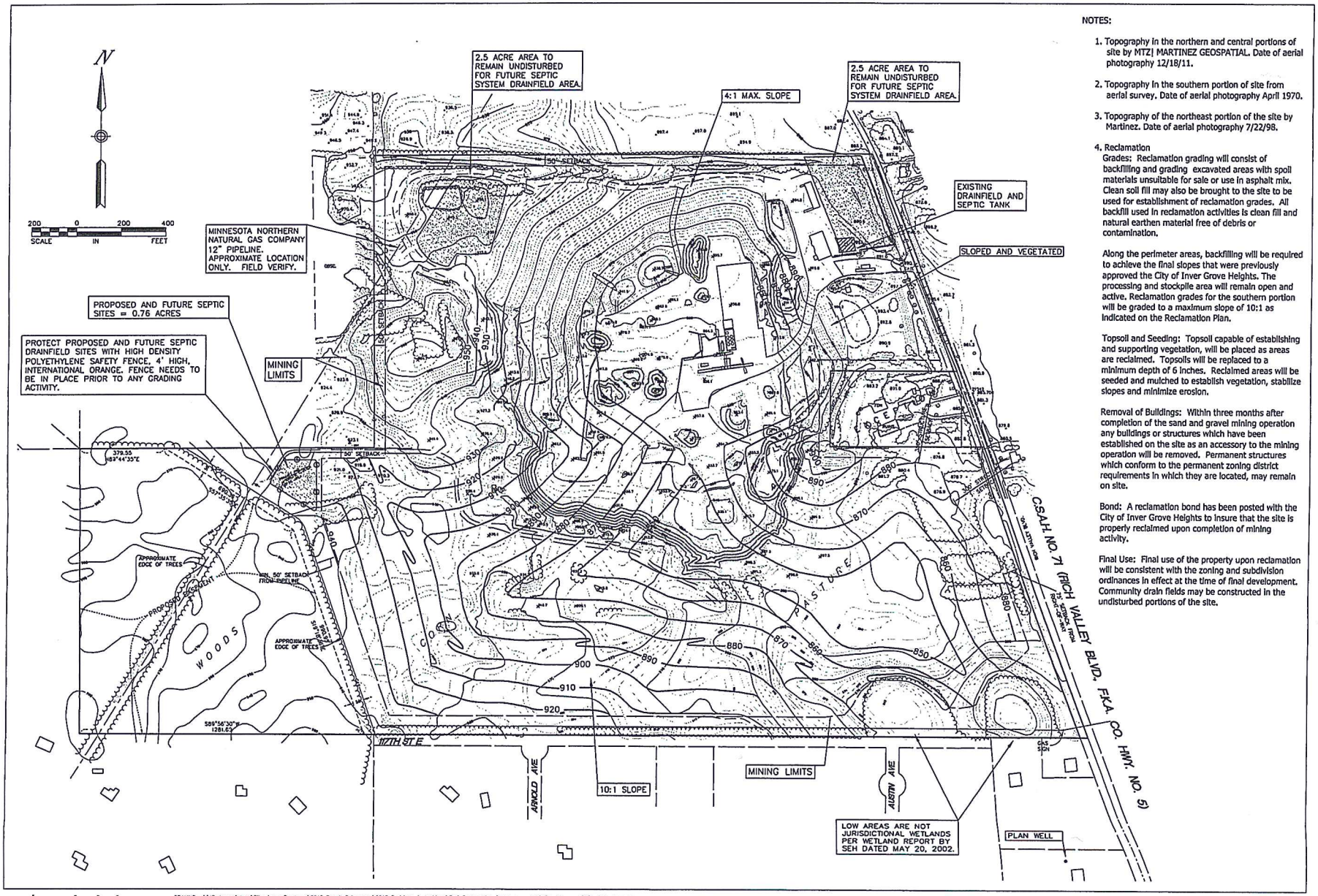
PROJECT NO.: 87-185
DRAWN BY: mm
CHECKED BY: kp
APPROVED BY: kp
SCALE: graphic
DATE: 04/24/12

DESCRIPTION:

CROSS-SECTION C-C'

SHEET NO:

C-5



NOTES:

1. Topography in the northern and central portions of site by MTZ| MARTINEZ GEOSPATIAL. Date of aerial photography 12/18/11.

2. Topography in the southern portion of site from aerial survey. Date of aerial photography April 1970.

3. Topography of the northeast portion of the site by Martinez. Date of aerial photography 7/22/98.

4. Reclamation
Grades: Reclamation grading will consist of backfilling and grading excavated areas with spoil materials unsuitable for sale or use in asphalt mix. Clean soil fill may also be brought to the site to be used for establishment of reclamation grades. All backfill used in reclamation activities is clean fill and natural earthen material free of debris or contamination.

Along the perimeter areas, backfilling will be required to achieve the final slopes that were previously approved the City of Inver Grove Heights. The processing and stockpile area will remain open and active. Reclamation grades for the southern portion will be graded to a maximum slope of 10:1 as indicated on the Reclamation Plan.

Topsoil and Seeding: Topsoil capable of establishing and supporting vegetation, will be placed as areas are reclaimed. Topsoils will be replaced to a minimum depth of 6 inches. Reclaimed areas will be seeded and mulched to establish vegetation, stabilize slopes and minimize erosion.

Removal of Buildings: Within three months after completion of the sand and gravel mining operation any buildings or structures which have been established on the site as an accessory to the mining operation will be removed. Permanent structures which conform to the permanent zoning district requirements in which they are located, may remain on site.

Bond: A reclamation bond has been posted with the City of Inver Grove Heights to insure that the site is properly reclaimed upon completion of mining activity.

Final Use: Final use of the property upon reclamation will be consistent with the zoning and subdivision ordinances in effect at the time of final development. Community drain fields may be constructed in the undisturbed portions of the site.

Sunde Engineering, PLLC.
CONSULTING CIVIL ENGINEERS
10630 NESBITT AVENUE SOUTH
BLOOMINGTON, MINNESOTA 55437
(952) 881-3344 TELEPHONE
(952) 881-1913 FAX
www.sundecivil.com

BITUMINOUS ROADWAYS INC.
INVER GROVE HEIGHTS GRAVEL PIT

2012 PERMIT REISSUANCE

DATE	REVISION
7/2/12	REVISIONS PER CITY COMMENTS

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Kristin Pauly
DATE: 7/2/12 REG. NO.: 21642

INFORMATION:

PROJECT NO.:	87-185
DRAWN BY:	mw
CHECKED BY:	kp
APPROVED BY:	kp
SCALE:	graphic
DATE:	04/24/12

DESCRIPTION:

RECLAMATION PLAN

SHEET NO:

C-6

T. . R. . S. DRAWING: \\Grstenspc\dwgs\Bituminous Roadways\2012 Permit Reissuance\2012 Revisions & Additions\C-6 Reclamation Plan.dwg LAYOUT: C6 XREF: SLS-easement

APPENDIX B

WETLAND DELINEATION REPORT

3535 Vadnais Center Drive, St. Paul, MN 55110-5196 651.490.2000 651.490.2150 FAX
architecture • engineering • environmental • transportation

May 20, 2002

RE: Bituminous Roadways, Inc.
11201 Rich Valley Road
Wetland Delineation
Inver Grove Heights, MN
SEH No. A-BITUM0201.00

Mr. Kent Peterson
President
Bituminous Roadways, Inc.
6898 Highway 101 East
Shakopee, MN 55379

Dear Mr. Peterson:

This letter constitutes our findings during a site visit at 11201 Rich Valley Road in Inver Grove Heights, Minnesota on May 10, 2002. The purpose of this site visit was to investigate the parcel, identify areas meeting the technical criteria for wetlands, delineate the jurisdictional extent of the wetland basins, and classify the wetland habitat.

The project site is located in the N½ of the SW¼ of Section 32, and the NE¼ of the SW¼ of Section 32 in Township 27 North, Range 22 West in Dakota County, Minnesota (see attached Figure 1). The 130-acre site is bounded on the north by a gravel pit, on the east by Rich Valley Road, on the south by private residences and agricultural land, and on the west by agricultural land.

Wetlands are defined jointly by the U.S. Army Corps of Engineers (Federal Register, 1982) and the U.S. Environmental Protection Agency (Federal Register, 1980) as follows: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

According to U.S. Army Corps of Engineers, one positive indicator (except in certain situations) from each of three elements must be in order to make a positive wetland determination, which are as follows:

- Greater than 50 percent dominance of hydrophytic plant species;
- Presence of hydric soil; and,
- The area is either permanently or periodically inundated, or soil is saturated to the surface during the growing season of the dominant vegetation.

The project site was examined on May 10, 2002 for areas meeting wetland criteria in accordance with the Corps of Engineers Wetlands Delineation Manual (U.S. Army Corps of Engineers, 1987). The 1987 Manual requires that soil inundation or saturation occur within 18 inches of the surface

and that all three wetland parameters (as discussed above) be present. The Routine Onsite Determination Method (RODM) as set forth by the U.S. Army Corps of Engineers was applied during this field investigation. Field data collected during the investigation is provided on the attached RODM data sheets.

The National Wetlands Inventory mapped two basins in the southeast corner of the parcel as Type 3 and Type 7 wetlands (see attached Figure 2). However, during the field investigation for wetland conditions on May 10, 2002, the two basins did not meet the criteria (as described above) for a jurisdictional wetland determination. Precipitation for the region is at or slightly above normal for the region according to the Minnesota Climatology Working Group. Precipitation totals for the month of April 2002 were reported as 4.22 inches (Rosemount Agriculture Experiment Station) and that Dakota County is within 90 – 110 % of normal precipitation from April 1 – May 6, 2002. The Minnesota Climatology Working Group indicates that average precipitation (1961 – 1990) for the month of April is approximately 2.87 inches (Rosemount Agriculture Experiment Station). The following paragraphs describe the results of the field investigation.

Basin 1

Basin 1 is a forested depression dominated by slippery elm (*Ulmus rubra*), box elder (*Acer negundo*) in the canopy, and tatarian honeysuckle (*Lonicera tatarica*) and red-berried elder (*Sambucus racemosa*) in the shrub layer. The forb layer is dominated by ground ivy (*Glecoma hederacea*), common burdock (*Arctium minus*), tatarian honeysuckle seedlings. Less than 50 percent of the dominant vegetation is Facultative (i.e., equally likely to occur in wetlands and non-wetlands, 34 – 66 percent probability) or wetter, therefore not meeting the criterion for wetland vegetation.

The soil in Basin 1 is mapped by the Soil Survey of Dakota County as Kennebec Variant silt loam (map unit 1816), which is not listed as a hydric soil, but may have hydric inclusions (see attached Figure 3). The upper 24 inches of the soil profile was dark silt loam (10YR2/1), but showed no signs of typical redoximorphic conditions (e.g., concretions, mottling, or oxidized rhizosphere) in the soil profile. The soil was not saturated in the upper 24 inches of the soil profile, but some shallow tree roots were observed (a secondary hydrologic indicator). The evidence suggesting hydric soil conditions and sustained hydrology to support a prevalence of hydrophytic vegetation was marginal.

It is likely Basin 1 receives runoff from adjacent side slopes with no aboveground outlet. However, the soil may have a high infiltration rate as saturated soil was not observed despite several days of rain previous to the field investigation and also, the likelihood of encountering wetter conditions would be expected in the spring of the year. The wetland vegetation criterion was not met and the soil and hydrology criteria were marginal for the basin. For these reasons, it was determined that all three wetland criteria were not met, therefore this basin did not meet the technical criteria for a jurisdictional wetland.

Basin 2

Basin 2 is a forested depression located in the southeast corner of the parcel and to the west of Basin 1. Basin 2 is dominated by box elder and red-berried elder in the canopy and shrub layer, respectively. The forb layer is dominated by common burdock and small-flowered crowfoot (*Ranunculus abortivus*). Less than 50 percent of the dominant vegetation is Facultative or wetter, therefore not meeting the criterion for wetland vegetation.

The soil in Basin 2 is mapped by the Soil Survey of Dakota County as Colo silt loam, a state-listed hydric soil (see attached Figure 3). The upper 24 inches of the soil profile was dark silt loam (10YR3/1) with very faint mottles (10YR4/2) less than 2 percent. The soil was not saturated in the upper 24 inches of the profile and showed no other hydric indicators, therefore not meeting the hydrology criterion.

Similar to Basin 1, Basin 2 likely receives runoff from adjacent side slopes and has no aboveground outlet. However, no saturation was observed in the upper 24 inches of the soil profile despite several days of rain prior to the field investigation. The wetland vegetation and hydrology criteria were not met, therefore it was determined that Basin 2 did not meet the technical criteria for a jurisdictional wetland.

If you have any questions regarding the results of this field investigation or other concerns, please feel free to contact Todd Udvig, SEH Project Manager, or me at the numbers provided below. SEH is pleased to provide you this information and looks forward to working with Bituminous Roadways, Inc. in the future.

Sincerely,

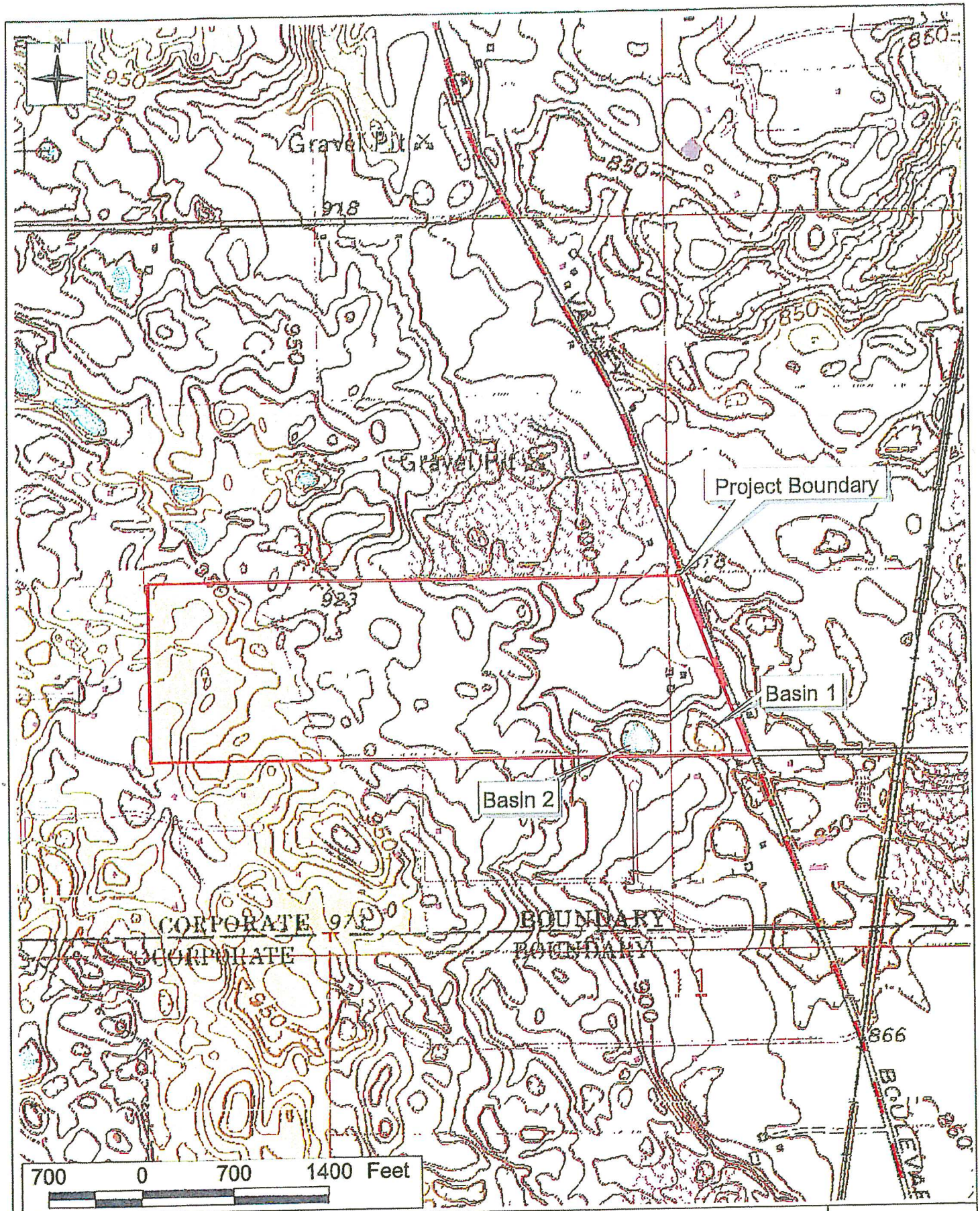
SHORT ELLIOTT HENDRICKSON INC.

Allyz D. Kramer
Staff Biologist
651.490.2162

Todd T. Udvig, P.S.S.
Senior Scientist/Professional Soil Scientist
651.765.2957

Attachment

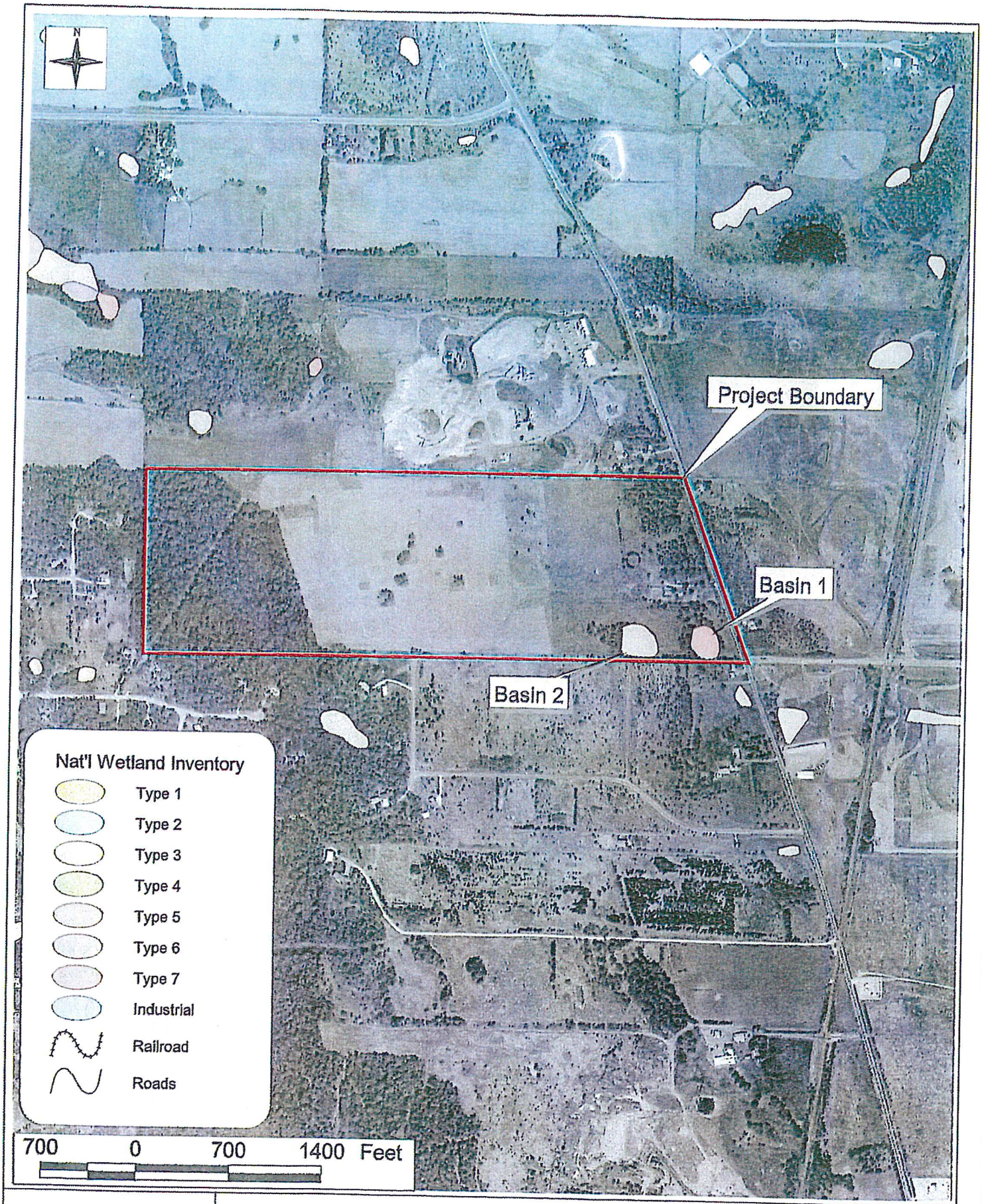
f:\wp\projects\ab\bitum\0201\c\petersonm13.02.doc



USGS 7.5 Minute Quad Map of Project Location

A-BITUM0201.00

Figure 1

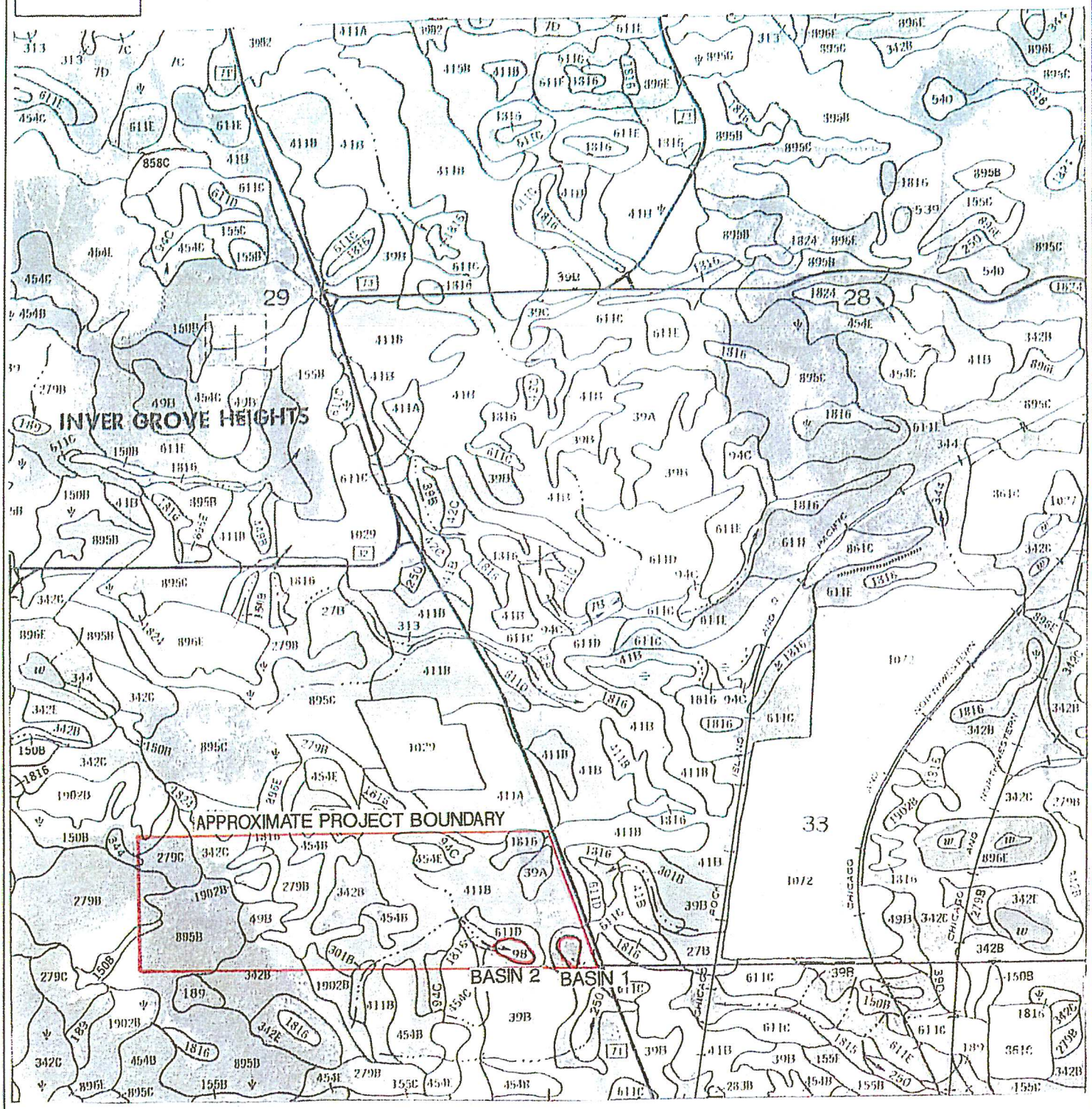


SEH

National Wetlands Inventory Map overlayed on 2000 aerial photograph

A-BITUM0201.00

Figure 2



Scale 1:15 840

SEH	Dakota County Soil Survey Map	ABITUM0201.00
		Figure 3

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

ESEH

Project/Site: 11201 Rich Valley Road, Inver Grove Hgts MN
Applicant/Owner: BITUMINOUS ROADWAYS INC.
Field Investigator: A. KRAMER
Investigation Date: 05/10/02
Transect No. _____
Site Sample No. BASIN 1

Abnormal conditions? Y (N)
Site disturbed? Y (N)
Problem area? Y (N)
If yes, explain in remarks

Is the Area (circle): Filled Floodplain Ditched Seasonal Permanent Tiled

VEGETATION

Dominant Plant Species	Stratum	%	Indicator
1. Ulmus rubra - Slippery Elm	TREE	50%	FAC
2. Acer Negundo - Box elder	TREE	50%	FACW+
3. Sambucus racemosa - Red berried elder	SHRUB	20%	FACU
4. Glechoma hederacea - Ground ivy	Herb	60%	FACU
5. Arctium minus - Common burdock	Herb	20%	NI
6. Lonicera tatarica - tatarian honeysuckle	Herb	20%	FACU
7. Lonicera tatarica - tatarian honeysuckle	Shrub	60%	FACU
8.			
9.			
10.			
11.			
12.			

Percent of dominant species that are OBL, FACW and/or FAC = <50 %

HYDROLOGY

_____ Stream, Lake or Well Data
_____ Precipitation Data
_____ Aerial Photographs
_____ Other (Explain in remarks)
✓ No recorded data used

Primary Wetland Hydrology Indicators
_____ Inundated
_____ Saturated in upper 18"
_____ Water Marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands

Secondary Wetland Hydrology Indicators
(If no primary indicator, 2 or more secondary indicators required)
_____ Oxidized Rhizosphere
_____ Water Stained Leaves
_____ Local Soil Survey Data
_____ FAC Neutral Vegetation Test
_____ Multiple Trunks
_____ Other (Explain in remarks)

Field Observations
Depth of Surface Water: 0
Depth to Water in Pit: >24"
Depth to Saturated Soil: >24

SOILS

Map Unit Name: Kennebec Variant Silt Loam
Soil Suborder: Cumulic Hapludolls
Natural Drainage Class: Moderately well drained
Whole unit hydric soil? Y (N)

Soil Profile Description

Depth (In)	Horizon Name	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle %	Soil Texture and Comments
0-24	A	10YR 2/1	—	—	Silt loam

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

ESEH

Project/Site: 11201 Rich Valley Road, Inver Grove Hgts, MN
Applicant/Owner: Bituminous Roadways Inc.
Field Investigator: AKramer Transect No. _____
Investigation Date: 05/10/02 Site Sample No. BASIN 2

Abnormal conditions? Y (N)
Site disturbed? Y (N)
Problem area? Y (N)
If yes, explain in remarks

Is the Area (circle):
Filled Floodplain Ditched
Seasonal Permanent Tiled

VEGETATION

Dominant Plant Species	Stratum	%	Indicator
1. Acer negundo - Boxelder	TREE	60	FACW+
2. Sambucus racemosa - Red berried elder	SHRUB	10	FACU
3. Ranunculus arboritivus - Small flowered crowfoot	Herb	20	FACW-
4. Arctium minus - Common burdock	Herb	20	NI
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

Percent of dominant species that are OBL, FACW and/or FAC = 50 %

HYDROLOGY

_____ Stream, Lake or Well Data
_____ Precipitation Data
_____ Aerial Photographs
_____ Other (Explain in remarks)
✓ No recorded data used

Primary Wetland Hydrology Indicators
_____ Inundated
_____ Saturated in upper 18"
_____ Water Marks
_____ Drift Lines
_____ Sediment Deposits
_____ Drainage Patterns in Wetlands

Secondary Wetland Hydrology Indicators
(If no primary indicator, 2 or more secondary indicators required)
_____ Oxidized Rhizosphere
_____ Water Stained Leaves
✓ Local Soil Survey Data
_____ FAC Neutral Vegetation Test
_____ Multiple Trunks
_____ Other (Explain in remarks)

Field Observations
Depth of Surface Water: 0
Depth to Water in Pit: >24"
Depth to Saturated Soil: >24

SOILS

Map Unit Name: Co/o Silt loam
Soil Suborder: Cumulic Haplaquolls
Natural Drainage Class: Poorly drained soil
Whole unit hydric soil? (Y) N

Soil Profile Description

Depth (In)	Horizon Name	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle %	Soil Texture and Comments
0-24	A	10YR 3/1	10YR 4/2	2-3	silt loam

Question and Answer Report

Bituminous Roadways Inc. (BRI) – Proposed Wash Water Well

Prepared for
The City of Inver Grove Heights, Minnesota

July 2012

BARR

Question and Answer Report

Bituminous Roadways Inc. (BRI) – Proposed Wash Water Well

Prepared for
The City of Inver Grove Heights, Minnesota

July 2012

BARR

4700 West 77th Street
Minneapolis, MN 55435-4803
Phone: (952) 832-2600
Fax: (952) 832-2601

Question and Answer Report
Bituminous Roadways Inc. (BRI) – Proposed Wash Water Well

Prepared for
The City of Inver Grove Heights

July 2012

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Introduction

This Question and Answer Report (Report) has been prepared by Barr Engineering Company (Barr) for the City of Inver Grove Heights and contains answers to questions regarding a wash water well and associated ponds proposed by Bituminous Roadways Inc. (BRI). BRI is proposing to construct these facilities to wash aggregate from their sand and gravel mine for use in their asphalt plant.

Reference information used for this Report includes:

- Minnesota Department of Natural Resource water appropriation permit amendment request by Sunde Engineering, PLLC (Sunde), dated April 25, 2012,
- Application for Reissuance of Conditional Use Permit 07-11C prepared by Sunde, dated April 25, 2012,
- Water quality monitoring data from BRI from 2002 through 2012, and
- A telephone conference call with BRI, Sunde, and Barr staff on June 20, 2012.

The questions contained in this Report were developed in agreement with City staff at the start of the project and are divided into six general categories below. These categories correspond to Sections 2 through 7.

- Need for Groundwater
- System Design
- Operation and Maintenance
- Groundwater Impacts
- Groundwater Monitoring, and
- Other Agencies

Our conclusions and recommendations are provided in Section 8.

2.0 Need for Groundwater

A. Question: What analysis has been performed that demonstrates that there is an insufficient quantity of surface water available from the existing onsite ponds for aggregate washing?

Answer: BRI has a need for washed aggregate to use in asphalt that it produces at its facility in Inver Grove Heights. Asphalt is typically produced at BRI's facility each year starting in April through the month of October. BRI indicated that in recent years they have not washed aggregate at the facility due to the lack of wash water. Instead, BRI has purchased washed aggregate and brought it to the site for use in the asphalt it produces.

It has been BRI's experience that surface water has not provided a reliable source of wash water during the washing season.

B. Question: Do the existing sediment ponds have a bottom liner and if not would lining those ponds provide sufficient wash water without the need for the groundwater well?

Answer: No, the existing sedimentation ponds do not have an engineered and constructed liner. However, sediment from washed aggregate contains very small particles of soil that significantly reduces the quantity of water that infiltrates out of the pond bottom.

The wash plant would be located in the southern part of the site. However, the main stormwater pond is located near the northern portion of the site and therefore is not available for wash water. Even with collecting all of the on-site available surface water and constructing pond liners, BRI has determined that the existing ponds would not contain enough surface water throughout an entire typical wash season to reliably meet its needs.

C. Question: What quantity and rate of groundwater and surface water is needed for aggregate washing?

Answer: BRI is proposing to operate the wash plant for 12 hours per day, 5 days per week, during the seven month washing season (April through October). During operation of the proposed wash plant, water would be lost to evaporation and to the surface of the aggregate particles. BRI estimates these losses would range from approximately 380 to 510 gallons per

minute (about 15% to 20% of the wash plant capacity of 2,550 gallons per minute). The water lost would be made up with water from the proposed wash water well. To allow for variations in water loss, BRI is proposing to install a groundwater well capable of supplying wash water at a rate of 450 gallons per minute for a total of 42.8 million gallons per year.

3.0 System Design

A. Question: Is an additional pond needed and if so would the proposed pond design differ from the existing ponds?

Answer: Yes, BRI is proposing to install three new wash water ponds that would be connected and operated in series so that fine sediment would settle out. Similar to the existing ponds, the proposed new ponds would not have a constructed liner; however the new ponds would be longer and narrower than the existing ponds. Water returning from the wash plant would be conveyed to the first pond which would overflow to the second pond. Overflow water from the second pond would go to the third pond where it would be returned to the wash plant for re-use. This method of operation would result in water returning from the plant to settle out fine particles in the first two ponds and clear water from the third pond returned to the wash plant for re-use.

B. Question: Would use of groundwater for aggregate washing increase the volume and size of the existing surface water ponds?

Answer: Yes, the size and volume of the proposed ponds is larger than the existing ponds. The larger pond sizes are needed to provide the time required for the water to reside in the ponds long enough to settle the fine particles before the water is returned to the wash plant.

C. Question: Would more water infiltrate from the ponds to the groundwater than from the existing operations?

Answer: Yes, because the proposed ponds would be larger, more water would be expected to infiltrate through the pond bottoms.

D. Question: Is the design of the proposed surface water ponds, especially the liner, adequate?

Answer: As indicated above, the proposed ponds would not be lined. Therefore, the major design features are expected to be the overflow and other conveyance infrastructure which require relatively little design effort for construction and were not submitted to the City or Barr.

E. ***Question: What would be the liner thickness and permeability, would the liner be subject to freeze-thaw, and what affect would freezing of the liner have on its effectiveness?***

Answer: The proposed ponds would not have a constructed liner.

F. ***Question: For the proposed operation, how much additional surface water would be available for aggregate washing by the installation of the pond liners?***

Answer: BRI indicated that they would not expect significantly more water to be retained in the ponds if a liner were installed. Therefore, BRI has determined that it is not advantageous for them to install liners in the proposed ponds. Consequently, Barr did not calculate the theoretical additional water that could potentially be available if liners were constructed.

G. ***Question: How can the City be assured that the ponds would be constructed per its design?***

Answer: City staff could conduct periodic site inspections to the ponds during construction to determine if they were being constructed as proposed.

H. ***Question: Would there be any surface water discharges from the ponds or from the mining operation?***

Answer: No, any available surface water will be conveyed to the proposed ponds to minimize the amount of groundwater needed for wash plant operations.

4.0 Operation and Maintenance

A. Question: How is the aggregate currently washed to remove fines and how would the use of groundwater change this process?

Answer: As discussed above, BRI does not currently wash it's aggregate due to the lack of reliable wash water. In the proposed wash plant, unwashed aggregate would be feed into the head of the wash plant and sprayed (washed) with water as it passes through the plant. The fine soil particles would be conveyed with the wash water to the ponds where they would settle to the bottom and the clear water would be used over again in the wash plant. No chemicals are used in the washing process. BRI indicates that the use of groundwater from the proposed wash water well would allow them to wash aggregate in this manner.

B. Question: Would surface water or groundwater be used first for aggregate washing?

Answer: All available surface water would be used first. Groundwater would be used as needed to supplement the surface water to provide the total volume of water needed for efficient aggregate washing.

C. Question: What maintenance, such as periodic dredging, would be performed on the surface water ponds and how would this be done without damaging the proposed pond liners?

Answer: BRI indicated that periodic dredging of the ponds will be performed. Since the proposed ponds would not have constructed liners, dredging of sediment out of the ponds could be achieved without the risk of liner damage. Sediment removed from the ponds would be mixed with topsoil and used for reclamation at the facility.

D. Question: Where would the fine sediment from the ponds be disposed of?

Answer: The fine sediment would be mixed with topsoil and used at the facility.

E. *Question: How would the City be assured that the necessary pond maintenance is being performed?*

Answer: The available volume in the proposed ponds needs to be large enough for the water to reside in the pond long enough to allow fine soil particles to settle to the bottom. If too much of the pond volume is occupied by sediment that has settled to the bottom, then removal of sediment would be needed to increase the volume available for water. Therefore, it is in BRI's best interest to remove sediment from the ponds periodically so that enough water volume is available to enable efficient settling.

Additionally, City staff could perform periodic inspections of the facility.

5.0 Groundwater Impacts

A. <u>Question</u>: *Is the groundwater modeling performed to date adequate or is there a need for more detailed modeling?*

<u>Answer:</u> Barr performed groundwater modeling of pumping by the proposed new groundwater well at the BRI facility. We believe this modeling is adequate and is discussed further below.

B. <u>Question</u>: *What would be the impacts (if any) to nearby residential wells or monitoring wells for Pine Bend Landfill from the proposed increase in pumping from the existing groundwater well?*

<u>Answer:</u> Groundwater model predictions of drawdown caused by pumping from the proposed BRI well indicate that it will not significantly impact the nearest residential well, but that it may cause the nearest Pine Bend Landfill (PBL) monitoring well to go dry for a short period of time at the beginning of the mining season.

The residential and monitoring wells nearest to the proposed BRI well are shown on Figure 1. The nearest residential well is identified in the April 25, 2012 letter from Sunde Engineering as being owned by Todd Wicker. The driller's log for this well (Unique ID 435227; Appendix A) indicates that it is completed in the Quaternary sand and gravel aquifer and had 57 feet of water above the pump intake when the static water level was measured at the time of construction in 1987. The nearest PBL monitoring well is M-11A, which is also completed in the sand and gravel aquifer and is approximately 1900 feet from the proposed BRI well. In 2011, the water level in M-11A was reported to be 8 - 10 feet above the bottom of the well screen (2011 PBL Annual Report).

As part of our evaluation of the impacts to nearby wells, a numerical model of groundwater flow in the vicinity of the BRI facility – developed from the Metropolitan Council's Metro Model 2 – was used to simulate two scenarios of continuous (steady-state) pumping at the proposed well: 1) pumping at the maximum rate of 450 gallons per minute (gpm) during filling of the wash water ponds at the beginning of the mining season (estimated by Sunde Engineering to require 55-60 hours of continuous pumping) and 2) pumping at the seasonal average rate of 160 gpm. It is necessary to consider two pumping scenarios because the

short-term effects represented by the pond-filling scenario are not likely to extend beyond the nearest wells mentioned above, given the relatively short period of time (2-3 days) over which pond filling occurs; the seasonally averaged pumping scenario better represents long-term effects, such as drawdown far from the well and sustained impacts to groundwater flow direction and velocity.

Pond-Filling Pumping Scenario (450 gpm)

Pumping at 450 gpm for the 2-3 days required to fill the wash water ponds results in a maximum predicted lowering of the water table of approximately 11 feet at the proposed well, as shown on Figure 2. Water table drawdown of 5-6 feet is predicted in the vicinity of the Wicker residential well and landfill monitoring well M-11A. The prediction of steady-state drawdown at these wells is a conservative estimate (i.e. highest anticipated drawdown), given that the time required for drawdown effects to travel to these wells from the proposed well is not accounted for in the simulation. The predicted magnitude of drawdown is unlikely to significantly interfere with the operation of the Wicker well, but may lower the water table below the bottom of M-11A for some or all of the duration of pond filling. Should M-11A go dry, it will likely remain so for only a short period of time, as the water table will rise when the pumping rate decreases after the ponds have been filled.

Long-Term Pumping Scenario (160 gpm)

Pumping averaged over the mining season is estimated to lower the water table up to 1.5 feet in the vicinity of the PBL, as shown on Figure 3. This estimate is conservative (i.e. shows the largest anticipated impact) because it does not account for recovery during periods when the well is not being pumped. It is unlikely that this magnitude of drawdown will significantly impact the PBL monitoring wells given that the seasonal variation in water table elevation in the area likely exceeds 1.5 feet.

C. *Question: Would the proposed increase in pumping from the existing groundwater well impact the direction or velocity of groundwater flow?*

Answer: The proposed pumping is predicted to have a modest impact on the direction and velocity of shallow groundwater flow in the immediate vicinity of the proposed well and negligible impact in the vicinity of the PBL, much less than would be required to affect the direction and velocity of migration of the PBL contaminant plume. The simulated impact to groundwater flow direction and velocity is shown by the flow arrows on Figure 4, which point in

the direction of flow and have lengths scaled by the flow velocity. A comparison of flow arrows for the baseline condition (no pumping) and the proposed long-term pumping (160 gpm) show little difference in flow direction and velocity away from the proposed well.

D. Question: *Would the proposed operation cause increased infiltration of surface water into the groundwater? If so, would this cause a greater potential for groundwater contamination?*

Answer: Infiltration from the wash water ponds will increase due to pumping of groundwater into the ponds. However, pumping of the proposed wash water well and the resulting new wash water ponds are unlikely to result in a significant increase of infiltration of surface water into groundwater or reduction of surface water levels or flow rates.

Surface water features in the area of the proposed BRI well, which are shown on Figure 1; include a number of small ponds east and west of the BRI facility and the Mississippi River to the east of the facility. The depth of the water table in the vicinity of the BRI facility – approximately 100 feet below ground surface – suggests that the ponds are poorly connected to the groundwater system and therefore are not likely to be affected by the proposed pumping. The flow arrows on Figure 4 show that the Mississippi River is a significant regional groundwater discharge area for both baseline and long-term pumping conditions. The reduction in groundwater discharge to the PBL area of the river, which is shown on Figure 4, is predicted to be less than one percent.

6.0 Groundwater Monitoring

A. Question: What groundwater monitoring does BRI currently perform?

Answer: BRI currently monitors water quality in one on-site well (Rainbow Well), the existing on-site sedimentation pond (North Pond), and two nearby residential wells (Todd Wicker and Robert Plan Wells). Samples are analyzed for various metals, Diesel Range Organics (DRO) and Gasoline Range Organics (GRO), total phenolics, pH, specific conductivity, and alkalinity.

B. Question: What are the results of BRI current groundwater monitoring?

Answer: The monitoring data indicate that all concentrations measured were below the Minnesota Department of Health's Health Risk Limits (HRLs). Historical water quality monitoring data from 2002 through 2012 are provided in Tables 1 through 4.

C. Question: Would additional groundwater monitoring at the existing monitoring points or the existing groundwater well be necessary or helpful? If so, for what parameters and at what frequency?

Answer: Barr believes that BRI's current water monitoring program is adequate. The Rainbow Well (which is currently monitored) is located downgradient of existing operations and is in a location that will allow early detection of groundwater contamination from BRI's operations, if any occurs. The operation of a well on-site will not affect the role that this well will continue to play in monitoring groundwater quality.

7.0 Other Agencies

A. *Question: What permits or licenses (if any) would be required by the State of Minnesota to increase pumping from the existing or a new groundwater well?*

Answer: The Minnesota Department of Natural Resources will likely require a Water Appropriations Permit for groundwater because the amount of water proposed to be pumped exceeds 10,000 gallons per day or 1-million gallons per year. BRI will be required to monitor groundwater use and record monthly total volumes pumped. Each year, in February, BRI will be required to submit a report to the MDNR that lists the monthly pumping volumes for the previous year. These data are made available by the MDNR through the SWUDS (State Water Use Database) data.

B. *Question: What permits or licenses (if any) would be required by Dakota County to increase pumping from the existing or a new groundwater well?*

Answer: Dakota County does not have authority to authorize, limit, or control groundwater appropriations. They have authority to review domestic well construction permits. However, high-capacity well construction permits (for which this well would be classified) are permitted by the Minnesota Department of Health's Well Construction group. The Minnesota Department of Health will review the proposed construction to ensure that it meets Well Code requirements.

8.0 Conclusions and Recommendations

Barr Engineering Co. conducted an evaluation of the proposed use of groundwater for washing aggregate at the Bituminous Roadways Inc. (BRI) facility in Inver Grove Heights. BRI is proposing to install a groundwater well capable of supplying wash water at a rate of 450 gallons per minute for a total of 42.8 million gallons per year. Barr concurs with BRI's position that surface water sources (i.e. stormwater ponds) are insufficient for their wash-water needs.

A groundwater flow model of the BRI facility and surrounding area was adapted from the Metro Model 2 – a regional groundwater flow model developed by Barr for the Metropolitan Council. This model was used to evaluate the effects of pumping of the proposed wash water well on groundwater levels, existing wells in the area, and groundwater flow/contaminant migration at the Pine Bend Landfill (PBL), located northeast of the BRI facility. Based on this groundwater modeling evaluation, the following are concluded:

1. The proposed pumping is predicted to have negligible impact on groundwater flow in the vicinity of PBL, much less than would be required to affect the direction and velocity of migration of the PBL contaminant plume. The proposed pumping is not predicted to cause contamination from PBL to migrate to residential wells and is not predicted to have a negative impact on the on-going in situ groundwater remedial actions at PBL.

2. Each spring, BRI proposes pumping the well continuously at 450 gpm for 2-3 days in order to fill the wash water ponds. We predict that this short-term pumping will cause a very short period (less than 2 days) when there will be up to 6 feet of drawdown in the nearest residential well (the Wicker well). The setting of the pump in this residential well is sufficiently deep that its use will not be affected.

3. During this same 2-3 day period each spring, pumping may result in a maximum predicted lowering of the water table of up to 5 feet in the vicinity of landfill monitoring well M-11A, possibly causing monitoring well M-11A to go dry for a brief period (less than a day). This short-term drawdown is not predicted to adversely affect the on-going monitoring program at PBL. Furthermore, model results show groundwater flow in the vicinity of monitoring well M-11A will continue to be predominantly eastward and downgradient contamination will not be pulled into M-11A as a result of this very short-term pumping.

4. We do not recommend a slower rate of BRI spring-time pumping, even if monitoring well M-11A would temporarily go dry. It is preferable to fill the wash water ponds as quickly as possible and primarily from aquifer storage rather than extend the pumping period over a longer period of time and thereby unnecessarily expand the cone of depression around the proposed well.

Recommendations

Based on the above conclusions and review of BRI's proposed wash water system, Barr recommends City approval of the proposed BRI wash water well and system.

Tables

Table 1
Bituminous Roadways, Inc.
Monitoring Well Sample Results
Years 2002 - 2012

Parameter	Unit	EPA Maximum Contaminant Limit	MN MDH Human Health Based Guidance Table	Sample Date Aug 28 2002	2003	2004	Sample Date May 17 2005	2006	Sample Date May 03 2007	August 10 2009	May 9 2011	May 21 2012
Effective Date		7/1/2002	6/22/2012									
Exceedance Key		No Exceed	No Exceed									
BRI UPPER WELL (RAINBOW WELL)												
Arsenic	ug/L	10		<2			<0.5		<0.5	0.56	<0.5	<20
Barium	ug/L	2000	2000 HRL93	60			55		63		67	71
Cadmium	ug/L	5	4 HRL93	<0.2			<0.1		0.12		<5	<2.0
Chromium	ug/L	100	100 CR HRL93	<2			<6		<10		<10	<5.0
Copper	ug/L	1300 TT(7)		16			<5		3.45	9	<5	<10
Lead	ug/L	1300 TT(7)		0.59			<15		1.26	<30	<30	<10
Mercury	ug/L	2		<0.06			<0.13		<0.02	<0.01	<0.01	<0.20
Nickel	ug/L		100 HRL93	<3			<5		1.59		<10	<5.0
Selenium	ug/L	50	30 HRL93	<2			0.54		<1		<1	<20
Silver	ug/L		30 HRL93	<0.5			<0.1 *		<0.2 *	<5	<5	<5.0
Zinc	ug/L		2000 HRL94	1970			174		231	132	104	75
DRO	ppm			<0.035			<0.035		<0.035	<0.046	<0.035	0.220
GRO	ppm			<0.03			<0.03		<0.03	<0.03	<0.03	<0.1
Phenolics, Total	ug/L		4000 HRL93	<5			<5		<5	<5	<5	<10
pH	Units			7.1			7.4		7.7	7.6	7.5	7.29
Specific Conductivity	umhos/cm			545.0			560.0		585.0	606.0	623.0	690
Alkalinity, Total	mg/L CaCO3			260			255		253	251	262	260
Beryllium	ug/L	4	0.08 HRL93							<5		
* Elevated "less than result" (<) due to sample matrix												
BRI LOWER WELL												
Arsenic	ug/L	10		<2			<0.5		<0.5			
Barium	ug/L	2000	2000 HRL93	96			97		109			
Cadmium	ug/L	5	4 HRL93	<0.2			0.30		<0.1			
Chromium	ug/L	100	100 CR HRL93	<2			<6		<10			
Copper	ug/L	1300 TT(7)		2			<5		1.46			
Lead	ug/L	1300 TT(7)		<0.5			<15		<0.5			
Mercury	ug/L	2		<0.06			<0.13		<0.02			
Nickel	ug/L		100 HRL93	<3			<5		1.68			
Selenium	ug/L	50	30 HRL93	<2			<0.5		<1			
Silver	ug/L		30 HRL93	<0.5			<0.1 *		<0.2 *			
Zinc	ug/L		2000 HRL94	46			42		108			
DRO	ppm			<0.035			<0.035		<0.038			
GRO	ppm			<0.03			<0.03		<0.03			
Phenolics, Total	ug/L		4000 HRL93	<5			<5		<5			
pH	Units			7.4			7.4		7.7			
Specific Conductivity	umhos/cm			504.0			530.0		542.0			
Alkalinity, Total	mg/L CaCO3			260			263		259			
* Elevated "less than result" (<) due to sample matrix												

Table 2
Bituminous Roadways, Inc.
Pond Sample Results
Years 2002 - 2012

Parameter	Unit	EPA Maximum Contaminant Limit	MN MDH Human Health Based Guidance Table	Sample Date Aug 28 2002	2003	2004	Sample Date May 17 2005	2006	Sample Date May 03 2007	May 14 2012	
Effective Date		7/1/2002	6/22/2012								
Exceedance Key		No Exceed	No Exceed								
										(Northwest Pond)	(Northeast Pond)
North Pond											
Arsenic	ug/L	10		<2			1.86		<0.5	<20	<20
Barium	ug/L	2000	2000 HRL93	102			57		19	130	73
Cadmium	ug/L	5	4 HRL93	0.37			0.23		<0.1	<2.0	<2.0
Chromium	ug/L	100	100 CR HRL93	<2			<6		<10	33	13
Copper	ug/L	1300 TT(7)		6			10		5.05	22	15
Lead	ug/L	1300 TT(7)		1.58			<15		0.91	12	10
Mercury	ug/L	2		<0.06			<0.13		<0.02	<0.20	<0.20
Nickel	ug/L		100 HRL93	<3			6		1.34	19	9.5
Selenium	ug/L	50	30 HRL93	<2			4.36		1.76	<20	<20
Silver	ug/L		30 HRL93	<0.5			<0.1 *		<0.2 *	<5.0	<5.0
Zinc	ug/L		2000 HRL94	20			23		27	40	30
DRO	ppm			<0.035			<0.035		<0.035	0.120	0.580
GRO	ppm			<0.03			<0.03		<0.03	<0.1	<0.1
Phenolics, Total	ug/L		4000 HRL93	<5			<5		<5	<10	<10
pH	Units			8.1			8.0		9.5	8.29	7.54
Specific Conductivity	umhos/cm			220.0			217.0		374.0	120	140
Alkalinity, Total	mg/L CaCO3			85			75		48	60	56
* Elevated "less than result" (<) due to sample matrix											
South Pond											
Arsenic	ug/L	10		3.3			1.39		<0.5		
Barium	ug/L	2000	2000 HRL93	21			30		34		
Cadmium	ug/L	5	4 HRL93	<0.2			0.16		0.11		
Chromium	ug/L	100	100 CR HRL93	<2			<6		<10		
Copper	ug/L	1300 TT(7)		4			<5		4.97		
Lead	ug/L	1300 TT(7)		<0.5			<15		1.05		
Mercury	ug/L	2		<0.06			<0.13		<0.02		
Nickel	ug/L		100 HRL93	4			<5		1.63		
Selenium	ug/L	50	30 HRL93	<2			0.51		1.15		
Silver	ug/L		30 HRL93	<0.5			<0.1 *		<0.2 *		
Zinc	ug/L		2000 HRL94	20			<10		15		
DRO	ppm			<0.035			<0.035		<0.038		
GRO	ppm			<0.03			<0.03		<0.03		
Phenolics, Total	ug/L		4000 HRL93	<5			<5		<5		
pH	Units			9.0			7.9		8.3		
Specific Conductivity	umhos/cm			195.0			198.6		309.0		
Alkalinity, Total	mg/L CaCO3			75			61		76		
* Elevated "less than result" (<) due to sample matrix											

Table 3
Bituminous Roadways, Inc.
Residential Well Sample Results
Years 2002 - 2012

Parameter	Unit	EPA Maximum Contaminant Limit	MN MDH Human Health Based Guidance Table	Sample Date Aug 28 2002	2003	2004	Sample Date May 17 2005	2006	Sample Date May 03 2007	August 10 2009	May 9 2011
Effective Date		7/1/2002	6/22/2012								
Exceedance Key		No Exceed	No Exceed								
Todd Wicker Well											
Arsenic	ug/L	10		<2			<0.5		<0.5	<0.5	<0.5
Barium	ug/L	2000	2000 HRL93	57			<5		<5		<5
Cadmium	ug/L	5	4 HRL93	<0.2			<0.1		<0.1		<5
Chromium	ug/L	100	100 CR HRL93	<2			<6		<10		<10
Copper	ug/L	1300 TT(7)		26			<5		2.77	<5	<5
Lead	ug/L	1300 TT(7)		1.79			<15		<0.5	<30	<30
Mercury	ug/L	2		<0.06			<0.13		<0.02	<0.01	<0.01
Nickel	ug/L		100 HRL93	<3			<5		<1 *		<10
Selenium	ug/L	50	30 HRL93	<2			<0.5		<1		<1
Silver	ug/L		30 HRL93	<0.5			<0.1 *		<0.2 *	<5	<5
Zinc	ug/L		2000 HRL94	1190			18		31	41	21
DRO	ppm			<0.035			<0.035		<0.035	<0.038	<0.035
GRO	ppm			<0.03			<0.3		<0.03	<0.03	<0.03
Phenolics, Total	ug/L		4000 HRL93	<5			<5		<5	<5	<5
pH	Units			7.4			7.4		7.9	8.0	7.6
Specific Conductivity	umhos/cm			559.0			593.0		613.0	867.0	641.0
Alkalinity, Total	mg/L CaCO3			270			271		269	267	272
Beryllium	ug/L	4	0.08 HRL93							<5	
* Elevated "less than result" (<) due to sample matrix											
Robert Plan Well											
Arsenic	ug/L	10		<2			<0.5		<0.5	<0.5	<0.5
Barium	ug/L	2000	2000 HRL93	60			60		78		83
Cadmium	ug/L	5	4 HRL93	<0.2			<0.1		0.1		<5
Chromium	ug/L	100	100 CR HRL93	<2			<6		<10		<10
Copper	ug/L	1300 TT(7)		10			7		9.83	29	28
Lead	ug/L	1300 TT(7)		<0.5			<15		0.64	<30	<30
Mercury	ug/L	2		<0.06			<0.13		<0.02	<0.01	<0.01
Nickel	ug/L		100 HRL93	<3			<5		1.56		<10
Selenium	ug/L	50	30 HRL93	<2			1.39		1.81		<1
Silver	ug/L		30 HRL93	<0.5			<0.1 *		<0.2 *	<5	<5
Zinc	ug/L		2000 HRL94	115			152		148	423	205
DRO	ppm			<0.035			<0.035		<0.035	<0.042	<0.035
GRO	ppm			<0.03			<0.03		<0.03	<0.03	<0.03
Phenolics, Total	ug/L		4000 HRL93	<5			<5		<5	<5	<5
pH	Units			7.4			7.4		7.6	7.5	7.5
Specific Conductivity	umhos/cm			601.0			560.0		666.0	682.0	676.0
Alkalinity, Total	mg/L CaCO3			280			257		275	273	274
Beryllium	ug/L	4	0.08 HRL93							<5	
* Elevated "less than result" (<) due to sample matrix											

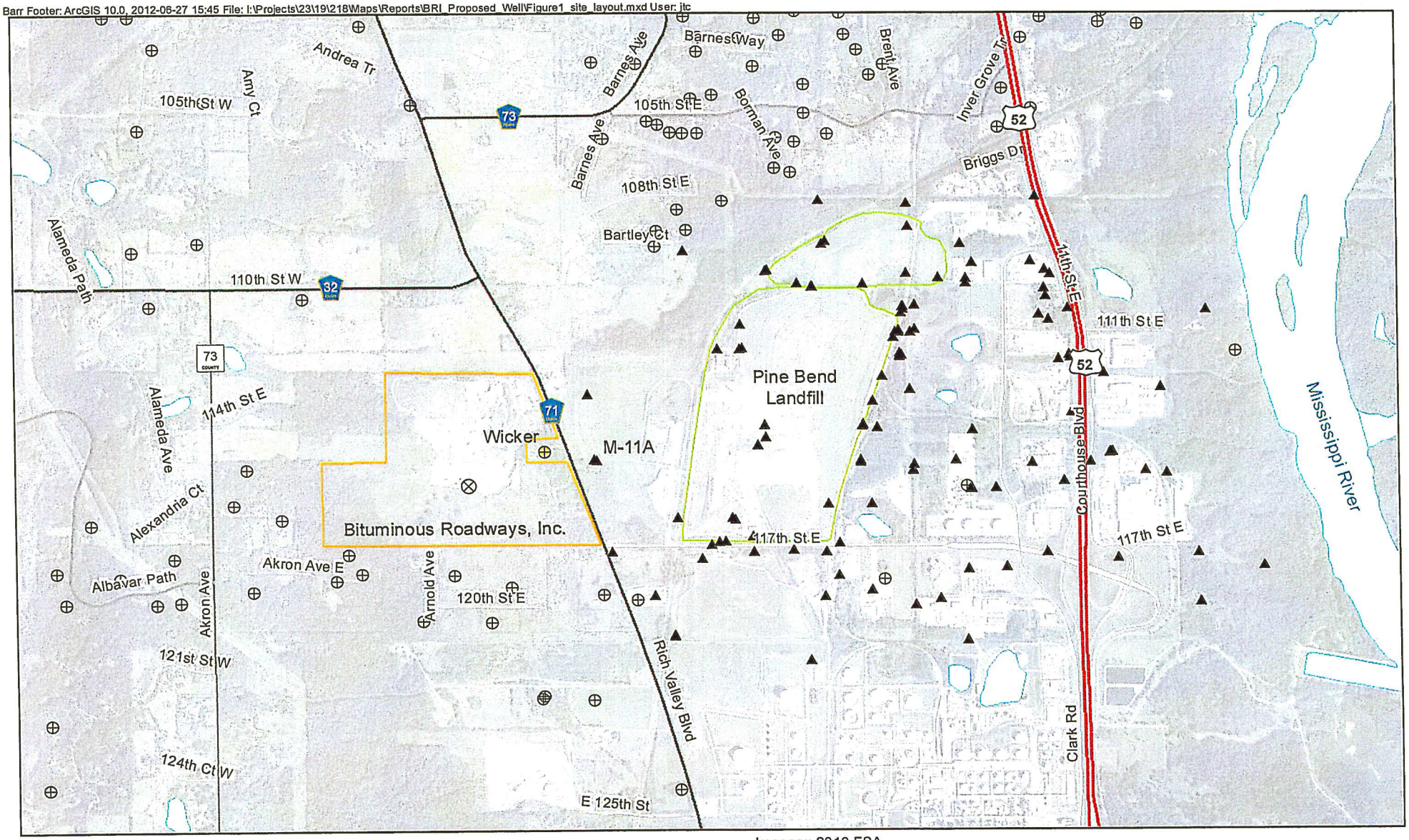
Table 4

Action Level Qualifiers/Footnotes

	Qualifier	Definition
EPA Max Contaminant Level	(1)	When acrylamide is used in drinking water systems, the combination (or product) of dose and monomer level shall not exceed that equivalent to a polyacrylamide polymer containing 0.05% monomer dosed at 1 mg/L.
	(2)	1998 Final Rule for Disinfectants and Disinfection By-products: The total for trihalomethanes is 0.08 mg/L.
	(3)	The MCL value for any combination of two or more of these three chemicals (Aldicarb, Aldicarb sulfone, Aldicarb sulfoxide) should not exceed 0.007 mg/L because of similar mode of action.
	(5)	No more than 5.0% samples total coliform-positive in a month. Every sample that has total coliforms must be analyzed for fecal coliforms; no fecal coliforms are allowed.
	(6)	Under review.
	(7)	Copper action level at 1.3 mg/L, Lead action level at 0.015 mg/L
	(8)	Proposed 7/2001 arsenic rule states that the Jan. 2001 MCL of 10 ppb will not be enforced until 2006, and is still being evaluated at 3,5,10,20 ppb.
	(14)	Millirems per years.
	(15)	Picocuries per liter.
	TT	Treatment technique.
MN MDH Human Health-Based Values Table	(1)	Value is representative of the lowest exposure duration published in the Minnesota Department of Health Groundwater Values Table.
	(2)	Set at short term HRL.
	CR	Value represents the criteria for Chromium, hexavalent.

Figures

Barr Footer: ArcGIS 10.0, 2012-06-27 15:45 File: I:\Projects\23\19\218\Maps\Reports\BRI_Proposed_Well\Figure1_site_layout.mxd User: jtc



Imagery: 2010 FSA

Legend

- ⊗ Proposed BRI Well (Approx)
- ⊕ Residential Well (Approx)
- ⊕ Residential Well (CWI)
- ▲ Pine Bend Landfill Monitoring Well
- BRI Property Line (Approx)
- Pine Bend Landfill Boundary

N

Feet

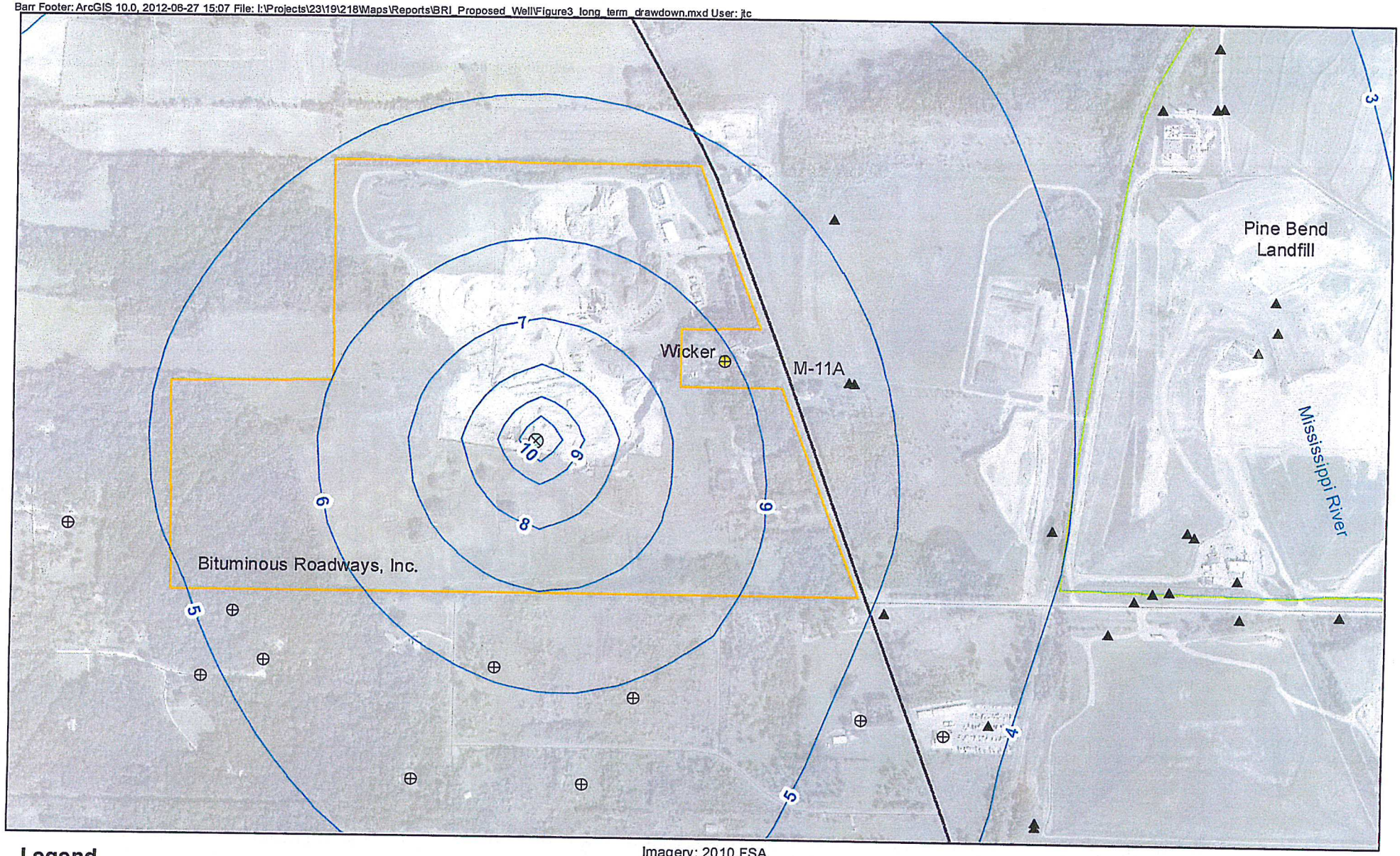
1,000 0 1,000 2,000

BARR

Figure 1

SITE LAYOUT
Evaluation of Proposed Pumping
at Bituminous Roadways, Inc.
City of Inver Grove Heights, MN

Barr Footer: ArcGIS 10.0, 2012-06-27 15:07 File: I:\Projects\23\19\218\Maps\Reports\BRI_Proposed_Well\Figure3_long_term_drawdown.mxd User: jtc



Imagery: 2010 FSA

Legend

- Drawdown (ft)
- Proposed BRI Well (Approx)
- Residential Well (Approx)
- Residential Well (CWI)
- Pine Bend Landfill Monitoring Well
- BRI Property Line (Approx)
- Pine Bend Landfill Boundary

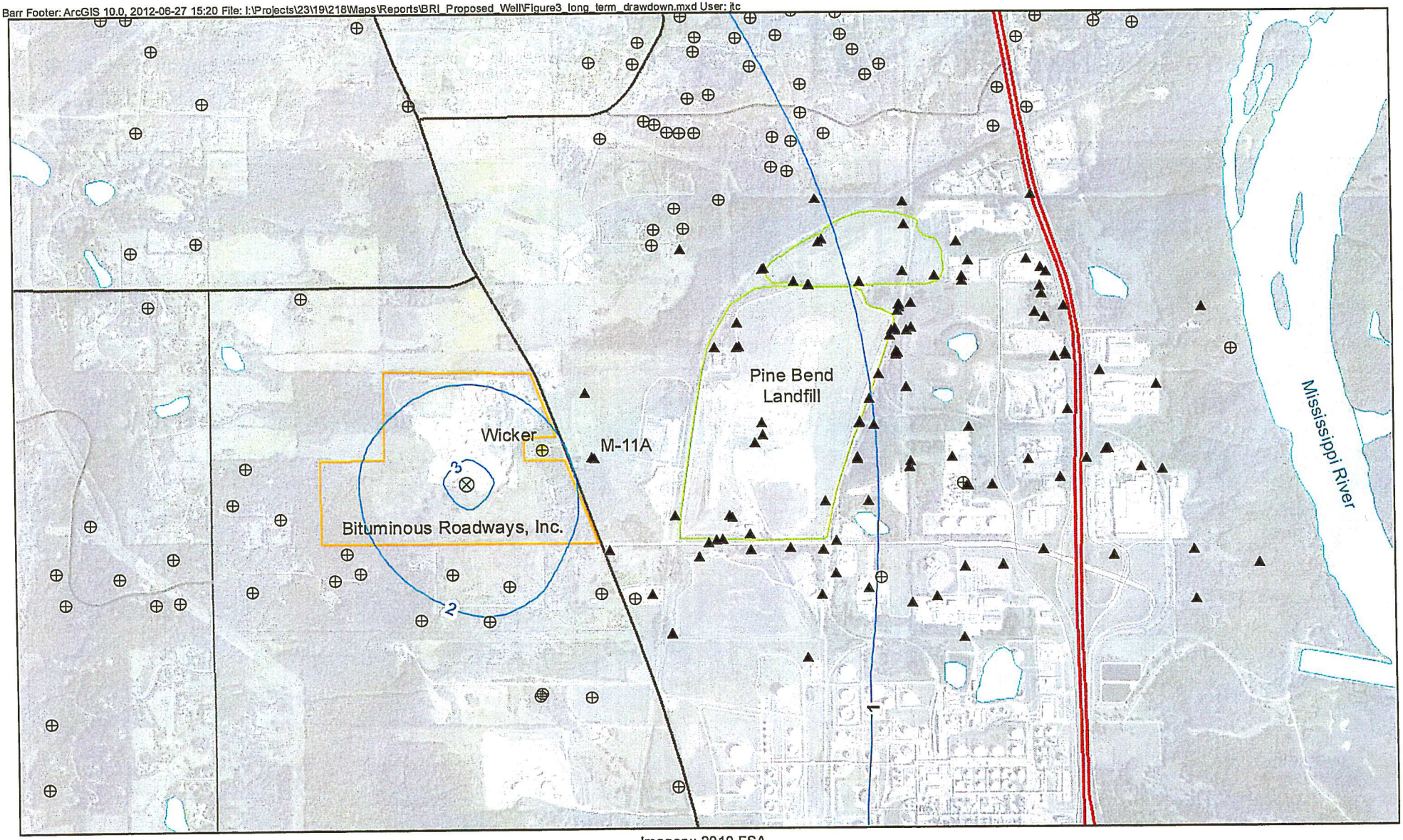
N

Feet
400 0 400

BARR

Figure 2
SIMULATED WATER-TABLE DRAWDOWN:
POND-FILLING PUMPING SCENARIO (450 GPM)
Evaluation of Proposed Pumping
at Bituminous Roadways, Inc.
City of Inver Grove Heights, MN

Barr Footer: ArcGIS 10.0, 2012-06-27 15:20 File: I:\Projects\23\19\218\Maps\Reports\BRI_Proposed_Well\Figure3_long_term_drawdown.mxd User: jtc



Imagery: 2010 FSA

Legend

- Proposed BRI Well (Approx)
- Residential Well (Approx)
- Residential Well (CWI)
- Pine Bend Landfill Monitoring Well
- Drawdown (ft)
- BRI Property Line (Approx)
- Pine Bend Landfill Boundary

N

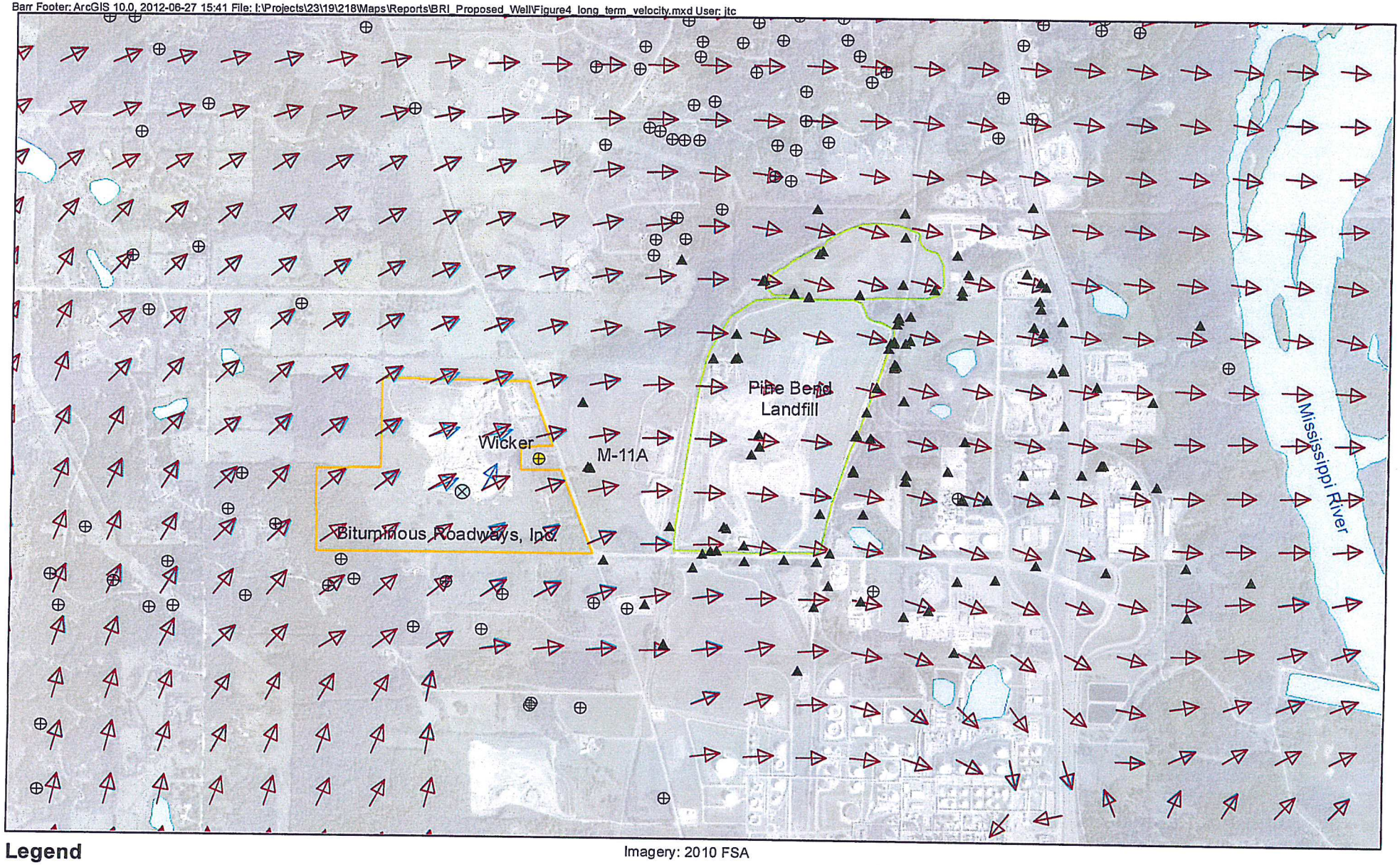
Feet

1,000 0 1,000 2,000

BARR

Figure 3
SIMULATED WATER-TABLE DRAWDOWN:
LONG-TERM PUMPING SCENARIO (160 GPM)
Evaluation of Proposed Pumping
at Bituminous Roadways, Inc.
City of Inver Grove Heights, MN

Barr Footer: ArcGIS 10.0, 2012-06-27 15:41 File: I:\Projects\23\19\218\Maps\Reports\BRI_Proposed_Well\Figure4_long_term_velocity.mxd User: jtc



Imagery: 2010 FSA

Legend

- Proposed BRI Well (Approx)
- Residential Well (Approx)
- Residential Well (CWI)
- Pine Bend Landfill Monitoring Well
- Velocity (No BRI Pumping)
- Velocity (160 gpm BRI Pumping)
- BRI Property Line (Approx)
- Pine Bend Landfill Boundary

N

Feet

1,000 0 1,000 2,000

BARR

Figure 4
SIMULATED GROUNDWATER VELOCITIES:
LONG-TERM PUMPING SCENARIO (160 GPM)
Evaluation of Proposed Pumping
at Bituminous Roadways, Inc.
City of Inver Grove Heights, MN

Appendices

Appendix A

Minnesota Department of Health
Well and Boring Record

Unique No. 00435227
County Name Dakota

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 1031

Update Date 2005/06/09
Entry Date 1993/12/19

Township Name	Township	Range	Dir	Section	Subsection
	27	22	W	32	AD

Well Name WICKER, JOHN

Contact's Name WICKER, JOHN
11479 RICH VALLEY BL
INVER GROVE HEIGHTS MN 55075

GEOLOGICAL MATERIAL	COLOR	HARDNESS	FROM	TO
GRAVEL	BROW	MEDIUM	0	183

USGS Quad Inver Grove Heights Elevation
Aquifer: Alt Id:

Report Copy

Well Depth 183 ft. | Depth Completed 183 ft. | Date Well Completed 1987/07/05

Drilling Method Non-specified Rotary

Drilling Fluid: Bentonite | Well Hydrofractured? ☐ Yes ☐ No | From ft. to ft.

Use Domestic

Casing | Drive Shoe? ☐ Yes ☑ N

Casing Diameter: 4 in. t 177 ft | Weight(lbs/ft): 11

Hole Diameter: in. t 183 ft

Screen Y | Open Hole From ft. to ft.

Make JOHNSON | Type L

Diameter	Slot	Length	Set		Fitting
2	10	7	177	ft. to 183 ft	

Static Water Level 100 ft. from Land surface Date 1987/07/05

PUMPING LEVEL (below land surface)
160 ft. after 2 hrs. pumping 20 g.p.m.

Well Head Completion
Pitless adapter mfr WHITEWATER Model SU4X5.5
Casing Protection ☐ 12 in. above grade
☐ At-grade(Environmental Wells and Borings ONLY)

Grouting Information Well grouted? ☑ Yes ☐ No

Material	From	To (ft.)	Amount(yds/bags)
B		177	2

Nearest Known Source of Contamination
75 ft. direction S type SDF
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed
Mfr nam GRUNDFOS
Model SP-2-15 HP 0.75 Volts 230
Drop Pipe Length 157 ft. Capacity 10 g.p.m
Type S

Any not in use and not sealed well(s) on property? ☐ Yes ☑ No

Was a variance granted from the MDH for this Well? ☐ Yes ☐ No

Well CONTRACTOR CERTIFICATION Lic. Or Reg. No. 19521
License Business Name
Name of Driller ANDERSON, L.

HE-01205-06 (Rev. 9/96)