VF

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February 7, 2006

UMA File: D534 007 00 (4.6.1)

Mr. Alv Dyregrov
Dyregrov Consultants
1666 Dublin Avenue
Winnipeg, MB., R3H 0H1

Dear Mr. Dyregrov:

RE: West End Water Pollution Control Centre
Groundwater Pressure Control Requirements
Hydrogeologic Assessment Report

UMA Engineering Ltd. was retained by Dyregrov Consultants to provide hydrogeologic services associated with the design and construction of new facilities for the City of Winnipeg West End Pollution Control Centre (WEWPCC, Figure 01) located south of Wilkes Avenue and west of the Perimeter Highway. These new facilities include the installation of a new clarifier on the south side of the existing wastewater treatment plant (Figure 02) and an effluent disinfection facility to be located to the west of the existing wastewater treatment plant (Figure 03). Both of these facilities will require excavation to depths where the geotechnical assessment indicates that basal instability of the excavation floors may occur due to high piezometric pressures in the bedrock aquifer underlying the site. Therefore, the need to reduce the piezometric pressures during construction has been identified. It has also been identified that there may be the need for a permanent groundwater pressure control system that would be operated whenever the clarifiers are dewatered for cleaning. This letter report provides the assessment of the hydrogeology of this site, how this may affect the proposed construction activities and the recommended actions to address these risks. This report will be submitted to the Manitoba Water Stewardship Water Licensing Branch in partial fulfillment of the requirements to obtain approval to construct and operate a groundwater pressure control system. This approval is required under the MB Water Rights Act. As part of this approval process, a Groundwater Exploration Permit was applied for and received from the regulator.

PROPOSED CONSTRUCTION

The two components of the proposed construction plans for the WEWPCC that are of concern in this study are the effluent disinfection facility and a new clarifier. The design of these facilities are near completion but have not yet been finalized. The following is a general description of what will be constructed and why they are of concern:

Effluent Disinfection Facility - This building will be located to the west of the main WEWPCC buildings (Figure 01) near where the discharge pipe from the WEWPCC passes under Wilkes Avenue. The general layout of what will be constructed is shown on Figure 03. The design of this facility includes a section of new discharge piping that will pass beneath the building where the effluent will be disinfected. This will require the completion of excavations to a depth of approximately 232.0 m (approximately 5.8 metres below grade). The excavation will extend into the till materials underlying the clay. Based on the geotechnical assessment completed by Dyregrov Consultants, depressurization of the bedrock aquifer is required to prevent failure of the excavation base and/or flooding of the excavation. Following the completion of construction, the confining mass of the soils and the structure will be sufficient to resist the uplift pressures and long term depressurization will not be required.

New Clarifier – A new clarifier will also be installed near the southwest corner of the WEWPCC facilities (Figure 02). The installation of this clarifier will require an excavation to a depth of approximately 234.4 metres (approximately 4.6 metres below grade) for the bulk of the structure with localized smaller excavations to 233.0 metres to accommodate the installation of the centre pivot equipment and a linear excavation below the clarifier to

install a pipe connecting the clarifier to the main facility. The depth of this pipe has not yet been finalized. The excavation base will be within the clay soils, and the geotechnical analysis indicates that for the main clarifier excavation, there will be sufficient confining soil present to resist the uplift pressures and groundwater depressurization will not likely be required. However, groundwater depressurization may be required for to allow the installation of the supply pipe, potentially to address groundwater seepage to the excavation from the aquifer through pre-existing pathways (natural fractures or improperly sealed boreholes), or due to anomalously high groundwater pressure. Following construction and filling of this clarifier with effluent, the confining pressure will be sufficient to resist the uplift pressures except when the clarifier is drained for cleaning. Therefore, there may be a need to operate the groundwater depressurization system during periodic maintenance of the clarifier.

REGIONAL HYDROGEOLOGY

The regional stratigraphy in the area of the site generally consists of clay to depths of 3 to 6 metres underlain by glacial till and then bedrock. The depth to bedrock is approximately 9 to 12 metres below grade. Bedrock consists of Gunton Member dolomites directly below the site and Amaranth shales and sandstones to the north of the site.

The current groundwater piezometric surface beneath the area is at an elevation of approximately 235.25 metres (approximately 3 metres below grade). Review of the historical hydrograph of groundwater levels recorded at provincial monitoring station MJ-005 (Figure 04, located on the north side of Wilkes Avenue opposite the WEWPCC facility) indicates that this current groundwater level is high and has been since approximately 2000. Of particular note is the high groundwater level of 235.7 metres recorded at this station on June 11, 2005. This is the highest groundwater level ever recorded at this station (since monitoring began in the mid 1960's). This rise in groundwater levels is attributable to increased precipitation and decreased consumptive use of groundwater within the city. It is not known at this stage whether this groundwater level peak in 2005 is a short term transient peak related to high precipitation in 2004 and 2005 or whether this is part of the rising trend in groundwater levels observed since 1993 and therefore will be a permanent condition. Similar long term groundwater level monitoring records are not available for directly beneath the site, but given the close proximity of the site to the provincial monitoring well, it is reasonable to assume that similar groundwater levels and trends will be encountered. It will be imperative that groundwater levels at the site at the time of construction be confirmed and taken into consideration in the groundwater control plans.

The interpreted regional groundwater flow directions, based on the existing monitoring well network, are shown on Figure 05. As can be seen, in the area of the site, groundwater flow is generally to the east towards the Red River, the major discharge point for all groundwater within the bedrock aquifer.

Groundwater in the area of the site is considered to be brackish and non-potable. The total dissolved solids content of the groundwater is on the order of 6,000 mg/l, chloride is approximately 1,400 mg/l and sulfate has been measured at concentrations of up to 2,000 mg/l. As a result of the poor quality of this groundwater, groundwater is not used as a potable water supply for rural residences and businesses in the area. Potential impacts to existing groundwater users in the area are therefore not a concern due to the lack of drinking water wells.

INVESTIGATION PROGRAM

In order to obtain the necessary information on the aquifer characteristics for the design of a construction groundwater pressure control system, investigations were conducted at both the effluent disinfection facility and the new clarifier sites. These investigations consisted of the installation of a pumping well and observation well at each site and the completion of an aquifer pumping test. Copies of the Driller's Reports provided by the drilling contractor are included in Appendix A. The results of the analysis of the aquifer pumping tests are provided in Appendix B.

The following summarizes the field results at each site:

Effluent Disinfection Facility – Investigations at the effluent disinfection facility consisted of the installation of a 150 mm (6 inch) pumping well (PW-1) and a 125 mm (5 inch) observation well (OW-1) at the locations shown on Figure 03. The observation well was installed as a 125 mm well rather than the specified 50 mm well at the discretion of the driller. As indicated on the drillers reports, the stratigraphy at this site consists of 8.2 metres of clay overlying 2.3 metres of glacial till. Bedrock was encountered at a depth of 10.5 metres and consisted of brown to purple limestone. Distinct fractures were noted at depths of 11.9 and 15.2 metres. The PW-1 well installation consisted of 10.6 metres of 150 mm PVC casing followed by a 115 mm open borehole to a depth of 24.1 metres. The OW-1 well installation consisted of 10.4 metres of 125 mm PVC casing followed by a 115 mm open borehole to a depth of 24.1 metres. The annulus around both well casings were grouted to surface.

Following completion of the drilling and development of the wells, an aquifer pumping test was conducted for a period of 4 hours. The test consisted of the pumping of well PW-1 at an average rate of 3.9 litres per second (62 USgpm) with periodic measurements of the change in groundwater level made in wells PW-1 and OW-1. During the test, a maximum drawdown in groundwater levels of 3.62 metres was recorded in well PW-1. The indicated specific well capacity based on this is approximately 1.0 litres per second/metre of drawdown (5 USgpm/ft) and the total well capacity is approximately 7.3 litres per second (115 USgpm). Analysis of the data for well PW-1 provided an estimate of transmissivity of approximately 1.4×10^{-3} m^2/s (10,000 USgpd/ft). Analysis of the data from well OW-1 provided an estimate of transmissivity of approximately 1.1×10^{-2} m^2/s (75,000 USgpd/ft, Appendix B). The OW-1 results are considered representative of the bulk transmissivity of the aquifer. The relatively low results from pumping well PW-1 may be more indicative of a low well efficiency and further well development may improve its capacity.

Clarifier Site – Investigations at the Clarifier site consisted of the installation of a 150 mm (6 inch) pumping well (PW-1) and a 125 mm (5 inch) observation well (OW-2) at the locations shown on Figure 02. As indicated on the drillers reports, the stratigraphy at this site consists of 9.4 metres of clay overlying 0.5 metres of glacial till. Bedrock was encountered at a depth of 9.9 metres and consisted of brown to purple limestone. A large fracture was noted at a depth of 20.4 metres. The PW-2 well installation consisted of 10.5 metres of 150 mm PVC casing followed by a 115 mm open borehole to a depth of 24.1 metres. The OW-1 well installation consisted of 10.5 metres of 125 mm PVC casing followed by a 115 mm open borehole to a depth of 24.4 metres. The annulus around both well casings were grouted to surface.

Following completion of the drilling and development of the wells, a preliminary aquifer pumping test was conducted at a rate of 5.7 litres per second (90 USgpm) to assess the well capacity. The observed drawdown in the pumping well was 2 cm. Therefore, due to the very high well capacity, the test was abandoned so that a larger pump could be mobilized to properly test the aquifer.

A second pumping test was conducted on well PW-2 at a rate of 25.6 litres per second (406 USgpm) using a suction lift pump. The test duration was 2.5 hours. During the test, periodic measurements of the change in groundwater level were made in wells PW-2 and OW-2. A maximum drawdown in groundwater levels of 0.72 metres was recorded in well PW-2. The indicated specific well capacity for well PW-2 is approximately 35.0 litres per second/metre of drawdown (170 USgpm/ft) and the total well capacity is approximately 31 litres per second (500 USgpm). Analysis of the data for well PW-1 provided an estimate of transmissivity of approximately 4.2×10^{-2} m^2/s (290,000 USgpd/ft). Analysis of the data from well OW-2 provided an estimate of transmissivity of approximately 5.0×10^{-2} m^2/s (350,000 USgpd/ft, Appendix B). The high transmissivity is likely the result of high flows within the major fracture encountered at a depth of 20.4 metres. As indicated on the data plots for this test included in Appendix B, the rate of drawdown was increasing in the latter part of the test. These results suggest that the drawdown cone created by pumping may have reached a portion of the fracture where flow is restricted. Therefore, the bulk regional transmissivity may be lower.

so that they are available for use if necessary during construction of the current clarifier or during any future maintenance of the clarifiers.

For initial design estimating purposes, it has been assumed that a 1.0 metre drawdown in groundwater levels will be required beneath the new clarifier. For the indicated high transmissivity in this area of 5.0×10^{-2} m^2/s (350,000 USgpd/ft, the estimated required total pumping rate is 76 litres per second (1,200 USgpm), assuming the pumping wells are located 20 metres from the centre of the excavation. The actual drawdown and pumping rate required would have to be determined once the design is finalized and the groundwater level at the time of construction is known.

In consideration of the assumed design requirements, the potential options to achieve the required level of drawdown below the excavation were reviewed. The first case considered was to use the existing 150 mm pumping well PW-2 and the 125 mm observation well OW-2. Well PW-2 has an indicated current capacity of approximately 31 litres per second (500 USgpm). The capacity of well OW-2 was not tested but it is likely less than the capacity of the larger well PW-2. Therefore, there is insufficient pumping capacity in the two existing wells to achieve the required drawdown and a third well is required. In consideration of the potential future requirement to depressurize the aquifer during maintenance of the existing clarifiers, the preferred location for the additional pumping well is on the north side of the proposed new clarifier and proximate to two of the existing clarifiers. The recommended design for the additional pumping well is a 250 mm (10 inch) well consisting of PVC casing installed through the overburden to the bedrock surface followed by open bedrock hole to the depth required to develop the necessary well capacity (ie: until sufficient fractures are exposed such that the well can be pumped at the required rate). The maximum depth of drilling should be 24 metres. Should insufficient fractures be encountered in this well to develop the necessary well capacity, it may be necessary to drill additional locations until the required capacity is obtained. Following completion of the construction and development of the additional well, a one hour well capacity test should be conducted prior to the start of construction dewatering to confirm that the required capacity is available. A 250 mm (10 inch) well is recommended as it is sufficiently large to install submersible pumps capable of discharging the several thousand gallons per minute that may be necessary to be pumped during maintenance of the existing clarifiers. The actual capacity of the well to transmit water from the aquifer to the pump would have to be determined after the well is installed and tested.

The groundwater that will be pumped from this site is brackish and discharge to the surface drainage system is not recommended. It is recommended that the water be discharged to the existing sewage lagoons located to the south of the site. The volume of water in these ponds is likely sufficiently large to dilute the brackish water to acceptable levels prior to discharge. Confirmation of this assessment and whether further testing of the outfall quality is required would have to be confirmed in consultation with MB Conservation.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this assessment, the following conclusions are made:

- Relative to the effluent disinfection facility site, an estimated combined pumping rate of 41 litres per second (650 USgpm) is required to achieve a drawdown of 3.5 metres in groundwater levels. The actual pumping rate required may increase or decrease if groundwater levels at the time of construction vary from an average assumed elevation of 234.8 metres or changes are made to the required depth of excavation. The pumping system would consist of the two existing test wells at this site and a new 250 mm (10 inch) diameter well to be installed by the contractor. The wells would be equipped with suitably rated pumps and configured to discharge to the existing outfall pipe for disposal.
- Relative to the new clarifier site, groundwater pumping may not be required for groundwater elevations up to 235.25 metres. However, groundwater pumping may be required for higher groundwater elevations, deeper excavation depths than currently planned, or for future maintenance of the existing clarifiers. Therefore, as a contingency, it is recommended that groundwater pumping wells be installed for future

use. The wells would consist of the two existing test wells and a third well installed prior to construction. The wells would only be equipped with pumps and controls capable of discharging 76 litres per second (1,200 USgpm) if their operation was necessary, and the groundwater discharged to the adjacent treatment ponds.

The following recommendations are made in consideration of the available information. These recommendations should be reviewed once the design has been finalized and the groundwater levels at the time of construction are known.

Effluent Disinfection Facility Site

- The existing 150 mm and 125 mm test wells have a low indicated well capacity and should be further developed to improve their capacity to the maximum degree practical.
- A new 250 mm (10 inch) well should be installed on the east side of the proposed excavation and as close to the excavation as possible but at a location that does not adversely affect construction.
- A 50 mm (2 inch) diameter monitoring well should also be installed at a suitable location near the excavation to allow groundwater levels to be monitored during pumping.
- The wells should be equipped with the appropriately rated pumps, controls and flow meters, and configured to discharge to the existing outfall pipe. A suitable back-up pump and power supply should be maintained on site in case a pump or the power fails.
- The contractor must be required to provide suitably qualified personnel to be on-site continuously during the operation of the system to monitor the water levels and flow rates, make adjustments as appropriate, and to make repairs should any system components fail.
- The services of a qualified hydrogeologist should be retained to supervise the operation of the system, review the monitoring and operation results and advise the Contractor with respect to system operation.

Clarifier Site

- It is recommended as a contingency that an additional 250 mm pumping well be installed in addition to the existing test wells to allow groundwater to be pumped if necessary during construction or during future maintenance of the clarifiers. Equipping the wells with pumps, controls and meters is not necessary at this time.

We trust that this assessment meets your requirements. Should you have any questions or require additional information, please contact the undersigned at (204) 928-7412. We appreciate the opportunity to work on this project and look forward to working with you as the project proceeds to the construction phase.

Sincerely,

UMA Engineering Ltd.

Steve Wiecek, P.Geo., P.Eng.
Senior Geologic Engineer
Steve.Wiecek@uma.aecom.com
/dh

cc: Eric Hutchison, P.Eng. – Earth Tech

B SIZE 11" x 17" (279.4mm x 431.8mm)

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61 6000 62 6000 63 6000 64 6000 65 6000 66 6000 67 6000

N W E S

RM of Rockwood

RM of Rosser

RM of West St. Paul

RM of St. Andrews

RM of St. Clements

RM of East St. Paul

RM of Brokenhead

RM of Springfield

RM of Tache

RM of Ste. Anne

RM of Richot

RM of MacDonald

RM of Headingly

City of Winnipeg

STUDY AREA

OUTLET CONTROL STRUCTURE

LOCKPORT

ST. ANDREWS LOCK AND DAM

Birds Hill Provincial Park

RED RIVER FLOODWAY

INLET CONTROL STRUCTURE

RED RIVER

OAKBANK

DUGALD

ANOLA

ORETTE

ILE DES CHENES

CPR KEEWATIN

CPR EMERSON

CNR

SPRAGUE

GWWD

CEMR

ASSINIBOINE

239 237 235 233 231 229 227 225 223 221 219

241 243 245 247 249 251 253 255 257 259 261 263 265

5540000 5550000 5560000

KEY MAP SHEET INDEX

Lake Winnipeg

SELKIRK

WINNIPEG

HWY 1

STEINBACH

MORRIS

0 10 20 30 Kilometres

Legend

- Major Highways
- Railway
- Major Rivers
- RM Boundaries
- 239 — Carbonate Aquifer Piezometric Surface Contour (m, Geodetic)
- Groundwater Flow Directions

0 1 2 4 6 8 10 Kilometres

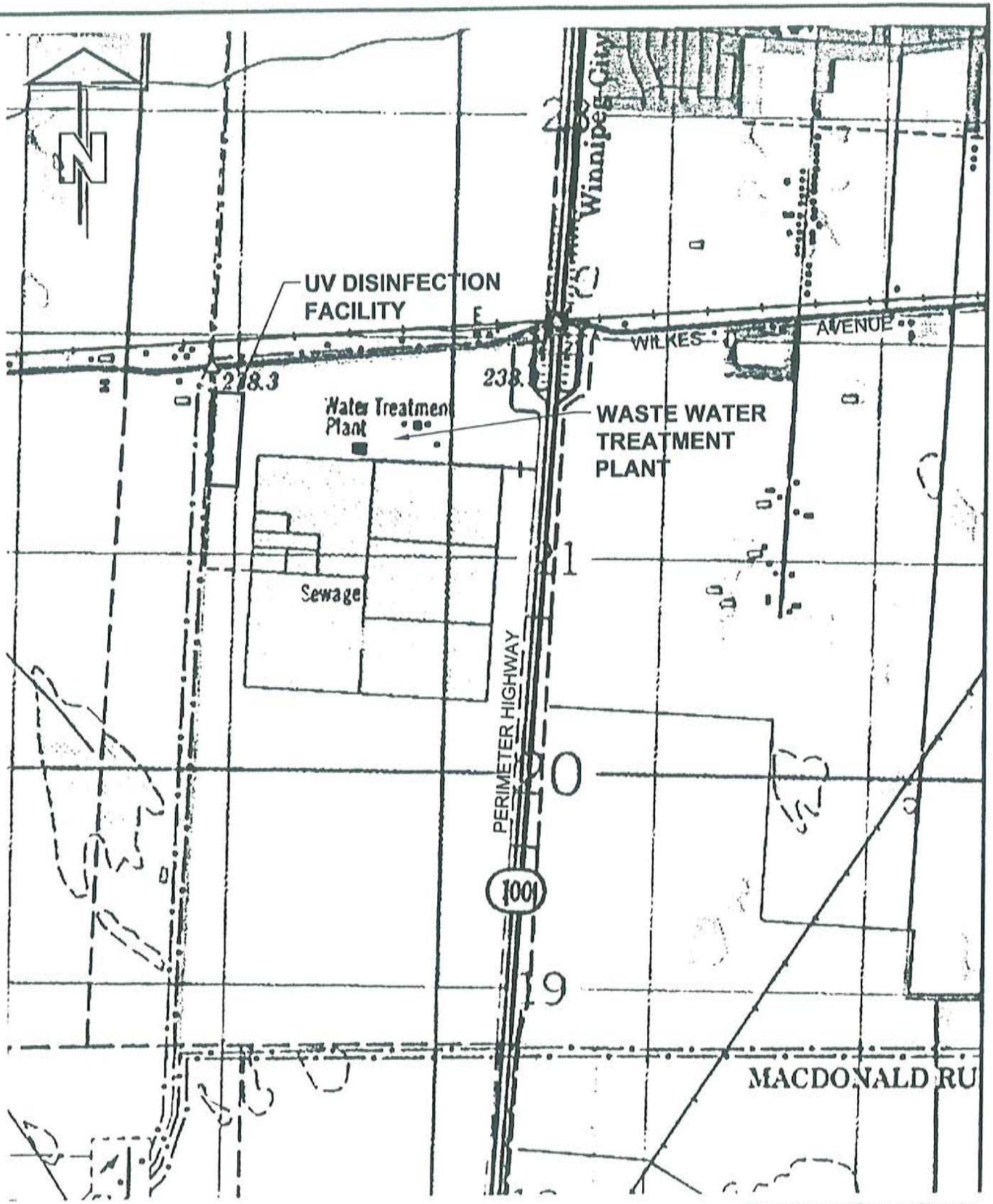
Dyregrov Consultants
WEWPCC Nutrient Removal and UV Disinfection Upgrade
Hydrogeological Investigations

Groundwater Flow Directions

UMA | AECOM

Figure - 05

Figures



Dyregrov Consultants
WEWPCC Nutrient Removal and UV Disinfection Upgrade
Hydrogeological Investigations

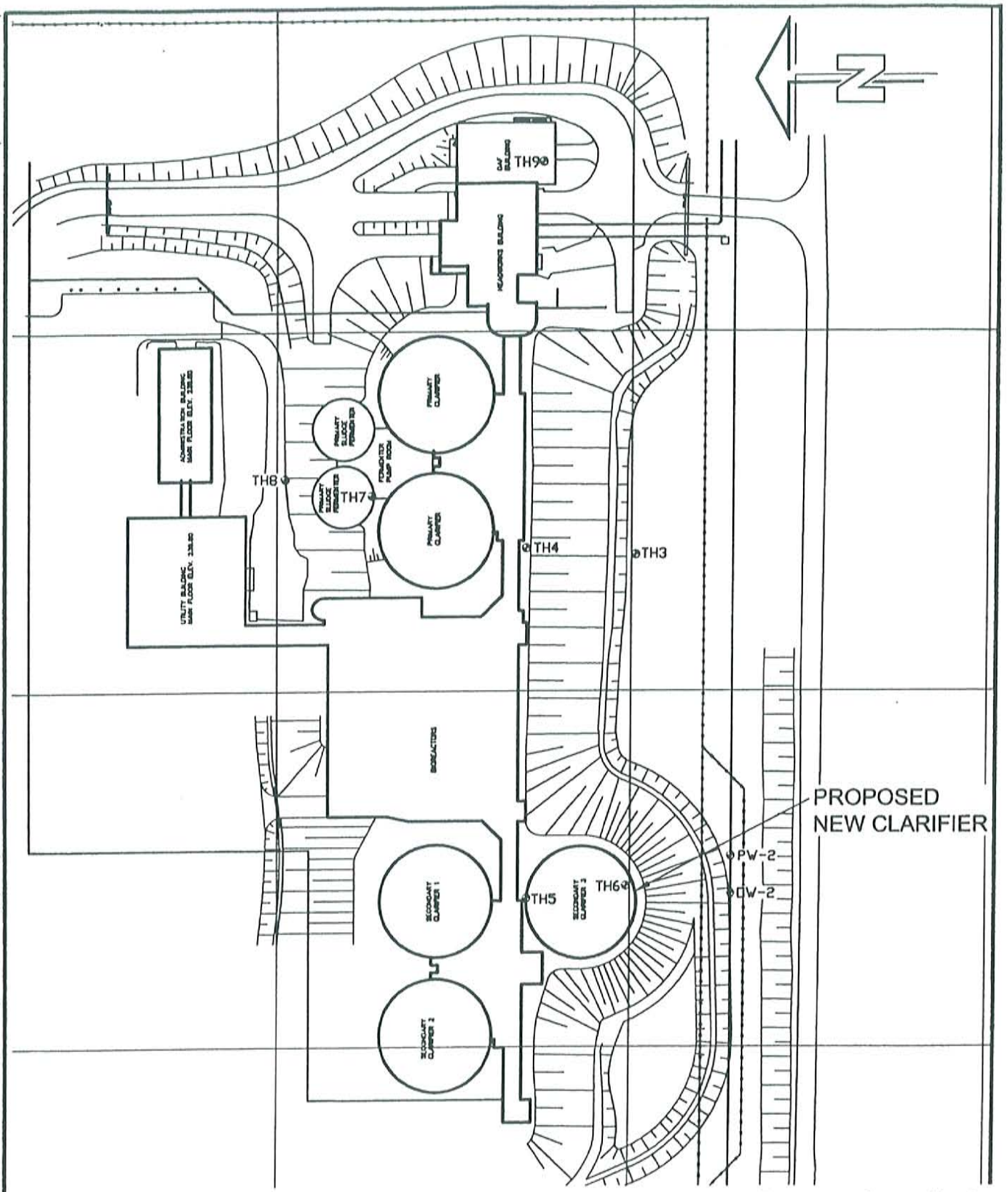
PLAN

0 250 500 750 m SCALE 1:25000

Site Location Plan

UMA | AECOM

Figure - 01



A SIZE 8.5" x 11" (215.9mm x 279.4mm)

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Dyregrov Consultants
WEWPCC Nutrient Removal and UV Disinfection Upgrade
Hydrogeological Investigations

PLAN

0 15 30 45 m SCALE 1:1500

New Clarifier Site

UMA | AECOM

Figure - 02

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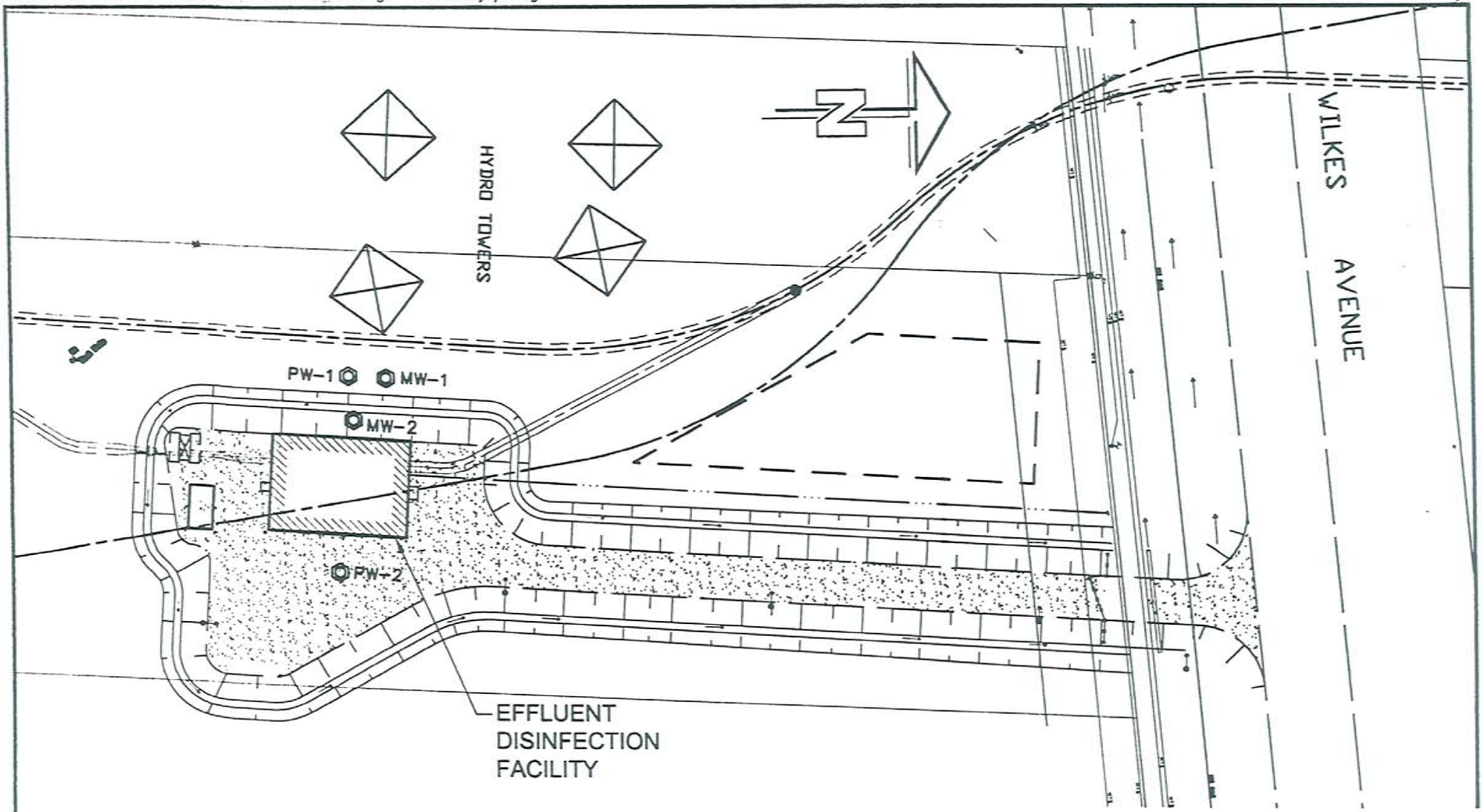

Dyregrov Consultants
WEWPCC Nutrient Removal and UV Disinfection Upgrade
Hydrogeological Investigations

PLAN

0 7.5 15 22.5 m SCALE 1:750

Effluent Disinfection Facility Site Plan

UMA | AECOM

Figure - 03

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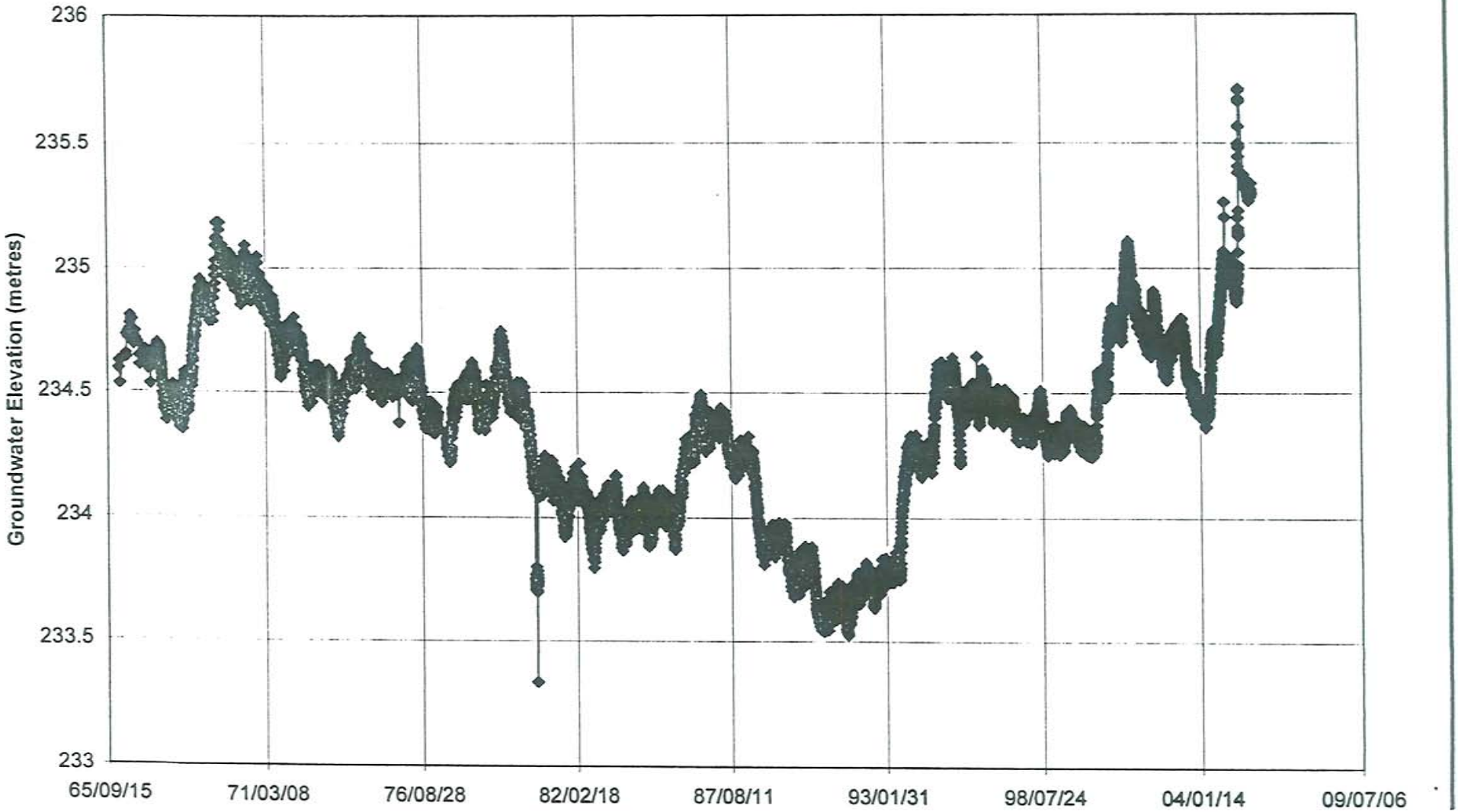


Dyregrov Consultants
WEWPCC Nutrient Removal and UV Disinfection Upgrade
Hydrogeological Investigations

Historical Groundwater Level Trends
Station MJ-005

UMA | AECOM

Figure - 04

Appendix A
Driller's Report

Driller's Report

Water Stewardship

WELL LOCATION
QTR. ___ SEC. ___ TWP ___ RGE. ___ E. ☐ W. ☐
R. LOT ___ PARISH St Charles
REMARKS City of WPG.

WELL OWNER
NAME West End Water pollution control center
ADDRESS ___ PHONE ___

WELL IDENTIFICATION (NO., NAME) PW-1

WELL USE: PRODUCTION ☒ TEST WELL ☐ RECHARGE ☐ OBSERVATION WELL ☐

WATER USE: DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL ☐ INDUSTRIAL ☒ IRRIGATION ☐
AIR CONDITIONING ☐ OTHER ☐ (Specify) ___

DATE WELL COMPLETED DAY 13 MONTH Nov 20 05

LOCATION SKETCH OF WELL: West Well

WELL CO-ORDINATES
Y NORTHING / LATITUDE
X EASTING / LONGITUDE

WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	8	Dark grey Clay	
8	22	Brown clay	
22	27	Light grey clay	
27	34.5	Brown till	
34.5	35.5	Soft brown limestone	
35.5	54	Brown limestone	
54	78	54, 64, 68, 73 limestone	

Bedrock

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
0	34' 7"	X						6"				PVC	
34' 7"	79		X					4.5					
0	35					X							

TOP OF CASING OR PITLESS UNIT 1.5 FEET ABOVE ☒ BELOW ☐ GROUND LEVEL

REMARKS:
grouted with Bentonite
Well located at proposed UV disinfection Building Site

PUMPING TEST

DATE OF TEST: DAY ___ MONTH Nov 13 20 05
PUMPING ☒ FLOWING ☐ RATE 52 I.G.P.M.
WATER LEVEL BEFORE PUMPING 19 FT. ABOVE ☐ BELOW ☒ GRD. LEVEL
WATER LEVEL AT END OF TEST 235 FT. ABOVE ☐ BELOW ☐ GRD. LEVEL
DURATION OF TEST 1 HOURS 30 MINUTES
WATER TEMPERATURE ___ °F
RECOMMENDED PUMPING RATE ___ I.G.P.M.
WITH PUMP INTAKE AT ___ FEET BELOW GROUND LEVEL

CONTRACTOR

LICENCE NO. 5801 05
NAME Selkirk Driller
ADDRESS 1021 Brooker
DRILL OPERATOR Patrick
Signature of Contractor

FORM MQ-7303 (REV. 04)

WELL OWNER'S COPY

Driller's Report

Water Stewardship

WELL LOCATION
QTR. ___ SEC. ___ TWP. ___ RGE. ___ E. ☐ W. ☐
R. LOT ___ PARISH RM St. Clair (?)
REMARKS City of (?)

WELL OWNER
NAME West End Water pollution control center
ADDRESS 7140 Wilkes ave PHONE

WELL IDENTIFICATION (NO., NAME) OW-1

WELL USE PRODUCTION ☐ TEST WELL ☐ RECHARGE ☐ OBSERVATION WELL ☒

WATER USE DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL ☐ INDUSTRIAL ☒ IRRIGATION ☐
AIR CONDITIONING ☐ OTHER ☒ (Specify) ___

DATE WELL COMPLETED DAY 4 MONTH Nov 20 05

LOCATION SKETCH OF WELL
West Well

WELL CO-ORDINATES
Y NORTHING / LATITUDE
X EASTING / LONGITUDE

WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	8	dark grey clay	
8	22	brown clay	
22	27	light grey clay	
27	30	brown till	
30	35	soft limestone	
35	55	brown limestone	
55	79	purple limestone	

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE		MATERIAL		MAKE
0	33' 8"	X						5"					PVC		
33' 8"	79		X					4.5							
0	33' 8"					X									

TOP OF CASING OR PITLESS UNIT 2 FEET ABOVE ☒ BELOW ☐ GROUND LEVEL

REMARKS:
grouted with bentonite
Well located at proposed UV disinfection building site
Observation well for pump test of well PW-1

PUMPING TEST

DATE OF TEST: DAY ___ MONTH Nov 4 20 05
PUMPING ☒ FLOWING ☐ RATE ___ I.G.P.M.
WATER LEVEL BEFORE PUMPING ___ FT. ABOVE ☐ BELOW ☐ GRD. LEVEL
WATER LEVEL AT END OF TEST ___ FT. ABOVE ☐ BELOW ☐ GRD. LEVEL
DURATION OF TEST ___ HOURS ___ MINUTES
WATER TEMPERATURE ___ °F
RECOMMENDED PUMPING RATE ___ I.G.P.M.
WITH PUMP INTAKE AT ___ FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. 5,8,0 0,5
NAME Selkirk Drilling
ADDRESS 1021 Brackenridge
DRILL OPERATOR Patrick
Signature of Contractor

FORM MG-7283 (REV. 04)

WELL OWNER'S COPY

Driller's Report

Water Stewardship

WELL LOCATION: QTR. ___ SEC. ___ TWP. ___ RGE. ___ E. ☐ W. ☐ R. LOT ___ PARISH RM St. Charles
REMARKS City of W/S

WELL OWNER: NAME West End Water pollution control center
ADDRESS 7740 Wilkes ave PHONE

WELL IDENTIFICATION (NO., NAME) PW-2

WELL USE: PRODUCTION ☒ TEST WELL ☒ RECHARGE ☐ OBSERVATION WELL ☐

WATER USE: DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL ☐ INDUSTRIAL ☒ IRRIGATION ☐
AIR CONDITIONING ☐ OTHER ☒ (Specify) construction dewatering

DATE WELL COMPLETED DAY 17 MONTH Nov 20 05

LOCATION SKETCH OF WELL: East Well

WELL CO-ORDINATES
Y NORTHING / LATITUDE
X EASTING / LONGITUDE

WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	26	brown Clay	
26	32.5	till	
32.5	45	white & brown limestone	
45	65	purple limestone	
65	79	white limestone	

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
0	34' 4"	X						6"				PVC	
34' 4"	79		X					4.5					
0	34' 4"					X							

TOP OF CASING OR PITLESS UNIT 2 FEET ABOVE ☒ BELOW ☐ GROUND LEVEL

REMARKS: grouted with Bentonite
Well located at new Clarifier site east of building
Well to be retested at higher pumping rate

PUMPING TEST

DATE OF TEST: DAY ___ MONTH Nov 17 20 05
PUMPING ☒ FLOWING ☐ RATE 76 I.G.P.M.
WATER LEVEL BEFORE PUMPING 19 FT. ABOVE ☐ BELOW ☒ GRD. LEVEL
WATER LEVEL AT END OF TEST 12 FT. ABOVE ☐ BELOW ☒ GRD. LEVEL
DURATION OF TEST ___ HOURS 5 MINUTES
WATER TEMPERATURE ___ °F
RECOMMENDED PUMPING RATE ___ I.G.P.M.
WITH PUMP INTAKE AT ___ FEET BELOW GROUND LEVEL.

CONTRACTOR

LICENCE NO. 5801 05
NAME Seekirk Drillers
ADDRESS 1621 Bracken rd
DRILL OPERATOR Patrick
P Hyggund
Signature of Contractor

FORM WB-7383 (REV 04)

WELL OWNER'S COPY

Water Stewardship

Driller's Report

WELL LOCATION
QTR. ___ SEC. ___ TWP. ___ RGE. ___ E. ☐ W. ☐
R. LOT ___ PARISH RM St. Charles
REMARKS City of Luling

WELL OWNER
NAME West End Water pollution control center
ADDRESS 7740 Wilkes ave PHONE

WELL IDENTIFICATION (NO., NAME) OW - 2

WELL USE: PRODUCTION ☐ TEST WELL ☐ RECHARGE ☐ OBSERVATION WELL ☒

WATER USE: DOMESTIC ☐ LIVESTOCK ☐ MUNICIPAL ☐ INDUSTRIAL ☒ IRRIGATION ☐
AIR CONDITIONING ☐ OTHER ☒ (Specify) Construction Dewatering

DATE WELL COMPLETED DAY 7 MONTH Nov 20 05

LOCATION SKETCH OF WELL
East Well

WELL CO-ORDINATES
NORTHINGS / LATITUDE
X EASTING / LONGITUDE

WELL LOG

DEPTH BELOW GROUND IN FEET FROM	TO	DESCRIPTION	WATER RECORD (KIND OF WATER)
0	31	brown Clay	
31	32.5	till	
32.5	45	white & brown limestone	
45	65	purple limestone	
65	80	white limestone	

WELL CONSTRUCTION

DEPTH BELOW GROUND LEVEL IN FEET FROM	TO	CASING	OPEN HOLE	PERFORATIONS	GRAVEL PACK	CASING GROUT	PITLESS UNIT	INSIDE DIAMETER INCHES	OUTSIDE DIAMETER INCHES	SCREEN SLOT SIZE NO. OR INCH	TYPE	MATERIAL	MAKE
0	34.5'	X						2"				PVC	
34.5'	80		X					4.5					
0	34.5'					X							

TOP OF CASING OR PITLESS UNIT 1.5 FEET ABOVE ☒ BELOW ☐ GROUND LEVEL

REMARKS:
grouted with bentonite
Well located at new Clarder site South of building
No pump test data

PUMPING TEST

DATE OF TEST: DAY ___ MONTH Nov 7 20 05
PUMPING ☒ FLOWING ☐ RATE ___ I.G.P.M.
WATER LEVEL BEFORE PUMPING ___ FT. ABOVE ☐ BELOW ☒ GRD. LEVEL
WATER LEVEL AT END OF TEST ___ FT. ABOVE ☐ BELOW ☐ GRD. LEVEL
DURATION OF TEST ___ HOURS ___ MINUTES
WATER TEMPERATURE ___ °F
RECOMMENDED PUMPING RATE ___ I.G.P.M.
WITH PUMP INTAKE AT ___ FEET BELOW GROUND LEVEL.

CONTRACTOR

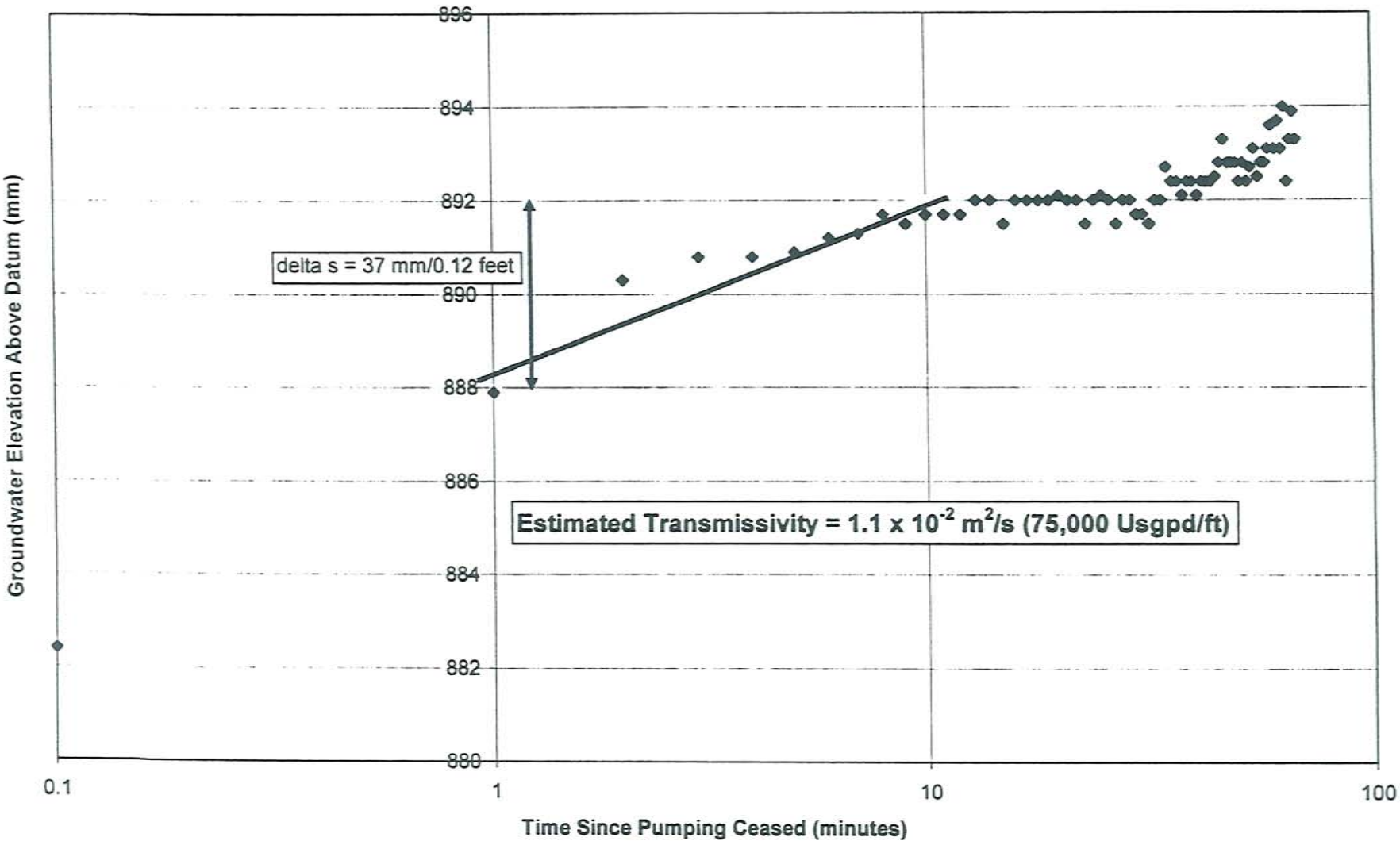
LICENCE NO. 5801 05
NAME Selkirk Drillers
ADDRESS 1021 Bracken RD
DRILL OPERATOR Patrick
P. Nygaard
Signature of Contractor

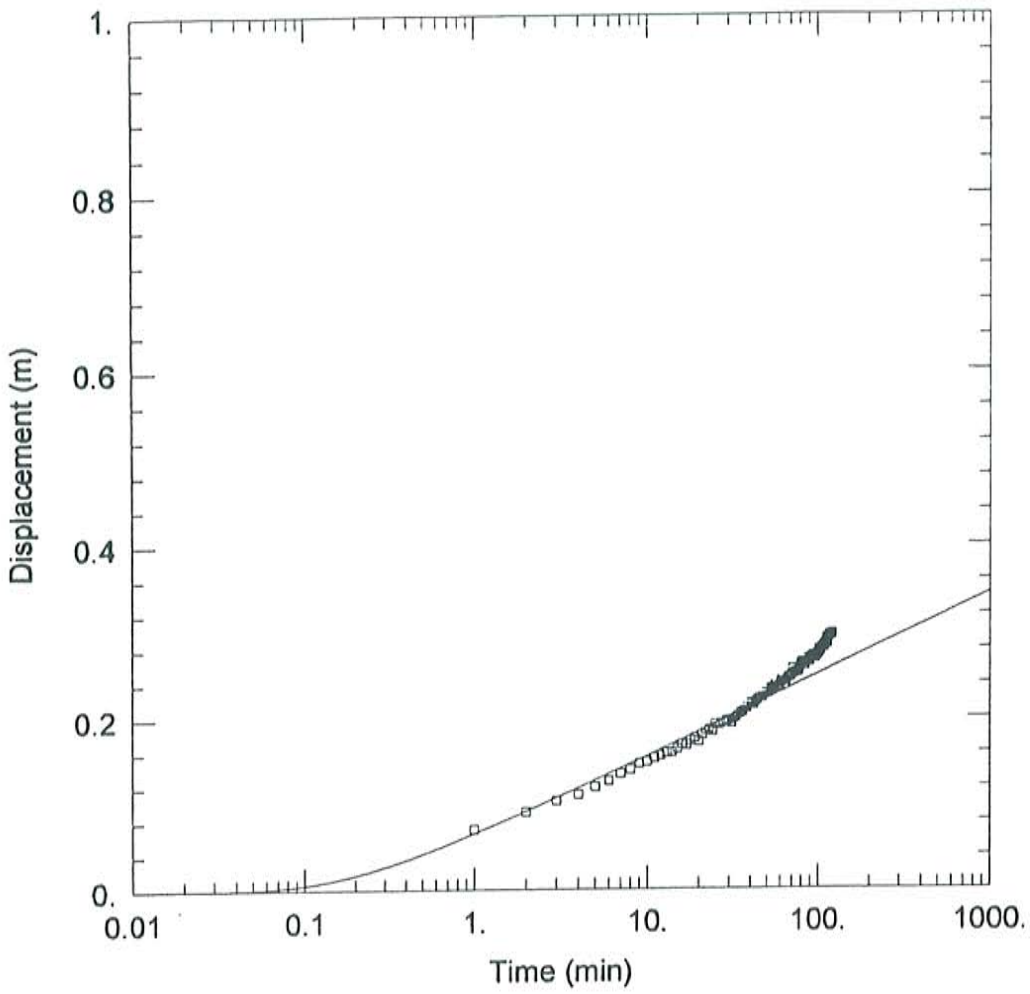
FORM MD-7383 (REV. 04)

WELL OWNER'S COPY

Appendix B
Pumping Test Results

Observation Well OW-1 Recovery Data





WEWPCC CLARIFIER SITE PUMPING TEST

Data Set:
Date: 12/02/05 Time: 14:44:17

PROJECT INFORMATION

Company: UMA Engineering
Client: City of Winnipeg
Project: D534-007-00-01
Test Location: WEWPCC
Test Well: PW-2
Test Date: Dec. 1, 2005

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PW 1	0	0

Observation Wells

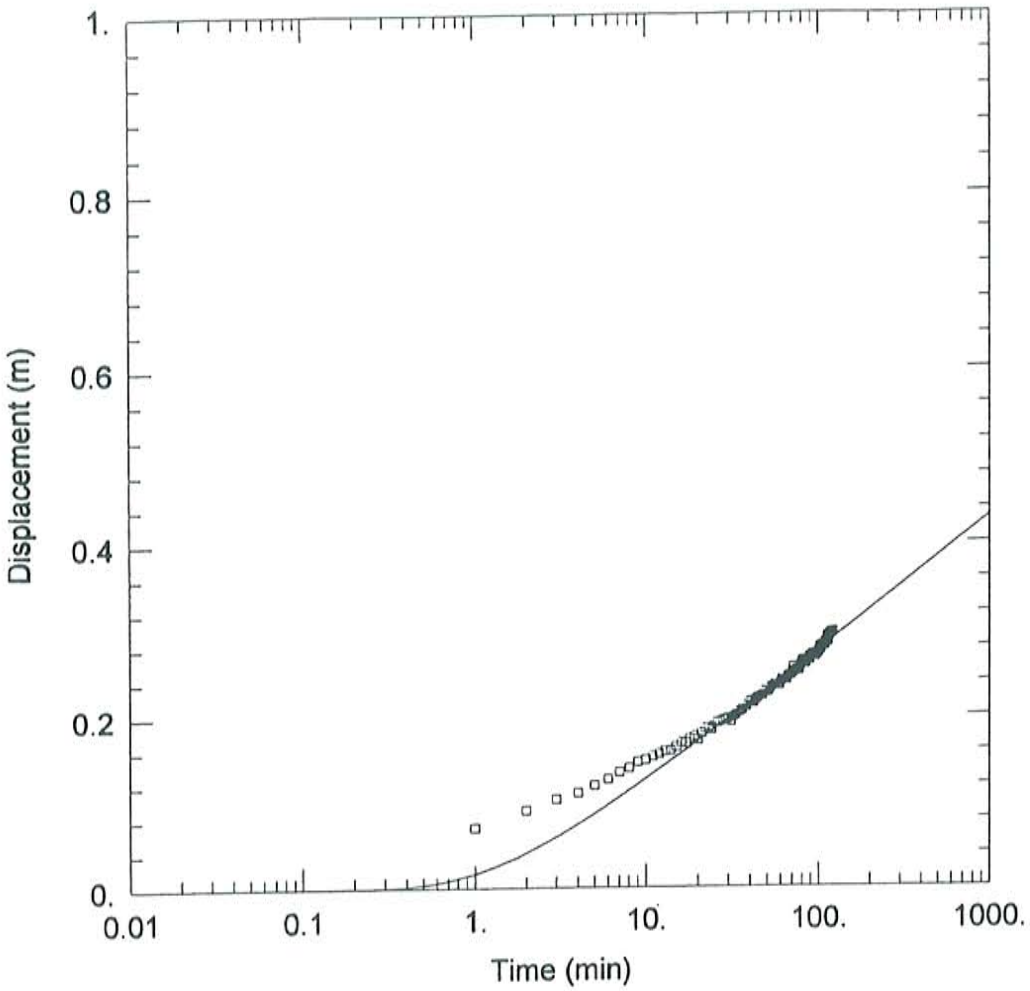
Well Name	X (m)	Y (m)
OW 2	5	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 3.463E+05 gal/day/ft
Kz/Kr = 1.

S = 0.06055
b = 13.7 m



WEWPCC CLARIFIER SITE PUMPING TEST

Data Set:
Date: 12/02/05 Time: 14:44:36

PROJECT INFORMATION

Company: UMA Engineering
Client: City of Winnipeg
Project: D534-007-00-01
Test Location: WEWPCC
Test Well: PW-2
Test Date: Dec. 1, 2005

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PW 1	0	0

Observation Wells

Well Name	X (m)	Y (m)
▫ OW 2	5	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 2.12E+05 gal/day/ft
Kz/Kr = 1.

S = 0.2678
b = 13.7 m