FEASIBILITY STUDY
VOCs IN GROUNDWATER - WEST OF GILFILLAN LAKE
NORTH OAKS, MINNESOTA

HIGHWAY 96 SITE
WHITE BEAR TOWNSHIP, MINNESOTA

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LIST OF ACRONYMS

AMSL	above mean sea level
ARARs	Applicable or relevant and appropriate requirements
bgs	below ground surface
CRA	Conestoga-Rovers & Associates
CWA	Consolidated waste area
DAR	Detailed Analysis Report
Feet	ft.
FS	Feasibility Study
HRL	Health risk limit
HRV	Health risk values
IRAP	Interim Response Action Plan
MCL	Maximum contaminant level
MDD	Minnesota Decision Document
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
ND	Not detected
NDA	North Disposal Area
NOHOA	North Oaks Homeowners Association
NPDES	National Pollutant Discharge Elimination System
PRPs	Potentially responsible parties
Reynolds	Reynolds Metals Company
RFRA	Request for Response Action
RI/FS	Remedial Investigation/Feasibility Study
SDA	South Disposal Area
SDS	State Disposal System
Site	Highway 96 site in White Bear Township, Minnesota
TCE	Trichloroethene
TMV	Toxicity, mobility, or volume
USEPA	United States Environmental Protection Agency
VAP	Vertical Aquifer Profiling
VOC	Volatile organic compound
Whirlpool	Whirlpool Corporation

EXECUTIVE SUMMARY

Reynolds Metals Company (Reynolds) and Whirlpool Corporation (Whirlpool) have, as responsible parties, worked to remediate the Highway 96 site in White Bear Township, Minnesota (Site), and monitor the groundwater conditions downgradient from the Site in North Oaks, Minnesota. In October 2004, during routine monitoring of residential wells in North Oaks, low levels of vinyl chloride were detected in water samples collected from two residential well locations (12 West Shore Road and 13 West Shore Road). Subsequent residential well sampling in 2005 of over 70 residential wells located in the southeast portion of North Oaks confirmed that vinyl chloride contamination in North Oaks is limited to three residential wells (12 West Shore Road, 13 West Shore Road, and 2 Hummingbird Hill) located near the west shore of Gilfillan Lake. To date, the vinyl chloride concentrations have remained at or below the health risk limit (HRL)[1] for vinyl chloride, as established by the Minnesota Department of Health (MDH).

Over the past two and a half years (from January 2005 through June 2007), Reynolds and Whirlpool have conducted extensive studies required by the Minnesota Pollution Control Agency (MPCA) to investigate the nature and extent of volatile organic compound (VOC) contamination in residential wells located west of Gilfillan Lake. These studies included:

- 12 rounds of residential well sampling;
- installation of 11 new monitoring wells in North Oaks;
- vertical aquifer profiling (VAP) to provide vertical delineation of groundwater quality;
- a geophysical survey;
- installation of a test extraction well west of Gilfillan Lake; and
- continued monitoring at existing wells in North Oaks and at the Highway 96 Site in White Bear Township.

The results of the studies have been documented within reports that have been provided to the MPCA and posted on the City of North Oaks website. These studies have also been presented to the City of North Oaks and the North Oaks Homeowners Association (NOHOA) at a number of meetings intended to keep City representatives updated and to provide information to the general public.

[1] Health Risk Limit (HRL) is the health standard adopted by the Minnesota Department of Health (MDH) for the safe consumption of water from a private water supply over a lifetime.

In the Spring 2007, the MPCA identified the need for a feasibility study (FS) and in June 2007, the MPCA requested that Reynolds and Whirlpool prepare a FS and specified the alternatives to be evaluated.

The FS provides an evaluation of remedial alternatives for VOCs in groundwater within the southeast portion of North Oaks, west of Gilfillan Lake. As required by the MPCA, three alternatives are evaluated for a scenario where there are no HRL exceedances at any residential well (MPCA Scenario A). These alternatives are:

- ***Alternative A1*** - No further action
- ***Alternative A2*** - Long term monitoring
- ***Alternative A3*** - Groundwater extraction and monitoring

The MPCA also required four alternatives for the scenario where there are HRL exceedances at residential wells (MPCA Scenario B). The alternatives are:

- ***Alternative B1*** - No further action
- ***Alternative B2*** - Residential carbon filter and monitoring
- ***Alternative B3*** - New/Deeper residential well and monitoring
- ***Alternative B4*** - Municipal water and monitoring

Each of the alternatives was evaluated using the following criteria:

- Overall protection of human health and the environment;
- Compliance with applicable or relevant and appropriate requirements (ARARs);
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume (TMV) through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost effectiveness.

Following submittal of the FS, the alternatives will also be evaluated based on the following criteria:

- Community acceptance; and
- State acceptance.

Tables ES-1 and ES-2 provide a comparison of the alternatives evaluated under the FS.

As required by MPCA guidance, the FS report does not include a recommended alternative. The MPCA will review and comment on this report. After the MPCA approves the final FS report, they will prepare a Proposed Plan which will identify the preferred remedial alternative. The Proposed Plan will be presented to the public and a public comment period will be held. Prior to selecting the final remedial alternative, the MPCA will consider public comments provided on the Proposed Plan and will then prepare a responsiveness summary, which addresses the comments provided. The responsiveness summary will be included in the amended Minnesota Decision Document.

TABLE ES.1

SUMMARY OF COMPARITIVE ANALYSIS OF ALTERNATIVES
MPCA SCENARIO A
NORTH OAKS, MINNESOTA

	Overall Protection of Human Health and the Environment	*Compliance with ARARs*	*Long-Term Effectiveness and Permanence*	*Reduction of Toxicity, Mobility, or Volume Through Treatment*	*Short-Term Effectiveness*	*Implementability*	*Cost Effectiveness*
Alternative A1 - No Further Action	Protective of human health, as under MPCA Scenario A, no HRLs are exceeded. Environmental protection not applicable due to lack of receptors. Status would not be evaluated, because monitoring is not provided.	Not compliant with chemical-specific ARARs because monitoring is not provided. No location or action-specific ARARs are associated with this alternative.	Long-term effectiveness is not attained, because monitoring is not provided.	No reduction of TMV through active treatment, because no further action would be taken. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would not be evaluated, because monitoring is not provided.	There would be no short-term impacts because no further action would be taken.	Does not apply to this alternative, because no further action would be taken.	Present Worth - $0
Alternative A2 - Long-Term Monitoring	Protective of human health, as under MPCA Scenario A, no HRLs are exceeded. Environmental protection not applicable due to lack of receptors. Status would be evaluated through monitoring.	Compliant with chemical-specific ARARs, as under MPCA Scenario A, no HRLs are exceeded. Compliant with action-specific ARARs for installation of monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative.	Long-term effectiveness would be evaluated through monitoring.	No reduction of TMV through active treatment. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would be evaluated through monitoring.	Minimal impact incurred to residents and environment during installation of additional monitoring wells. No impact to workers during sampling activities.	Installation of monitoring wells is an established procedure and is readily implemented by licensed well drillers. Monitoring is also an established procedure and is readily implemented. Alternative requires agreements and coordination with NOHOA and property owners.	Present Worth - $680,208
Alternative A3 - Groundwater Extraction and Monitoring	Protective of human health, as under MPCA Scenario A, no HRLs are exceeded. Environmental protection not applicable due to lack of receptors, unless extraction system is constructed in wetlands. Status would be evaluated through monitoring.	Compliant with chemical-specific ARARs, as under MPCA Scenario A, no HRLs are exceeded. Compliant with action-specific ARARs for construction and operation of extraction system, installation of monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative, unless the extraction system in constructed in wetlands.	The objective of this alternative is to prevent migration of groundwater with VOC concentrations above HRLs. Under MPCA Scenario A, no HRLS are exceeded, therefore there is no way to evaluate the effectiveness or permanence of this alternative.	Reduces TMV through treatment by hydraulic extraction and treatment of extracted groundwater. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would be evaluated through monitoring.	Minimal to moderate impact incurred to residents and environment during installation of monitoring wells, extraction wells, and treatment system. Extraction system may change groundwater flow patterns and cause additional well locations to become impacted.	Construction and operation of groundwater extraction systems would take several months to implement due to design, approval and construction times. Infiltration of treated groundwater may be limited by existing subsurface geology. Discharge of treated groundwater to Gilfillan Lake may be difficult because of access. Alternative requires agreements and coordination with NOHOA, the City, and property owners.	Present Worth - $1,087,434 (discharge to infiltration gallery) $1,129,434 (discharge to Gilfillan Lake)

TABLE ES.2

SUMMARY OF COMPARITIVE ANALYSIS OF ALTERNATIVES
MPCA SCENARIO B
NORTH OAKS, MINNESOTA

	Overall Protection of Human Health and the Environment	*Compliance with ARARs*	*Long-Term Effectiveness and Permanence*	*Reduction of Toxicity, Mobility, or Volume Through Treatment*	*Short-Term Effectiveness*	*Implementability*	*Cost Effectiveness*
Alternative B1 - No Further Action	Not protective of human health because no action proposed to address HRL exceedences. Environmental protection not applicable due to lack of receptors. Status would not be evaluated because monitoring is not provided.	Not compliant with chemical-specific ARARs due to HRL exceedences. No location or action-specific ARARs are associated with this alternative.	Long-term effectiveness is not attained because monitoring is not provided and no further action is proposed to address HRL exceedences.	No reduction of TMV through active treatment, because no further action would be taken. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would not be evaluated, because monitoring is not provided.	There would be no short-term impacts because no further action would be taken.	No implementation is required because no further action would be taken.	Present Worth - $0
Alternative B2 - Residential Carbon Filter and Monitoring	Protective of human health as exposure to impacted groundwater is eliminated by provision of carbon filter. Environmental protection not applicable due to lack of receptors. Status would be evaluated through monitoring.	Compliant with chemical-specific ARARs (HRLs) and action-specific ARARs for installation of monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative.	Carbon filters are a proven technology for use as a long-term or permanent remedy. Long-term effectiveness would be evaluated through monitoring.	Reduces TMV through treatment in potable water by provision of carbon filter. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would be evaluated through monitoring.	Minimal impact incurred to residents during installation of carbon filters and additional monitoring wells. No impact to environment or workers during sampling activities.	Installation and maintenance of carbon filters is an established procedure and is readily implemented. This alternative would require agreements with property owners and NOHOA. This alternative also requires long-term coordination with the property owner related to maintenance of the carbon filters.	Present Worth - $748,530 (3 homes) $1,368,192 (33 homes) $2,494,721 (82 homes)
Alternative B3 - New/Deeper Residential Well and Monitoring	Protective of human health as exposure to impacted groundwater is eliminated by provision of a new/deeper well. Environmental protection not applicable due to lack of receptors. Status would be evaluated through monitoring.	Compliant with chemical-specific ARARs (HRLs) and action -specific ARARs for installation of residential wells and monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative.	New/deeper residential wells are a proven technology for use as a permanent remedy. Long-term effectiveness would be evaluated through monitoring.	No reduction of TMV through active treatment. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would be evaluated through monitoring.	Minimal impact incurred to residents during installation of new/deeper residential wells and additional monitoring wells. No impact to environment or workers during sampling activities.	Installation of residential wells and monitoring wells is an established procedure and is readily implemented by licensed well drillers. This alternative would require agreements and coordination with property owners and NOHOA.	Present Worth - $740,575 (3 homes) $1,280,682 (33 homes) $2,277,274 (82 homes)
Alternative B4 - Municipal Water and Monitoring	Protective of human health as exposure to impacted groundwater is eliminated by provision of municipal water. Environmental protection not applicable due to lack of receptors, unless watermains are constructed through wetlands. Status would be evaluated through monitoring.	Compliant with chemical-specific ARARs (HRLs) and action -specific ARARs for watermain construction, installation of monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative, unless watermains are constructed through wetlands.	Provision of municipal water is a proven technology for use as a permanent remedy. Long-term effectiveness would be evaluated through monitoring.	No reduction of TMV through active treatment. Reduces TMV in aquifer over time through natural processes. Reduction of TMV would be evaluated through monitoring.	Moderate impact incurred to residents during installation of municipal water and additional monitoring wells. No impact to environment or workers during sampling activities.	Installation of municipal water is an established procedure, but would take 6 to 12 months to implement due to design, approval, and construction time. This alternative would require agreements and coordination with the City, property owners, and NOHOA.	Present Worth - $1,209,705 (3 homes) $2,021,583 (33 homes) $3,116,757 (82 homes)

1.0 INTRODUCTION

1.1 PURPOSE OF FEASIBILITY STUDY (FS)

This Feasibility Study (FS) provides an evaluation of remedial alternatives for volatile organic compounds (VOCs) in groundwater west of Gilfillan Lake in the southeastern portion of North Oaks, Minnesota.

In the Spring 2007, the Minnesota Pollution Control Agency (MPCA) determined that a FS was needed in order to evaluate potential remedial alternatives west of Gilfillan Lake. MPCA's letter to Reynolds Metals Company (Reynolds) and Whirlpool Corporation (Whirlpool) in June 2007 set forth the scope and schedule of the FS report. Details on the scope are presented in Section 3.6.

The MPCA will use the FS report to develop an amended Minnesota Decision Document (MDD) for the area west of Gilfillan Lake.

1.2 STUDY AREAS

Figures 1.1 and 1.2 present the study areas. Areas 3, 4, and 5, west of Gilfillan Lake, are the areas addressed by this FS. Area 1 represents the Highway 96 Site (Site), which has an ongoing remedy. Area 2 is the greater part of North Oaks, which does not require study or remediation.

2.0 BACKGROUND

2.1 SUMMARY OF HIGHWAY 96 SITE REGULATORY HISTORY

In 1986, a study was conducted at the Site by the United States Environmental Protection Agency (USEPA), which identified groundwater contamination by VOCs. The MPCA subsequently issued a Request for Response Action (RFRA) to three potentially responsible parties (PRPs): Whirlpool, Reynolds and Red Arrow Waste Disposal Services. Conestoga-Rovers and Associates (CRA) was retained by Reynolds and Whirlpool in 1986 to assist with the implementation of the RFRA.

On behalf of Reynolds and Whirlpool, CRA conducted a Remedial Investigation and Feasibility Study (RI/FS). The RI involved a review of the waste disposal history, installation of monitoring wells, excavation of test pits within the waste, and groundwater monitoring in monitoring wells and nearby residential wells. The results of the RI were submitted to the MPCA in March 1988 (Ref. 1).

In response to the confirmation of groundwater contamination at the Site, Whirlpool and Reynolds proposed an Interim Response Action Plan (IRAP) (Ref. 1) involving the removal of drums found during the investigation and the installation of a groundwater extraction system.

In May 1988, the MPCA approved the RI and IRAP.

The FS involved the evaluation of remedial alternatives, which were presented in the Alternatives Analysis Report (Ref. 2), and were submitted to the MPCA in October 1988. The MPCA approved the Alternative Analysis Report in February 1989. Whirlpool and Reynolds continued with the FS by evaluating potential remedial alternatives. A Detailed Analysis Report (DAR) was submitted to the MPCA in April 1989 (Ref. 3). This evaluation included a proposed remedial plan for the Site. The MPCA did not comment on the DAR until June 1992, and approved the DAR with modifications in June 1994.

In 1993, Reynolds and Whirlpool conducted a groundwater investigation in the southeastern portion of North Oaks, Minnesota. The groundwater investigation provided a general definition of the groundwater flow system in the vicinity of the Site and the southeast portion of North Oaks. This investigation also delineated the extent of a remnant VOC plume. The North Oaks Southeast Groundwater Investigation report was submitted to the MPCA in October 1993 (Ref. 4).

In October 1993, the MPCA issued a MDD, which included a drum removal, waste consolidation, landfill cover, groundwater extraction, municipal water east of Gilfillan Lake, and monitoring.

In January 1994, Whirlpool and Reynolds submitted the Phase I Response Action Plan (Ref. 5) to the MPCA. The Phase I Response Action Plan (Phase I RAP) outlined the activities required for the implementation of the final remedy at the Site. The MPCA approved the Phase I RAP, with modifications, by letter, dated March 1, 1994.

In May 1994, Whirlpool and Reynolds submitted the Phase II Response Action Plan (Ref. 6) to the MPCA. The Phase II Response Action Plan (Phase II RAP) provided additional construction details on the Phase I RAP and installation of a dewatering sump and landfill gas probes. The MPCA approved the Phase II RAP, with modifications, by letter, dated October 3, 1994.

2.2 SUMMARY OF HIGHWAY 96 SITE REMEDIATION AND MONITORING PROGRAM

As a parallel activity to the RI/FS, interim remedial actions have been implemented by Whirlpool and Reynolds. These actions have included drum removal, groundwater extraction system installation, North Oaks groundwater investigation, and South Disposal Area (SDA) investigation. The final remedy for the Site is divided into three operable units: Source Control Operable Unit, Residential Water Supply Operable Unit, and Groundwater Operable Unit.

2.2.1 SOURCE CONTROL OPERABLE UNIT

During 1987 and 1988, contractors for the responsible parties removed drums containing hazardous substances from the North Disposal Area (NDA). In 1993, additional drums were removed from the SDA. In 1994, waste from the NDA and SDA were screened using a backhoe to look for any remaining drums. Drums and drum-related waste identified during the screening process were removed and transported off-site for disposal. The contractors also drained the pond located within the NDA. All the pond water was discharged to the sanitary sewer, the sediment and material from the pond bottom were screened, and drums of waste were removed. The drums were disposed at licensed facilities in the fall of 1995.

After screening the NDA and the pond, the contractors transferred all waste material from the SDA to the NDA. Tests of the soils underlying the SDA showed no residual contamination, and the SDA was backfilled with clean soil. The results of the SDA investigation were submitted to MPCA in January 1994 (Ref. 7). All waste material at the NDA, including the waste material transferred from the SDA, was compacted, graded, and capped with two feet (ft.) of clean soil and remains on the property. Because the waste areas were combined, the NDA has been referred to as the Consolidated Waste Area (CWA).

The Source Control Operable Unit remedy was completed in the fall of 1995 and is discussed in further detail in the Remedial Action Final Report (Ref. 8).

2.2.2 RESIDENTIAL WATER SUPPLY OPERABLE UNIT - EAST OF GILFILLAN LAKE

In 1993, the Minnesota Department of Health (MDH) issued drinking water well advisories to 12 homes in North Oaks between the Site and Gilfillan Lake, because vinyl chloride was detected in their wells at levels exceeding the recommended health-based allowable level that existed in 1993. Reynolds and Whirlpool chose to address this off-site contamination by connecting all 60 homes with private wells on the east side of Gilfillan Lake to the White Bear Township municipal water system. These connections were completed in 1994.

2.2.3 GROUNDWATER OPERABLE UNIT

The Groundwater Operable Unit, which began as an interim remedial action, consists of continued operation of the groundwater extraction system at the Highway 96 Site and groundwater monitoring.

2.2.3.1 GROUNDWATER EXTRACTION SYSTEM - HIGHWAY 96 SITE

Groundwater contamination is present beneath the CWA and migrates to the west, in the direction of groundwater flow. Since June 1989, a groundwater extraction system operates at the Site. The extraction system collects groundwater from Lower Sand aquifer and St. Peter Sandstone aquifer, and limits the spread of contamination by

removing contaminants from the groundwater. The contaminated groundwater is discharged to the sanitary sewer for treatment.

In late 1994, after the consolidation of the NDA and SDA, a dewatering sump was installed directly into and under the CWA. The Sump collects leachate and discharges to the sanitary sewer. Leachate is produced when rain and melting snow filter through the waste and dissolve chemicals from the waste. The responsible parties continue to operate the Sump to reduce the potential for degradation of the groundwater in the deeper, drinking-water aquifers.

2.2.3.2 GROUNDWATER MONITORING PROGRAM

Monitoring at the Highway 96 Site

The on-Site groundwater-monitoring network includes 13 monitoring wells and 3 extraction wells screened in the perched groundwater, the unconsolidated glacial drift aquifer (i.e., Lower Sand aquifer), and the St. Peter Sandstone aquifer. The current on-site groundwater monitoring network is shown on Figure 2.1.

Groundwater samples are collected from the three on-Site extraction wells (EW1A, EW2, and the Sump) on a quarterly basis and from monitoring wells on an annual basis. Groundwater samples are collected from the on-Site monitoring wells on an annual basis. Three of the 13 on-Site monitoring wells are designated as compliance wells and are used to evaluate the effectiveness of the groundwater extraction system.

Monitoring in North Oaks - East of Gilfillan Lake

The groundwater-monitoring network east of Gilfillan Lake includes residential wells, former residential wells that have been converted into monitoring wells, and other monitoring wells that have been installed by the responsible parties. The current off-site groundwater monitoring network east of Gilfillan Lake is shown on Figure 2.2.

Twenty residential wells located outside the municipal water service area, east of Gilfillan Lake, have been monitored by Whirlpool/Reynolds and the MPCA on a regular basis since 1993. These residential well locations are currently monitored on a biennial basis (odd numbered years).

There are four former residential wells located east of Gilfillan Lake that are used as monitoring wells. The four converted residential monitoring wells are located at 6 Blue Goose Road, 1 Lily Pond Road, 11 Lily Pond Road, and 11 Robb Farm Road. The four

converted residential monitoring wells remain in place and are monitored on an annual basis.

Nine monitoring wells have been installed east of Gilfillan Lake to monitor groundwater conditions downgradient from the Highway 96 Site in the glacial drift, St. Peter Sandstone, and Prairie du Chien aquifers. Groundwater samples are collected from these monitoring wells on an annual basis. Six of these monitoring wells are also designated as compliance wells and are used to evaluate the effectiveness of the groundwater extraction system.

Monitoring in North Oaks - West of Gilfillan Lake

The groundwater-monitoring network west of Gilfillan Lake includes residential wells and other monitoring wells that have been installed by the responsible parties. The current off-site groundwater monitoring network west of Gilfillan Lake is shown on Figure 2.2.

From 1993 to 2004, Whirlpool/Reynolds and the MPCA monitored 31 residential wells located west of Gilfillan Lake on a regular basis. In 2005, the residential well monitoring network west of Gilfillan Lake was expanded to include an additional 31 residential well locations. The current residential well monitoring network west of Gilfillan Lake includes 62 residential wells.

Six monitoring wells and one test extraction well have been installed west of Gilfillan Lake to monitor groundwater conditions downgradient from the Highway 96 Site in the St. Peter Sandstone and Prairie du Chien aquifers. Two of the six monitoring wells (MW-19B and MW-19L) were installed in 2005 and are sampled on an annual basis. The other four monitoring wells (MW-18A, MW-18B, MW-18L, MW-20B) and the test extraction well (EW-3) were installed in 2006, and will also be sampled on an annual basis.

2.3 SUMMARY OF RECENT GROUNDWATER INVESTIGATIONS AND RESIDENTIAL WELL EVALUATIONS

In October 2004, during routine monitoring of residential wells in North Oaks, low levels of vinyl chloride were detected in water samples collected from two residential well locations (12 West Shore Road and 13 West Shore Road). Subsequent residential well sampling in 2005 of over 70 residential wells located in the southeast portion of North Oaks confirmed that vinyl chloride contamination in North Oaks is limited to

three residential wells (12 West Shore Road, 13 West Shore Road, and 2 Hummingbird Hill) located near the west shore of Gilfillan Lake. Maximum vinyl chloride concentrations detected in residential wells during the period from October 2004 through April 2007 are shown on Figure 2.3. To date, the vinyl chloride concentrations have remained at or below the health risk limit (HRL) for vinyl chloride, as established by the MDH.

In January 2005, the MPCA requested that Reynolds and Whirlpool conduct a six-month residential well study to investigate the nature and extent of vinyl chloride contamination in residential wells located west of Gilfillan Lake. In June 2005, CRA submitted a report to MPCA that presented the results of the six month study and provided recommendations for continued monitoring and permanent solutions (Ref. 9).

In September 2005, the MPCA requested that Reynolds and Whirlpool conduct a series of additional response actions as part of a continued groundwater and residential well evaluation in North Oaks. The primary activities included: ongoing residential well sampling (three rounds), monitoring well installation and sampling, geophysical logging, and upgrading the Highway 96 on-Site extraction system. In February 2006, CRA submitted a report to the MPCA that presented a summary of results from the response actions completed during the period from June 2005 to January 2006 (Ref. 10).

During the period from February 2006 through January 2007, two additional field programs were conducted as part of a continued groundwater and residential well evaluation in North Oaks. A groundwater investigation was conducted at 15 West Shore Road that included vertical aquifer profiling (VAP), monitoring well installation, and groundwater sampling. An extraction system pilot test was conducted in the Ski Lane Ravine that included well installation, aquifer performance testing, and infiltration analysis. In February 2007, CRA submitted a report to the MPCA that presented a summary of results from the response actions completed during the period from February 2006 to January 2007 (Ref. 11).

2.4 NATURE AND EXTENT OF CONTAMINATION - WEST OF GILFILLAN LAKE

2.4.1 CONTAMINANTS OF CONCERN

Extensive testing of 79 residential wells and 7 monitoring wells west of Gilfillan Lake since 2004 has shown:

- vinyl chloride is the principal contaminant of concern;
- vinyl chloride contamination is limited to three residential well locations at concentrations at or below the vinyl chloride HRL; and
- an MDH well advisory was issued to one residential well location (based on additional risk associated with the presence of multiple non-Site related compounds) and;
- as of the submittal date of this FS, no well advisories are currently issued.

Additional Site-related VOCs have been detected and are summarized as follows:

VOCs	*Maximum Detection (µg/L)*	*HRL (µg/L)*
1,1-dichloroethane	0.5	70
cis-1,2-dichloroethene	0.2	70

Detected concentrations of these VOCs are well below their respective HRLs.

It should be noted that periodic detections of other non-Site related VOCs in samples collected from residential wells have occurred. Chloroform, bromoform, and bromodichloromethane have been detected, but the presence of these compounds is likely related to residential well chlorination. Toluene and methyl ethyl ketone have also been detected, and are potential contaminants from residential septic systems.

As discussed in CRA's 2006 report (Ref. 10), periodic detections of coliforms that occur are attributed to residential septic systems.

2.4.2 AREA OF VINYL CHLORIDE CONTAMINATION

Figure 2.4 shows the area of vinyl chloride detections west of Gilfillan Lake as defined by residential and monitoring well sampling. These data show an area of vinyl chloride contamination, which is estimated to be approximately 300 feet wide (north to south), and migrates westward within the St. Peter Sandstone aquifer.

2.4.3 DEPTH OF VINYL CHLORIDE CONTAMINATION

Based on residential well, monitoring well, and VAP testing, vinyl chloride is only detected in the St. Peter Sandstone aquifer. Vinyl chloride is not detected in the glacial drift aquifer, which lies above the St. Peter Sandstone aquifer. Vinyl chloride is also not detected in the Prairie du Chien aquifer, which lies below the St. Peter Sandstone aquifer. Vinyl chloride concentrations observed in the glacial drift, St. Peter Sandstone and Prairie du Chien aquifers are shown on Figures 2.5, 2.6, and 2.7, respectively. As shown, all results for the glacial drift and Prairie du Chien aquifers are "not detected" (ND).

West of Gilfillan Lake, vinyl chloride has only been detected in the St. Peter Sandstone aquifer, which is found approximately 100 to 200 feet below the ground surface (bgs), or 820 to 720 ft above mean sea level (AMSL). The basis for determining that the vinyl chloride is limited to the St. Peter Sandstone aquifer is from monitoring data for three residential wells. Vinyl chloride is known to be in the St. Peter Sandstone aquifer at 12 West Shore Road because the well log shows that the well was installed into the St. Peter Sandstone aquifer. Well logs are not available for 13 West Shore Road and 2 Hummingbird Hill. As such, the depth of the wells are unknown. CRA has requested access from these two homeowners to geophysically log the well and measure well depth. At this time, the wells at 13 West Shore Road and 2 Hummingbird Hill are both believed to be installed into the St. Peter Sandstone aquifer because of a former North Oaks ordinance, which required residential wells to be installed to a minimum depth of 150 ft bgs. In addition, the iron concentrations at 2 Hummingbird Hill (5 mg/L) are indicative of a St. Peter Sandstone well. The average iron concentration in St. Peter Sandstone aquifer wells located west of Gilfillan Lake is 5 mg/L.

For remediation purposes, it is important to understand the layers within the St. Peter aquifer. The St. Peter Sandstone aquifer consists of an upper portion and a basal portion. A shale layer separates the upper and basal units, except in areas where the shale layer may have been eroded beneath Gilfillan Lake. Most residential wells were installed into the basal portion of the St. Peter Sandstone aquifer. However, based on common well construction practices, no seal was required between the upper and basal portions of the St. Peter Sandstone aquifer. Hence, downward leakage may be occurring from the upper St. Peter Sandstone to the basal St. Peter Sandstone at some residential wells. As such, a vinyl chloride detection in a residential well installed in the basal St. Peter Sandstone aquifer may be the result of leakage from the upper St. Peter Sandstone aquifer.

It is also possible that the well at 2 Hummingbird Hill is installed in the upper St. Peter Sandstone aquifer because the ground elevation at 2 Hummingbird Hill is much higher than most other properties (approximately 960 ft AMSL). If the well at 2 Hummingbird Hill is between 150 and 200 feet deep (typical range of residential well depths in the area), then it would be screened above the shale layer, which is encountered approximately 760 ft AMSL.

Based on aquifer testing of the upper and basal portions of the St. Peter Sandstone aquifer, CRA has determined that groundwater migrates at approximately 80 ft./yr. in the upper portion and at rates less than 10 ft./yr. in the basal portion because of the increased shale content in the basal unit. This means that migration of VOCs is more likely to occur within the upper St. Peter Sandstone aquifer.

Given the above, CRA has prepared this FS based on the possibility that vinyl chloride in the St. Peter Sandstone aquifer could be in the upper St. Peter Sandstone aquifer, the basal St. Peter Sandstone aquifer, or both portions of the St. Peter Sandstone aquifer. Hence, the groundwater extraction alternative (A3) includes extraction from both portions of the St. Peter Sandstone aquifer. Also, new monitoring wells in the upper St. Peter Sandstone have been included in the long-term monitoring program that is common to all alternatives.

3.0 COMPONENTS OF THE FEASIBILITY STUDY

3.1 PROCESS FOR REMEDY SELECTION

MPCA guidance requires that the FS evaluate potential remedial alternatives using an established protocol and a defined list of evaluation criteria.

The FS report will be used by the MPCA to develop a Proposed Plan that will be presented to the public. A public meeting will be held within a 30 day public comment period. The MPCA will then consider and provide responses to comments as part of the remedy selection process. After the comment period, the MPCA will prepare an amended MDD. The selected remedy will then be incorporated into the existing Highway 96 remedial program.

3.2 REMEDIAL OBJECTIVES

This section identifies the remedial action objectives, which were established based on the protection of human health and the environment as follows:

- Protect human health from exposure to groundwater above the HRLs; and
- Protect residential wells from further migration of groundwater above the HRLs.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs represent standards, requirements, and criteria limitations under Federal, State, or local regulations that may govern Site remediation. The more stringent of State or Federal regulations must be met. ARARs are identified during the FS to aid in the preparation of a list of remedial alternatives, the evaluation of remedial alternatives under an FS, and, ultimately, the selection of a remedy.

3.3.1 ARAR CATEGORIES

A review of potential ARARs was conducted as part of this FS. Table 3.1 provides a summary of the potential ARARs. The ARARs are categorized as either chemical-specific, location-specific, or action-specific as described below:

Chemical-Specific

Chemical-specific requirements define acceptable exposure levels for specific hazardous substances and, therefore, may be used as basis for establishing preliminary remediation goals and cleanup levels for chemicals of concern in the designated media. Chemical-specific ARARs are also used to determine treatment and disposal requirements that may occur in a remedial activity. In the event a chemical has more than one requirement, the more stringent requirement will govern.

Location-Specific

Location-specific requirements set restrictions on the types of remedial activities that can be performed based on site-specific characteristics or location. Alternative remedial actions may be restricted or precluded based on Federal, State, or local zoning laws for hazardous waste facilities, proximity to wetlands or floodplains, or to man-made features such as existing landfills, disposal areas, and local historic landmarks or buildings.

Action-Specific

Action-specific requirements set controls or restrictions on the design, implementation, and performance of waste management actions. They are triggered by the particular types of treatment or remedial actions that are selected to accomplish the cleanup. After remedial alternatives are developed, action-specific ARARs that specify performance levels, as well as specific levels for discharges or residual chemicals, provide a basis for assessing the feasibility and effectiveness of the remedial actions.

3.4 STATUS OF HEALTH RISK LIMITS

The MDH is currently reviewing a list of chemicals, including vinyl chloride, for possible inclusion in the 2007 draft HRL rule revision. For the purposes of this FS, the current HRLs apply. The current HRL for vinyl chloride is 0.2 µg/L.

3.5 GUIDANCE DOCUMENTS FOR EVALUATION AND REMEDIATION OF VOCs IN GROUNDWATER

The presence of VOCs in groundwater at residential wells occurs frequently throughout Minnesota and the United States. The USEPA and the MPCA have developed guidance documents that establish protocols for evaluation and remediation. The following guidance documents were consulted during the preparation of this FS:

- USEPA, 1988a - Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA; EPA/540/G-89/004.
- USEPA, 1996 - Presumptive Response Strategy and Ex-situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance; EPA/540/R-96/023.
- MPCA Guidance on Sampling.
- USEPA, 1988b - Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites; EPA/540/G-88/003.
- USEPA, 1988c - Guidance Document for Providing Alternate Water Supplies; EPA/540/G-87/006.
- USEPA, 2000 - A Guide to Developing and Documenting Cost Estimates During the Feasibility Study; EPA/540/R-00/002.
- National Contingency Plan 40 CFR 300.
- USEPA, 1999 - Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents; EPA/540/R-98/031.

3.6 IDENTIFICATION OF POTENTIAL ALTERNATIVES

In April 2007, the MPCA proposed a list of alternatives to be evaluated under the FS and invited comments from the City of North Oaks. The City provided comments to the MPCA in May 2007. In a letter dated June 7, 2007, the MPCA formally requested that Whirlpool and Reynolds complete a FS to evaluate potential response actions under two potential scenarios related to contaminated groundwater on the west side of Gilfillan Lake.

The following provides the remedial alternatives to be evaluated by the FS. Each of these alternatives is discussed in detail within Sections 4.0 and 5.0.

Section 4.0 will evaluate alternatives for MPCA Scenario A. These alternatives are:

- ***Alternative A1*** - No Further Action;
- ***Alternative A2*** - Long-term Monitoring; and
- ***Alternative A3*** - Groundwater Extraction and Monitoring.

Section 5.0 will evaluate alternatives for MPCA Scenario B. These alternatives are:

- ***Alternative B1*** - No Further Action;
- ***Alternative B2*** - Residential Carbon Filter and Monitoring;
- ***Alternative B3*** - New/Deeper Residential Well and Monitoring;
- ***Alternative B4*** - Municipal Water and Monitoring;

3.7 EVALUATION CRITERIA

The following evaluation criteria are required by the MPCA and come from USEPA guidance (EPA, 1988a). The first two criteria are known as threshold criteria, because they must be met. These are:

- ***Overall Protection of Human Health and the Environment*** - considers whether the remedial alternative adequately protects human health and the environment posed by the contaminants present at the Site and in preventing future releases. This may be accomplished by either eliminating, reducing, or controlling exposures to levels of these substances established during development of remediation goals. This criterion draws on assessments of other evaluation criteria, notably risks remaining after implementation, long-term effectiveness, and permanence. This criterion is the primary objective of the remediation program.
- ***Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)*** - assures that each alternative is assessed to determine its compliance with the applicable or relevant and appropriate requirements of Federal, State, and local laws and regulations. ARARs are either location-specific, action-specific, or chemical-specific.

The remaining criteria are known as balancing criteria and are used to compare the merits of one alternative against another. These criteria are:

- ***Long-Term Effectiveness and Permanence*** - addresses the anticipated results of the remedial alternative in terms of the risk remaining at the Site once the remedial objectives have been met. The focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk associated with the treatment residuals and/or untreated wastes. This criterion also assesses the degree of certainty that the alternative will prove successful.
- ***Reduction of Toxicity, Mobility, or Volume (TMV) Through Treatment*** - addresses the statutory preference for selecting remedial actions, which implement treatment technologies that permanently and significantly reduce the TMV of the hazardous

contaminants. This preference is satisfied when treatment is implemented to reduce principal threats at a site through destruction of hazardous compounds, reduction in the total mass of the contaminant, irreversible reduction in contaminant mobility, or reduction in the total volume of contaminated media.

- ***Short-Term Effectiveness*** - addresses the short-term impacts posed by the remedial alternatives during construction and implementation of the remedial action and until remedial objectives are achieved. Such impacts include impacts to the surrounding community during implementation, impacts to Site workers during implementation of the remedial action, and potential adverse environmental impacts that may result from the construction and implementation of the remedial action. Another factor considered under this criterion is the length of time until the remedial objectives are achieved.
- ***Implementability*** - addresses the technical and administrative feasibility of implementing the proposed remedial alternatives and the availability of various services and materials required during its implementation.
- ***Cost Effectiveness*** - identifies the capital costs of construction, including engineering fees and contingencies, and annual O&M costs associated with each remedial alternative. Total present worth of these costs is also determined. An alternative must be considered cost-effective to be eligible for selection. A discount rate of 7% for annual costs is used pursuant to EPA Guidance (EPA, 2000).
- ***Community Acceptance*** - assesses the degree of acceptance or opposition interested persons in the community have regarding the proposed remedy. Following the FS, the MPCA will draft a Proposed Remedial Plan and allow for a minimum 30-day public comment period. For this site, the MPCA has also elected to hold a public meeting during the 30-day comment period to discuss the Proposed Plan. The MPCA will consider all public comments and will prepare a responsiveness summary to the questions and comments received during the 30-day public comment period. Because the Community Acceptance criteria is evaluated following submittal of the FS, this criterion will not be evaluated in the FS.
- ***State Acceptance*** - is a determination of the acceptability a remedial alternative will have by achieving remedial goals within the framework of State laws, rules, and regulations. This criterion is addressed once comments on the FS report are completed. As such, this criterion will not be evaluated in the FS.

4.0 EVALUATION OF ALTERNATIVES - MPCA SCENARIO A

The following section provides an evaluation and comparison of potential alternatives listed under MPCA Scenario A:

> "*Where the concentrations of vinyl chloride and other Site-related Volatile Organic Compounds (VOCs) in water samples from residential wells west of Gilfillan Lake (singly or through additivity) remain at or below the Minnesota Department of Health (MDH) Health Risk Limits (HRLs)*"

4.1 ALTERNATIVE A1 - NO FURTHER ACTION

4.1.1 DESCRIPTION

Evaluation of Alternative A1 is a requirement of the FS process and would involve no further remediation or monitoring in North Oaks. Under Alternative A1, the remedy and monitoring program at the landfill would continue and monitoring of residential and monitoring wells in North Oaks would be discontinued.

4.1.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative A1 is, by definition, protective of human health because it represents a scenario where no HRLs are exceeded. However, monitoring would not be conducted to demonstrate that levels are below HRLs.

Environmental protection is not applicable, because there are no environmental receptors.

4.1.3 COMPLIANCE WITH ARARs

A chemical-specific ARAR requires compliance with HRLs, which has monitoring as a minimum requirement. Monitoring is not included in this alternative. Hence, it would not comply with ARARs.

There are no location- or action-specific ARARs associated with Alternative A1.

4.1.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Monitoring is a minimum requirement to evaluate long-term effectiveness and permanence. As such, Alternative A1 would not meet this criterion.

4.1.5 REDUCTION OF TMV THROUGH TREATMENT

Alternative A1 would have some reduction of TMV through natural attenuation processes. However, its effectiveness would not be measured or evaluated. As such, Alternative A1 does not meet this criterion.

4.1.6 SHORT-TERM EFFECTIVENESS

There would be no short-term impact under Alternative A1, because no further action would be taken.

4.1.7 IMPLEMENTABILITY

This criterion does not apply to Alternative A1, because no further action would be taken.

4.1.8 COST EFFECTIVENESS

There is no cost associated with Alternative A1.

4.2 ALTERNATIVE A2 - LONG-TERM MONITORING

4.2.1 DESCRIPTION

Monitoring at residential wells involves the collection of a water sample from a household tap or outside spigot. The water is purged for a minimum of 15 minutes to ensure that a representative groundwater sample is collected. Samples are collected by trained personnel using standard protocols approved by the MPCA. Water samples are

analyzed for VOCs using MDH approved, low-level analyses (i.e., MDH Methods 460 and 468).

Laboratory results are provided to the homeowner along with a letter, which compares the results to HRLs.

Sampling from monitoring wells involves the use of a pre-cleaned sampling pump to collect the sample. Again, MPCA-approved protocols are followed. VOCs are analyzed by MDH Methods 460/468 in residential areas and by EPA Method 8260 at the landfill.

Alternative A2 would involve the following sampling program, which is illustrated on Figure 4.1:

- Semi-Annual Sampling of 33 residential wells located in Area 3 - west of Gilfillan Lake;
- Annual sampling of 20 residential wells located in Area 4 - north and west of Gilfillan Lake and 14 residential wells located in Area 5 - west of Gilfillan Lake (residential wells located along the shoreline of Gilfillan Lake, including wells along West Shore Road and Duck Pass Road);
- Biennial sampling of 11 residential wells located in Area 4 - east and west of Gilfillan Lake and 4 residential wells located in Area 5 - west of Gilfillan Lake; and
- Annual sampling of the 9 off-Site monitoring wells and 4 converted residential monitoring wells located in North Oaks.

In addition, four new upper St. Peter Sandstone aquifer monitoring wells would be installed west of Gilfillan Lake as part of an expanded monitoring program. The proposed new monitoring well locations are shown on Figure 4.1.

Two new upper St. Peter Sandstone aquifer monitoring wells would be installed in the Ski Lane Ravine. These wells will monitor water quality downgradient of VOC impacted groundwater and will be used to evaluate potential future migration.

A major topic discussed over the past two years has been groundwater quality beneath Gilfillan Lake. Options of drilling on ice during winter or on a barge in the summer were evaluated for installation of monitoring wells beneath the Lake, but were determined to be impractical.

CRA has consulted a well driller that can install monitoring wells beneath Gilfillan Lake by drilling an angle borehole from the west shore of the Lake. Based on the technology, a well screened in the upper St. Peter Sandstone aquifer could be installed approximately 200 feet east of the west shoreline. Based on a groundwater migration rate of 80 feet/year, monitoring data from these wells would establish a sentry system and provide an indication of VOC concentrations under the lake approximately two years prior to the same groundwater arriving at any west shore residential wells. Therefore, two angle monitoring wells installed into the upper St. Peter Sandstone aquifer have been incorporated into the FS alternatives.

For this FS, a monitoring period of 20 years is assumed. The scope and frequency of monitoring would be periodically reviewed and adjusted. MPCA will determine when the scope of monitoring can be modified. Monitoring will be conducted until the MPCA determines that it is no longer required.

4.2.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative A2 is, by definition, protective of human health because no HRLs would be exceeded. Status would be evaluated through monitoring.

Environmental protection is not applicable because there are no environmental receptors.

4.2.3 COMPLIANCE WITH ARARs

Alternative A2 would be compliant with chemical-specific ARARs (HRLs). The principal contaminant of concern, vinyl chloride, would be analyzed using MDH Methods 460 and 468, with a method detection limit of 0.1 μg/L which is one-half of the HRL (0.2 μg/L). Alternative A2 would also be compliant with action-specific ARARs for installation of monitoring wells, sampling, and analysis. There are no location-specific ARARs associated with this alternative.

4.2.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

The scope, frequency, and duration of monitoring is approved by the MPCA based upon review of historical data, contaminant migration, and the rate of groundwater

movement. Monitoring provides an effective tool and could be used for as long as MPCA requires monitoring to evaluate groundwater.

4.2.5 REDUCTION OF TMV THROUGH TREATMENT

No active treatment is associated with Alternative A2. Alternative A2 may provide reduction in TMV by natural attenuation, which would be measured and evaluated through monitoring.

4.2.6 SHORT-TERM EFFECTIVENESS

Alternative A2 would not pose increased risk to the community. The installation of additional monitoring wells may cause short-term disruption to residents, which are located in close proximity to the well installation activities. There is essentially no risk to workers while sampling the wells because the VOC concentrations would be below HRLs. Environmental impacts resulting from installation of additional monitoring wells or sampling activities would also be minimal.

4.2.7 IMPLEMENTABILITY

Installation of monitoring wells is an established procedure and is readily implemented by licensed well drillers. Monitoring is also an established procedure and is readily implemented. Alternative A2 requires an access agreements and coordination with NOHOA and property owners.

4.2.8 COST EFFECTIVENESS

The total present worth of Alternative A2 is estimated at $680,208.

A summary of cost estimates associated with MPCA Scenario A is provided in Table 4.1. A detailed cost estimate for Alternative A2 is presented on Table 4.2.

4.3 ALTERNATIVE A3 - GROUNDWATER EXTRACTION AND MONITORING

4.3.1 DESCRIPTION

Alternative A3 would involve the installation of a groundwater extraction system within the Ski Lane Ravine area. This alternative would also include the same groundwater monitoring program presented under Alternative A2. The groundwater extraction system would capture and remove groundwater from both the upper and basal portions of the St. Peter Sandstone aquifer. Captured groundwater would be treated by aeration and discharged to an infiltration basin also located in Ski Lane Ravine area. Alternately, treated discharge water could be discharged directly to Gilfillan Lake. The groundwater extraction system would be operated until the MPCA determines it is no longer needed (assumed period of 20 years for FS). MPCA will determine when operation of the groundwater extraction system can be discontinued.

Under MPCA's Scenario A, the purpose of a groundwater extraction system would be to capture VOCs and prevent further westward migration. Presently, there are three residential wells in Area 3 with vinyl chloride concentrations at or below the vinyl chloride HRL (see Figure 2.2). As described in Section 2.4.2, the extent of vinyl chloride contamination is estimated to be 300 feet wide (north-south) based on sampling data from residential wells west of Gilfillan Lake. The Ski Lane Ravine is located hydraulically downgradient of the three locations with vinyl chloride detections.

Locations, other than the Ski Lane Ravine, were considered for placement of a groundwater extraction system (e.g., along the western shoreline of Gilfillan Lake). However, none of the other locations would prevent the westward migration of VOCs present in Area 3 west of Gilfillan Lake. In addition, an extraction, treatment, and discharge system requires an area of approximately one acre. Hence, the lack of space on private property would prevent the installation of an extraction system on residential properties.

Under Alternative A3, two extraction wells would be used to capture groundwater from the upper and basal St. Peter Sandstone aquifer. As described in Section 2.4.3, the reason for two extraction wells is to capture groundwater from both portions of the St. Peter Sandstone aquifer. The proposed St. Peter Sandstone aquifer extraction well locations are shown on Figure 4.2.

The two extraction wells would pump at a combined rate between 20 and 40 gpm. The basal St. Peter Sandstone aquifer extraction well (EW-3) would pump at a rate of

10 gpm, as determined from the EW-3 pumping test (Ref. 11). The upper St. Peter Sandstone aquifer extraction well (EW-4) would pump at a rate between 10 and 30 gpm based on CRA's experience with a similar pumping system at the Highway 96 Site. The actual upper St. Peter Sandstone aquifer pumping rate would be determined based on an aquifer pumping test. Extraction rate design calculations are provided in Appendix A.

At 10 gpm, EW-3 would create a maximum capture width of 2,400 feet in the basal St. Peter Sandstone aquifer, which occurs because of its low aquifer transmissivity. For the upper St. Peter Sandstone aquifer, which has a higher aquifer transmissivity, the objective would be to create a maximum 1,000 foot wide capture width in Area 3 along the western shore of Gilfillan Lake. A 1,000-foot capture width is three times greater than the suspected plume width in Area 3 west of Gilfillan Lake. Figure 4.3 presents the estimated capture widths for EW-3 and EW-4.

The groundwater extraction system is designed to take advantage of the natural westward flow direction by placing the extraction wells directly downgradient of the vinyl chloride plume. By placing the extraction wells in this area, changes to the groundwater flowpath are minimized and the potential to redirect impacted groundwater to currently unaffected areas is reduced. However, operation of an extraction system alters the groundwater flowpaths near the extraction well in order for the remedy to be effective. The potential groundwater flow paths associated with operation of the groundwater extraction system in the Ski Lane Ravine are shown on Figure 4.4. It is possible that one or two residential wells upgradient and near the extraction wells may become contaminated due to operation of the groundwater extraction system in the Ski Lane Ravine.

The extracted groundwater would be conveyed from the extraction wells to a manhole. Extracted groundwater would be treated by aeration in the manhole for VOC removal. The groundwater would go through a diffuser to aerate the groundwater and remove VOCs. A small blower (100 cfm) would be used to promote air exchange within the manhole. The off-gas air would be vented to atmosphere by a stack connected to the pumphouse. The treated groundwater would then be gravity-fed to an infiltration basin located in the Ski Lane Ravine. The infiltration basin would allow the treated groundwater to naturally infiltrate back into the soil. Discharge of the treated groundwater would be performed under a State Disposal System (SDS) Permit.

The proposed infiltration basin location is shown on Figure 4.2. The initial design of the infiltration basin was presented in the CRA's February 2007 Groundwater Evaluation

Report (Ref. 11). The actual location and dimensions of the infiltration basin would be addressed as part of pre-design studies. A wetland delineation of Ski Lane Ravine will need to be conducted, because it has been tentatively identified as a freshwater emergent wetland by the National Wetlands Inventory. The wetland delineation study would identify the existence and extent of the wetland.

In the event that discharge to an infiltration basin is not feasible, then the extracted groundwater would be conveyed by a pipeline to Gilfillan Lake under a National Pollutant Discharge Elimination System (NPDES) permit. The proposed discharge line is shown on Figure 4.5. Based on information provided to CRA by the City of North Oaks, this work would require individual access agreements from each property owner along the discharge route.

CRA evaluated the potential effect of the vinyl chloride off-gas to the atmosphere caused by aerating the extracted groundwater. The USEPA model Screen3 was used to determine atmospheric concentrations for vinyl chloride. The modeled results were compared to the State Health Risk Values (HRVs) for vinyl chloride, which show that vinyl chloride concentrations in air will be below the chronic HRV for vinyl chloride. A technical memorandum that provides detail of the air modeling evaluation is provided in Appendix B.

4.3.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative A3 is, by definition, protective of human health because it represents a scenario where no HRLs are exceeded. Status would be evaluated through monitoring.

Environmental protection is not applicable because there are no environmental receptors, unless the extraction system is constructed in a wetland.

4.3.3 COMPLIANCE WITH ARARs

Alternative A3, by definition, would meet chemical specific ARARs because HRLs would be met.

Alternative A3 would be compliant with action-specific ARARs for construction and operation of the groundwater extraction system, installation of additional monitoring wells, sampling and analysis.

There are no location-specific ARARs associated with Alternative A3, with the possible exception of wetland delineation in the Ski Lane Ravine.

4.3.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

The objective of Alternative A3 is to prevent migration of groundwater with VOC concentrations above HRLs. Under MPCA Scenario A, no HRLs are exceeded, therefore there is no way to measure the effectiveness or permanence of Alternative A3.

4.3.5 REDUCTION OF TMV THROUGH TREATMENT

Alternative A3 reduces VOC contamination by natural processes as well as by hydraulic containment and treatment of extracted groundwater. Reduction of TMV would be evaluated through monitoring.

4.3.6 SHORT-TERM EFFECTIVENESS

The construction of a groundwater extraction system would cause short-term disruption (e.g., noise and dust) to residents near the ravine for a period of several months. In addition, the groundwater extraction system may cause one or two residential wells to become impacted in Area 3 west of Gilfillan Lake, because of slight changes in groundwater flow patterns.

Residents have raised a concern over the possibility that the groundwater extraction system could cause additional well locations to be impacted by vinyl chloride or other Site-related VOCs, because of changes in groundwater flow patterns. The impact of the groundwater extraction system on surrounding residential wells would be monitored through the long-term sampling program. In the event that additional wells are impacted with Site-related VOC concentrations above their respective HRLs, the remedy selected under MPCA Scenario B (e.g., carbon filter, new wells, or municipal water) would be available.

4.3.7 IMPLEMENTABILITY

Implementation of a groundwater extraction system in the Ski Lane Ravine would use the extraction wells similar to those at the Highway 96 Site. Implementation would require an access agreement with North Oaks Homeowners Association (NOHOA) and approvals from the City of North Oaks, and the MPCA. If an infiltration system is used for treated water, field testing and monitoring would be required to ensure performance. Infiltration of treated groundwater may be limited by existing subsurface geology. Alternatively, if discharge of treated water to Gilfillan Lake is sought, individual access agreements would be needed with every homeowner along the proposed discharge route.

4.3.8 COST EFFECTIVENESS

The total present worth of Alternative A3 has been estimated based on two different discharge alternatives:

Alternative A3a (groundwater extraction - discharge to infiltration gallery) - $1,087,434

Alternative A3b (groundwater extraction - discharge to Gilfillan Lake) - $1,129,434

A summary of cost estimates associated with MPCA Scenario A is provided in Table 4.1. Detailed cost estimates for the two scenarios under Alternative A3 are presented in Table 4.3a and Table 4.3b, respectively.

4.4 COMPARATIVE ANALYSIS OF ALTERNATIVES - MPCA SCENARIO A

A summary of the comparative analysis of each potential alternative under MPCA Scenario A is provided in Table 4.4.

4.4.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

All of the alternatives under MPCA Scenario A categorically provide protection of human health because, by definition, Alternative A1, A2, and A3 represent a scenario where no HRLs are exceeded.

4.4.2 COMPLIANCE WITH ARARs

Alternative A1 does not comply with ARARs because monitoring is not provided. Alternatives A2 and A3 comply with ARARs.

4.4.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Effectiveness of Alternative A1 can not be demonstrated because monitoring is not provided. Effectiveness of Alternatives A2 and A3 would be demonstrated through monitoring.

4.4.4 REDUCTION OF TMV THROUGH TREATMENT

Alternative A3 is the only alternative under MPCA Scenario A that would provide active treatment. All three alternatives would provide reduction of TMV through natural processes.

4.4.5 SHORT-TERM EFFECTIVENESS

Alternatives A1 and A2 present essentially no short-term impacts. However, Alternative A3 may cause VOC detections in one or two residential wells due to minor changes in groundwater flow patterns.

4.4.6 IMPLEMENTABILITY

Under MPCA Scenario A, Alternative A1 requires no implementation, Alternative A2 could be readily implemented, and Alternative A3 would be the most difficult to implement.

4.4.7 COST EFFECTIVENESS

Alternative A1 requires no additional costs to implement. Of the remaining alternatives under MPCA Scenario A, Alternative A2 would be the least expensive followed by Alternative A3.

5.0 EVALUATION OF ALTERNATIVES - MPCA SCENARIO B

The following section provides an evaluation and comparison of potential alternatives listed under MPCA Scenario B:

> "*Where the concentrations of vinyl chloride and/or other Site-related VOCs in water samples from residential wells west of Gilfillan Lake (singly or through additivity) exceed the MDH HRLs, and a well advisory is issued by the MDH*"

The alternatives under Scenario B include separate cost evaluations based on provision of residential carbon filters, new/deeper residential wells, or municipal water to 3 homes (the 3 locations where vinyl chloride has been detected in Area 3, west of Gilfillan Lake), 33 homes (all locations in Area 3, west of Gilfillan Lake) and 82 homes (all locations in Areas 3, 4, and 5 currently included in the study area).

5.1 ALTERNATIVE B1 - NO FURTHER ACTION

5.1.1 DESCRIPTION

Evaluation of Alternative B1 is a requirement of the FS process and would involve no further remediation or monitoring in North Oaks. Under Alternative B1, the remedy and monitoring program at the landfill would continue and monitoring of residential and monitoring wells in North Oaks would be discontinued.

5.1.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative B1 would not be protective of human health, because monitoring is not provided and no action is proposed to address HRL exceedences. Status would not be evaluated because monitoring is not provided.

Environmental protection would not apply because there are no environmental receptors.

5.1.3 COMPLIANCE WITH ARARs

Alternative B1 would not comply with chemical-specific ARARs because, under MPCA Scenario B, a HRL would be exceeded. There are no location or action-specific ARARs associated with this alternative.

5.1.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative B1 would not provide long-term effectiveness and would not provide a permanent remedy because no further action would be taken and no monitoring would be provided.

5.1.5 REDUCTION OF TMV THROUGH TREATMENT

Alternative B1 would have some reduction of TMV through natural attenuation processes. However, its effectiveness would not be measured or evaluated. As such, Alternative B1 does not meet this criterion.

5.1.6 SHORT-TERM EFFECTIVENESS

There would be no short-term impact associated with Alternative B1, because no further action would be taken.

5.1.7 IMPLEMENTABILITY

This criterion does not apply to Alternative B1, because no further action would be taken.

5.1.8 COST EFFECTIVENESS

There is no cost associated with Alternative B1.

5.2 ALTERNATIVE B2 - RESIDENTIAL CARBON FILTER AND MONITORING

5.2.1 DESCRIPTION

The installation of a residential carbon filter is a common technology used to eliminate exposure to groundwater contamination and can be used as an interim or permanent remedy for remediation of VOCs at residential wells. Carbon filters are effective at removing most VOCs, including vinyl chloride. The MPCA currently uses carbon filters to remediate vinyl chloride in residential wells at two other sites in Minnesota.

Installation of a residential carbon filter would include placement of two carbon filters (in series). Based on typical iron concentrations of 5 mg/L observed in most residential wells in the area, an iron removal system would be installed prior to the carbon filter system. Figure 5.1 illustrates a typical residential carbon filter system set-up. Groundwater from the well would flow through the pressure tank, the iron removal system and then through the carbon units. Treated water would then be distributed through the existing household piping. The primary carbon unit would provide treatment until its adsorption capacity is reached, resulting in breakthrough to the secondary carbon unit. The secondary carbon unit would provide back-up treatment to the primary unit until the primary unit is changed out. When change-out occurs, the secondary unit would become the primary unit and a regenerated (fresh) secondary carbon unit would be installed.

Based on influent groundwater concentrations, carbon vendors have calculated that carbon filter change-out would be required approximately every two years. During the first five years of operation, confirmatory sampling would be conducted pre-treatment, between the carbon units, and post-treatment on a semi-annual basis, in order to determine an appropriate change-out frequency. Following the first five years of operation and determination of an appropriate change-out frequency, sampling would be conducted on an annual basis. Operation of the carbon filter system would be conducted for an assumed period of 20 years. MPCA will determine when operation of the carbon filter systems can be discontinued.

Alternative B2 would also include the same long-term groundwater monitoring program presented under Alternative A2. However, the number of residential wells in the monitoring program would decrease with each corresponding carbon filter system that would be installed.

5.2.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative B2 would provide protection of human health, because the carbon filters would provide potable water below HRLs. Status would be evaluated through monitoring.

Environmental protection is not applicable, because there are no environmental receptors.

5.2.3 COMPLIANCE WITH ARARs

Alternative B2 would be compliant with chemical-specific ARARs (HRLs) and action-specific ARARs for installation of additional monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative.

5.2.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative B2 is a proven technology for treating water for potable use and could be used as a long-term or permanent remedy. For example, the Baytown site located east of St. Paul, has approximately 160 residential carbon filter systems in operation for treatment of trichloroethene (TCE) in groundwater. Long-term effectiveness would be evaluated through monitoring.

5.2.5 REDUCTION OF TMV THROUGH TREATMENT

Alternative B2 would reduce the TMV through treatment in potable water used at the residence. TMV of VOCs in groundwater would be reduced via natural processes. Reduction of TMV would be evaluated through monitoring.

5.2.6 SHORT-TERM EFFECTIVENESS

There would be no short term impact to the community related to the construction of Alternative B2. The impact incurred to the residents would be minimal during installation of carbon filters and additional monitoring wells. For example, impacts associated with installation of a carbon filter would be similar to impacts associated with

installation of a residential water softener or iron filtration system. There would be no impact to the environment or the workers during installation or sampling activities.

5.2.7 IMPLEMENTABILITY

Alternative B2 is readily available and would be maintained using standard procedures. Alternative B2 would require an agreement and long-term coordination with each homeowner.

The use of carbon filtration has a distinct disadvantage in that it requires long-term involvement between the homeowner, the MPCA, the MDH and Whirlpool/Reynolds contractor is related to ongoing maintenance of the treatment system, sampling, and data reporting.

5.2.8 COST EFFECTIVENESS

The total present worth of Alternative B2 has been estimated based on three different connection alternatives:

Alternative B2a (installation and maintenance of carbon filters to 3 homes) - $748,530

Alternative B2b (installation and maintenance of carbon filters to 33 homes) - $1,368,192

Alternative B2c (installation and maintenance of carbon filters to 82 homes) - $2,494,721

A summary of cost estimates associated with MPCA Scenario B is provided in Table 5.1. A detailed cost estimate for each of the three scenarios under Alternative B2 is presented in Table 5.2a, 5.2b, and 5.2c, respectively. The cost estimates reflect lower monitoring costs when the number of carbon filtration units is increased.

5.3 ALTERNATIVE B3 - NEW/DEEPER RESIDENTIAL WELL AND MONITORING

5.3.1 DESCRIPTION

The installation of a new residential well into a different and deeper aquifer is a common remedy to provide an alternate water source to affected residents as a permanent solution for groundwater contamination.

Installation of a new residential well would be performed by a licensed well driller. A 4 -inch well would be installed into the lower portion of the Prairie du Chien aquifer (approximately 300 ft bgs). A typical Prairie du Chien aquifer residential well is shown on Figure 5.2. The new well would be connected to the residence using the existing household piping. The new residential well would be sampled twice within the 6 month period following installation to confirm that the well provides water below the HRLs.

From an aesthetic perspective, the Prairie du Chien aquifer is a preferred drinking water source compared to the St. Peter aquifer because iron levels are much lower.

The existing residential well would be sealed or converted to a monitoring well.

Alternative B3 would also include the same long-term groundwater monitoring program outlined under Alternative A2. However, the number of residential wells monitored would decrease with each new residential well installed.

5.3.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative B3 would provide protection of human health, because HRLs would be met. Status would be evaluated through monitoring.

Environmental protection is not applicable, because there are no environmental receptors.

5.3.3 COMPLIANCE WITH ARARs

Alternative B3 would be compliant with chemical-specific ARARs (HRLs) and action-specific ARARs for installation of residential wells and monitoring wells, sampling, and analysis. No location-specific ARARs are associated with this alternative.

5.3.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative B3 is a proven technology for providing a potable water supply and is considered to be a permanent remedy. Long-term effectiveness would be measured by monitoring.

5.3.5 REDUCTION OF TMV THROUGH TREATMENT

No active treatment is associated with Alternative B3. Alternative B3 would reduce TMV of contaminated groundwater through natural processes. Reduction in TMV would be evaluated through monitoring.

5.3.6 SHORT-TERM EFFECTIVENESS

There would be no short term impact to the community related to the construction of Alternative B3 other than the installation of a new well. Minimal impact incurred to residents during installation of residential wells and additional monitoring wells. There would be no impact to the environment or workers during sampling activities.

5.3.7 IMPLEMENTABILITY

Alternative B3 is a common technology and would be implemented by licensed well drillers. The installation of a new residential well and sealing of the existing residential well would require permits from MDH and agreements with property owners.

5.3.8 COST EFFECTIVENESS

The total present worth of Alternative B3 has been estimated based on three different connection alternatives:

Alternative B3a (installation of a new/deeper well to 3 homes) - $740,575

Alternative B3b (installation of a new/deeper well to 33 homes) - $1,280,682

Alternative B3c (installation of a new/deeper well to 82 homes) - $2,277,274

A summary of cost estimates associated with MPCA Scenario B is provided in Table 5.1. A detailed cost estimate for each of the three alternatives under Alternative B3 is presented in Table 5.3a, 5.3b, and 5.3c, respectively. The cost estimates reflect lower monitoring costs as new wells are installed.

5.4 ALTERNATIVE B4 - MUNICIPAL WATER AND MONITORING

5.4.1 DESCRIPTION

The provision of municipal water would involve the construction of watermains, installation of water service connections, and well sealing.

Watermains were constructed east of Gilfillan Lake in 1993/1994. Under that project, water was provided to the area through an inter-governmental agreement between the City of North Oaks and White Bear Township. White Bear Township operates and maintain the water system. Figure 5.3 shows the location and watermain sizes of the existing municipal water system.

In order to evaluate the feasibility of extending municipal water to the west side of Gilfillan Lake, CRA spoke with Jeff Roos (City of North Oaks engineer), Bill Short of White Bear Township and Larry Bohrer of TKDA (engineer for White Bear Township). All parties worked on the 1993/1994 water system east of Gilfillan Lake. TKDA conducted a water distribution analysis to determine pressures of a future potential extension and whether a booster station would be required. TKDA also provided CRA with representative unit costs for watermain, valves, hydrants, and water services.

Under Alternative B4, White Bear Township would have a one-time fee, known as a water availability charge, to cover the capital cost of water supply which includes the municipal water wells, treatment, and water tower storage.

CRA evaluated three municipal water service alternatives as follows:

Alternative B4a - Municipal Water Service to 3 Residential Locations
Figure 5.4 presents the location of the watermain and three residential connections within area 3 west of Gilfillan Lake.

Under this scenario, a total of 5,000 feet of watermain would be installed using 8 -inch watermains. The watermains would be extended from the existing main located at the corner of Gilfillan Road and Robb Farm Road and would be constructed using directional boring to minimize restoration. Each resident would be required to sign an access agreement which would permit contractors to install the water service and seal the existing well.

Similar to the water system east of Gilfillan Lake, the water system west of Gilfillan Lake would not be designed to provide fire protection.

Alternative B4b - Municipal Water Service to 33 Residential Locations

Figure 5.5 presents the location of the watermains and 33 residential connections within Area 3 west of Gilfillan Lake.

Under this scenario, a total of 13,500 feet of watermain would be installed using 8 -inch and 6 -inch watermains. The watermains would be extended from the existing main located at the corner of Gilfillan Road and Robb Farm Road and would be constructed using directional boring to minimize restoration. Each resident would be required to sign an access agreement which would permit contractors to install the water service and seal the existing well.

Similar to the water system east of Gilfillan Lake, the water system west of Gilfillan Lake would not be designed to provide fire protection.

Alternative B4c - Municipal Water Service to 82 Residential Locations

Figure 5.6 presents the location of the watermains and 82 residential connections within Areas 3, 4, and 5.

Under this scenario, a total of 20,500 feet of watermain would be installed using 8 -inch and 6 -inch diameter watermains. This system would be extended from the existing system which currently terminates at Gilfillan Road and Robb Farm to the south and near Duck Pass Road and Lily Pond Road to the north. The watermains would be constructed using directional boring to minimize restoration. Each resident would be required to sign an access agreement, which would permit contractors to install the water service, and seal the existing well.

Similar to the water system east of Gilfillan Lake, the water system would not be designed to support fire protection.

The monitoring program associated with Alternatives B4a, B4b, and B4c would be the same as Alternative A2. However, the number of residential wells monitored would decrease with each corresponding connection to municipal water.

Under all three water service alternatives, TKDA's modeling demonstrated that a booster station was not required for domestic use and in all cases, watermain pressures were adequate for domestic use.

TKDA's watermain extension system analysis and unit prices are provided in Appendix C.

5.4.2 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative B4 would provide protection of human health, because exposure to contaminated groundwater would be eliminated. Status would be evaluated through monitoring.

Environmental protection is not applicable because there are no environmental receptors, unless watermains are constructed through wetlands.

5.4.3 COMPLIANCE WITH ARARs

There are two chemical-specific ARARs associated with Alternative B4:

- The existing HRLs apply to existing residential wells. The HRL for vinyl chloride is 0.2 μg/L. Residential wells in excess of HRLs would receive municipal water.
- Municipal water is regulated under the Safe Drinking Water Act. As such, water provided through a municipal system must meet the Federal Maximum Containment Levels (MCLs). It should be noted that MCLs are not necessarily the same as HRLs. For example, the MCL for vinyl chloride is 2 μg/L (i.e., ten times higher than the HRL).

White Bear Township water is supplied from 6 wells installed in the Prairie du Chien - Jordan Aquifer. The well depths range from 360 to 445 feet. The quality of the water supply is documented through routine testing and published on the Township web site at *www.ci.white-bear-township.mn.us*.

VOCs, including vinyl chloride, are tested routinely by White Bear Township to demonstrate compliance with MCLs.

The action specific ARARs include a review and approval to construct the water system which would be issued by the MDH. Approval by each homeowner (for connection and well sealing), NOHOA, City of North Oaks and White Bear Township would also be required.

There are no location specific ARARs anticipated. However, the design would include an evaluation of potential wetland areas. If wetlands are present, permits would be required.

5.4.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Municipal water is a proven technology and is considered to be a permanent remedy. Status would be evaluated through monitoring.

5.4.5 REDUCTION OF TMV THROUGH TREATMENT

No active treatment is associated with Alternative B4. TMV reduction of VOCs in groundwater would occur by natural processes. Reduction in TMV would be evaluated through monitoring.

5.4.6 SHORT-TERM EFFECTIVENESS

Alternative B4 would have a short term impact on the community during the construction of the watermain system. The watermain system would take 6 months to one year to design and construct.

There would be no impact to the environment or workers during sampling activities.

5.4.7 IMPLEMENTABILITY

The construction of a municipal water system would require the following:

- A new or amended agreement between White Bear Township and the City of North Oaks. Similar agreements are already in place and this task should be straight forward.

- Approval by the City of North Oaks. The City Engineer must review and approve the design.
- Approval by the NOHOA, which is responsible for roadways and utility easements.
- As required for all water systems, a design approval would be required by the MDH.
- Individual agreements with property owners.

The design, approvals, and construction would take approximately one year from start to finish. Restoration would depend on the season. Construction can generally occur any time of the year. However, summer construction is preferred and road restrictions would apply in the spring.

An operational issue is associated with Alternative B4a where only three residents are connected. Given the low demand, routine flushing of the system would be required in order to maintain required levels of residual chlorine.

5.4.8 COST EFFECTIVENESS

The total present worth of Alternative B4 has been calculated based on three different connection scenarios:

Alternative B4a (municipal water system to 3 homes) - $1,209,705

Alternative B4b (municipal water system to 33 homes) - $2,021,583

Alternative B4c (municipal water system to 82 homes) - $3,116,757

A summary of cost estimates associated with MPCA Scenario B is provided in Table 5.1. A detailed cost estimate for each of the three scenarios under Alternative B4 is presented in Table 5.4a, 5.4b, and 5.4c, respectively. The cost estimates take into account a lower monitoring cost as the number of municipal water connections increase.

The cost for each scenario was based on unit costs provided by TKDA based on similar construction projects in the Twin Cities. The water availability charge was provided by White Bear Township. The cost of well sealing was obtained from a well driller. The cost estimates do not include the cost of the water bill. Similar to the system east of Gilfillan Lake, each resident would be required to pay for the monthly water bill which is approximately $10 per month, depending on water use.

5.5 COMPARATIVE ANALYSIS OF ALTERNATIVES - MPCA SCENARIO B

A summary of the comparative analysis of each potential alternative under MPCA Scenario B is provided in Table 5.5.

5.5.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

With the exception of Alternative B1, all of the alternatives under MPCA Scenario B would provide adequate protection of human health.

5.5.2 COMPLIANCE WITH ARARs

With the exception of Alternative B1, all of the alternatives under MPCA Scenario B would be compliant with the ARARs. Alternative B4 would be slightly more difficult to comply with ARARs due to construction activities, potential wetland delineation, and discharge of treated groundwater.

5.5.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

With the exception of Alternative B1, all of the alternatives under MPCA Scenario B would provide long-term effectiveness and are considered permanent remedies.

5.5.4 REDUCTION OF TMV THROUGH TREATMENT

All alternatives under MPCA Scenario B would provide reduction of TMV through natural processes.

5.5.5 SHORT-TERM EFFECTIVENESS

With the exception of Alternative B1, all of the alternatives under MPCA Scenario B would have short-term impacts. Short-term impacts associated with Alternatives B2 and B3 would be minimal. Short-term impacts associated with Alternative B4 would be more substantial based on potential construction and wetland impacts.

5.5.6 IMPLEMENTABILITY

Under MPCA Scenario B, Alternative B1 requires no implementation. Alternatives B2 and B3 could be readily implemented, but carbon filters have the disadvantage of long-term maintenance. Alternative B4 would be the most difficult to implement due to the size of the project.

5.5.7 COST EFFECTIVENESS

Alternative B1 requires no additional costs. Of the remaining alternatives under MPCA Scenario B, Alternative B3 would be the most cost effective alternative.

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