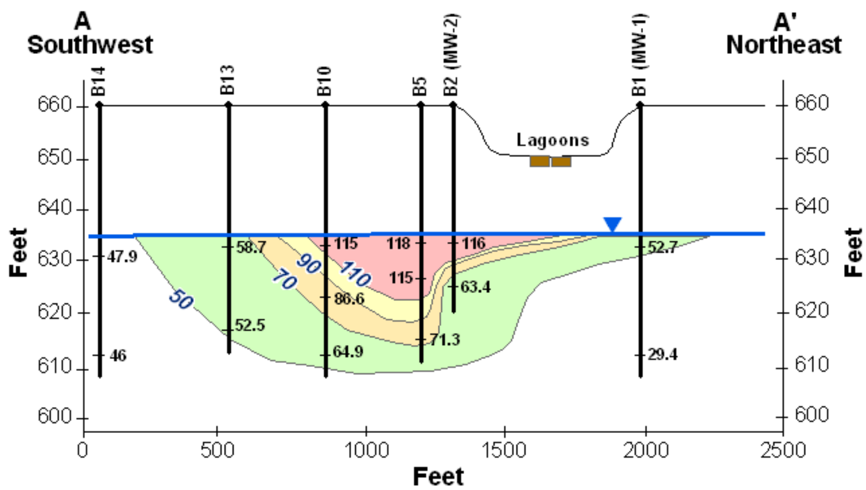
State of Ohio
Environmental Protection Agency

Division of Drinking and Ground Waters

Ground Water Quality Impacts of Infiltration of Partially Treated Wastewater at Catalina MHP, Butler Co., Ohio



October 2007

Ted Strickland, Governor
Chris Korleski, Director

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Executive Summary

At the Catalina Mobile Home Park (MHP), northeast Butler County, partially treated wastewater is directed to four unlined infiltration lagoons. The infiltrate from these lagoons constitutes a discharge to ground water. There are concerns that these lagoons impact ground water quality and pose health threats to people using ground water from the Great Miami River buried valley aquifer in the area downgradient of the lagoons. The purpose of this study was to determine the magnitude of ground water quality impacts in the downgradient area of the infiltration lagoons.

A sampling plan was developed to identify the probable flow direction and then to select Geoprobe boring and monitoring well locations to evaluate ground water quality impacts. Locations were selected to provide geochemical data to identify the plume extent and water quality impact, and to collect microbiological data to evaluate transport of bacteria and viruses in sand and gravel lithologies. Samples were analyzed for microbiologic indicators that were identified as possible indicators in the proposed U.S. EPA's Ground Water Rule as well as other microbe analysis with established methodologies run by the U.S. EPA lab in Cincinnati. U.S. EPA and USGS staff also analyzed the samples for pharmaceutical chemicals. Isotope samples for nitrogen (N^{14} and N^{15}) and oxygen (O^{18} and O^{16}) in nitrate were analyzed as additional tracers.

The quarterly sampling static water levels in the monitoring wells document a fairly consistent flow direction of the wastewater plume, ranging from S 35^{o} W to S 5^{o} E with an average flow to the south, southwest. This flow direction is consistent with the flow direction based on the August 2005 boring static water levels. The wastewater plume sourced from the Catalina MHP wastewater lagoons is clearly identified by the chloride and TDS concentrations in the August 2005 boring samples as well as a parallel storm water plume of low chloride concentrations immediately to the west of the wastewater plume (Figure 1). The quarterly sampling confirms consistent elevated chloride and TDS in the downgradient monitoring well MW2. Although the wastewater plume is clearly delineated, the ground water quality impacts for inorganic parameters do not appear to approach maximum contaminant levels (MCL). Nitrate values downgradient of the wastewater lagoons were as high as 6.68 mg/l but the average value was 4.5 mg/L, not far above nitrate concentrations of the upgradient monitoring well or the PWS source water. It appears that the lagoon vegetation and infiltration processes are effective at fixing and denitrifying nitrate compounds. On average the nitrate concentrations are less than 5 mg/L within the wastewater plume, well below the nitrate MCL of 10 mg/L.

The flow direction appears to be consistent and the wastewater plume is clearly documented, however, scattered results from MW1, the upgradient monitoring, suggest that at times wastewater discharge influences this monitoring well. Detection of ammonia in the August 2005 sample, the detection of phosphorous in MW1in the non turbid January and April 2006 samples, the enterococci and somatic phage detections in the August 2005 MW1 sample, and the weak septic signature of the nitrate isotopic data for August 2005 and July 2006 all suggest some wastewater influence at MW1. Any one of these results could be dismissed, but the repeated occurrence of hints of septic influence, suggests the flow regime is a bit more complicated than the well defined chloride/TDS plume indicates. Another possibility is that there is a leaking sewer line or other septic source close to MW1 which is a real possibility, considering the location adjacent to the mobile home park and drilling company offices.

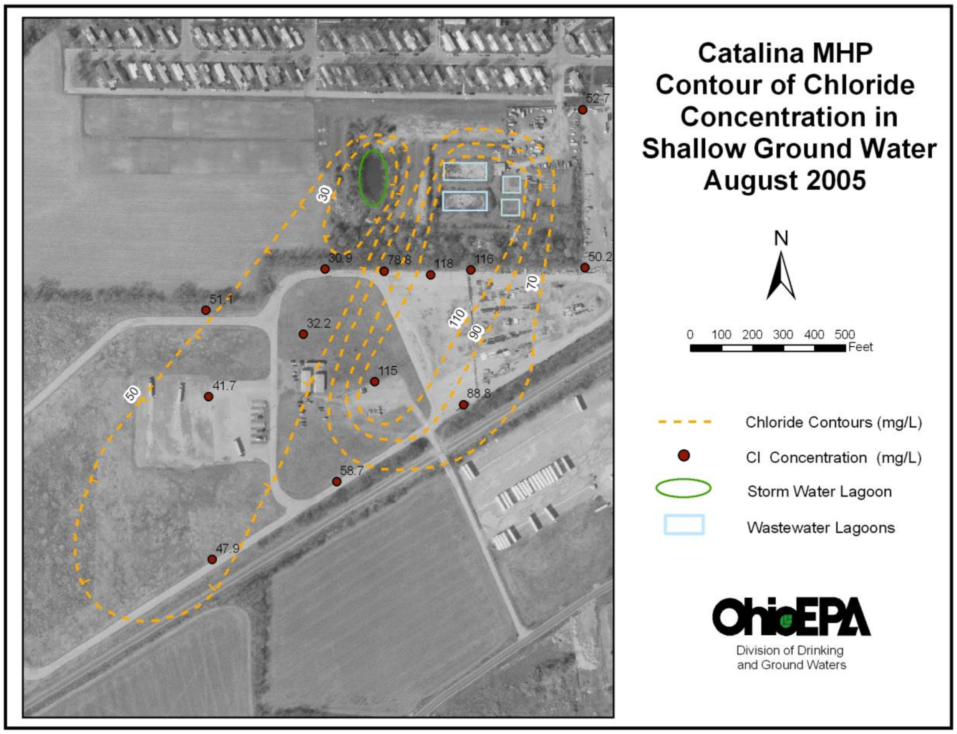

Figure 1. Wastewater and storm water plumes as defined by chloride in boring data.

The microbiologic results from ground water samples produced low counts to non detects for bacteria indicators in contrast to significant detection levels in the final effluent and lagoon samples. This indicates that the filtering processes associated with assimilation and infiltration of partially treated wastewater from the lagoons are removing the bulk of the pathogens. The episodic nature of microbiologic data makes these results more difficult to interpret and several ground water samples did record detections of total coliform, *E. coli*, and enterococci. Thus there is evidence of pathogen transport but at low levels. The areas of pathogen detections do not all coincide with the wastewater plume. It is difficult to say that the lagoon infiltration and flow to groundwater is a perfect filtration system for pathogens, but it appears to be a very good one. A second element of uncertainty in the data analysis is the general reduction of pathogen concentrations in the lagoons as the quarterly sampling progressed. Whether this reflects improved management (seasonal or general chlorination of wastewater) at Catalina MHP's wastewater system as a result of our investigation or an annual cycle is not clear.

Overall, based on ground water sample data collected at and downgradient from the Catalina MHP property boundary, the water quality impacts do not appear to be as significant as anticipated. This statement is based on the following interpretations of data collected:

- A distinct wastewater plume is present based on chloride and TDS concentrations which documents a stable ground water flow direction to the south southwest;
- Elevated ammonia concentrations occur only in the lagoons and the core of the plume;
- Detections of pharmaceuticals, sulfamethoxazole and carbamazapine, occur in the delineated wastewater plume and not in the storm water plume;
- Although the nitrate in ground water is elevated (average < 5 mg/L), it is well below the MCL (10 mg/L) and not far above the upgradient monitoring well nitrate concentration (3.1 mg/L);
- The pathogen concentrations exhibit low counts to non detects for bacteria indicators and coliphage in downgradient borings in contrast to significant detection levels in the final effluent and lagoon samples; and
- The presence of some pathogens in the wastewater plume areas may result from transport from the wastewater lagoons, but the data is not definitive.

Clearly, there are water quality impacts associated with the wastewater infiltration plume, but inorganic MCLs are not exceeded and in general the counts for pathogen indicators are low. Although the infiltration processes are reducing the pathogen concentrations significantly, the uncertainty of the microbiologic data makes it difficult to categorically state that the water is safe. The ground water impacts, however, are significantly below what we expected.

These results suggest that the processes of chemical transformations, predation, and filtration associated with aeration, lagoon processes, infiltration through the bottom of the lagoons, flow through the vadose zone, and transport within the aquifer provide a significant amount of treatment. Since our samples were only collected in the lagoons and in ground water at the downgradient property boundary and beyond we have little information to identify which of these areas provide the most effective treatment for individual parameters or pathogens.

Ground Water Quality Impacts of Infiltration of Partially Treated Wastewater at Catalina MHP - Final Report

Table of Contents

List of Figures

List of Tables

Ground Water Quality Impacts of Infiltration of Partially Treated Wastewater at Catalina MHP – Butler Co., OH

October 2007

Introduction

At the Catalina Mobile Home Park (MHP), northeast Butler County, partially treated wastewater is directed to four unlined infiltration lagoons. The infiltrate from these lagoons constitutes a discharge to ground water. There are concerns that these lagoons may impact ground water quality and pose health threats to people using ground water from the buried valley aquifer in the area downgradient of the lagoons. The purpose of this study is to determine the magnitude of ground water quality impacts in the downgradient area of the infiltration lagoons. The information collected will help determine options for Ohio EPA's response to ground water quality impacts and potential public health threats associated with wastewater infiltration lagoons.

Background

The Catalina MHP wastewater treatment facility was designed and installed in the late 1960's with a design capacity around 80,000 gpd. The current flow is estimated around 120,000 gpd (for approximately 400 units). In a 1993 letter to Catalina MHP, Ohio EPA indicated that no National Pollutant Discharge Elimination System (NPDES) permit was required for their wastewater treatment system since the NPDES Permit Program only applies to direct discharges to surface water. The Ohio EPA has the responsibility and authority (ORC 6111) to protect ground water as waters of the state. The primary purpose of this investigation is to determine the extent to which the wastewater treatment system at Catalina MHP impacts ground waters of the state. Consequently, in July 2004 Ohio EPA's Division of Drinking and Ground Waters (DDAGW) committed to completing a hydrogeologic study to evaluate possible ground water impacts at Catalina MHP. Evaluating water quality impacts associated with wastewater disposal at Catalina MHP will increase our understanding of migration of bacteria and viruses through sand and gravel aquifers associated with wastewater treatment lagoons in Ohio.

Physical Setting and Local Geology

Catalina MHP is located in southwest Ohio in the northeast corner of Butler County in the NE/4, section 11, T2N and R4E of Madison Township. Catalina MHP is located north of the Middletown Airport and the Great Miami River and just west of Route 4, Germantown Road. The address is 6501 Germantown Road, Middletown, OH. Figure 1 illustrates the main features of the area and indicates the location of the Catalina MHP and the study area.

The Catalina MHP is located on the edge of the outwash plain of the Great Miami River (GMR) buried valley, a federally designated Sole Source Aquifer. Bedrock uplands covered with trees lie immediately to the northwest of Catalina MHP. The break in slope is roughly delineated by trees as shown in Figure 1. The local relief between the uplands and the outwash plain is typically 150 feet. Browns Run drains the uplands and flows across the outwash plain in a north-northwest to south-southeast direction to the GMR. This tributary crosses the GMR flood plain approximately one half mile down valley from the Catalina MHP wastewater lagoons. Browns Run is a perennial stream in the uplands and becomes a losing stream when it flows onto the GMR outwash plain. Under normal flow conditions, Browns Run loses all surface flow before it reaches the railroad tracks. The volume of stream water recharged or lost to the aquifer illustrates the generally high permeability of the GMR outwash material.

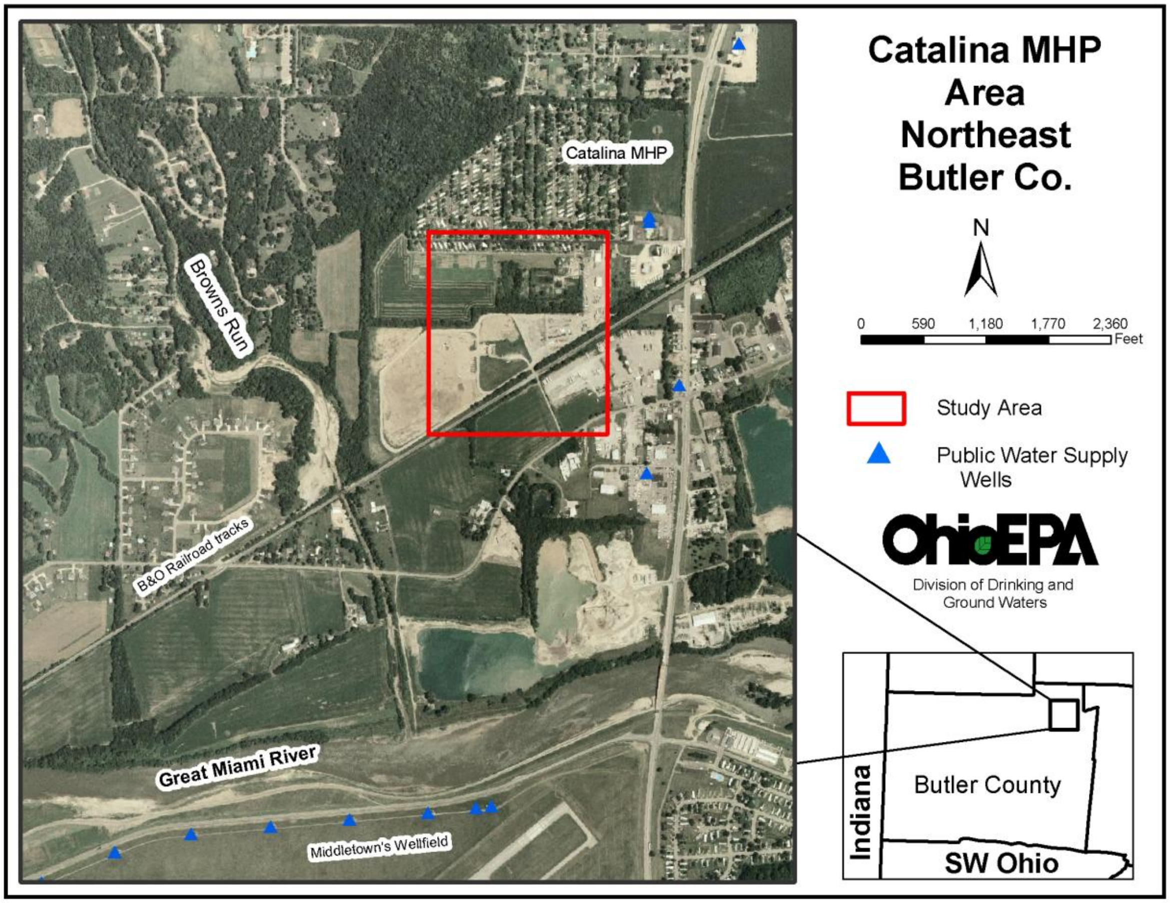

Figure 1. General area of Catalina MHP with the study area identified.

The bedrock in the area is Ordovician shaley limestone which is a poor aquifer providing minimal water production (Schmidt, 1986). In upland and slope areas the bedrock is overlain by Wisconsin ground moraine deposits. The GMR valley was carved out of the Ordovician bedrock by preglacial rivers. The valley was back filled with glacial outwash material to produce the Great Miami River buried valley aquifer, a tremendous ground water resource. The GMR buried valley deposits in NE Butler County are at least 200 feet thick in central valley locations and thin towards the valley walls. The glacial outwash material is dominated by poorly sorted sand and gravel deposited from braided streams, but also includes discontinuous layers of glacial till (0-40 feet thick) which is confirmed with notations of clay or clay and gravel in local well logs. In the

Middletown wellfield, a 10-25 foot thick locally continuous till, separates the buried valley into an upper and lower aquifer (Middletown WHP Plan documents - CH2MHILL, 1996). The most recent erosion and deposition in the area is associated with Browns Run. This stream has reworked glacial deposits to developed alluvium deposits within a valley in the uplands and contributes new material and reworks outwash material in the GMR outwash plain. The distribution of unconsolidated deposits in the area is illustrated in Figure 2. A conceptual cross section through the study area (location provided in Figure 2) is provided in Figure 3. The high sensitivity of the GMR buried valley is documented by a high pollution potential index (182) in the study area (ODNR, 1991). The shallow penetration of some borings suggests the presence of discontinuous tills as described above. The ground water evaluation described in this report has focused on the shallower, more sensitive aquifer.

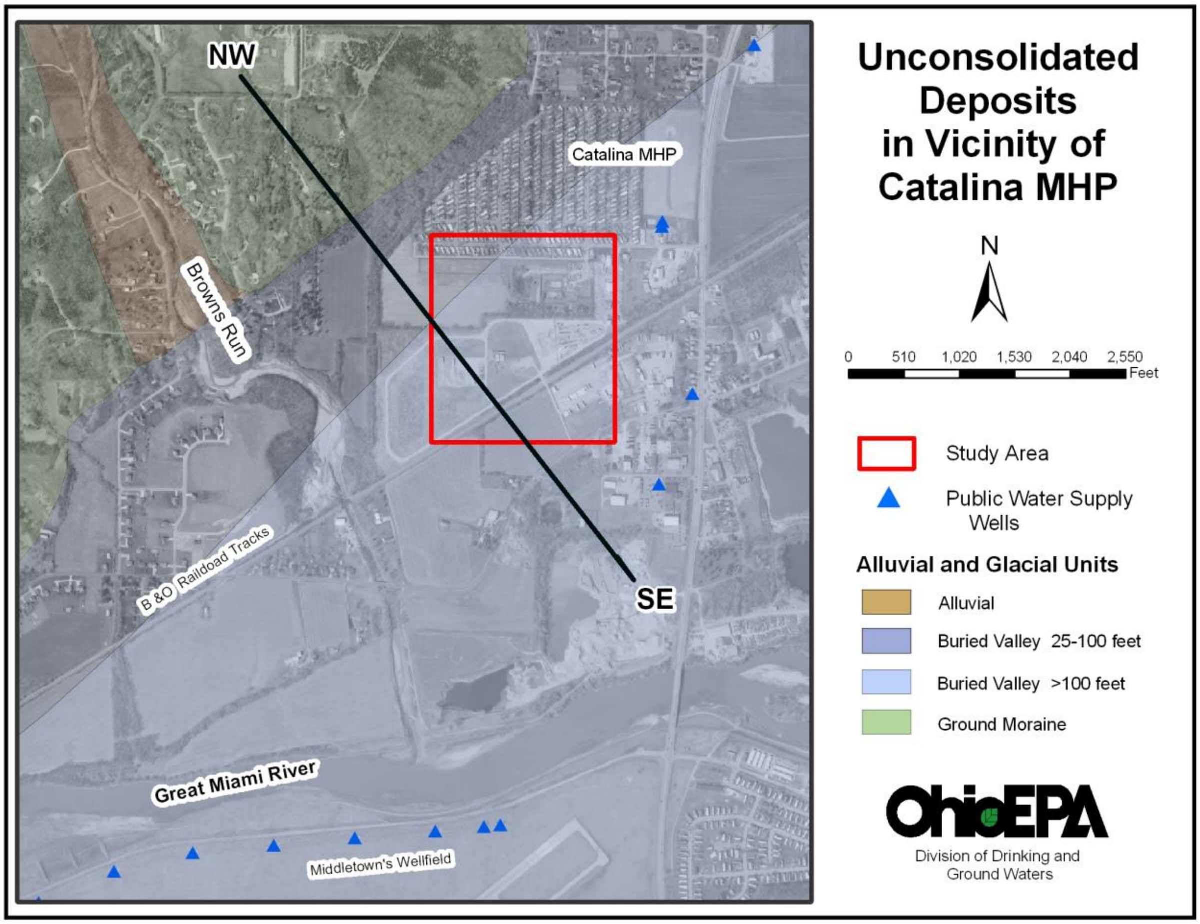

Figure 2. Unconsolidated deposits in the area of Catalina MHP.

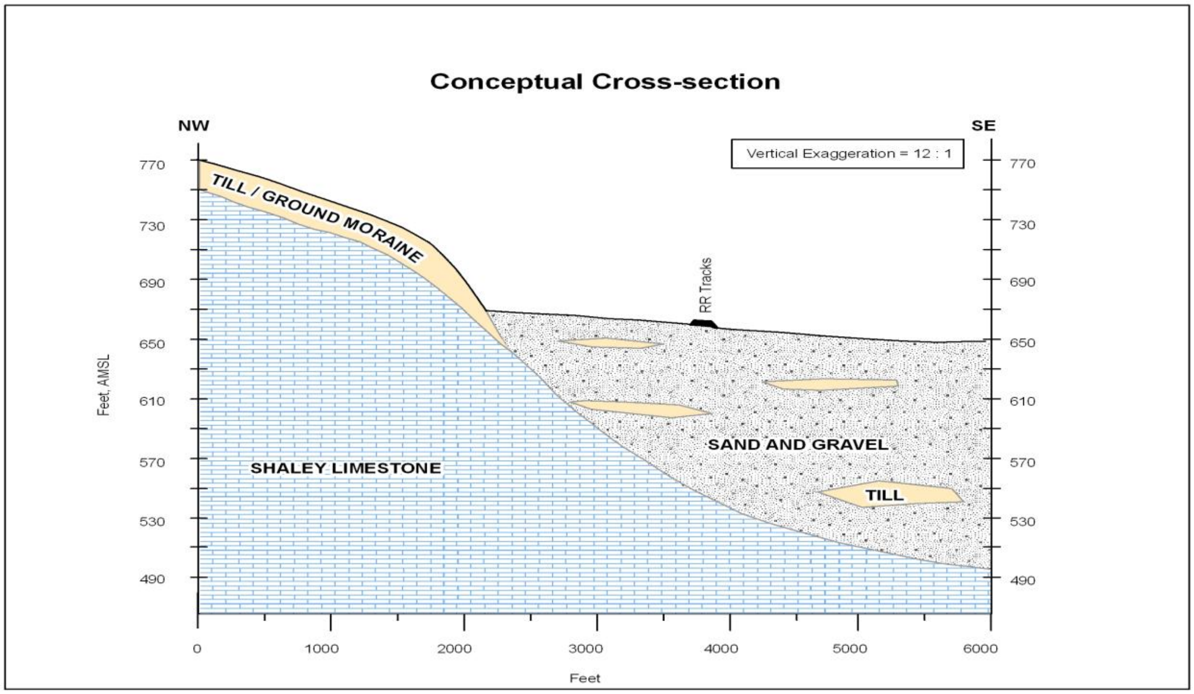

Figure 3. Schematic cross section of local geology, looking to the northeast.

Property Access

Discussions with Sun Communities Inc, owner and operator of Catalina MHP, to gain access for boring and ground water sampling on the Catalina MHP property, were not successful. Consequently, alternative access was secured for evaluating the ground water quality impacts within the infiltration plume. Boring and sampling along the southern Catalina MHP property boundaries allows the ground water quality to be sampled about 200 feet downgradient from the southern edge of the infiltration lagoons rather than 75 to 100 feet downgradient that would have been tested with access to the Catalina MHP property. Access to the Reynolds Inc. property and the Wise property (area of the truck driving school) was secured with standard Ohio EPA Consent to Access Agreements. During boring and sampling operations, the Catalina MHP staff was always cooperative in providing access for sampling their PWS wells and wastewater lagoons.

Wastewater Treatment Plant

The WWTP includes an aeration system and four infiltration lagoons, which are located on the south side of the Catalina MHP approximately in the center of the northeast quarter of section 11. The components of the WWTP are identified in Figure 4. Originally, flow from the aeration unit could be directed to individual infiltration lagoons. Currently, the operator reported that flow is discharged primarily to the northeast lagoon and then flows to the other infiltration lagoons. Immediately west of the wastewater infiltration lagoons a storm water lagoon is present. The WWTP was built in the late 1960s and there appear to be maintenance issues, such as slumping around the aeration tanks. From an operations perspective, the chlorination appeared to be erratic based on the variable number of chlorine tablets observed in the post aeration wastewater flow during sampling events. Figure 5 is a picture of the aeration plant and Figure 6 illustrates the density of the vegetation in the wastewater lagoons. The high permeability of the GMR aquifer is an important element for the effectiveness of the Catalina MHP wastewater treatment plant (WWTP).

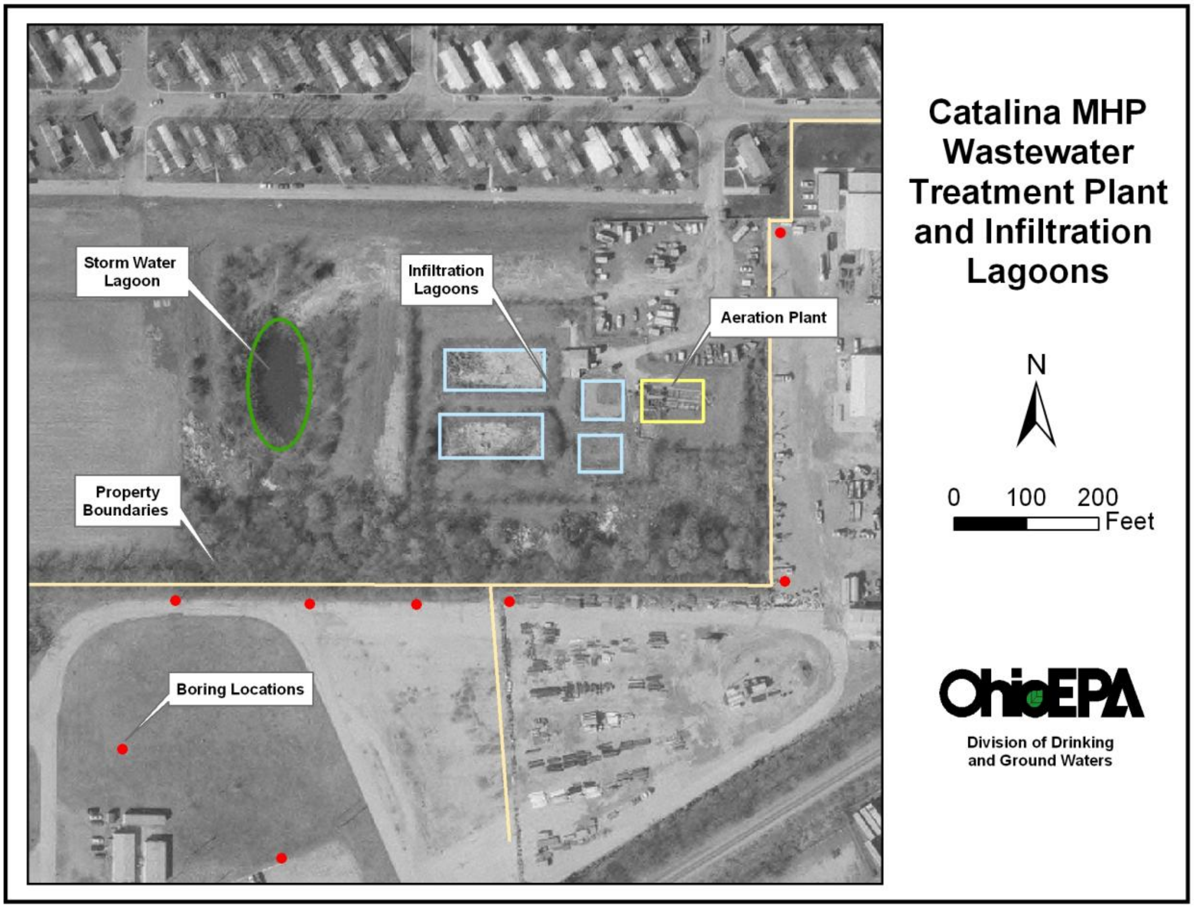

Figure 4. Catalina MHP wastewater treatment plant and infiltration lagoons.

Figure 5. A picture of the Catalina MHP aeration plant.

Figure 6. Picture of the SE wastewater lagoon looking towards the SW wastewater lagoon.

Sampling Plan

A sampling plan was developed that focused on identifying the probable flow direction and then selecting Geoprobe boring and monitoring well locations. Locations were selected to provide geochemical data to identify the plume extent and water quality impact, and to collect microbiological data to document transport of bacteria and viruses in sand and gravel lithologies. Samples were analyzed for microbiologic indicators that were identified as possible indicators in the proposed Ground Water Rule as well other microbe analysis with established methodologies run by the U.S. EPA lab in Cincinnati. The U.S. EPA and USGS also analyzed the samples for pharmaceutical chemicals. Isotope samples for nitrogen in nitrate (N^{14} and N^{15}) and oxygen (O^{18} and $O^{16)}$ in samples were analyzed as additional tracers.

Preliminary Sampling

Preliminary sampling of the Catalina MHP PWS well (raw water), the storm water lagoon, and the wastewater lagoons was completed on October 20, 2004 to help identify parameters that would be most useful for identifying the ground water quality impacts of the infiltration of the wastewater into the Great Miami River buried valley aquifer. Samples of the final effluent and wastewater lagoons collected by the DSW in 2002 were also used in this preliminary analysis. The results of these samples indicated that chloride and sodium exhibit the largest differences between ground water and wastewater effluent, and were consequently, targeted to be the best tracers. Conductivity and total dissolved solids (TDS) were also elevated in the effluent. Nitrate and other nitrogen species provided evidence of elevated concentrations in the wastewater lagoons. Catalina MHP raw water is elevated in nitrate (3.3 to 6.2 mg/L 2000-2005 in treated water), so the source water for the effluent is starting with elevated nitrate concentrations. These initial water quality data (2002-2004) are presented in Appendix A. These data confirmed that several parameters exhibit significant differences to allow identification of an infiltration plume.

Multiple Samples in Borings and Monitoring Wells

One unknown about the potential wastewater infiltrations plume was how deep the wastewater infiltrated below the water table driven by vertical gradients generated by the wastewater lagoons. The total dissolved solid load in the samples from the infiltration lagoons is not particularly high, TDS of 600-700 mg/L compared to 550-600 mg/L in the Catalina MHP source water. Consequently, there should not be a strong geochemical vertical density gradient pushing the effluent infiltration to depth, however, diffusion and dispersion will contribute to the expansion of the plume downgradient and vertical recharge will drive the plume downward. To identify the bottom of the infiltration plume, water samples were collected at multiple depths in the Geoprobe borings: at the bottom of the boring; at intermediate depths if the boring was sufficiently deep; and at the water table.

To address the potential for seasonal variation in the water quality impacts three monitoring wells were installed, one upgradient and two downgradient. The well screens in the monitoring wells were set within the first five feet of the water table and samples were collected on a quarterly basis for a year to identify seasonal variation. The locations of the borings and monitoring wells are provided in Figure 7.

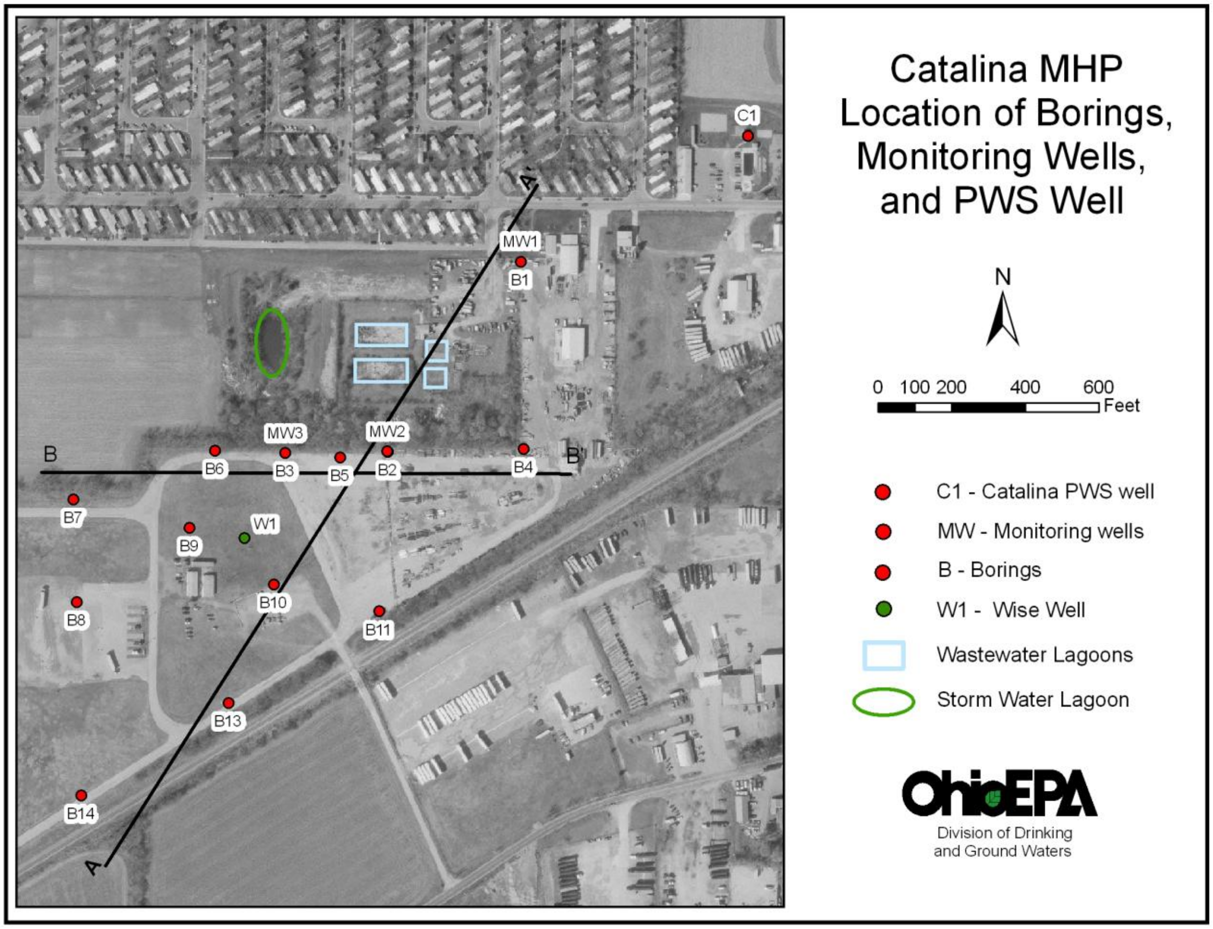

Figure 7. Location of boring and monitoring wells.

The Geoprobe samples were collected by driving the probe to depth and then pulling the rods up to expose a four foot screen. The deepest sample was collected first and shallower samples were collected as the rods were retracted. This process creates the possibility of transporting shallower contaminants to depth. The low pumping rate during purging (typically 2 gallon purge) and sampling (approximately 1 liter/minute), however, assured that the water collected was coming from the depth of the screen for sampling in permeable material of the GMR aquifer. The Geoprobe boring samples were collected between August 17-19, 2005 and were significantly more turbid than typical ground water samples. Borings were abandoned after the rods were removed by packing the borehole with bentonite.

The monitoring wells were set using the Geoprobe. Larger rods were driven to a depth of six to seven feet below the water table. A prepackaged, three foot screen was lowered into the well/boring with 1/2 inch tubing attached for sampling. The middle of the screen was placed about 5 feet below the water table. The monitoring wells were purged and the first samples were collected using a hand pump (inertial check value). We continued to use the hand pump for purging the monitoring wells, but a peristaltic pump was setup for sample collection, due to the reduced sample turbidity with the peristaltic pump.

Samples Collected and Parameter Selection

Water quality samples were analyzed by Ohio EPA, Division of Environmental Services (DES) for the following parameters: nitrogen species (nitrate/nitrite, nitrite, ammonia, and total kjeldahl nitrogen (TKN)), chemical oxygen demand (COD), total organic carbon (TOC), total dissolved solids (TDS), chloride, sodium, potassium, total phosphorous, alkalinity, sulfate, calcium, magnesium, hardness, barium, fluoride, strontium, and a suite of metals. Most inorganic samples were not filtered, but a few samples were filtered and analyzed for metals to evaluate the influence of turbidity on metal concentrations. Some boring samples were analyzed for a reduced set of parameters. Due to the high turbidity of the boring samples, filtered and unfiltered samples were collected for the January and April quarterly monitoring well sampling events. Filtered samples for the monitoring wells were discontinued after we determined there was no significant difference between filtered and unfiltered monitoring well samples.

Samples for stable isotopes of oxygen (O^{16} and O^{18}) and the nitrogen (N^{14} and N^{15}) in nitrate were collected and analyzed at the Cornell University Stable isotope Lab (COIL) Lab at Cornell University.

Samples collected for microbiologic analysis were analyzed for the standard biologic indicators: total coliform, *E. coli*, and enterococci. In addition, HPC-heterotrophic plate counts (PCA and R2A culture media) and Aerobic Spores were analyzed and some samples had viral indicators (somatic Phage and F+ Phage) evaluated (8/05, 4/06, and 10/06 samples). Microbiologic samples were analyzed by the U.S.EPA, Office of Research and Development, National Risk Management Research Lab, in Cincinnati.

The U.S. EPA Office of Research and Development, National Exposure Research Lab,(NERL) in Cincinnati coordinated analysis of samples for pharmaceutical compounds. The results of these samples are summarized in this report, however, the U.S. EPA data on pharmaceutical compounds are considered preliminary and the reader is referred to references in the pharmaceutical compounds section for officially published data.

Results of Catalina MHP Hydrogeologic Study

Ground Water Flow Direction

Ohio EPA's Drinking Water Source Assessment Report for the Catalina MHP public water system used the City of Middletown♣s ModFlow model of the Great Miami River buried valley aquifer to provide the ground water flow direction. This model indicates a down valley ground water flow direction, from northeast to southwest and indicates a depression of the water table within the City of Middletown's wellfield. The losing nature of Browns Run where it flows over the outwash plain should influence the local ground water flow direction. Browns Run acts like a line of high recharge along the stream within the buried valley aquifer. The surface stream flow in Browns Run generally disappears before the flow reaches the railroad tracks which cut diagonally through Figure 1 from the northeast to southwest. The mounding of the stream recharge along Brown's Run should divert the down valley ground water flow from a southwest direction to a more southerly flow direction. This analysis suggests water flow direction downgradient of the Catalina MHP infiltration lagoons could be south-southwest or south. The east-west trending Great Miami River, due south of the Catalina MHP provides the obvious discharge point for the lagoon recharge. Integration of these data provided a high confidence that the ground water flow direction in the vicinity of the Catalina MHP lies between a southwest to south flow direction.

Geoprobe borings were located with GPS units and water levels were measured at all sites. Water table levels were measured during quarterly sampling events at the monitoring wells. The boring locations and monitoring wells were surveyed for elevation control. No benchmark was present locally so the elevation data is relative. The elevations presented in Figures 8 and 9 are estimated based on ground elevation from a local contour line of 660 feet above mean sea level (MSL), but the accuracy of the relative elevations is preserved. Figure 8 presents the relative elevation of the water table as measured in the Geoprobe borings on August 16-18, 2005 with contours for the ground water table surface. The measurement for the boring northeast of the lagoons, the upgradient boring (B1, Figure 7), has been ignored in contouring the ground water table because the associated monitoring well (MW1) data at this location consistently documented water table levels above the downgradient monitoring wells (MW2 and MW3) as documented in Figure 9. The water levels in monitoring wells were consistently higher than water levels measured in the borings.

The ground water table exhibits influence from the storm water and wastewater infiltration lagoons. Although the number of borings is limited, the control downgradient of the lagoons is good. The contours indicate a south-southwest flow direction as expected. This flow direction is generally consistent with the ground water table levels recorded in the monitoring wells during quarterly sampling events, as indicated in the insert included in Figure 8. The average ground water flow direction for the five measurements of the monitoring wells is S 10-15^{o} W, which is very close to the S 20^{o} W GW flow direction illustrated in Figure 8 for August 2005 boring data. The measured flow directions ranged from S 35^{o} W (April 2006) to S 5^{o} E (October 2006). Figure 9 illustrates the consistent relationships between the water levels in the three monitoring wells. The similar water levels in MW2 and MW3 (downgradient wells) as compared to MW1 (upgradient well) supports the consistent ground water flow direction. Figure 9 also suggests an annual ground water level rise of over three feet with highest ground water levels in the spring.

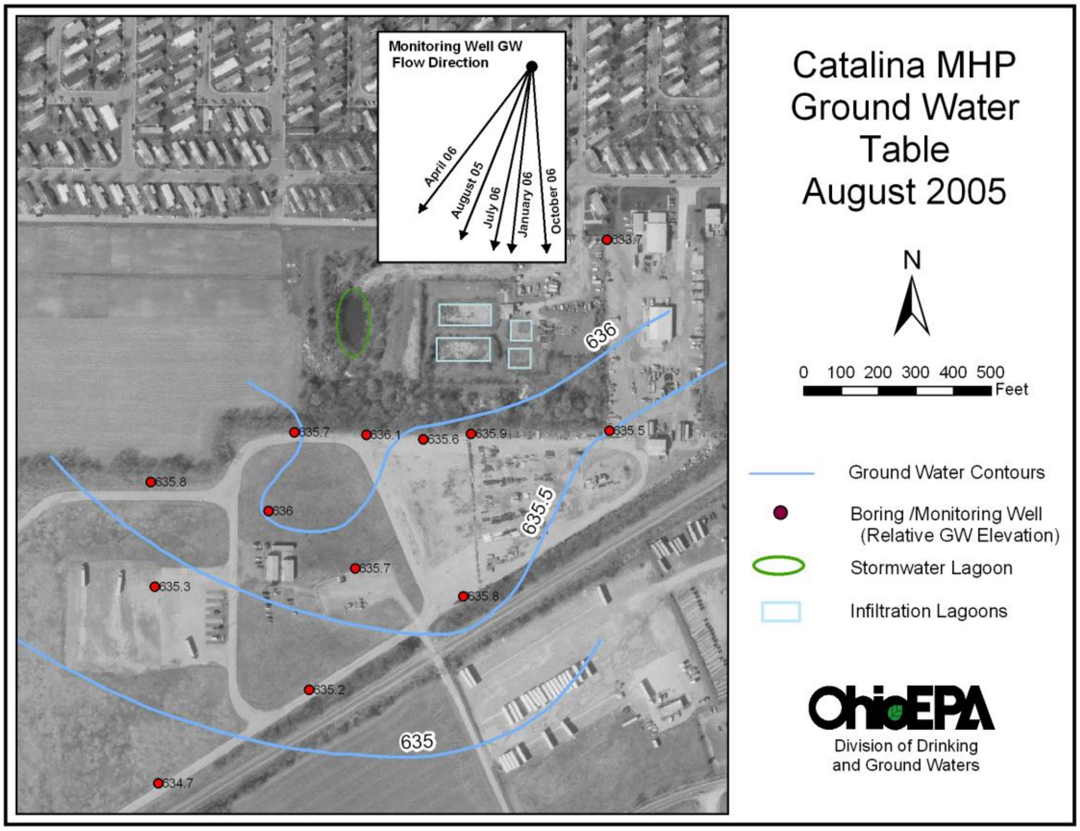

Figure 8. Contours of the ground water table based on the Geoprobe boring static water data.

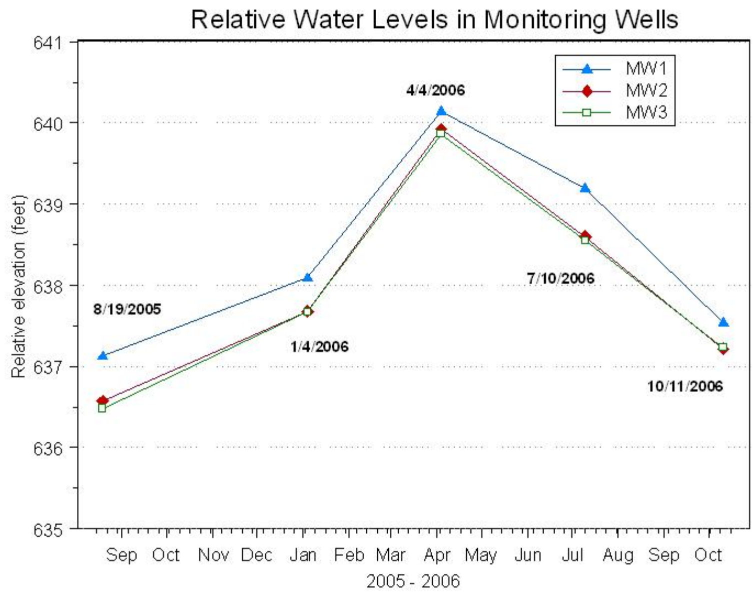

Figure 9. Relative elevation of monitoring wells for quarterly samples.

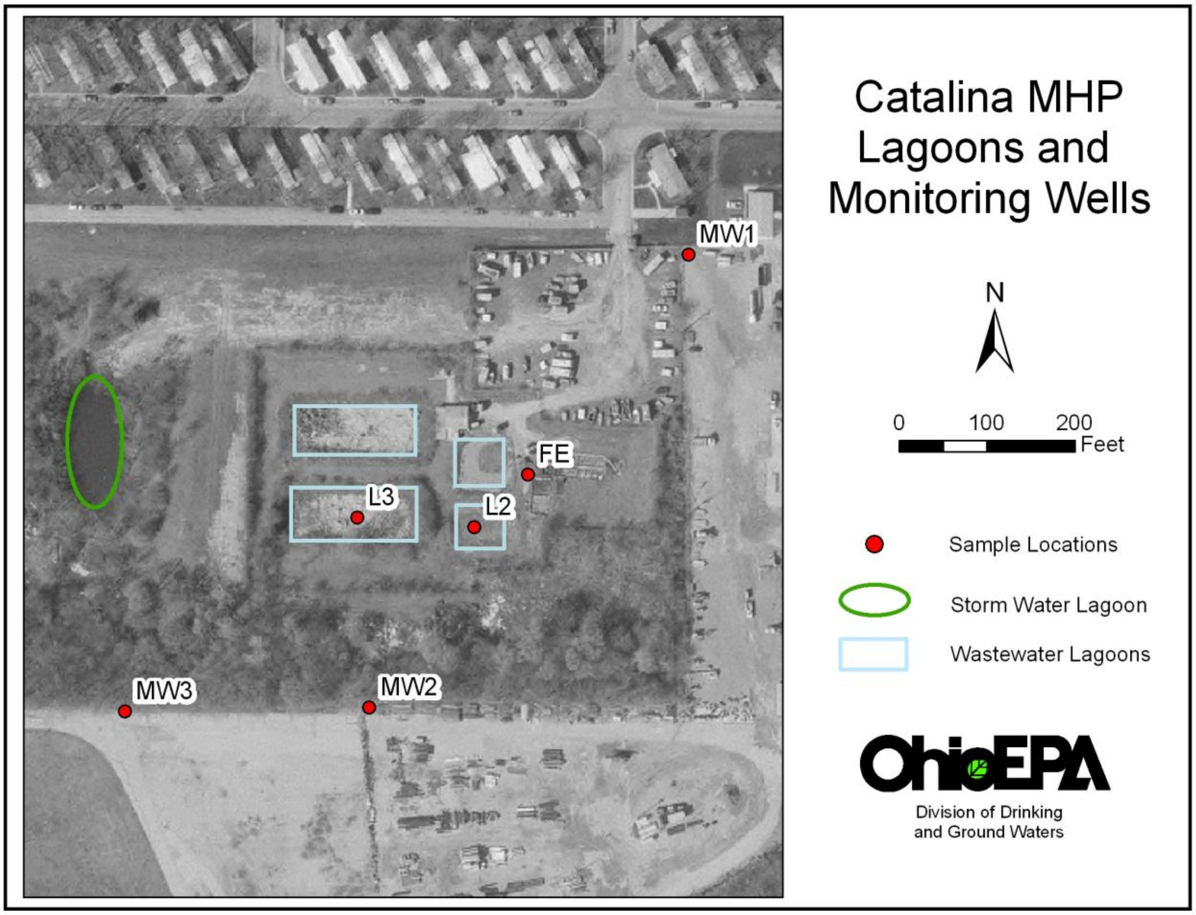

Figure 10. Locations of the monitoring wells (MW) and lagoon (L) samples.

Inorganic Geochemistry

The inorganic data results, including ground water and surface water results, are presented in Appendix B: Appendix B1 for the boring sample results, and Appendix B2 for the monitoring well sample results. Appendix F includes the surface water sample results. The ground water samples include the boring samples (B) collected using Geoprobe methods (inertial hand pump for sampling) and the monitoring well (MW) data collected as quarterly samples using a peristaltic pump after the initial August 05 sampling event. The surface water samples were collected from the southeast (L2) or southwest (L3) lagoons in conjunction with the quarterly monitoring well sampling events. The inorganic geochemistry chloride and total dissolved load (TDS) concentrations clearly identifies the presence of plumes associated with the wastewater infiltration lagoons (elevated Cl and TDS) and the storm water lagoon (reduced Cl and TDS). Figure 10 identifies the locations of the monitoring wells (MW), lagoons (L), and the location of the final effluent (FE). The Catalina MHP public water system wells are located 700 feet upgradient to the northeast from MW1 (Figure 7).

The majority of ground water samples collected from the Geoprobe borings were turbid and high turbidity created a problem with the acid preserved samples. The normal acid volume used for preservation of ground water samples was not sufficient to lower pH to the specified range leading to improper preservation in the field. As a result, these samples were acidified in the lab to generate the correct preservation pH and analyzed. Thus, the results of many preserved samples are qualified (J = parameters estimated due to improper preservation in the field), as listed in Appendix B1. Several boring samples were collected as pairs of unfiltered and filtered samples and analyzed for metals. The metal concentrations for the filtered samples are similar to the non turbid monitoring well samples. The significantly lower turbidity of the monitoring well samples makes them typical ground water samples and normal acid volumes were sufficient to preserve the samples properly. The only monitoring well data that includes qualified data are the first monitoring well samples collected on August 18 without the use of a peristaltic pump. The inorganic boring data used to identify the plume trace (chloride and TDS) are analyzed from the unpreserved samples and, fortunately, are not particularly sensitive to turbidity.

The format of Table 1 is used repeatedly in the following sections. The table provides data collected from the monitoring wells and lagoons during the quarterly sampling events. The data is presented with upgradient locations at the top of the Chemical Indicator Table, the lagoon data in the middle, and the downgradient locations at the bottom of the table, in order to represent the water quality changes associated with ground water flow and infiltration of wastewater into ground water. The middle of the three foot monitoring well screens was set at 5 feet below the water table or about 27-30 feet below the ground surface. The PWS well is deeper (50 feet deep versus 30 feet) than the monitoring wells. The Catalina MHP PWS well is the source water for the partially treated wastewater discharge to the lagoons

Table 1. Chemical Indicator - Chloride mg/L

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		84	89	77	67	77	85
Storm water			< 5	--	--	--	--	--
Upgradient	MW1		--	49	49	50	53	48
	FE		136	109	--	--	--	--
Lagoons	L2		--	108	120	113	115	--
	L3		--	110	--	--	--	--
Downgradient	MW2		--	108	119	116	105	121
	MW3		--	68	106	43	35	57

-- Indicates no sample collected

Chloride

The results for the chloride analysis are presented in Table 1. The chloride concentrations in the upgradient monitoring well, MW1, are considerably below the concentrations determined for the lagoons and for monitoring well MW2, which is located directly south, downgradient, of the lagoons (Figure 10). The lagoon chloride concentration increase of approximately 40 mg/l from the PWS source water (C1) is consistent with a low to medium concentration wastewater (Table 3-15, Tchobanoglous et al., 2003). Variation of chloride concentration in monitoring well MW3 (35-106 mg/L) is attributed to influence of recharge of low chloride (<5 mg/L) water from the storm water lagoon. It should be note that the deeper PWS well provides source water with elevated chloride concentrations (67-89 mg/L) compared to the upgradient monitoring well (MW1).

The contoured chloride data collected in August 2005 from the Geoprobe borings, delineates the chloride plume as illustrated in Figure 11. The chloride plume trends south- southwest from the wastewater infiltration lagoons, and a parallel plume of low chloride concentrations sourced from the storm water lagoon is present just to the west of the plume defined by elevated chloride values. Both plumes are mixed and diluted downgradient with concentrations approaching background levels 1000-1600 feet downgradient of their infiltration sources. The trend of the chloride plumes identified in Figure 11 is consistent with the general ground water flow directions determined from ground water level data illustrated in Figure 8.

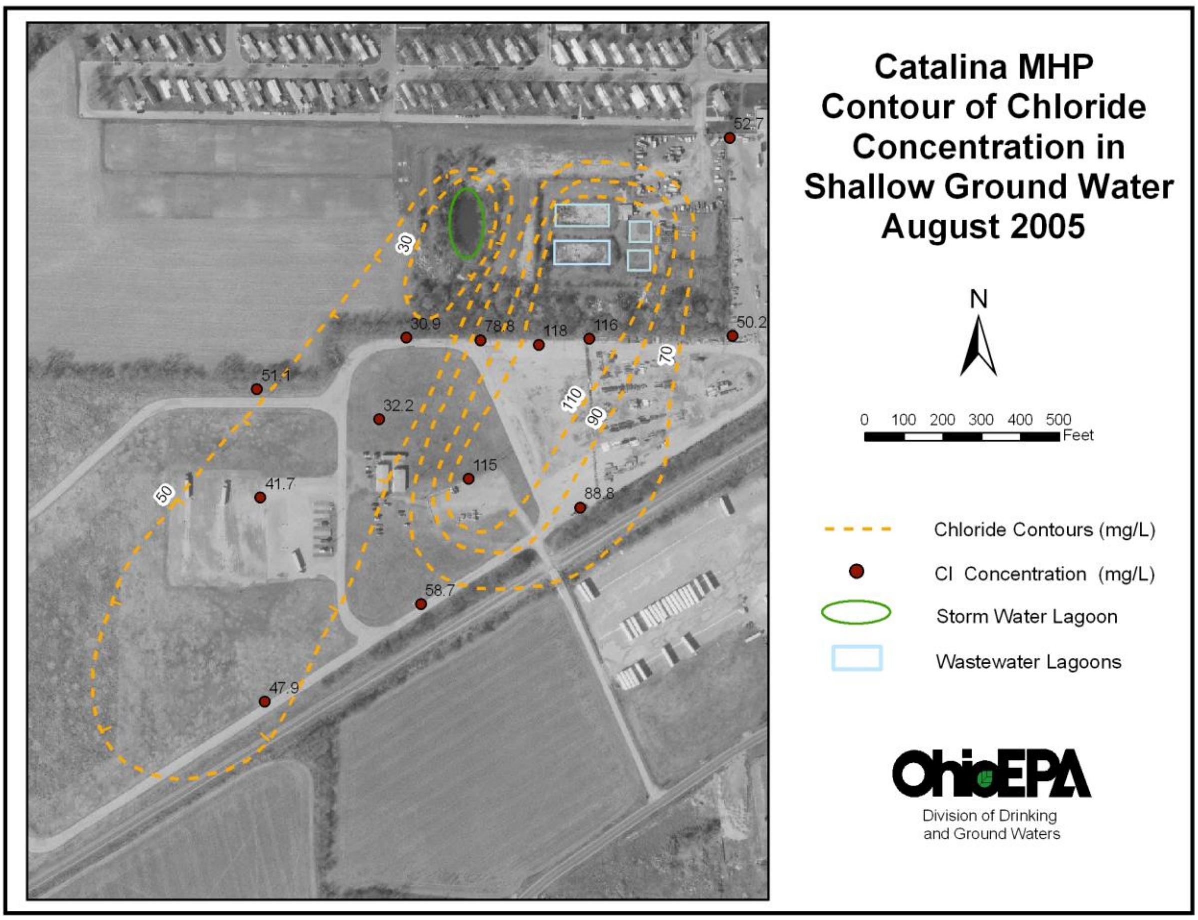

Figure 11. Wastewater and storm water plumes as defined by chloride in Geoprobe boring data.

Since the boring samples exhibited high turbidity, it is reasonable to question if the chloride data from these samples is accurate for identifying the plume trace. Chloride is a conservative tracer that is not readily absorbed to mineral surfaces so it is logical to expect chloride concentration to be independent of turbidity. Figure 12 illustrates the chloride concentration of the borings associated with monitoring wells (B1, B2, B3 collected in August 2005, associated with MW1, MW2, and MW3 respectively), the monitoring well samples collected in August 2005 (all slightly turbid) and the quarterly monitoring well samples collected after August 2005 (not turbid). The range of chloride concentrations for the turbid samples (August 2005) is about the same as for the non turbid, quarterly monitoring well samples. The turbid boring samples are slightly higher in chloride than the less turbid August 2005 monitoring well, but the difference is small, less than the temporal chloride variation observed in the quarterly samples for MW1 and MW2. These data relationships document the limited influence of turbidity on chloride concentration. The variability of chloride in MW3 is clearly illustrated in Figure 12 and is attributed to dilution of the wastewater plume by the influence of the storm water lagoon.

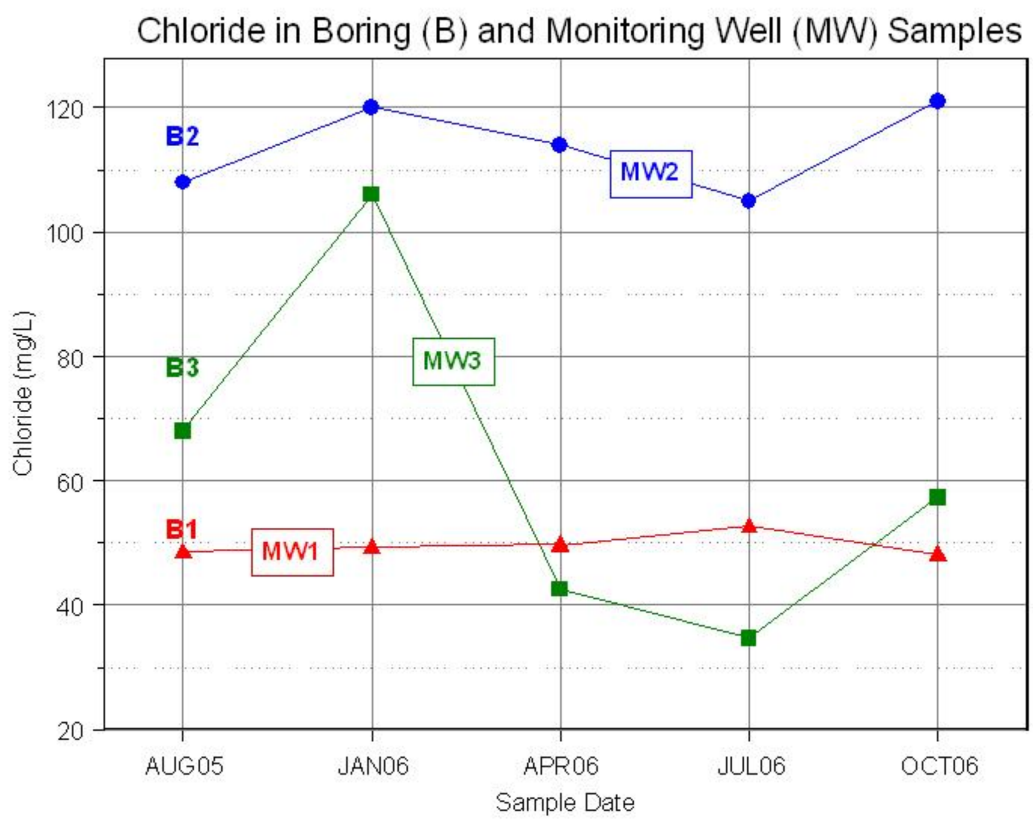

Figure 12. Chloride concentrations in monitoring well and associated boring samples.

Two cross sections are presented in Figures 13 and 14 to illustrate the geometry of the plumes at depth as defined by chloride contours. Figure 13 illustrates a longitudinal section of the wastewater plume (A-A') and Figure 14 provides a cross sectional view of the plume geometries (B-B') approximately perpendicular to flow direction. Cross section locations are presented in Figure 7. The depression excavated within the outwash plain for the lagoons is the obvious topographic feature in Figure 13 and the slopes of the excavation illustrates the significant vertical exaggeration (V.E. = 20 in A-A' and 10 in B-B') in these cross sections. The ground water table is typically 23-26 feet below the flat ground surface. Evidence of elevated chloride values associated with the wastewater plume was found to depths of 25 feet below the water table.

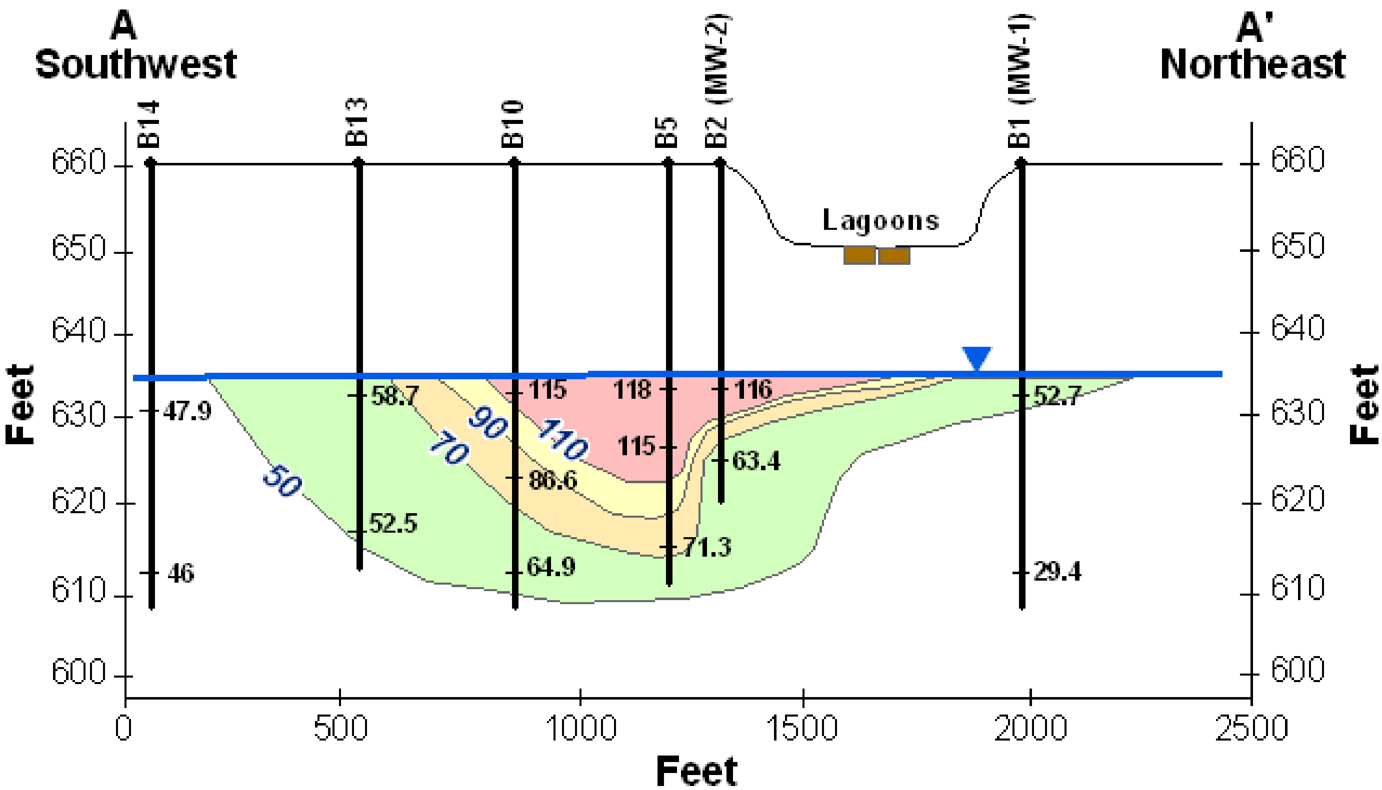

Figure 13. Longitudinal section of wastewater plume defined by chloride concentration. Cross section A-A', looking northwest.

The deeper boring data exhibits reduced concentrations of selected parameters, like chloride and TDS, documenting that the borings penetrated the wastewater plume. The diffusion of the plume increases the depth of the plume downgradient until the plume is diluted to background levels. The chloride contours in Figure 13 are drawn to indicate little migration of chloride upgradient, suggesting that there is little to no ground water mounding under the lagoons. The projection of B2 and B5 onto the cross section A-A'(Figure 7) foreshortens the distance between them and may accentuate the vertical drop of the plume between these borings. The fact remains that elevated chloride concentration in B5 extends to greater depth (115 mg/L at 33-37 feet) than in B2 (63.4mg/L at 36-40 feet) although the shallow sample chloride concentrations are very similar, 118 and 116 mg/L in B5 and B2 respectively. The cause of this is not known, but may be attributed to permeability differences or variation in vertical gradients associated with infiltration of wastewater from the lagoons .

Figure 14 clearly identifies the elevated chloride concentrations in the wastewater plume and the reduced chloride concentrations in the storm water plume to the west. This cross section provides the depth dimension to the chloride contours presented in Figure 11. The limited extension of the wastewater plume to depth as based on chloride concentrations implies that there is little density differences between ground water and partially treated wastewater to drive infiltration to depth and that the vertical gradients driving the wastewater downward from the lagoons are limited.

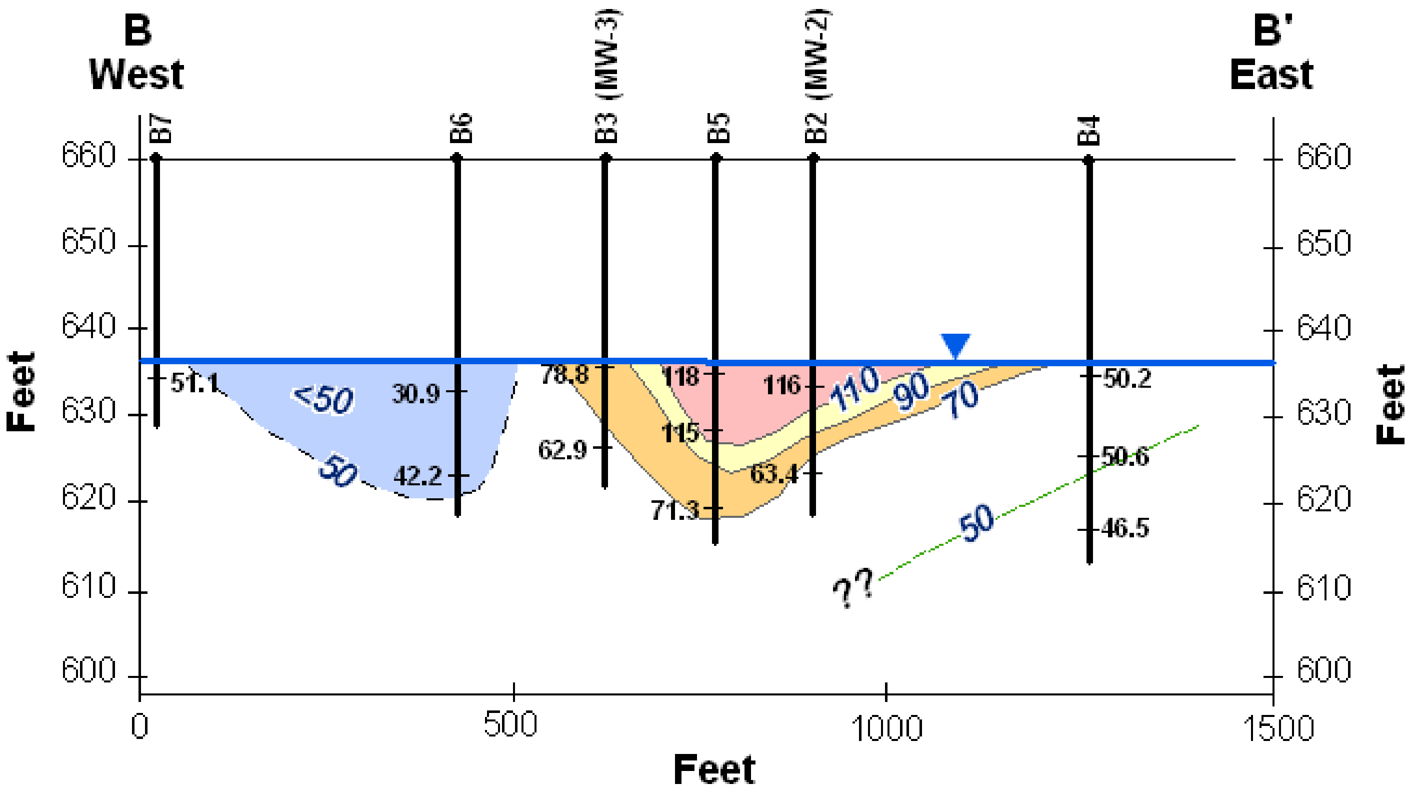

Figure 14. Perpendicular section of wastewater and storm water plumes.
Cross section B-B', looking north.

Total Dissolved Solids

The sample results for Lab total dissolved solids (Lab TDS) are presented in Table 2 in the upgradient to downgradient format used to present the chloride data in Table 1. TDS exhibits parallel relationships as exhibited in the chloride data and is generally independent of turbidity. The TDS increase from PWS source water to partially treated wastewater in the lagoons or MW2 ranges from 80-130 mg/L, which is below the low concentration of untreated domestic wastewater (Table 3-15, Tchobanoglous et al., 2003). Higher TDS concentrations are present in the lagoons and MW2 as compared to MW1 consistently for all quarterly sampling events. The TDS values in MW3 are variable and probably relate to storm water infiltration of low TDS concentration water from the storm water lagoons, as seen in the chloride data as well. The elevated TDS (and conductivity) in MW2 was noted in the field parameter measurements during the quarterly sampling events.

Table 2. Chemical Indicator - Total Dissolved Solids (TDS) mg/L (Field Filtered sample)

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		566	582	534	568	560	610
Storm water			70	--	--	--	--	--
Upgradient	MW1		--	570	494 (526)	556 (574)	518	560
	FE		644	664	--	--	--	--
Lagoons	L2		--	668	594	704	----	--
	L3		--	660	--	--	--	--
Downgradient	MW2		--	702	650 (578)	676 (672)	640	714
	MW3		--	582	636 (668)	500 (508)	482	578

-- Indicates no sample collected;

---- Sample collected, TDS not analyzed

Figure 15 illustrates concentration contours of TDS in the shallow Geoprobe borings (<33 feet). This provides a clear representation of the wastewater and storm water plumes as identified by TDS. As expected, the plumes documented with TDS exhibit similar geometry and size as the chloride plume in Figure 11.

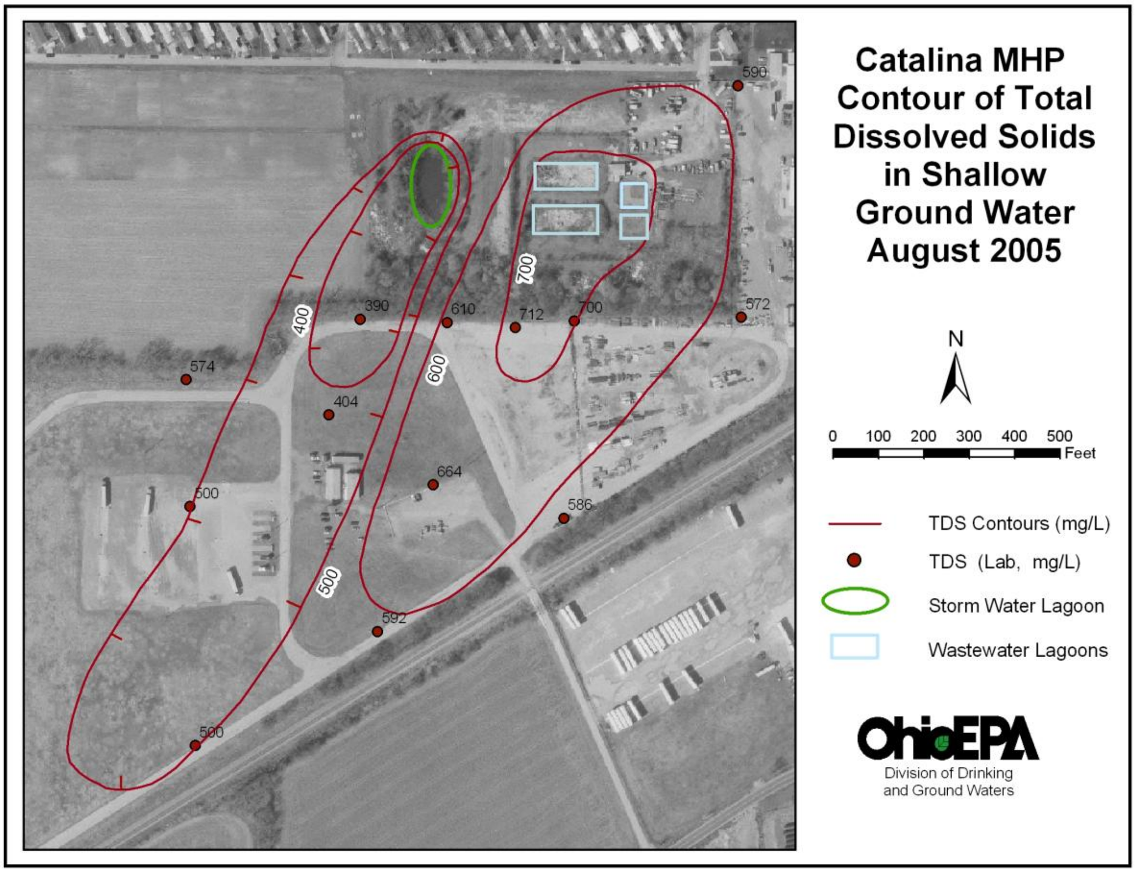

Figure 15. TDS contours for the shallow Geoprobe borings.

Nitrogen Species

The nitrogen species known to be elevated in wastewater are present in significant concentrations in the lagoons: Nitrate + Nitrite as N was measured at 8.5 to 12.7 mg/L, Total Kjeldahl Nitrogen (TKN) from 2.0 to 12.5 mg/L, and Ammonia from 0.38 to 7.0 mg/L. The multiple species of nitrogen in individual samples indicate a disequilibrium setting characterized by transformations of nitrogen species. The nitrate concentration in Catalina MHP wells is commonly in the 3-6 mg/L range, and thus, the public water system source water contributes to the nitrogen in the wastewater. The lack of equilibrium in the nitrogen species makes the interpretation of these compounds difficult. However, the boring data delineated ammonia and TKN plumes with variable nitrate concentrations in the boring data. The fact that the Catalina MHP PWS wells, which draw water from 50 feet deep, consistently record nitrate concentrations (nitrate average 5.2 mg/L, non detect for ammonia and TKN) confirms local ground water in the Great Miami Aquifer is oxidized to depths greater than 50 feet in the study area. Consequently, the presence of ammonia and TKN plumes document impact to shallow oxidized ground water from infiltration of reduced wastewater from the lagoons with unoxidized species of nitrogen. Figure 16 illustrates the ammonia plume distribution in the shallow (≤ 33 feet) and mid-level (33 to 45 feet) ground water. The contours close within or just upgradient of the infiltration lagoons.

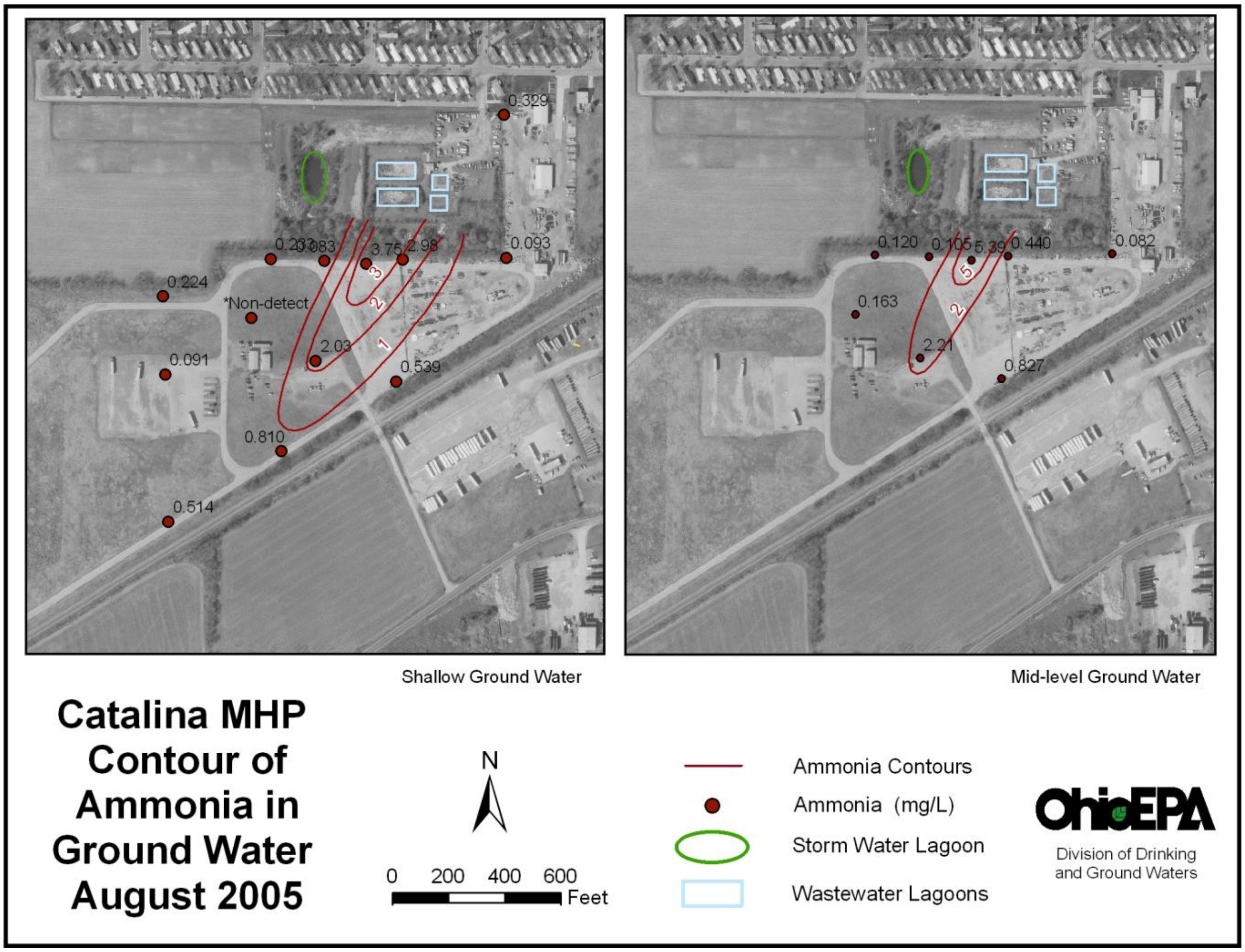

Figure 16. Ammonia plume in shallow and mid-level ground water.

The area of the ammonia plume is restricted compared to the plume extent defined by chloride and TDS concentrations. The plume is especially narrow in the mid-level ground water samples. This may be due in part to decreased permeability in the mid-level depth in the area of B2 and MW2 (locations in Figure 7) as discussed in the description of cross-section A-A' (Figure 13).

Figure 17 presents the ammonia data for the borings and the monitoring wells. Boring samples with ammonia values greater than 1.2 mg/L occur only in the borings within 700 feet of the lagoons and in the path of the plume (borings B2, B5, and B10). The bulk of the ammonia results greater than 0.5 and less than 1.0 mg/L occur in the borings downgradient from B2, B5, and B10 and within the plume (B11, B13, and B14). Elevated levels of ammonia in the turbid samples only show up in the area of the plume. Figure 17 also illustrates a change in ammonia concentrations with depth. The deepest samples collected in B2 (40 feet) and B5 (47 feet) exhibit ammonia concentrations below 0.5 mg/L in contrast to the shallower samples in B2 and B5 with values of 2.98 and greater. This indicates borings B2 and B5 have penetrated through the core of the wastewater plume. At B10, all three of the boring samples (deepest at 52 feet) record ammonia concentrations of 1.87 mg/L and greater indicating that the plume has diffused to greater depths while moving 700 feet downgradient of the lagoons. Non turbid samples collected at the monitoring wells exhibit ammonia concentrations that are generally non detect (<0.05 mg/L), with the exception of the sample collected at MW2 in January 2006 (.465mg/L). Although the majority of these ammonia data are qualified due to improper preservation in the field, the consistency of occurrence of elevated ammonia with the core of the wastewater plume supports the validity of the results.

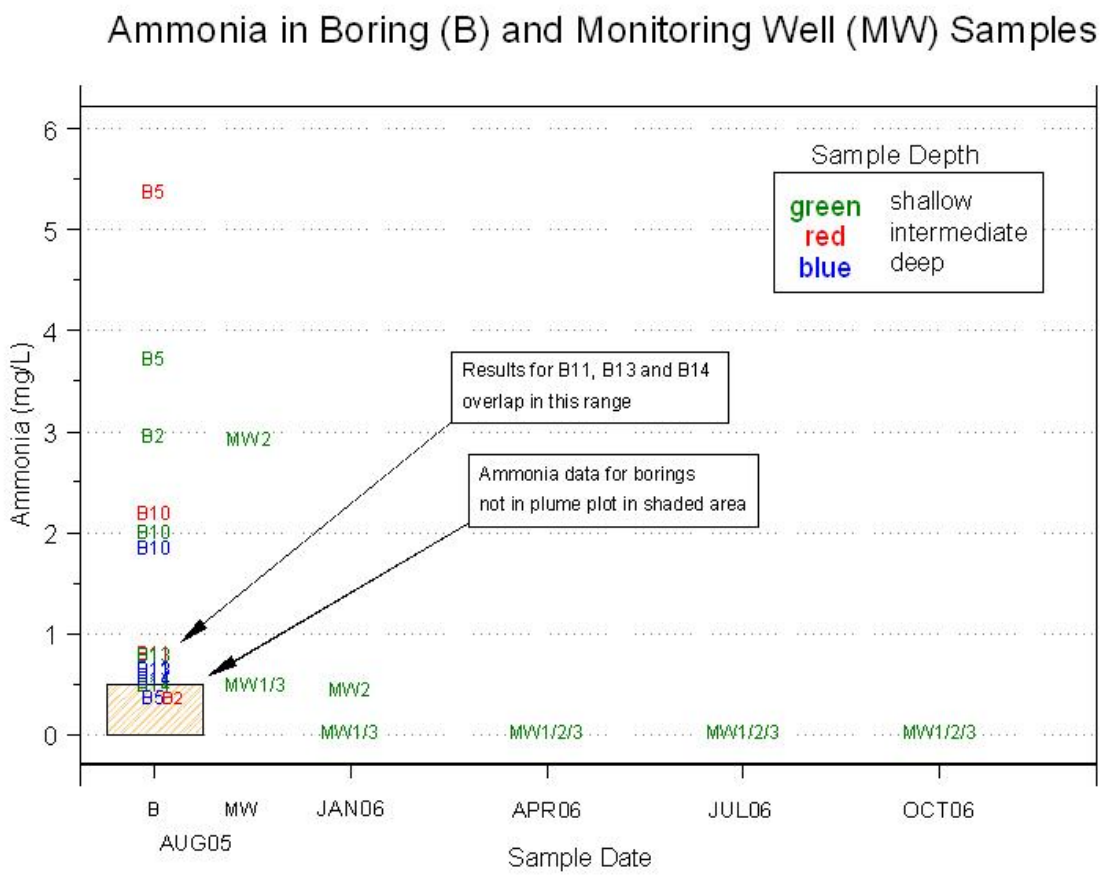

Figure 17. Ammonia concentrations in borings and monitoring well samples.

The ammonia data from the quarterly sampling are presented in Table 3 in the upgradient to downgradient format. The PWS wells record non detects for ammonia and the lagoon ammonia concentrations are variable, but consistently elevated compared to typical ground water values. The interesting point is that the presence of elevated levels of ammonia in ground water samples is generally restricted to the August and January samples which is probably related to the turbidity of the samples. The April to October 2006 samples from the monitoring wells are all non detect for ammonia. For the April sampling event, significant concentrations of ammonia were present in the lagoons. The Geoprobe boring samples were much more turbid (200-500 NTUs) than clear ground water samples (< 5 NTUs) and since ammonia cations (NH_4^+) are absorbed on mineral surfaces, the more turbid samples provided higher ammonia concentrations (if ammonia is present) as a result of desorption with acid preservation. The progressive development of the monitoring wells due to purging prior to quarterly sample collection and the use of a peristaltic pump for quarterly sample collection (starting in January 2006) reduced the turbidity of the monitoring well samples significantly. The lack of detection of ammonia in the monitoring wells does not discount the ammonia plume based on the August 2005 boring samples. Table 3 documents a slight reduction of ammonia in the low turbidity and filtered MW2 monitoring well sample collected in January 2006. The detected arsenic in all MW2 quarterly samples (6.1-14.4 µg/L) supports a more reducing environment at MW2 which is consistent with the presence of ammonia.

Table 3. Chemical Indicator – Ammonia mg/L (Filtered)

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		ND	ND	ND	ND	ND	ND
Storm water			< 0.05	--	--	--	--	--
Upgradient	MW1			0.14	ND	ND	ND	ND
	FE		7.03	0.77	--	--	--	--
Lagoons	L2		--	--	5.67	4.73	0.38	--
	L3		--	1.06	--	--	--	--
Downgradient	MW2		--	2.10	0.465 (0.454)	ND	ND	ND
	MW3		--	0.12	ND	ND	ND	ND

ND Non Detect -- Indicates no sample collected

Figure 18 illustrates the concentrations of ammonia versus nitrate in the boring samples. The primary relationship is that samples with elevated ammonia do not exhibit significant nitrate concentrations. In addition, the borings located in the wastewater plume core are the only samples with ammonia concentrations above 1.5 mg/L and borings located in the downgradient portion of the wastewater plume exhibit ammonia concentrations of 0.5 -1.0 mg/L. This relationship supports the process of ammonia from the wastewater lagoons transforming to nitrate downgradient, moving towards equilibrium to nitrate in the oxidized shallow aquifer.

The boring upgradient of the infiltration lagoons (B1) is an anomaly with an ammonia concentration of 0.329 mg/L in the shallow sample (30 feet) and 1.12 mg/L in the deep sample (51 feet). It was expected that B1 sample results would be oxidized, based on the water quality results from the upgradient Catalina MHP PWS well with an average nitrate value of 5.2 mg/L.

The high turbidity of the B1 boring samples is contributing to the ammonia concentration, and the adjacent MW1 monitoring well sample collected in August 2005 had 0.121 mg/L ammonia. The subsequent monitoring wells samples were non detect for ammonia as expected. The reduced nature of sample results from B1 samples suggest that there may be some migration of infiltrated wastewater upgradient to boring B1. This is a concern considering that this is the direction of the Catalina MHP PWS wells. Overall, the data collected consistently points to a south-southwest flow direction, but the August 2005 B1 ammonia results should not be ignored without consideration. Possible explanations include some local sources such as leakage from sewer lines going to the wastewater treatment plant, or local nitrogen associated with concentrations of organic matter near the boring. The deeper sample at 47-51 feet may be approaching the depth of reduced ground water. All things considered, we believe the B1 ammonia results are anomalous, based on the consistency of the plume geometry as indicated by the geochemical results, The hydrologic system is complex and the number of borings are limited so the B1 ammonia results send a note of caution to the general consistency of the data presented in this report.

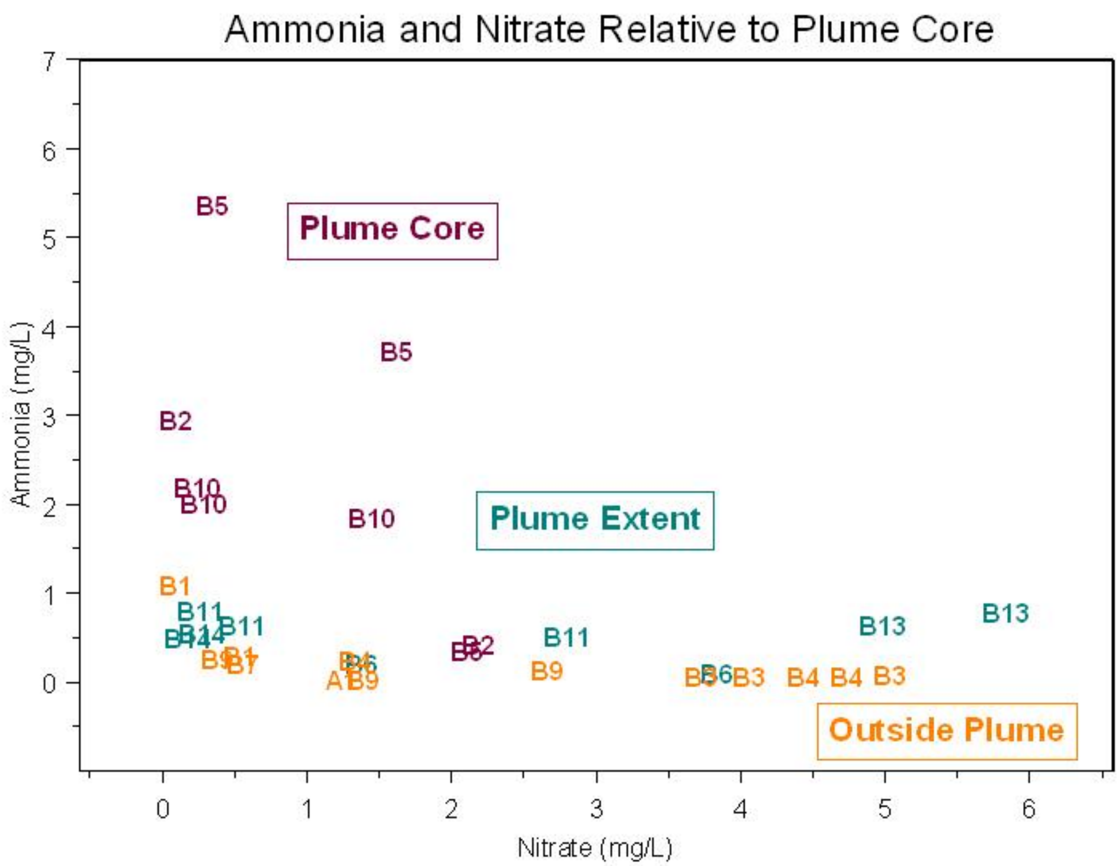

Figure 18. Ammonia and nitrate relationships in boring samples.

The inverse relationship between ammonia and nitrate is also exhibited in Figure 19 in boring sample data projected on to the east-west trending cross section B-B'(location in Figure 7). The ammonia contours (1, 3, and 5 mg/L) identify the core of the wastewater plume. The sample values presented in Figure 19 are nitrate concentrations measured in the boring samples. As illustrated in Figure 18 the borings with elevated ammonia exhibit relatively low nitrate values. Outside the core ammonia plume the nitrate values are higher, typically in the 2-5 mg/L range. Nitrate values to the west (left side of Figure 19) of the wastewater ammonia plume exhibit lower nitrate concentrations due to the storm water infiltration that contains low nitrate concentrations.

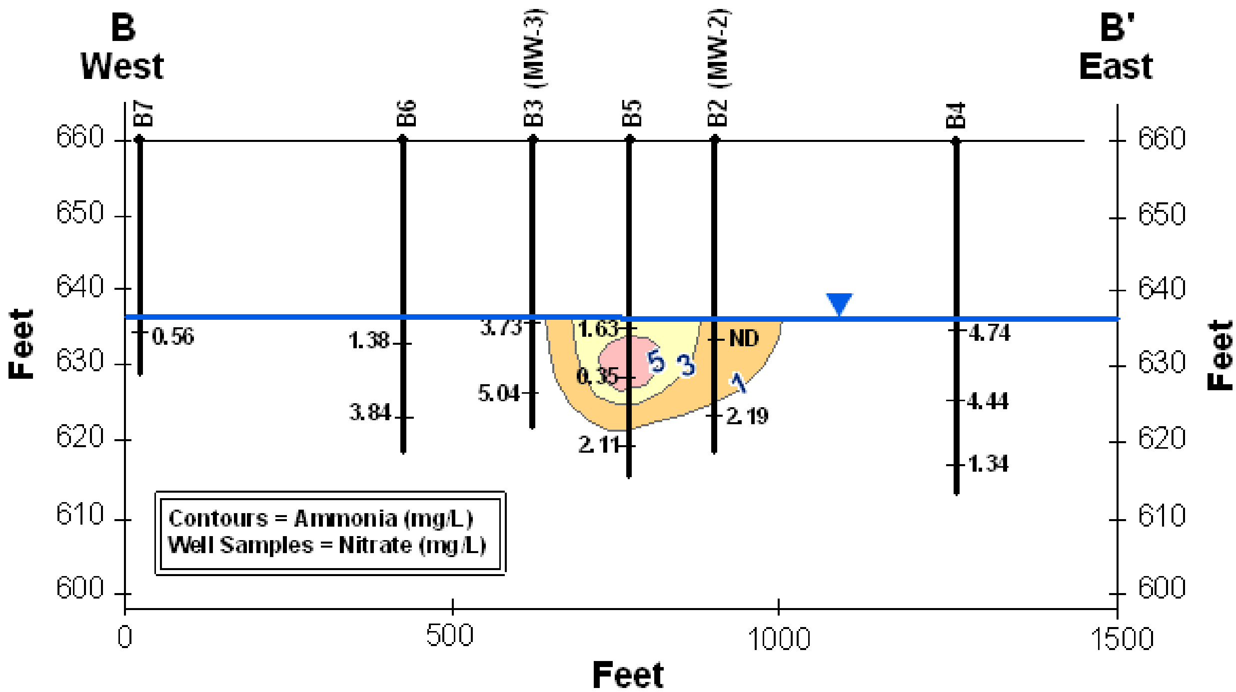

Figure 19. Perpendicular section illustrating ammonia contours in wastewater plume and nitrate concentrations in boring samples. Cross section B-B', looking north.

The most interesting observation concerning the nitrate concentrations outside the ammonia plume (Figure 19, plume extent and outside plume) is that they are similar to the 3-6 mg/L range noted for the Catalina MHP source water (5.2 mg/L nitrate average for PWS raw water) upgradient of the infiltration lagoons. This suggests that the nitrogen processing in the wetland type environment of the wastewater lagoons is fixing or denitrifying the bulk of the nitrogen loading associated with the Catalina MHP wastewater. A rough calculation of the nitrogen loading using average lagoon nitrate + nitrite (9.2 mg/L) and TKN (7.6 mg/L, including ammonia) for 120,000 gallons per day indicates a nitrogen loading of about 17 pounds of nitrogen per day to an area of less than 1 acre. A corn crop with a fertilizer annual application rate of 200 pounds per acre is equivalent to a rate of 0.55 pounds per day. In spite of continuous application of nitrogen at 30 times corn application rates to the Catalina MHP wastewater lagoons since the late 1960's, the ground water concentrations of nitrate appear to be similar to upgradient concentrations recorded for the Catalina MHP PWS wells, and only slightly above the nitrate range reported at MW1. Table 4 presents total nitrogen (Nitrate + TKN as nitrogen) in the upgradient-downgradient table format. The total nitrogen in the lagoons is consistently elevated compared to the downgradient monitoring wells. The nitrogen content in the downgradient monitoring wells is generally similar to the PWS well and typically only 1-2 mg/L above the upgradient monitoring well. Dilution of the wastewater by ground water certainly helps to reduce total nitrogen concentration between the lagoons and the downgradient portions of the plume. The chloride concentrations in the lagoons and at Monitoring Well 2, however, are similar (Table 1) which documents limited dilution between the lagoons and MW2. Thus, assimilative and infiltration processes appear to be removing significant volumes of nitrogen from the wastewater. This is not the result we anticipated but the nitrate concentrations in the wastewater plume do not approach the MCL for nitrate.

Table 4. Chemical Indicator – Total Nitrogen (Nitrate +TKN) mg/L

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		4.61	4.59	6.06	5.77	5.76	5.42
Storm water			0.53	--	--	--	--	--
Upgradient	MW1		--	1.66	4.85	4.1	3.13	3.93
	FE		15.11	11.48	--	--	--	--
Lagoons	L2		--	--	14.63	17.68	25.2	--
	L3		--	10.54	--	--	--	--
Downgradient	MW2		--	3.35	6.95	6.11	1.22	1.3
	MW3		--	3.44	7.38	4.83	4.32	3.53

-- Indicates no sample collected

Phosphorous

Total phosphorous is a component of sewage and its mobility is limited by absorption onto particulate material. The mean value for total phosphorous in ground water in sand and gravel aquifers in Ohio is 0.1 mg/L based on Ambient Ground Water Monitoring Program data. Figure 20 illustrates the total phosphorous results for the boring and monitoring wells samples. Two things stand out. The first is the elevated values, up to 5.74 mg/L, for many of the high turbidity, August 2005 boring samples with phosphorous species adsorbed on to particulate material which are released with acid preservation. The second point is the elevated phosphorous recorded at MW2 in non turbid quarterly samples (filtered equals unfiltered for MW2 duplicate pairs) immediately downgradient from the wastewater infiltration lagoons. The MW2 results document the migration of phosphorous into the aquifer from the infiltration lagoons.

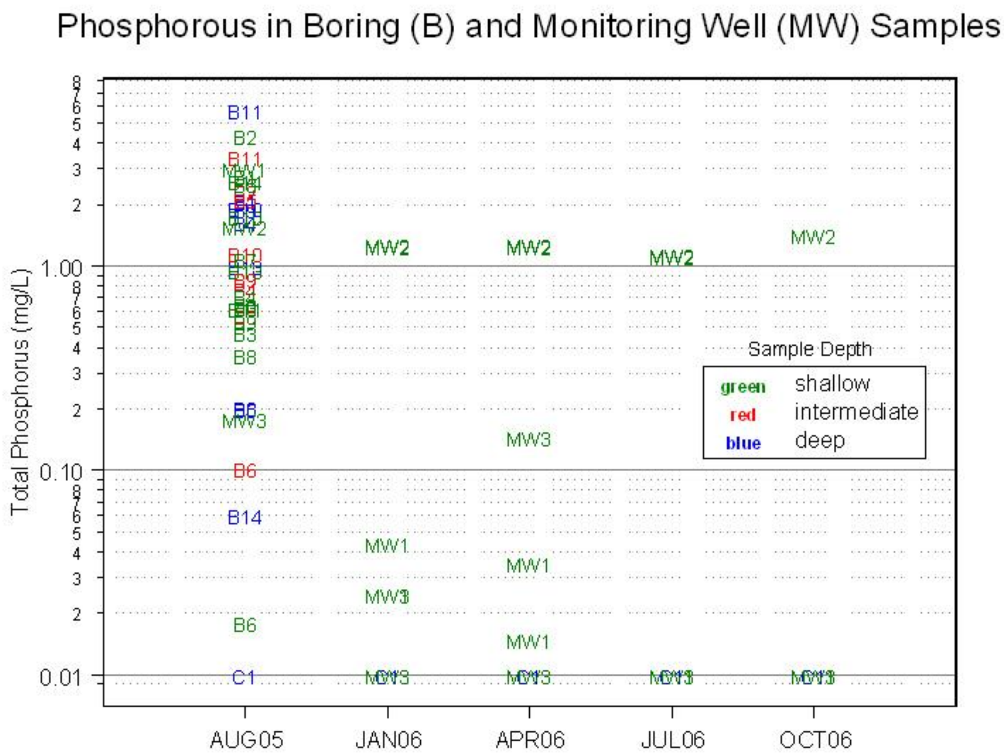

Figure 20. Total phosphorous in boring and monitoring well samples.

Nitrogen and Oxygen Isotopic Analysis

Although the wastewater nitrogen source at the Catalina MHP is known, we collected samples for stable isotope analysis of nitrogen in nitrate to enhance our understanding of the source and fate of nitrogen in this system. Figures 21 and 22 exhibit the nitrogen and oxygen isotope values of nitrate in the monitoring well/lagoon and boring well samples, respectively. For both figures, the horizontal axes record the $\delta^{15}N/^{14}N$ values of nitrate and the vertical axes report the $\delta^{18}O/^{16}O$ values in nitrate. The various boxes drawn on these graphs indicate typical fields into which samples with characteristic nitrogen compositions fall. Note that the synthetic fertilizer field (upper left) coincides with the value $\delta^{18}O$ of +23.5 ‰ (red line), indicating that components of synthetic nitrate fertilizer are typically derived from atmosphere sources. A short summary of basics on nitrogen and oxygen isotopes in nitrate is provided in Appendix C1. The isotope sample results for the boring samples are provided in Appendix C2 and the results for the quarterly samples are provided in Appendix C3.

The most significant processes which can modify nitrate isotope compositions in near surface waters are denitrification and nitrification. Nitrification is the biological oxidation of ammonia first to nitrite (NO2), and then to nitrate (NO3). This process is most active in an aerobic environment, and probably occurs to some extent within the wastewater treatment plant operations. However, detectable ammonia concentrations found at Catalina are generally limited to the lagoons and downgradient plume core samples, and due to the limited increase in nitrate concentration in the plume nitrification is not seen as a dominant process for generating nitrates. Denitrification is defined as the step-wise loss of oxygen from the nitrate molecule ($NO_3 \rightarrow NO_2 \rightarrow NO \rightarrow N$), which occurs generally in the presence of reducing (anoxic) conditions. For interpretation of nitrate isotopes, it is particularly important to identify and account for denitrification, which can greatly enrich (increase) the $\delta^{15}N/^{14}N$ values of the residual nitrate. This enrichment can be mistaken as having a septic/manure source, since the $\delta^{15}N/^{14}N$ isotope compositions of denitrified nitrate and a septic source can be similar. Using a dual-isotope approach (analyzing both nitrogen and oxygen of nitrate), in conjunction with nitrate concentrations, helps to clarify whether denitrification is a dominant process in the system being studied. In the case of Catalina, no denitrification was identified in either the lagoon system, or the downgradient monitoring wells or borings, based on interpretation of sample nitrate concentrations and their associated isotope values. Reducing conditions, as identified through low oxidation reduction potential (ORP) values within and beside the plume certainly make denitrification possible. But the combination of oxygen isotope values in excess of background levels, and the lack of correlation between increasing $\delta^{15}N/^{14}N$ and lowered nitrate concentrations (the primary signature of denitrification), rules out denitrification as a dominant source of elevated $\delta^{15}N/^{14}N$ values in Catalina MHP ground water.

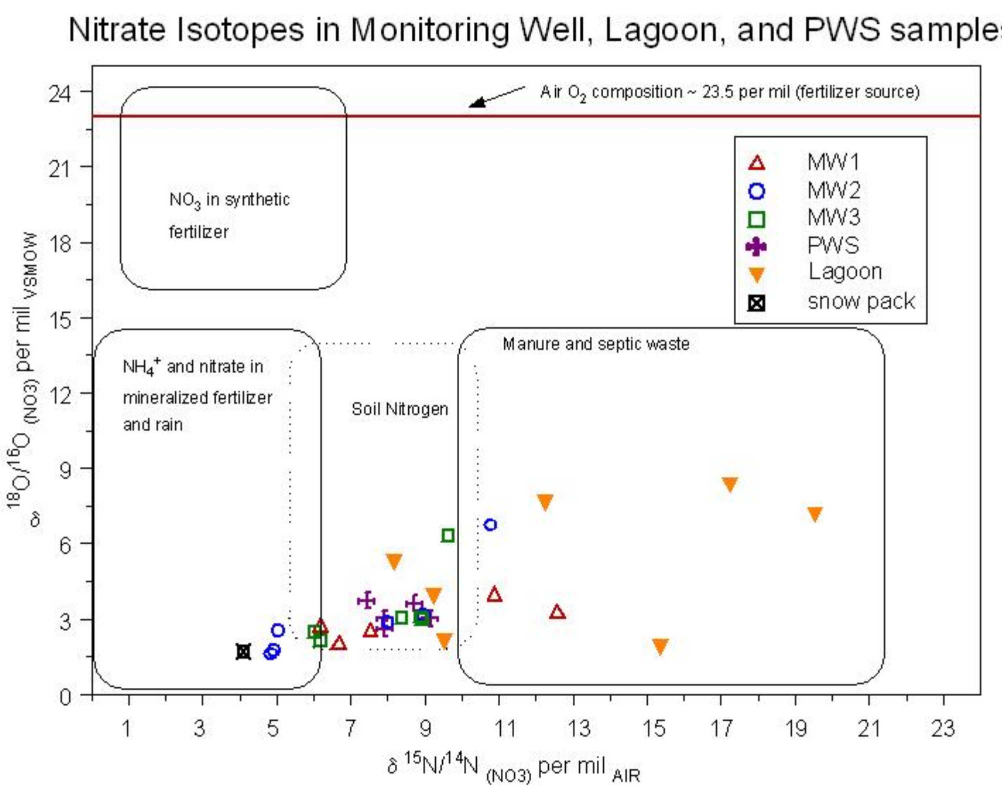

Figure 21. Nitrate isotopes in monitoring wells, lagoon and PWS samples.

The isotopic results for Catalina MHP samples are consistent with a septic source for nitrate in the wastewater lagoons and dilution of wastewater downgradient as the lagoon infiltrate mixes with soil-water and groundwater. Figure 21 includes the lagoon, monitoring well, and snowpack samples. Several lagoon samples record heavy nitrate isotopes ($\delta^{15}N/^{14}N > 10$) and occur solidly in the manure and septic waste field as expected for a wastewater source. The snowpack sample was collected in Columbus to identify the nitrate isotopic signal in rainfall/recharge in central Ohio. Its nitrate isotope composition is the most depleted (lowest) of all samples, consistent with its winter air-mass source. The monitoring well samples in Figure 21 plot between the extremes of the lagoon samples and the snowpack sample and generally occur within the soil nitrogen field and lower manure and septic field. Figure 22 records the isotopic composition of nitrate in the boring samples with the samples clustering again mainly in the soil nitrogen field, but also within the lower manure and septic field. The boring samples are coded to indicate borings in the plume core, plume extent, and outside plume, the same boring subsets used in the ammonia discussion (Figure 18). Generally, the most isotopically enriched (higher $\delta^{15}N/^{14}N_{(NO3)}$ values) boring samples are associated with the plume and the lightest are outside the plume extent. The simplest interpretation of the data presented in Figures 21 and 22 is two-end member mixing of the lagoon wastewater with existing ground water causing a dilution of the more enriched wastewater composition to produce mixed waters with a range of lighter nitrogen isotope compositions.

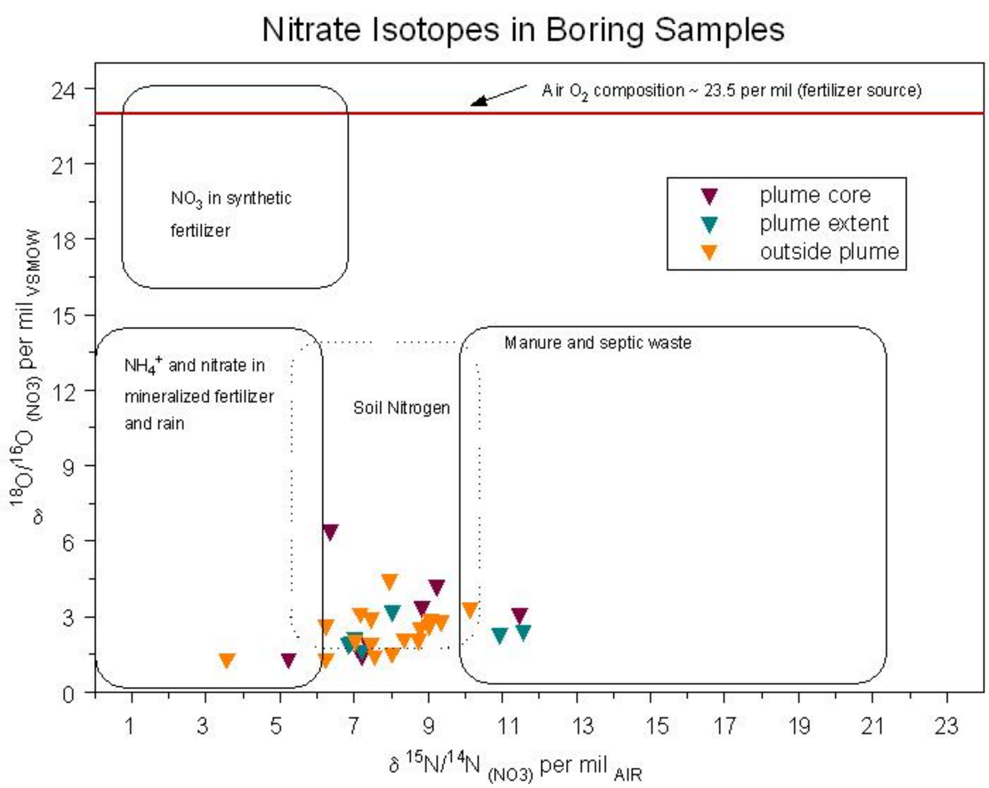

Figure 22. Nitrate isotopes in boring samples.

In Figure 21the results for the PWS samples, the lagoon samples, and the individual monitoring well samples are indicated with distinct symbols. The lagoon samples indicate a significant range of $\delta^{15}N/^{14}N$ values. The range in isotope composition of the lagoon samples (about 10 per mil in both $\delta^{18}O$ and $\delta^{15}N$) is interpreted as resulting mainly from changes in composition at the surface due to dilution through precipitation, evaporation, uptake by lagoon biota, denitrification within the lagoon environment (water body, flora and lagoon mat), and perhaps some variability in the source term itself, the septic inflow isotope composition. These processes are most active in the surface environment, for example the storm water or wastewater lagoons in which reducing conditions tend to prevail due to the influx of nutrients. The isotopic signature developed in the lagoons, and other surface environments is carried with the infiltrate/recharge water and this signature is diluted as the recharge mixes with the resident ground water. The quarterly samples from each monitoring well exhibit a variability in $\delta^{15}N/^{14}N_{(NO3)}$ of 5-7 per mil. This variability results from the inconsistent isotopic composition of the recharge waters that are mixed with ground water. The result is a mixed water that exhibits a reduced range of $\delta^{15}N/^{14}N$ values. It is important to note that the ground water with which the wastewater infiltrate is mixing may also exhibits some isotopic variability as a result of recharge.

All of the monitoring wells exhibit variability in their isotope composition, but the range of the monitoring well sample values is much less than that of the lagoon (source) samples, which is indicative of their mixed nature. Two samples taken from monitoring well (MW1, red triangles), upgradient of the infiltration lagoons, plot in the lower left portion of the manure and septic waste field, and are the most enriched of all monitoring well samples. This suggests that MW1 is influenced by wastewater recharge and may indicate some groundwater flow upgradient from the wastewater lagoons. Alternatively, the ground water chemistry at MW1 may be influenced by wastewater inflow from poorly maintained sewage infrastructure or organic rich sediments within the aquifer. The remaining two monitoring wells, MW2 and MW3, within the core and on the west flank of the wastewater plume respectively, are also plotted (blue circles and green squares) in Figure 21. Both monitoring wells have single samples which plot in or near the manure and septic waste field. Significantly, the enriched oxygen isotope values of these samples cannot be attributed to any source but the infiltrate of the upgradient wastewater lagoons. The rest of the MW2 and MW3 samples cluster in the soil nitrogen field of Figure 21, and represent regional ground waters perhaps mixed with minor amounts of lagoon infiltrate.

The public water system nitrate isotope samples taken at Catalina MHP plot consistently within 2 per mil of each other for both oxygen and nitrogen (orange crosses in Figure 21). These samples have isotope values well within the soil nitrogen field on Figure 21, and can be interpreted as reflecting the upgradient background of the aquifer approximately 20 feet below the water table (50 foot wells). The lack of isotopic variability within the PWS samples is a further indication that this portion of the aquifer receives recharge which is isotopically consistent (due largely to the depth of the well screen), in contrast to the monitoring wells, whose range in isotope compositions is much greater due to their proximity to the water table.

The boring samples at Catalina are summarized in Figure 22, and display a variability of about 9 per mil in nitrogen and about 5 per mil in oxygen. The samples are coded according to their position within the plume, as defined in previous sections using chloride and TDS. With respect to the core of the plume, the boring samples range from the low soil-nitrogen portion of the field to well into the manure and septic field, indicating that the input to the plume is quite variable. The borings identified as "plume extent" (meaning that they lie in the downgradient portions of the wastewater plume) reveal isotope compositions nearly as variable as those from the core, but not quite as varriable. The most enriched "plume extent" samples are solidly within the manure and septic waste field of Figure 22. In contrast, the boring samples identified as being "outside plume" on Figure 22 occur only within or slightly below the soil nitrogen field. The most depleted boring sample (lowest $\delta^{15}N/^{14}N$) is boring B3 which exhibits influence from the storm water lagoon. The storm water lagoon does not include septic discharge and thus exhibits lower $\delta^{15}N/^{14}N$ values than the wastewater lagoons. Consequently, it is logical that a boring sample that receives storm water recharge would be lighter than the other boring samples.

Overall the isotopes of nitrogen and oxygen in nitrate are consistent with simple mixing of lagoon infiltrate with local ground water to generate the wastewater plume. The isotope values of the monitoring wells and borings generally coincide with boundaries and extent of the wastewater plume as defined by more conservative inorganic parameters. The wastewater lagoons are a highly complex environment with respect to nitrogen transformations. Processes within can fractionate (change) the relevant isotope compositions include denitrification and nitrification. Other complicating processes include intricate mixing interactions of recharge and ground water, and the natural lag time between recharge and sampling. Even with these considerable complications, the isotope data presented in this report clearly record the mixing of wastewater infiltrate and ground water downgradient of the wastewater lagoons, providing additional documentation for the presence of a wastewater infiltration plume downgradient of the Catalina MHP wastewater lagoons.

Analysis of Microbiological Results

The biologic results from ground water samples produced low counts to non detects for pathogen indicators in contrast to significant detection levels in the final effluent and lagoon samples. This indicates that the filtering processes associated with infiltration of partially treated wastewater from the lagoons are removing the bulk of the pathogens. Several ground water samples did record detections of total coliform, *E. coli*, and enterococci so there is evidence of pathogen transport but at low levels. The microbiologic results are presented in Appendix D with one table for the Geoprobe boring sample results (Appendix D1) and a second table for the monitoring well sample results (Appendix D2). These samples are presented separately due to the high turbidity of the boring samples and the contrast of low turbidity and repeated samples collected from the monitoring wells.

Fecal Indicators in the Monitoring Wells

The total coliform, enterococci, and *E. coli* sample results for the PWS wells, the lagoon and monitoring wells are presented in Tables 5, 6, and 7 respectively. The data are presented in the upgradient to downgradient format used previously. The preliminary October 2004 sample results, used to help identify parameters to define the wastewater plume, are also presented.

Table 5. Microbiologic Indicators - Total Coliforms (Colilert Method, colonies/100mL)

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		<1	--	<1	<1	<1	<1
Storm water			>2419	--	--	--	--	--
Upgradient	MW1		--	<1	<1	<1	<1	<1
	FE		>2419	198600	--	--	--	--
Lagoons	L2		--	198280	19863	5500	579	>2500*
	L3		--	198628	--	--	--	--
Downgradient	MW2		--	<1	5	<1	<1	387
	MW3		--	3	<1	<1	<1	<1

-- Indicates no sample collected * Sample 2/3 sediment - results inaccurate

Table 6. Microbiologic Indicators - Enterococci #/100 mL

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		<1	--	<1	<1	<1	<1
Storm water			110	--	--	--	--	--
Upgradient	MW1		--	16	<1	<1	<1	<1
	FE		2755	2723				
Lagoons	L2		--	7701	933	127	23	>2500*
	L3		--	5794	--	--	--	--
Downgradient	MW2		--	2	<1	<1	<1	<1
	MW3		--	<1	<1	<1	<1	<1

-- Indicates no sample collected * Sample 2/3 sediment - results inaccurate

Table 7. Microbiologic Indicators - *E-coli* #/100mL

Sample Location			October-04	August-05	January-06	April-06	July-06	October-06
PWS	C1		<1	--	<1	<1	<1	<1
Storm water			228	--	--	--	--	--
Upgradient	MW1		--	----	<1	<1	<1	<1
	FE		>2419	27230	--	--	--	--
Lagoons	L2		--	30900	4611	630	62	550*
	L3		--	32550	--	--	--	--
Downgradient	MW2		--	----	<1	<1	<1	4
	MW3		--	----	<1	<1	<1	<1

-- Indicates no sample collected * Sample 2/3 sediment; results inaccurate

---- Sample collected, no results

The August 20005 samples were the initial samples collected from the monitoring wells that were installed with the Geoprobe. These August 2005 samples were turbid. The January, April, July, and October 2006 samples were collected on subsequent quarterly sampling events. The purging of the monitoring well prior to sampling for each quarterly sample helped to improve the development of the monitoring wells and the use of a peristaltic pump for all quarterly sampling after the August 2005 sampling helped to produce non turbid samples. The relative locations of the monitoring wells and the lagoons are provided in Figure 10 and ground water flows in a direction of South 10-15^{o} West (Figure 8).

The contrast in the concentration of these biologic indicators between the lagoons (FE, L2, L3) and the upgradient and downgradient wells is striking. Most of the ground water samples are non detect for the biologic indicators, and only two samples have counts greater than 10 cfu/100 mL (MW1 in August 05 for enterococci and MW2 in October 06 for coliform). From a regulatory basis, values of less than 10 cfu/100 mL would not trigger the membrane filtration test results as unsafe samples for these indicators. Considering the high concentrations of these biologic indicators in the lagoons and the dominance of non detect values in the downgradient monitoring wells, it appears most pathogens associated with the partially treated wastewater are being removed by disinfection and filtration processes within the lagoon bottoms, the vadous zone, and/or within the shallow aquifer. Thus it appears that poorly sorted sand and gravel deposits typical of Ohio buried valley aquifers are an effective filtration media.

The presence of several pathogenic indicators in the monitoring well samples, however, indicates the filtering processes are not perfect. The October 2006 coliform sample from MW2 with a result of 387 counts /100 mL and *E. coli* of 4 counts /100 mL stands out and suggests that some microbiologic migration is occurring up to 200 feet downgradient of the lagoons. September 2006 recorded high rates of rainfall, 5 inches for the month, which may help explain the October 2006 samples.

The steady decrease in the concentration of microbiologic indicators within the lagoons from August 2005 through July 2006 (Tables 5-7) is surprising. Clearly there are complex interactions between septic sources, rainfall, temperature variation, and lagoon biota, but generally the expectation is that fecal indicators will be elevated in wastewater lagoons. The Ohio EPA, Division of Environmental Services lab recorded significantly higher counts for *E. coli* in the July 2006 sample than the U.S. EPA lab, so the trend may not be as clear as suggested in Tables 5-7 and may reflect sample variation. This trend may be associated with the practice of chlorinating partially treated wastewater. NPDES permits require chlorination of treated wastewater discharged to streams from April to October. The Catalina MHP does not have an NPDES permit since they do not discharge their wastewater to a stream and consequently, they are not required to chlorinate their partially treated wastewater. However, chlorine tablets were observed in the partially treated wastewater flow path. We do not know if the inclusion of chlorine tablets in the wastewater flow is a common practice at Catalina MHP or if this practice was instituted or increased during the course of our infiltration study.

The conclusion that the infiltration of partially treated wastewater from the lagoons is removing the bulk of the pathogens is further documented by the generally low counts of fecal indicators in the boring samples as compared with the lagoon samples. The details of the microbiological results in the borings are difficult to interpret due to a lack of trends within the data, but this inconsistency supports the broader conclusion that the unconsolidated material provides an effective downgradient barrier to pathogen transport. The seemingly random nature of the boring data may not be straight forward for several reasons:

- Geoprobe sampling technique may transport soil particles to depth;
- Some microbiologic parameters analyzed are not fecal specific;
- Duplicate samples indicate some variability;
- Elevated numbers for equipment blank; and
- The borings with elevated boring pathogen indicator sample counts do not correlate with the core of the plume trace.

These details provide uncertainty in the interpretation of the microbiologic results and each is discussed below.

Geoprobe Boring Sampling Technique

The Geoprobe sampling method of driving rods to depth and sampling the ground water as the rods are removed, may transport soil material to depth. We have little experience with the Geoprobe sampling for microbiological parameters, and consequently we tried to evaluate these data to determine if the microbiologic results suggest vertical contamination transport along the well bore. Figure 23 plots the heterotrophic plate count (R2A media) against depth. The general decrease in HCP counts in the deeper samples is what we would expect for the microbiologic community. Thus, it appears that the sampling technique, in spite of possible material transport, has provided reasonable results.

Non Fecal Indicators - Aerobic Spores

Appendix D includes the results for aerobic spores. The analytical procedure used to determine aerobic spore concentrations was designed to be a surrogate measure of the microbiologic content in water. Elevated aerobic spores could indicate a potential break in treatment/ distribution lines. The bacteria that produce these spores exhibit high numbers in soil and surface water. Spore counts in the Ohio River are typically in the 200 to 400 cfu/mL (20,000-40,000 cfu/100mL, Cliff Johnson personal communication), similar to what we are seeing in the lagoon samples (11,000 – 33,000 cfu/100mL). The Geoprobe boring methods utilized, driving rods to depth and sampling the ground water as the rods are removed, may transport soil material to depth. Low flow purging before sampling was completed to minimize contamination due to sampling procedures. The presence of aerobic spores in the boring samples was not unexpected, but it is not clear if the variable results (<1 to 2,800 cfu/100mL) reflect the microbiologic community at the sample depth, or results from contamination transported to depth during the boring process to collect the sample.. The heterotrophic plate count data presented in Figure 23, illustrating decreased HPC-R2A sample counts with depth, suggests the sampling approach is not contaminating the sample results, but it is circumstantial evidence.

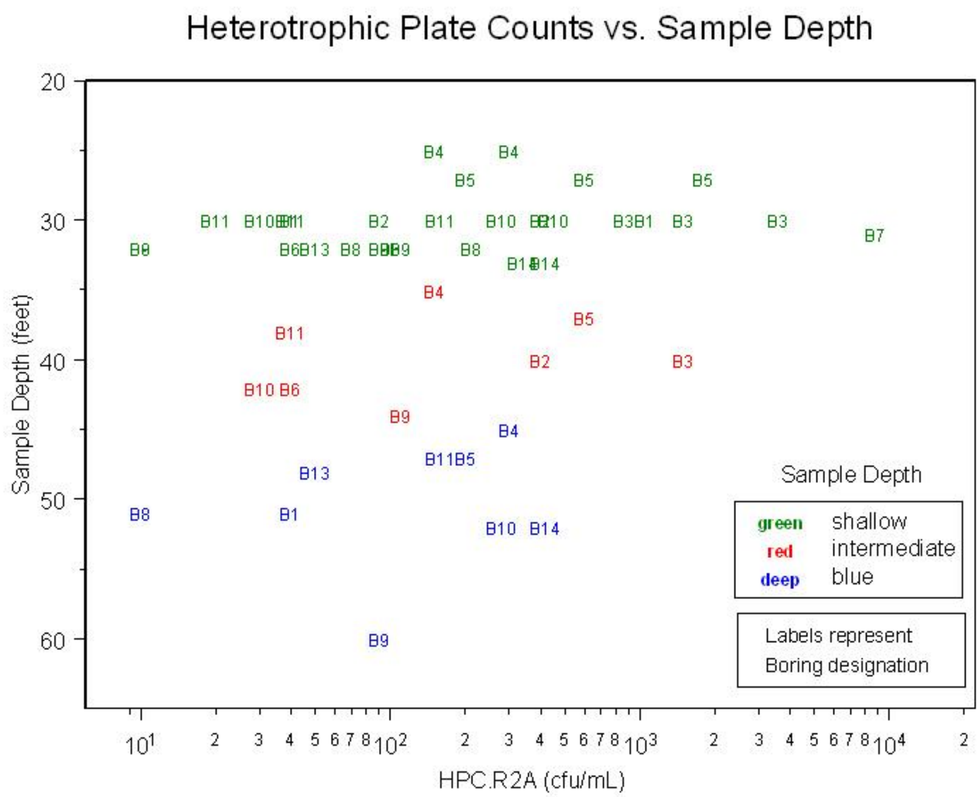

Figure 23. HCP-R2A counts against sample depth.

Non Fecal Indicators - Heterotrophic Plate Counts

The heterotrophic plate counts (HPC) are “simple culture-based tests which are intended to recover a wide range of microorganisms” (WHO, 2002, pg. 2). The organisms detected require organic carbon for growth and include bacteria, yeasts, and molds, many of which are non-hazardous micro-biota in water. The World Health Organization states, “there is no evidence that HCP values alone directly relate to health risk either from epidemiological studies or from correlation with occurrence of waterborne pathogens.” They further state, “in the absence of fecal contamination, there is no direct relationship between HPC values in ingested water and human health effects in the population at large” (2002, pg.5). Consequently, not much weight is placed on the HPC data for evaluating health impacts of the Catalina MHP infiltration of partially treated wastewater. However, the total microbiological load, whether enteric or otherwise, could reasonably be expected to be greater in a mixture of lagoon effluent and ground water than in ground water alone. Samples with elevated coliform counts generally exhibit higher HPC numbers. Samples with significant heterotrophic plate counts, however, may not detect coliforms as illustrated in Figure 24 with HPC (R2A media) samples of up to 1000 cfu/mL with no coliforms detected.

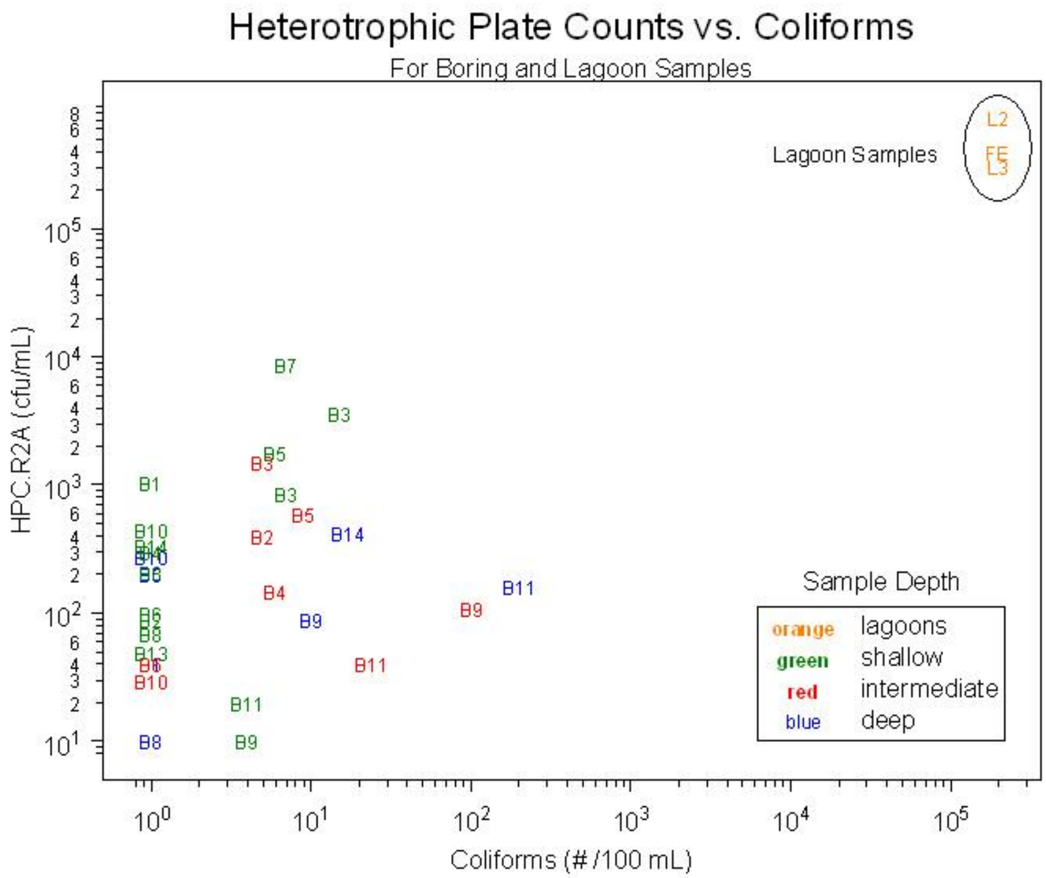

Figure 24. Association of heterotrophic plate counts (R2A) and coliform in boring samples.

Duplicate Samples Indicate Variability

The boring samples included two duplicate samples. These are not true aliquot duplicates but rather discrete samples taken right after one another. In a low flow setting, detectable differences are to be expected, especially in turbid samples as these samples were. Although the results of the duplicate samples (dupes in Appendix D1) were similar, significant variability is present in the turbid boring samples. For example the coliform pairs exhibited results of 15 and 7 (#/ 100 mL) and a pair of non detects and the enterococci pairs recorded 12 and 16 (#/100mL) and non detect and 5 (#/100 mL). These results are within 5-10 percent of the higher counts detected, but they do not indicate high precision. The heterotrophic plate count for duplicate pairs exhibit differences of three to four times (cfu/mL). We see significant differences between duplicate samples for the inorganic parameters strongly influenced by turbidity, but the major elements like chloride, sodium and TDS are similar (within 2 %). These results suggest caution in interpretation. Fortunately, the overall numbers are low but suggesting a significant distinction between a parameter with 5 and 10 #/100 mL in the boring microbiologic data has to be considered risky at best. The duplicate samples collected with the low turbidity monitoring well data exhibit better correlation.

Elevated Counts for Equipment Blank

One equipment blank was collected with the boring samples and the results indicate that more attention to detail should have been taken regarding equipment blanks. The inorganic results for the equipment blank were good, with all parameters at non detect concentrations, but this was not the case for the microbiologic samples. The equipment blank results recorded non detect for enterococci; 5/100 mL for coliforms; 800 cfu/100mL for aerobic spores; 830 cfu/100 mL for HCP-PCA; 32,000 cfu/100mL for HPC-R2A; 50 pfu /50mL for somatic phage; and non detect for F+ phage (Appendix D1). The values for the HCP-R2A and somatic phage are the highest results recorded for the Catalina ground water samples by significant margins.

Several 5 gallon containers were used for rinse water. The rinse water was derived from a filtration system consisting of two mixed bed filters followed by a charcoal filter. The system is set up for inorganic and VOC removal. Historically the Site Investigation Field Unit (SIFU) has not worried about microbiological contamination. The rinse water is stored in 5 gallon containers (rinsed with rinse water and air dried). The moist environment of these containers during the air drying process appears to be a good breeding ground for microbiological organisms.

The U.S. EPA virologist suggested we may have contaminated the rinse water with lagoon water (no rinse water used in collecting lagoon samples) which is characterized by elevated somatic phage over F+ phage. This possibility seems unlikely since different workers sampled the lagoons and the Geoprobe borings. Given that only one blank was taken and analyzed, it's impossible to pin down the source of the contamination, or when it occurred, a deficiency in our QA/QC sampling. This equipment blank suggests that the rinse water may be contributing elevated microbiological counts

The equipment blank was collected by collecting rinse water poured through a Geoprobe rod and disposable screen prior to use in a boring. Rinse water was only used to wash and rinse the Geoprobe rods between borings. Washed and rinsed rods were driven to depth and then the rods were pulled up to expose the 4 foot screen. The sample was collected using a low flow inertial hand pump (2 gallon purge volume) to collect water through the screen attached to dedicated tubing for each boring. Consequently, the rinsed rods had limited exposure to the sampled water, which may explain the apparent limited impact of elevated detections in the equipment blank compared to the Geoprobe boring sample results.

Clearly we should have addressed the possible contamination of rinse water with microbiologic parameters more carefully. The fact that the counts for the equipment blank are generally higher than the sample results suggests the rinse water contributed a significant portion of the microbiologic equipment blank results, but the rinse water did not contaminate the actual boring ground water samples. The quarterly monitoring well samples are higher quality ground water samples due to their reduced turbidity, and the duplicate samples exhibit significantly lower variability than the boring samples. This suggests that most of the detections recorded did not come from the rinse water, but the possibility of significant contamination from rinse water is real and difficult or impossible to evaluate.

Elevated Microbiologic Samples Do Not Correlate with Plume Source

The wastewater lagoons are the major source of pathogens within the study area. If the infiltration processes are not removing pathogens, the borings immediately downgradient of the wastewater lagoons should exhibit high concentration of these pathogens. Filtration processes and pathogen die off with continued movement downgradient should decrease the presence of pathogenic organisms. Figure 25 illustrates the distribution of detections for coliform and entercocci along cross section A-A' (location in Figure 7). There are frequent but low detections (1-9 counts/100 mL) in the borings just downgradient of the lagoons. These detections appear to be more frequent in the area of high chloride content in the core of the wastewater plume, than in distal areas of the plume. Detections of both coliform and enterococci, however, are present at greater distances and at higher counts than within the core of the plume. Other borings not projected on to section A-A' exhibit higher counts for both coliforms (100-200 cfu/100mL in B9 and B11) and enterococci (20-200 cfu/100mL in B3, B9, and B11). Considering the uncertainty of these data (turbid samples, duplicate variability, and possible rinse water contamination), it is not possible to identify any trends beyond the general concept that the pathogens are present at low concentrations.

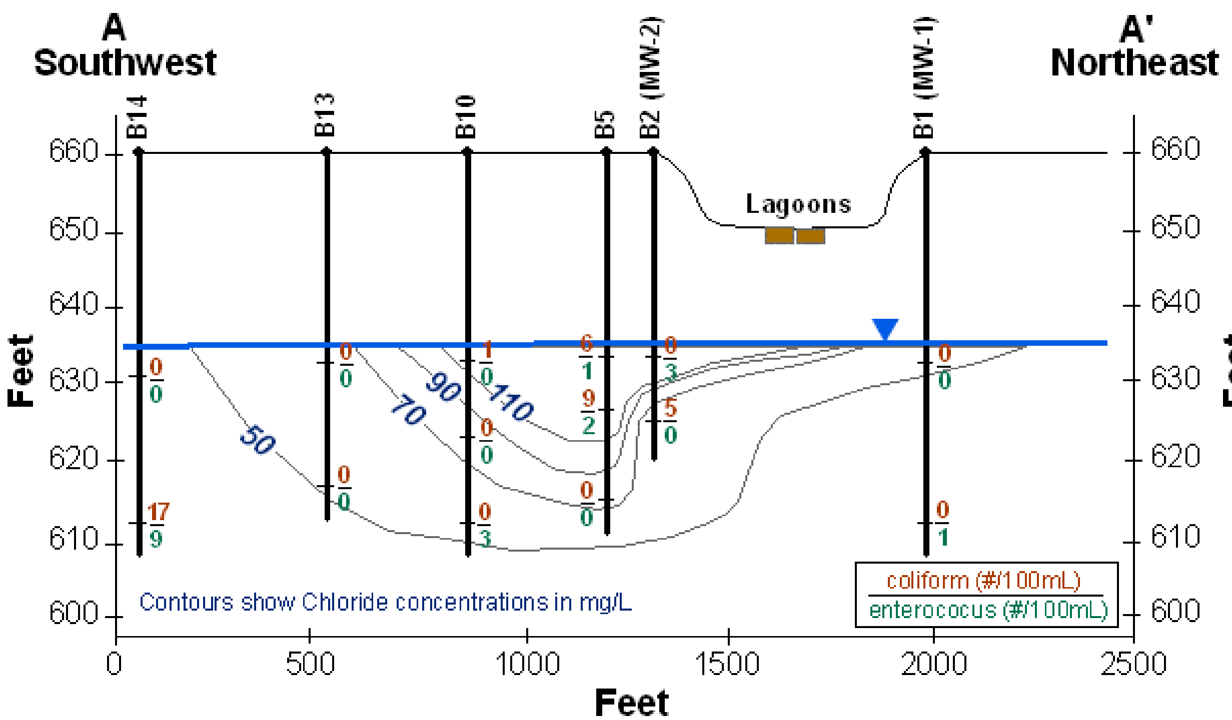

Figure 25. Coliform and Enterococci counts for boring samples in section A-A'.

Overall the lagoon infiltration system appears to be effective at removing most of the pathogens and pathogen indicators by the time infiltration water reaches the property boundary. The microbiologic results from the boring samples do not exhibit significantly higher concentrations of counts immediately downgradient of the lagoons or in the core of the plume. Although several of the boring samples collected immediately downgradient detected pathogens, the detections counts are generally low with higher counts or comparable counts in boring samples located further downgradient.

Virus Indicators

The August 05, April 06, and October 06 samples were analyzed for coliphage. Coliphage are viruses that infect *E.coli.*, but few other bacteria. Consequently, coliphage are associated closely with fecal contamination and they were included as a fecal indicator in the final Ground Water Rule (November 2006). Some Catalina MHP samples were analyzed for somatic phage and F+ Phage (male specific phage) with results reported in phage forming units (pfu). Tables 8 and 9 provide the coliphage data from the monitoring wells for somatic phage and F+ phage respectively. Coliphage is not present in the downgradient monitoring wells except for the August 05 somatic phage sample. Somatic phage was detected in all the August 05 monitoring well samples. For the F+ phage samples only the upgradient monitoring well and the PWS sample from the April 06 sampling recorded detections. These results make it difficult to attribute the phage sources solely to the wastewater lagoons.

Table 8. Microbiologic Indicators - Somatic Phage pfu/50 mL

Sample Location			August-05	January-06	April-06	July-06	October-06
PWS	C1		--	--	0	--	0
Upgradient	MW1		8	--	0	--	0
	FE		TNTC (922)	--	--	--	--
Lagoons	L2		TNTC (1128)	--	27	--	--
	L3		TNTC (964)	--	--	--	--
Downgradient	MW2		9	--	0	--	0
	MW3		6	--	0	--	0

TNTC – too numerous to count; ( ) values of 1:2 dilution sample

-- Indicates no sample collected

Table 9. Microbiologic Indicators - F+ Phage pfu/50 mL

Sample Location			August-05	January-06	April-06	July-06	October-06
PWS	C1		--	--	1	--	0
Upgradient	MW1		0	--	4	--	0
	FE		40	--	--	--	--
Lagoons	L2		54	--	0	--	--
	L3		35	--	--	--	--
Downgradient	MW2		0	--	0	--	0
	MW3		0	--	0	--	0

-- Indicates no sample collected

A plot of the F+ phage results (by location and depth) is provided in Figure 26 for the August 2005 boring samples. The numbers for phage forming units are low, even in the lagoons. There is an association of detections of F+ phage in borings within the core of the wastewater plume (B5 and B10, locations in Figure 7) with detections ranging from 1-4 pfu/50 mL. There are no detections of F+ phage in the borings and monitoring wells adjacent to B5 (B2/MW2 and B3/MW#, east and west respectively) or B10 (B9 or B11, northwest and south southeast respectively). The lack of impact documented in the monitoring well and boring B2/MW2 that have consistently recorded inorganic water quality impacts related to wastewater infiltration, may suggest the low count F+ phage (male-specific phage) detection is more random than significant. This is not easy to determine with the limited data available.

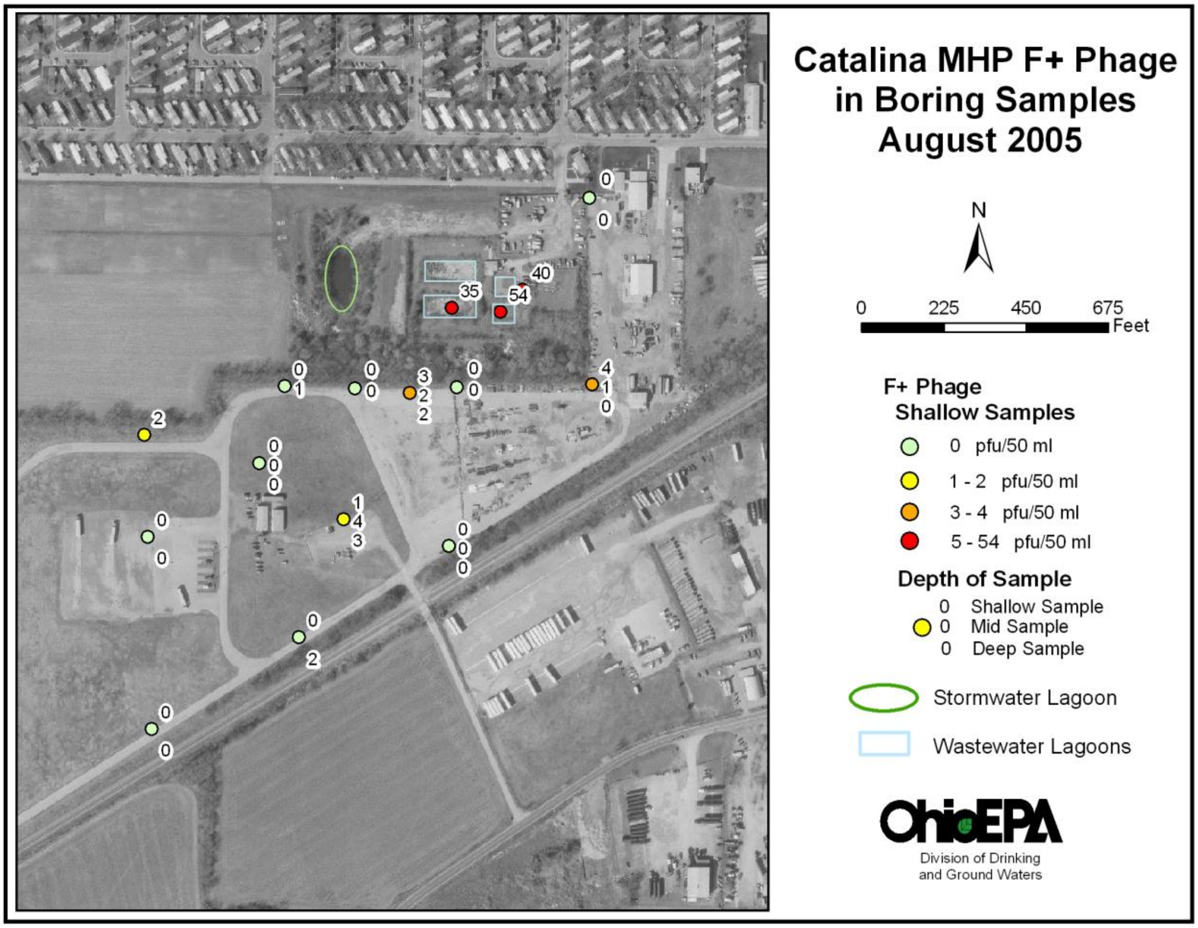

Figure 26. F+ phage (male-specific phage) in boring samples.

By their nature microbiologic parameters are episodic and consequently analytical results are difficult to interpret. The ground water samples are recording low numbers for detections of F+ phage and slightly higher numbers of somatic phage, but it is not clear that the lagoons are the only source of the phage detected in the ground water samples.

Pharmaceutical Parameters

Susan Glassmeyer, U.S. EPA Office of Research and Development, coordinated the analysis of the Catalina MHP samples for a suite of pharmaceutical parameters (USGS method 9003, Cahill et al. 2004) with the USGS National Water Quality Laboratory staff. This analytical method identifies the following parameters: codeine, caffeine (a nicotine metabolite), thiabendazole, albuterol, acetaminophen, cotinine, dehydronifedine, carbamazapine, trimethoprim, warfarin, diphenhydramine, sulfamethoxazole, diltiazem, ibuprofen, ranitidine, cimetidine, fluoxetine, gemfibrozil, naproxen, erythromycin, azithromycin, miconazole, metformin. The results identified significant detections of sulfamethoxazole, an antibiotic, and carbamazapine, an anticonvulsant and mood stabilizing drug. A preliminary geographic analysis of the sulfamethoxazole results is provided here in support of the delineation of the Catalina MHP wastewater plume. The pharmaceutical sample results are presented in Appendix E with the boring sample results in Appendix E1 and the quarterly sample results in Appendix E2. Detailed analysis of the pharmaceutical results will be presented by U.S. EPA and USGS staff in separate publications.

Table 10 presents the sulfamethoxazole results for the lagoons and monitoring well samples in the upgradient to downgradient format used in previous tables. The PWS wells and the upgradient monitoring well (MW1) recorded non detects with one exception. The presence of sulfamethoxazole in MW1 in the August 2005 sample is one more indication that there may be some migration of wastewater infiltrate moving upgradient to MW1. The lagoons record the highest concentrations of sulfamethoxazole, however, significant variation is observed. The variation in the lagoon concentrations of sulfamethoxazole leads to ground water samples recording higher sulfamethoxazole concentration than the lagoons at the time of the August 2005 sampling. MW2, the downgradient monitoring well due south of the wastewater lagoons recorded the highest ground water concentrations for sulfamethoxazole, with significantly lower concentrations in MW3, which appears to be influenced by the storm water lagoon. These results are consistent with the inorganic samples from the monitoring wells.

Table 10. Sulfamethoxazole in Lagoon and Boring Samples (ppb)

Sample Locations			August-05	January-06	April-06	July-06	October-06
PWS	C1		ND	ND	ND	ND	ND
Upgradient	MW1		0.049	ND	ND	ND	ND
	FE		E 0.156	--	--	--	--
Lagoons	L2		0.188	1.770	3.050	1.630	ND
	L3		E0.237	--	--	--	--
Downgradient	MW2		0.354	0.266	0.898	0.451	E0.127
	MW3		E0.02	0.029	0.030	E0.011	E0.018

E Estimated result -- Indicates no sample collected

Figure 27 illustrates the distribution of sulfamethoxazole in the boring samples. The detections of sulfamethoxazole along a south southwest trend downgradient from the wastewater lagoons follows the delineated wastewater plume based on inorganic parameters. This is exactly what we would expect to see with pharmaceutical tracers that are not strongly absorbed or otherwise attenuated in ground water. The pharmaceutical equipment blank exhibited no detections of analyzed parameters with the possible exception of caffeine. The results of sulfamethoxazole for the boring samples are provided in Figure 27 in stacks of labels just to the right of the boring locations. The stack of results is ordered according to depth with shallow sample results on the top and deeper samples on the bottom of the list. A quick review of these results illustrate that the concentration of sulfamethoxazole decreases with depth in the borings within the core of the wastewater plume. This is what we would expect with dispersion and diffusion of wastewater components to greater depth as flow moves downgradient. These pharmaceutical data support the delineation of the Catalina MHP wastewater plume.

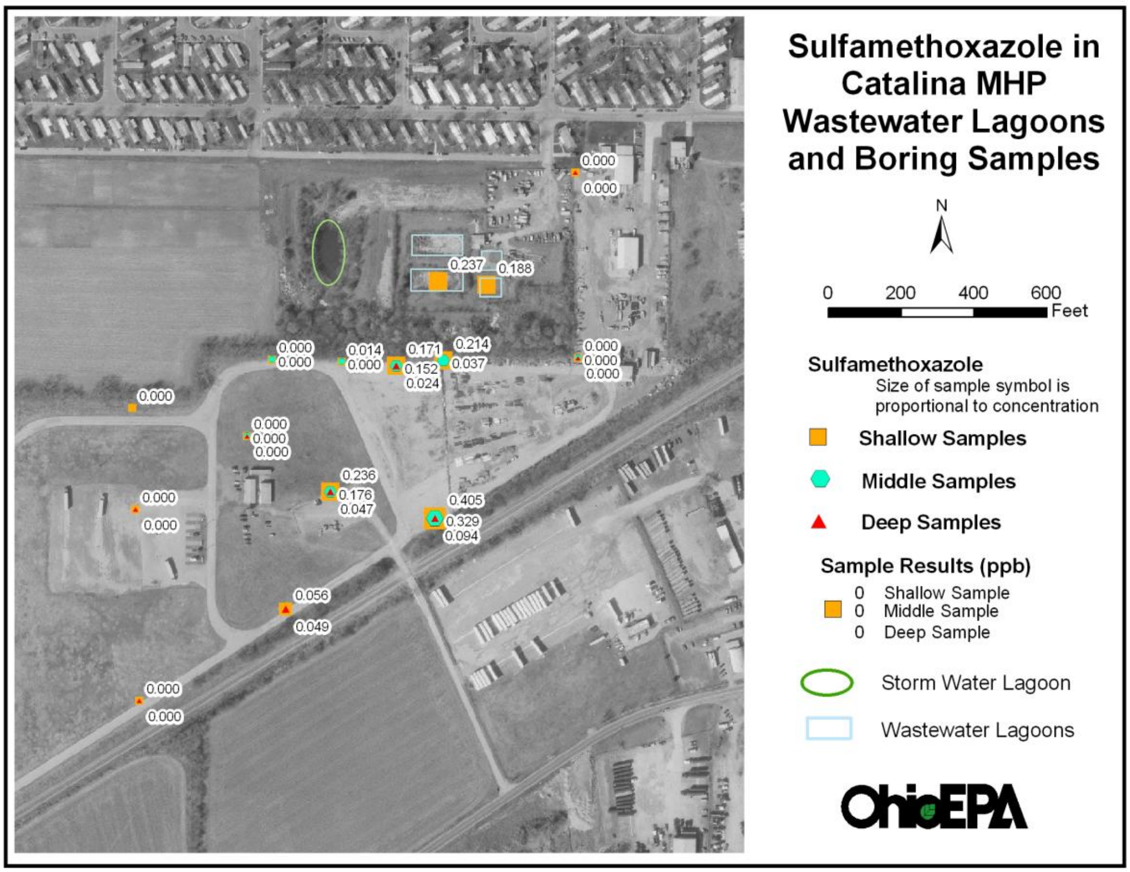

Figure 27. Distribution of sulfamethoxazole in the boring samples.

The presence of sulfamethoxazole at low concentrations in MW1, the upgradient monitoring well (Table 10), suggests that there is some migration of wastewater upgradient. The results from the B1 samples for sulfamethoxazole were non detect. The August 2005 MW1 inorganic sample recorded a low concentrations of ammonia (Table 3, 0.14 mg/L) which, at higher concentrations has been used to identify portions of the downgradient wastewater plume in the turbid boring samples. The possibility of wastewater flow towards MW1 was discussed in the Ground Water Flow Direction section, where we concluded the static water levels in the monitoring wells probably provide accurate flow directions. Although this conclusion generally appears to be true, the August 2005 MW1 sample and other hints suggest the answer is more complicated and at times there may be minor radial flow outward from the wastewater lagoons including the possibility of upgradient flow. An alternative interpretation is that there is wastewater leakage from the Catalina MHP sewer lines or a septic system upgradient of MW1.

Wise Well

The Wise well is located just upgradient of the mid- point between borings B9 and B10 (Figure 7). This irrigation well was drilled in 1984 and is 41 feet deep with a 3 foot screen at 38-41 feet. The log indicates the presence of clay and gravel and dirty gravel in the upper 20 feet with coarse and medium sand and gravel in the bottom 20 feet of the well. In the early 2000’s this well became a public water system well used by Construction Careers of America (PWSID 937712) for an education facility with classrooms. An onsite septic system was installed at this time. PWS sampling records record a nitrate range of 2-5 mg/L in samples from 2001-2004 and a long history of unsafe water based on microbiologic sampling (total coliform positive/ E.coli negative) from 2001- 2003.

The well had not been used for over a year when we sampled it and the sampling conditions were poor due to the stagnant nature of the water in the well, the inability to use the submersible pump to purge the well properly, limited purge volume using a peristaltic pump, and debris knocked off the casing when the sampling tube was lowered into the well. Consequently, placing value on the sample results is questionable. However, the well is located downgradient of the wastewater lagoons and has a history of unsafe microbiological samples so the results need to be included in the discussion.

We sampled this well twice in 2005. The well bore volume from water table to bottom of screen is approximately 25 gallons. On July 20 we collected a sample after purging approximately 7-8 liters (2 gallons) with a peristaltic pump at 29 feet (static water at 24 feet). The bore water was stagnant with reduced water dominating based on oxidation-reduction potential (ORP) readings of -57mV, elevated iron values, and non detect nitrate. In this sample total coliform was present and E.coli was absent. On August 17 we purged approximately 20 gallons (peristaltic pump at about 29 feet) and collected another sample, but still less than 1 well bore volume of water was purged and water was not withdrawn at the level of the well screen (38-41 feet). The August sample did provide a nitrate result of 4.24 mg/L indicating we purged a sufficient volume to pull in oxidized water from the aquifer, in contrast with the July sample. The inorganic results for chloride and TDS from both these samples are consistent with the chloride and TDS concentration contours presented in this report. The microbiologic results for the August sample exhibit elevated coliform (495 cfu/100 mL) and enterococci (2,063 cfu/100 mL) at concentrations that approach those in the wastewater lagoons and high HPC values as well. The microbiological results for coliform and enterococci are well above all the boring sample results. The results suggest the stagnant well is a good environment for microbiological growth. It is possible the persistent coliform presence is related to lower grouting standards for irrigation wells than wells used for water consumption. All things considered we cannot place much weight on the samples collected from the unused, stagnant well.

Conclusions and Recommendations

The wastewater plume associated with the Catalina MHP wastewater lagoons is clearly identified by the chloride and TDS concentrations in the August 2005 boring samples. The quarterly sampling static water levels in the monitoring wells confirm a fairly consistent flow direction of the wastewater plume, ranging from S 35^{o} W to S 5^{o} E with an average of S 10-15^{o} W. The quarterly sampling documents consistent elevated chloride and TDS in the downgradient monitoring well MW2. Although the wastewater plume is clearly delineated, the ground water quality impacts for inorganic parameters do not approach maximum contaminant levels (MCL). Nitrate values downgradient of the wastewater lagoons were as high as 6.68 mg/l but the average value was 4.5 mg/L, not far above the 3.1 mg/L nitrate concentration of the upgradient monitoring well. It appears that the lagoon vegetation and infiltration processes are effective at fixing and denitrifying nitrate compounds. On average the nitrate concentrations are less than 5 mg/L, well below the nitrate MCL of 10 mg/L.

The analysis of the data collected for this study clearly documents the downgradient plume. Variable results from MW1, the upgradient monitoring well, however, suggest that at times wastewater discharge influences this monitoring well. Detection of ammonia in August 2005, the detection of phosphorous in MW1 in the non turbid January and April 2006 samples, the enterococci and somatic phage detections in August 2005 MW1 sample, and the weak isotopic septic signature of nitrate isotopic data for August 2005 and July 2006 all suggest some wastewater influence. Any one of these results could be dismissed, but the reoccurrence of hints of wastewater influence, suggests the flow regime is a bit more complicated than the well defined chloride/TDS plume indicates. These results may indicate some flow from the lagoons towards the upgradient monitoring well or the presence of a leaking sewer line close or leakage from a local septic system close to MW1.

The microbiologic results from ground water samples produced low counts to non detects for bacteria indicators in contrast to significant detection levels in the final effluent and lagoon samples. This indicates that the filtering processes associated with assimilation and infiltration of partially treated wastewater from the lagoons to ground water are removing the bulk of the pathogens. Several ground water samples did record detections of total coliform, *E. coli*, and enterococci so there is evidence of pathogen transport but at relatively low levels. Consequently, it is difficult to say that the lagoon infiltration is a perfect filtration system for pathogens, but it appears to be a very good one. A second element of uncertainty in the data analysis is the general reduction of pathogen concentrations in the lagoons as the quarterly sampling progressed. Whether this reflects improved management (more chlorination of wastewater) of Catalina MHP's wastewater system as a result of our investigation or an annual cycle is not clear.

Overall, based on ground water sample data collected at and downgradient from the Catalina MHP property boundary, the water quality impacts do not appear to be as significant as anticipated. This statement is based on the following interpretations of data collected:

- A distinct wastewater plume is present based on chloride and TDS concentrations which documents a stable ground water flow direction to the south southwest;
- Elevated ammonia concentrations occur only in the lagoons and the core of the plume;

- Detections of pharmaceuticals, sulfamethoxazole and carbamazapine, occur in the delineated wastewater plume and not in the storm water plume;
- Although the nitrate in ground water is elevated (average < 5 mg/L), it is well below the MCL (10 mg/L) and not far above the upgradient monitoring well nitrate concentration (3.1 mg/L);
- The pathogen concentrations exhibit low counts to non detects for bacteria indicators and coliphage in downgradient borings in contrast to significant detection levels in the final effluent and lagoon samples; and
- The presence of some pathogens in the wastewater plume areas may result from transport from the wastewater lagoons, but the data is not definitive.

Clearly, there are water quality impacts associated with the wastewater infiltration plume, but inorganic MCLs are not exceeded and in general the counts for pathogen indicators are low. Although the infiltration processes are reducing the pathogen concentrations significantly, the uncertainty of the microbiologic data makes it difficult to categorically state that the water is safe. The ground water impacts, however, are significantly below what we expected.

These results suggest that the processes of chemical transformations, predation, and filtration associated with aeration, lagoon processes, infiltration through the bottom of the lagoons, flow through the vadose zone, and transport within the aquifer provide a significant amount of treatment. Since our samples were only collected in the lagoons and in ground water at the downgradient property boundary and beyond we have little information to identify which of these areas provide the most effective treatment for individual parameters.

This study has identified chloride, sodium,TDS, the nitrate species (ammonia, nitrate, and TKN) as the most useful inorganic parameters for identifying wastewater plumes. The pharmaceutical parameters, sulfamethoxazole and carbamazapine, also appear to be useful tracers for identifying wastewater plumes. Our data on pathogens is not definitive, but pathogens need to be considered as important parameters due to potential health impacts they may identify.

Since this plume is well identified and relatively stable with a constant source and steady state conditions, it appears to be an excellent location for additional study. If access could be obtained to the property, borings or monitoring wells could be developed at multiple depths around and under the lagoons. These wells would allow further evaluation of the water quality and assessment of the filtration effectiveness of sand and gravel in areas around the lagoons. This effort would allow us to refine the results of this study and increase our knowledge of the filtration processes associated with flow through the lagoon bottom, in the vadose zone, and within the sand and gravel aquifer. This refined knowledge could be critical in helping identify the aquifers in Ohio that may be sensitive to infiltration of partially treated wastewater from treatment systems similar to the Catalina MHP system, as well providing valuable information for implementing the GW Rule.

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Appendix A – Initial Sample Results for Catalina MHP

Initial sample results for Catalina MHP PWS wells, wastewater lagoons, and storm water lagoon samples collected prior to Geoprobe boring.

Appendix A - Initial Sample Results for Catalina MHP

Sample Location	Sample Type	Location details	Sample #	Date	Method	Conductivity (umhos/cm)	pH	TDS (field) (mg/L)	Temp (deg C)	ORP	TDS (mg/L)
Catalina PWS, 49'	Raw GW	south well	70269	10/20/2004	AGWMP	991	7.07	687	13.4	271	566
Abner well, 45'	Raw GW	SW of ponds	70268	10/20/2004	AGWMP	620	7.75	425	13.1	150	360
Catalina WWT	Effluent	Clorine contact tank	70263	10/20/2004	DSW/WW	1250	7.73				644
Catalina WWT	Effluent	NE Lagoon input	70262	10/20/2004	DSW/WW	1230	7.78				650
Catalina Stormwater	Stormwater	Stormwater lagoon	70261	10/20/2004	DSW/WW	71	6.88				70
Catalina WWT	Effluent	Chlorine contact tank	46903	5/9/2002	DSW/WW						
Catalina WWT	Effluent	Chlorine contact tank	48984	07/302002	DSW/WW						
Catalina WWT	Effluent	Chlorine contact tank	SIW-100	10/20/2004	isotopes	1282	7.61	908	17.6	267	
SW WWTP pond	Infiltration	SW infiltration pond	SIW-300	10/20/2004	isotopes	690	6.99	482	12	182	
SE WWTP pond	Infiltration	SE infiltration pond	SIW-500	10/20/2004	isotopes	650	6.9	452	11.3	176	
WWTP Spicket	Treated GW	Spicket at WWTP	SIW-400	10/20/2004	isotopes	972	7.4	593	15.4	682	
Catalina Stormwater	Stormwater	Stormwater lagoon	SIW-600	10/20/2004	isotopes	75.6	6.8	50.5	11.6	230	

Appendix A - Initial Sample Results for Catalina MHP

Sample Location	Sample Type	TSS (mg/L)	TOC (mg/L)	Ba (ug/L)	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	K (mg/L)	Na (mg/L)	Cl (mg/L)	F (mg/L)	Cu (ug/L)	Pd (ug/L)
Catalina PWS, 49'	Raw GW		<2.0	112	110	37	427	2	44	83.6	<0.20	<10	<2.0
Abner well, 45'	Raw GW		<2.0	90	72	32	312	2	12	24.6	0.29	<10	<2.0
Catalina WWT	Effluent	18	11	86	106	37	417	13	84	136	<0.20	<10	<2.0
Catalina WWT	Effluent	13	9.5	85	106	37	417	13	85	136	<0.20	<10	<2.0
Catalina Stormwater	Stormwater	<5	9.7	<15	10	2	33	3	<5	<5	<0.20	<10	2
Catalina WWT	Effluent	7											
Catalina WWT	Effluent	22											
Catalina WWT	Effluent												
SW WWTP pond	Infiltration												
SE WWTP pond	Infiltration												
WWTP Spicket	Treated GW												
Catalina Stormwater	Stormwater												

Appendix A - Initial Sample Results for Catalina MHP

Sample Location	Sample Type	Fe (ug/L)	Zn (ug/L)	Se (ug/L)	Cd (ug/L)	Sr (ug/L)	Alkalinity (mg/L)	COD (mg/L)	BOD5 (mg/L)	CBOD5 (mg/L)	Ammonia (mg/L)	NO3+NO2 (mg/L)	Nitrite (mg/L)
Catalina PWS, 49'	Raw GW	<50	<10	<2.0	<0.20	768	314	<10			<0.050	4.61	
Abner well, 45'	Raw GW	61	<10	<2.0	<0.20	1490	225	<10			<0.050	1.24	
Catalina WWT	Effluent	96	53	<2.0	<0.20	630	329	27	12	7	7.03	6.09	5.38
Catalina WWT	Effluent	91	79	<2.0	<0.20	635	331	30	17	3.8	7.61	6.02	4.73
Catalina Stormwater	Stormwater	695	42	<2.0	0.29	<30	26.8	29	8.8	5.8	<0.050	<0.1	<0.02
Catalina WWT	Effluent									2	0.691	7.85	0.515
Catalina WWT	Effluent									2.1	8.07	3.92	0.037
Catalina WWT	Effluent												
SW WWTP pond	Infiltration												
SE WWTP pond	Infiltration												
WWTP Spicket	Treated GW												
Catalina Stormwater	Stormwater												

Appendix A - Initial Sample Results for Catalina MHP

Sample Location	Sample Type	SO4 (mg/L)	TKN (mg/L)	Total P (mg/l)	Oil & Grease (mg/L)	Organics
Catalina PWS, 49'	Raw GW	32.6	<0.20	<0.01		none
Abner well, 45'	Raw GW	39.2	0.42	0.02		none
Catalina WWT	Effluent	44.2	9.02	1.98	5.7	Chloroform,1,4-Dichlorobenzene, & TICS
Catalina WWT	Effluent	44.5	9.21	2.16		Chloroform,1,4-Dichlorobenzene, & TICS
Catalina Stormwater	Stormwater	5	0.53	0.245		A few TICS
Catalina WWT	Effluent					
Catalina WWT	Effluent		10.1	1.82		
Catalina WWT	Effluent					
SW WWTP pond	Infiltration					
SE WWTP pond	Infiltration					
WWTP Spicket	Treated GW					
Catalina Stormwater	Stormwater					

Appendix A - Initial Sample Results for Catalina MHP

		DES Samples			U.S. EPA Results					
Sample Location	**Sample Type**	**Fecal Coliform (#/100ml)**	**E.coli (#/100ml)**	**Fecal Streptoco (#/100ml)**	**PCA (CFU/ml)**	**R2A (CFU/ml)**	**Aerobic Spores (CFU/ml)**	**Enterolert (CFU/ml)**	**Total Coliform (CFU/100ml)**	**E-coli (CFU/100ml)**
Catalina PWS, 49'	Raw GW				<1	70	<1	<1	<1	<1
Abner well, 45'	Raw GW				81	76	<1	<1	<1	<1
Catalina WWT	Effluent	280	2700		15,100	530,000	71	2,755	>2,419.2	>2,419.2
Catalina WWT	Effluent	60	440		18,600	340,000	91	336	>2,419.2	>2,419.2
Catalina Stormwater	Stormwater	190	400		4,100	1,830,000	65	110	>2,419.2	228.2
Catalina WWT	Effluent	8000	3500	5100						
Catalina WWT	Effluent	34000	8000	5100						
Catalina WWT	Effluent									
SW WWTP pond	Infiltration									
SE WWTP pond	Infiltration									
WWTP Spicket	Treated GW									
Catalina Stormwater	Stormwater									

Appendix B - Inorganic Sample Results

Inorganic results for ground water samples collected during the Catalina MHP investigation.

Appendix B1 – Inorganic Sample Results for Boring Samples

Appendix B2 - Inorganic Sample Results for Quarterly Samples
PWS Well and Monitoring Wells

Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

Facility	ID	Sample Date	Sampler	Sampleid	Location	Alkalinity mg/L	Alk-qual
CATALINA BORING	B1S	8/16/2005	Lowry	77320	B1-SHALLOW-30	483	
CATALINA BORING	B1D	8/16/2005	Lowry	77321	B1-DEEP-51	390	
CATALINA BORING	B2S	8/16/2005	Lowry	77323	B2 SHALLOW 30	487	
CATALINA BORING	B2M	8/16/2005	Lowry	77322	B2-DEEP-40	448	
CATALINA BORING	B3S	8/17/2005	Brown	77338	B3-30	442	
CATALINA BORING	B3Sd	8/17/2005	Brown	77339	B3-30 dupe	446	
CATALINA BORING	B3M	8/17/2005	Brown	77337	B3-42 DEEP	442	
CATALINA BORING	B4S	8/17/2005	Lowry	77351	B4-SHALLOW-25	465	
CATALINA BORING	B4M	8/17/2005	Lowry	77347	B4-INTERM-35		
CATALINA BORING	B4D	8/17/2005	Lowry	77346	B4-DEEP-45		
CATALINA BORING	B5S	8/17/2005	Lowry	77350	B5-SHALLOW-27	498	
CATALINA BORING	B5M	8/17/2005	Lowry	77348	B5-INTERMEDIATE-37		
CATALINA BORING	B5D	8/17/2005	Lowry	77349	B5-DEEP-47		
CATALINA BORING	B6S	8/17/2005	Slattery	77330	B6-32	339	
CATALINA BORING	B6S-F	8/17/2005	Slattery	77336	B6-32 FILTERED		
CATALINA BORING	B6M	8/17/2005	Slattery	77331	B6-42	438	
CATALINA BORING	B7S	8/17/2005	Slattery	77333	B7-31	459	
CATALINA BORING	B7S-F	8/17/2005	Slattery	77334	B7-31 FILTERED		
CATALINA BORING	B8S	8/18/2005	Lowry	77460	B8-SHALLOW-28	410	
CATALINA BORING	B8Sd	8/18/2005	Lowry	77461	B8-SHALLOW-28 dupe	420	
CATALINA BORING	B8D	8/18/2005	Lowry	77459	B8-DEEP-51		
CATALINA BORING	B9S	8/16/2005	Slattery	77326	B9-32 SHALLOW	333	
CATALINA BORING	B9M	8/16/2005	Slattery	77327	B9-40 MID	424	
CATALINA BORING	B9D	8/16/2005	Slattery	77328	B9-60 DEEP	445	
CATALINA BORING	B10S	8/17/2005	Brown	77341	B10-30	448	
CATALINA BORING	B10S-F	8/17/2005	Brown	77345	B10-30 FILTERED		
CATALINA BORING	B10M	8/17/2005	Brown	77343	B10-42		
CATALINA BORING	B10D	8/17/2005	Brown	77340	B10-52	452	
CATALINA BORING	B10D-F	8/17/2005	Brown	77344	B10-52 FILTERED		
CATALINA BORING	B11S	8/18/2005	Brown	77464	B11-30	419	
CATALINA BORING	B11S-F	8/18/2005	Brown	77468	B11-30 FILTERED		
CATALINA BORING	B11M	8/18/2005	Brown	77463	B11-38		
CATALINA BORING	B11D	8/18/2005	Brown	77462	B11-47		
CATALINA BORING	B13S	8/17/2005	Slattery	77332	B13-32	450	
CATALINA BORING	B13S-F	8/17/2005	Slattery	77335	B13-32 FILTERED		
CATALINA BORING	B13D	8/17/2005	Slattery	77329	B13-48		
CATALINA BORING	B14S	8/16/2005	Slattery	77324	B14-29	397	
CATALINA BORING	B14D	8/16/2005	Slattery	77325	B14-52	470	
WISE PROPERTY	W1P	7/20/2005	Kenah	75689	Wise Well Catalina project	291	
WISE PROPERTY	W1	8/17/2005	Brown	77342	WISE WELL	428	

If there is nothing written in a parameter column, the parameter wasnot analyzed for the sample.

Sample depth range: S = shallow (< 35 feet); M = Mid-range (35 ? M ? 45 feet); and D=Deep (> 45 feet)

J = Analyte was positively identified, the associated numerical value is estimated (estimated due to improper preservation in the field)

UJ = Analyte was not detected above the sample quantitation Limit (QL) - QL is estimated

Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Aluminum µg/L	Al-qual	Ammonia mg/L	NH3-qual	Arsenic µg/L	As-qual	Barium µg/L	Ba-qual	Cadmium µg/L	Cd-qual
B1S	22200		0.329	J	19.4		299		0.82	
B1D	156000	J	1.12	J	101	J	2670	J	6.00	J
B2S	26100	J	2.98	J	30.0	J	282	J	1.16	J
B2M	27500		0.440	J	18.1		1410		1.81	
B3S	5910		0.083		10.6		151		0.26	
B3Sd	9950		0.095		14.0		184		0.39	
B3M	12500		0.105		13.9		223		0.49	
B4S	5280		0.093		14.9		229		0.83	
B4M			0.082							
B4D			0.271	J						
B5S	14000	J	3.75	J	18.9	J	283	J	0.96	J
B5M			5.39							
B5D			0.381							
B6S	53000	J	0.233	J	9.9	J	705	J	4.40	J
B6S-F	*Non-detect						53			
B6M	18400		0.120		16.7		278		0.88	
B7S	39700	J	0.224	J	11.2	J	510	J	3.40	J
B7S-F	*Non-detect	UJ					90	J		
B8S	14000	J	0.091		9.0	J	216	J	0.60	J
B8Sd	35400		0.106		14.6		412		1.56	
B8D			0.131							
B9S	15700	J	*Non-detect		12.8	J	229	J	1.03	J
B9M	36600	J	0.163		10.3	J	395	J	1.38	J
B9D	115000	J	0.280	J	6.2	J	2180	J	12.9	J
B10S	27900		2.03	J	14.6		329		1.27	
B10S-F	*Non-detect						110			
B10M			2.21	J						
B10D	62000	J	1.87	J	16.4	J	1120	J	5.20	J
B10D-F	*Non-detect						132			
B11S	9390		0.539		15.3		164		0.38	
B11S-F	*Non-detect						98			
B11M			0.827	J						
B11D			0.672	J						
B13S	49500	J	0.810		7.2	J	784	J	4.50	J
B13S-F	*Non-detect						129			
B13D			0.664	J						
B14S	33600	J	0.514	J	15.1	J	358	J	1.71	J
B14D	31400	J	0.577	J	14.6	J	433	J	1.87	J
W1P	*Non-detect		0.061		*Non-detect		48		*Non-detect	
W1	*Non-detect		0.073		*Non-detect		114		*Non-detect	

If there is nothing written in a parameter column, the parameter wasnot analyzed for the sample.

Sample depth range: S = shallow (< 35 feet); M = Mid-range (35 ? M ? 45 feet); and D=Deep (> 45 feet)

J = Analyte was positively identified, the associated numerical value is estimated (estimated due to improper preservation in the field)

UJ = Analyte was not detected above the sample quantitation Limit (QL) - QL is estimated

Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Calcium mg/L	Ca-qual	Chloride mg/L	Cl-qual	Chromium µg/L	Cr-qual	COD mg/L	COD-qual	Copper µg/L	Cu-qual
B1S	863		52.7		123		*Non-detect	UJ	198	
B1D	3960	J	29.4		319	J	60	J	663	J
B2S	1670	J	116		113	J	12	J	283	J
B2M	1040		63.4		87		17	J	251	
B3S	295		78.8		*Non-detect		20		37	
B3Sd	466		79.7		33		*Non-detect		65	
B3M	554		62.9		61		*Non-detect		88	
B4S	352		50.2		36		*Non-detect		47	
B4M			50.6				*Non-detect			
B4D			46.5				*Non-detect	UJ		
B5S	680	J	118		58	J	*Non-detect	UJ	109	J
B5M			115				*Non-detect			
B5D			71.3				15			
B6S	4200	J	30.9		392	J	57	J	377	J
B6S-F	82				*Non-detect				*Non-detect	
B6M	802		42.2		140		20		158	
B7S	1630	J	51.1		149	J	*Non-detect	UJ	297	J
B7S-F	132	J			*Non-detect	UJ			*Non-detect	UJ
B8S	360	J	41.7		35	J	*Non-detect		81	J
B8Sd	840		42.2		86		19		220	
B8D			43.5				*Non-detect			
B9S	1790	J	32.2		70	J	*Non-detect		76	J
B9M	1120	J	44.0		177	J	11		202	J
B9D	7200	J	48.4		269	J	40	J	635	J
B10S	977		115		131		*Non-detect	UJ	121	
B10S-F	113				*Non-detect				*Non-detect	
B10M			86.6				*Non-detect	UJ		
B10D	2200	J	64.9		317	J	20	J	384	J
B10D-F	116				*Non-detect				*Non-detect	
B11S	551		88.8		40		10		64	
B11S-F	113				*Non-detect				*Non-detect	
B11M			85.2				10	J		
B11D			56.5				13	J		
B13S	2780	J	58.7		177	J	*Non-detect		299	J
B13S-F	120				*Non-detect				*Non-detect	
B13D			52.5				*Non-detect	UJ		
B14S	1680	J	47.9		218	J	*Non-detect	UJ	224	J
B14D	1620	J	46.0		273	J	66	J	266	J
W1P	30		99.7		*Non-detect		*Non-detect		*Non-detect	
W1	116		56.7		*Non-detect		12		*Non-detect	

If there is nothing written in a parameter column, the parameter wasnot analyzed for the sample.

Sample depth range: S = shallow (< 35 feet); M = Mid-range (35 ? M ? 45 feet); and D=Deep (> 45 feet)

J = Analyte was positively identified, the associated numerical value is estimated (estimated due to improper preservation in the field)

UJ = Analyte was not detected above the sample quantitation Limit (QL) - QL is estimated

Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Fcoliform #/100 ml	FC-qual	Fluoride mg/L	Fl-qual	Hardness mg/L	Hrd-qual	Iron µg/L	Fe-qual	Lead µg/L	Pb-qual
B1S			0.35		3560	J	100000		65.5	
B1D			0.93		14400	J	491000	J	408	J
B2S			0.24		6850	J	117000	J	104	J
B2M			0.21		4430	J	111000		67.5	
B3S			0.25		1170	J	19300		16.6	
B3Sd			0.25		1880	J	33800		30.6	
B3M			0.27		2270	J	47800		34.6	
B4S			0.24		1430	J	27800		13.5	
B4M										
B4D										
B5S			0.26		2890	J	59000	J	34.8	J
B5M										
B5D										
B6S			0.33		16900	J	172000	J	195	J
B6S-F					308		256			
B6M			0.30		3260	J	82300		74.0	
B7S			0.27		7040	J	189000	J	162	J
B7S-F					511	J	*Non-detect	UJ		
B8S			0.29		1480	J	57500	J	54.0	J
B8Sd			0.31		3490	J	141000		115	
B8D										
B9S			0.29		6570	J	61100	J	31.8	J
B9M			0.32		4650	J	122000	J	58.5	J
B9D			0.29		29700	J	143000	J	142	J
B10S			0.28		3950	J	85800		31.8	
B10S-F					463		164			
B10M										
B10D			0.35		8620	J	232000	J	243	J
B10D-F					491		735			
B11S			0.25		2240	J	30500		22.7	
B11S-F					455		416			
B11M										
B11D										
B13S			0.35		11300	J	146000	J	200	J
B13S-F					497		566			
B13D										
B14S			0.31		6660	J	125000	J	117	J
B14D			0.30		6430	J	132000	J	104	J
W1P	*Non-detect		*Non-detect		178		8860		*Non-detect	
W1			0.23		450		271		*Non-detect	

If there is nothing written in a parameter column, the parameter wasnot analyzed for the sample.

Sample depth range: S = shallow (< 35 feet); M = Mid-range (35 ? M ? 45 feet); and D=Deep (> 45 feet)

J = Analyte was positively identified, the associated numerical value is estimated (estimated due to improper preservation in the field)

UJ = Analyte was not detected above the sample quantitation Limit (QL) - QL is estimated

Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Magnesium mg/L	Mg-qual	Manganese µg/L	Mn-qual	Nickel µg/L	Ni-qual	Nitrate mg/L	NO3-qual	Nitrite mg/L	NO2-qual
B1S	340		3250		102		0.54	J	*Non-detect	
B1D	1100	J	16300	J	498	J	*Non-detect	UJ	*Non-detect	PS
B2S	650	J	3630	J	126	J	*Non-detect	UJ	*Non-detect	
B2M	445		14400		224		2.19	J	*Non-detect	PS
B3S	105		544		*Non-detect		3.73		*Non-detect	
B3Sd	174		918		*Non-detect		4.06		*Non-detect	
B3M	215		1620		*Non-detect		5.04		*Non-detect	
B4S	134		2430		*Non-detect		4.74		*Non-detect	
B4M							4.44		*Non-detect	
B4D							1.34	J	*Non-detect	
B5S	290	J	2730	J	75	J	1.63	J	*Non-detect	
B5M							0.35		*Non-detect	
B5D							2.11		*Non-detect	
B6S	1550	J	12000	J	235	J	1.38	J	*Non-detect	
B6S-F	25		274		*Non-detect					
B6M	306		2480		74		3.84		*Non-detect	
B7S	720	J	6650	J	166	J	0.56	J	*Non-detect	
B7S-F	44	J	91	J	*Non-detect	UJ				
B8S	140	J	1000	J	47	J	2.85		*Non-detect	
B8Sd	339		2600		117		1.76		*Non-detect	
B8D							2.42		*Non-detect	
B9S	510	J	7610	J	51	J	1.39		*Non-detect	
B9M	450	J	4530	J	159	J	2.67		*Non-detect	
B9D	2850	J	81400	J	436	J	0.39	J	*Non-detect	
B10S	367		2300		107		0.29	J	*Non-detect	
B10S-F	44		120		*Non-detect					
B10M							0.25	J	*Non-detect	
B10D	760	J	16600	J	298	J	1.45	J	*Non-detect	
B10D-F	49		1060		*Non-detect					
B11S	211		943		*Non-detect		2.80		*Non-detect	
B11S-F	42		103		*Non-detect					
B11M							0.27	J	*Non-detect	
B11D							0.56	J	*Non-detect	
B13S	1060	J	8400	J	247	J	5.84		*Non-detect	
B13S-F	48		158		*Non-detect					
B13D							4.99	J	*Non-detect	
B14S	600	J	4660	J	116	J	0.18	J	*Non-detect	
B14D	580	J	6240	J	153	J	0.28	J	*Non-detect	
W1P	25		134		*Non-detect		*Non-detect			
W1	39		64		*Non-detect		4.24		*Non-detect	

If there is nothing written in a parameter column, the parameter wasnot analyzed for the sample.

Sample depth range: S = shallow (< 35 feet); M = Mid-range (35 ? M ? 45 feet); and D=Deep (> 45 feet)

J = Analyte was positively identified, the associated numerical value is estimated (estimated due to improper preservation in the field)

UJ = Analyte was not detected above the sample quantitation Limit (QL) - QL is estimated

Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	ORP mV	PH SU	Phosphorus mg/L	P-qual	Potassium mg/L	K-qual	Spec. Cond. µmho/cm	Selenium µg/L	Se-qual
B1S	55	7.00	2.78	J	7		980	4.0	
B1D	-110	7.49	2.10	J	23	J	785	6.3	J
B2S	32	6.93	4.33	J	18	J	1194	3.6	J
B2M	115	6.06	2.35	J	9		960	3.4	
B3S	0	7.04	0.471		5		1052	*Non-detect	
B3Sd	0	7.04	0.627		5		1052	2.7	J
B3M	13	6.99	0.575		6		983	*Non-detect	
B4S	40	6.97	0.713		4		996	2.1	
B4M	-31	6.94	0.773		5		994		
B4D	-29	7.2	1.64	J	7	J	952		
B5S	-103	7.31	2.52	J	17	J	1258	*Non-detect	UJ
B5M	-150	7.43	2.13		15		1254		
B5D	-110	7.06	0.200		7	J	1028		
B6S	5	7.26	0.018	J	13	J	660	6.1	J
B6S-F	5	7.26			3		660		
B6M	10	7.04	0.102		7		880	3.2	
B7S	97	6.91	1.09	J	9	J	927	4.4	J
B7S-F	97	6.91			2	J	927		
B8S	195	6.77	0.649		5	J	875	*Non-detect	UJ
B8Sd	195	6.77	0.370		8		875	3.7	
B8D	110	6.57	0.204		7	J	960		
B9S	100	7.21	0.540		5	J	677	4.4	J
B9M	-52	7.06	0.870		8	J	877	3.2	J
B9D	-2	7.10	1.88	J	16	J	917	7.4	J
B10S	17	7.27	1.74	J	13		1141	2.5	
B10S-F	17	7.27			8		1141		
B10M	-50	7.28	1.16	J	13	J	1041		
B10D	-82	7.16	1.92	J	14	J	1049	5.3	J
B10D-F	-82	7.16			7		1049		
B11S	-112	7.18	0.620		10		1090	2.4	
B11S-F	-112	7.18			8		1090		
B11M	-164	7.24	3.40	J	17	J	1103		
B11D	-155	7.22	5.74	J	23	J	1027		
B13S	77	7.05	0.962		14	J	976	7.6	J
B13S-F	77	7.05			5		976		
B13D	2	7.26	0.999	J	10	J	1028		
B14S	-35	7.11	2.59	J	8	J	854	3.5	J
B14D	-110	7.05	0.061	J	8	J	956	3.5	J
W1P	-57		*Non-detect		3		906	*Non-detect	
W1			*Non-detect		3			*Non-detect	

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Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Sodium mg/L	Na-qual	Strontium µg/L	Sr-qual	Sulfate mg/L	SO4-qual	Tcoliform #/100 ml	TC-qual	TDS field mg/L	TDS Lab mg/L	TDS-qual
B1S	28		1030		31.9				677	590	
B1D	21	J	10700	J	44.5				533	480	
B2S	86	J	1670	J	36.3				827	700	
B2M	34		1120		31.3				682	594	
B3S	36		578		33.2				501	610	
B3Sd	37		674		32.3				501	612	
B3M	31		800		33.1				468	576	
B4S	28		676		35.8				471	572	
B4M	29								471		
B4D	30	J							453		
B5S	86	J	1050	J	32.4				601	712	
B5M	84								599		
B5D	36	J							487		
B6S	37	J	3290	J	17.7				441	390	
B6S-F	28		286						441		
B6M	26		1040		33.3				604	526	
B7S	27	J	1400	J	33.5				667	574	
B7S-F	23	J	457	J					667		
B8S	23	J	562	J	33.0				597	500	
B8Sd	24		904		33.5				597	512	
B8D	26	J							658		
B9S	32	J	1800	J	19.4				317	404	
B9M	30	J	1090	J	28.6				414	518	
B9D	31	J	6150	J	41.6				430	570	
B10S	77		1220		31.2				784	664	
B10S-F	75		642						784		
B10M	53	J							728		
B10D	48	J	2520	J	52.6				720	618	
B10D-F	42		672						720		
B11S	67		910		43.7				519	586	
B11S-F	64		650						519		
B11M	71	J							525		
B11D	49	J							488		
B13S	51	J	2670	J	40.9				671	592	
B13S-F	46		572						671		
B13D	40	J							707		
B14S	24	J	1460	J	27.8				404	500	
B14D	27	J	1570	J	34.7				448	572	
W1P	154		208		25.6		1		616	510	
W1	32		511		33.1					558	

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Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Temperature C	TKN mg/L	TKN-qual	TOC mg/L	TOC-qual	Turbidity ntu	Turb-qual	Zinc µg/L	Zn-qual
B1S	16.6	0.46	J			371		1960	
B1D	17.1	1.68	J			308	PS	2420	J
B2S		3.08	J			320		1380	J
B2M	16.6	0.64	J			274		871	
B3S	16.7	0.32		*Non-detec		337		204	
B3Sd	16.7	0.35		*Non-detec		365		286	
B3M	15.8	0.29		*Non-detec		321		368	
B4S	17.6	0.30		*Non-detec		236		293	
B4M	17.6	0.27		*Non-detec		426		601	
B4D	17.3	0.38	J			369		552	J
B5S	16.5	4.76	J			289		549	J
B5M	17.9	6.16		2.6		347		616	
B5D	17.4	0.60		*Non-detec		301		794	J
B6S	15.5	0.44	J			408		816	J
B6S-F	15.5							12	
B6M	15.7	0.32		*Non-detec		493		486	
B7S	18.4	0.39	J			447		647	J
B7S-F	18.4							*Non-detect	UJ
B8S	17.0	0.21		*Non-detec		331		303	J
B8Sd	17.0	0.26				303		779	
B8D	17.2	0.29		*Non-detec		387		554	J
B9S	17.2	0.30		*Non-detec		285		197	J
B9M	17.1	0.46		*Non-detec		354		769	J
B9D	18.4	0.37	J			186		1080	J
B10S	18.5	2.24	J			306		355	
B10S-F	18.5							*Non-detect	
B10M	16.7	2.30	J			353		768	J
B10D	18.8	1.84	J			447		1030	J
B10D-F	18.8							12	
B11S	18.7	0.75				285		148	
B11S-F	18.7							*Non-detect	
B11M	15.5	2.70	J			322		742	J
B11D	18.7	2.47	J			241		1270	J
B13S	17.2	0.85		*Non-detec		442		728	J
B13S-F	17.2							33	
B13D	17.7	0.79	J			485		561	J
B14S	17.5	0.45	J			491		499	J
B14D	17.5	0.68	J			390		943	J
W1P	18.1	0.60		*Non-detec				38	
W1		0.25		*Non-detec		1.92		*Non-detect	

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Appendix B1 - Catalina MHP Boring Samples - Inorganic Sample Results

ID	Filtered	Depth	Customerid	Fieldqc	Use Code	Latitude - dec	Longitude - dec
B1S	N	30	B1		Test	39.5506144	-84.38691
B1D	N	51	B1		Test	39.5506144	-84.38691
B2S	N	30	B2		Test	39.5491738	-84.388155
B2M	N	40	B2		Test	39.5491738	-84.388155
B3S	N	30	B3		Test	39.5491488	-84.389147
B3Sd	N	30	B3	FD	Test	39.5491488	-84.389147
B3M	N	40	B3		Test	39.5491488	-84.389147
B4S	N	25	B4		Test	39.5492163	-84.386847
B4M	N	35	B4		Test	39.5492163	-84.386847
B4D	N	45	B4		Test	39.5492163	-84.386847
B5S	N	27	B5		Test	39.5491252	-84.388614
B5M	N	37	B5		Test	39.5491252	-84.388614
B5D	N	47	B5		Test	39.5491252	-84.388614
B6S	N	32	B6		Test	39.5491566	-84.389825
B6S-F	Y	32	B6		Test	39.5491566	-84.389825
B6M	N	42	B6		Test	39.5491566	-84.389825
B7S	N	31	B7		Test	39.5487697	-84.391177
B7S-F	Y	31	B7		Test	39.5487697	-84.391177
B8S	N	32	B8		Test	39.5480054	-84.391124
B8Sd	N	32	B8	FD	Test	39.5480054	-84.391124
B8D	N	51	B8		Test	39.5480054	-84.391124
B9S	N	32	B9		Test	39.5485763	-84.390055
B9M	N	44	B9		Test	39.5485763	-84.390055
B9D	N	60	B9		Test	39.5485763	-84.390055
B10S	N	30	B10		Test	39.5481677	-84.389229
B10S-F	Y	30	B10		Test	39.5481677	-84.389229
B10M	N	42	B10		Test	39.5481677	-84.389229
B10D	N	52	B10		Test	39.5481677	-84.389229
B10D-F	Y	52	B10		Test	39.5481677	-84.389229
B11S	N	30	B11		Test	39.5479823	-84.388203
B11S-F	Y	30	B11		Test	39.5479823	-84.388203
B11M	N	38	B11		Test	39.5479823	-84.388203
B11D	N	47	B11		Test	39.5479823	-84.388203
B13S	N	32	B13		Test	39.5472751	-84.389639
B13S-F	Y	32	B13		Test	39.5472751	-84.389639
B13D	N	48	B13		Test	39.5472751	-84.389639
B14S	N	33	B14		Test	39.5465646	-84.391046
B14D	N	52	B14		Test	39.5465646	-84.391046
W1P	N		W1		Withdrawal of Water	39.5485111	-84.389519
W1	N		W1		Withdrawal of Water	39.5485111	-84.389519

If there is nothing written in a parameter column, the parameter wasnot analyzed for the sample.

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Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

Facility	ID	Sample Date	Sampler	location	Sampleid	Alkalinity mg/L	Alk-qual	Aluminum µg/L	Al-qual
CATALINA MHP	C1	10/20/2004	Kenah	PWS RW	70269	314		*Non-detect	
CATALINA MHP	C1	9/1/2005	Kenah	PWS RW	78157	386		*Non-detect	
CATALINA MONITORING WELL	MW1	8/18/2005	Lowry	MW1	77467	442		54600	J
CATALINA MONITORING WELL	MW2	8/18/2005	Lowry	MW2	77466	466		3160	
CATALINA MONITORING WELL	MW3	8/18/2005	Lowry	MW3	77465	432		4360	
CATALINA MHP	C1	1/4/2006	Kenah	PWS WELL	80890	339		*Non-detect	
CATALINA MONITORING WELL	MW1	1/4/2006	Kenah	MW1	80886	379		*Non-detect	
CATALINA MONITORING WELL	MW1F	1/4/2006	Kenah	MW1F FILTERED	80889	381		*Non-detect	
CATALINA MONITORING WELL	MW2	1/4/2006	Kenah	MW2	80885	347		*Non-detect	
CATALINA MONITORING WELL	MW2F	1/4/2006	Kenah	MW2F FILTERED	80888	339		*Non-detect	
CATALINA MONITORING WELL	MW3	1/4/2006	Kenah	MW3	80884	371		*Non-detect	
CATALINA MONITORING WELL	MW3F	1/4/2006	Kenah	MW3F FILTERED	80887	366		*Non-detect	
CATALINA MHP	C1	4/4/2006	Kenah	PWS RW	81573	343		*Non-detect	
CATALINA MONITORING WELL	MW1	4/4/2006	Kenah	MW1	81574	391		*Non-detect	
CATALINA MONITORING WELL	MW1F	4/4/2006	Kenah	MW1F FILTERED	81575	394		*Non-detect	
CATALINA MONITORING WELL	MW2	4/4/2006	Kenah	MW2	81576	344		*Non-detect	
CATALINA MONITORING WELL	MW2F	4/4/2006	Kenah	MW2F FILTERED	81577	337		*Non-detect	
CATALINA MONITORING WELL	MW3	4/4/2006	Kenah	MW3	81578	334		*Non-detect	
CATALINA MONITORING WELL	MW3F	4/4/2006	Kenah	MW3F FILTERED	81579	337		*Non-detect	
CATALINA MHP	C1	7/10/2006	Kenah	PWS RW	83915	359		*Non-detect	
CATALINA MONITORING WELL	MW1	7/10/2006	Kenah	MW1	83916	372		*Non-detect	
CATALINA MONITORING WELL	MW2	7/10/2006	Kenah	MW2	83917	396		*Non-detect	
CATALINA MONITORING WELL	MW2d	7/10/2006	Kenah	MW2 Dupe	83918	418		*Non-detect	
CATALINA MONITORING WELL	MW3	7/10/2006	Kenah	MW3	83919	366		*Non-detect	
CATALINA MHP	C1	10/11/2006	Kenah	PWS RW	88652	271		*Non-detect	
CATALINA MONITORING WELL	MW1	10/11/2006	Kenah	MW1	88653	298		*Non-detect	
CATALINA MONITORING WELL	MW2	10/11/2006	Kenah	MW2	88654	304		*Non-detect	
CATALINA MONITORING WELL	MW3	10/11/2006	Kenah	MW3	88655	304		*Non-detect	
CATALINA MONITORING WELL	MW3d	10/11/2006	Kenah	MW3 Dupe	88656	302		*Non-detect	

If there is nothing written in a parameter column, the parmeter was not analyzed for the sample.

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Samples were collected from the lagoons by DSW during the quarterly sampling events Final effluent and individual lagoons.

Results for the lagoon samples are included in Appendix F - Surface Water Sample Results

Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

ID	Ammonia mg/L	NH3-qual	Arsenic µg/L	As-qual	Barium µg/L	Ba-qual	BOD-bio mg/L	BOD-qual	BOD-carb mg/L	BODC-qual	Cadmium µg/L	Cd-qual
C1	*Non-detect		*Non-detect		112						*Non-detect	
C1	*Non-detect		*Non-detect		112						*Non-detect	
MW1	0.135	J	24.3	J	764	J	*Non-detect		*Non-detect		4.10	J
MW2	2.10		14.4		87		*Non-detect		*Non-detect		0.35	
MW3	0.121		8.8		140		*Non-detect		*Non-detect		*Non-detect	
C1	*Non-detect		*Non-detect		109						*Non-detect	
MW1	*Non-detect		*Non-detect		100		*Non-detect		*Non-detect		*Non-detect	
MW1F	*Non-detect		*Non-detect		100						*Non-detect	
MW2	0.465		6.1		60		*Non-detect		*Non-detect		*Non-detect	
MW2F	0.454		6.7		61						*Non-detect	
MW3	*Non-detect		*Non-detect		120		*Non-detect		*Non-detect		*Non-detect	
MW3F	*Non-detect		*Non-detect		116						*Non-detect	
C1	*Non-detect		*Non-detect		109						*Non-detect	
MW1	*Non-detect		*Non-detect		98						*Non-detect	
MW1F	*Non-detect		*Non-detect		99						*Non-detect	
MW2	*Non-detect		6.8		47						*Non-detect	
MW2F	*Non-detect		6.2		48						*Non-detect	
MW3	*Non-detect		*Non-detect		98						*Non-detect	
MW3F	*Non-detect		*Non-detect		97						*Non-detect	
C1	*Non-detect		*Non-detect		105						*Non-detect	
MW1	*Non-detect		*Non-detect		95						*Non-detect	
MW2	*Non-detect		6.4		53						*Non-detect	
MW2d	*Non-detect		6.8		53						*Non-detect	
MW3	*Non-detect		*Non-detect		85						*Non-detect	
C1	*Non-detect		*Non-detect		108						*Non-detect	
MW1	*Non-detect		*Non-detect		95						*Non-detect	
MW2	*Non-detect		7.2		67						*Non-detect	
MW3	*Non-detect		*Non-detect		107						*Non-detect	
MW3d	*Non-detect		*Non-detect		108						*Non-detect	

If there is nothing written in a parameter column, the parmeter was not analyzed for the sample.

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Samples were collected from the lagoons by DSW during the quarterly sampling events Final effluent and individual lagoons.

Results for the lagoon samples are included in Appendix F - Surface Water Sample Results

Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

ID	Calcium mg/L	Ca-qual	Chloride mg/L	Cl-qual	Chromium µg/L	Cr-qual	COD mg/L	COD-qual	Copper µg/L	Cu-qual	Fluoride mg/L	Fl-qual
C1	110		83.6		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
C1	112		89.4		*Non-detect		*Non-detect		*Non-detect		0.27	
MW1	1490	J	48.5		170	J	10	J	364	J	0.27	
MW2	249		108		34		*Non-detect		36		0.22	
MW3	203		68.0		*Non-detect		*Non-detect		27		0.25	
C1	110		76.8		*Non-detect		138		*Non-detect		0.27	
MW1	126		49.4		*Non-detect		184		*Non-detect		0.22	
MW1F	124		49.4		*Non-detect		24		*Non-detect		0.21	
MW2	117		119		*Non-detect		114		*Non-detect		0.20	
MW2F	118		120		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW3	124		106		*Non-detect		*Non-detect		*Non-detect		0.21	
MW3F	122		107		*Non-detect		*Non-detect		*Non-detect		0.21	
C1	111		66.8		*Non-detect		*Non-detect		*Non-detect		0.25	
MW1	122		49.9		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW1F	125		49.5		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW2	105		116		*Non-detect		16		*Non-detect		*Non-detect	
MW2F	108		114		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW3	108		43.0		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW3F	106		42.5		*Non-detect		13		*Non-detect		*Non-detect	
C1	111		76.9		*Non-detect		*Non-detect		*Non-detect		0.24	
MW1	119		52.7		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW2	109		105		*Non-detect		*Non-detect		11		*Non-detect	
MW2d	109		105		*Non-detect		14		11		*Non-detect	
MW3	106		34.7		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
C1	107		85.3		*Non-detect		*Non-detect		*Non-detect		0.28	
MW1	119		48.2		*Non-detect		*Non-detect		*Non-detect		0.22	
MW2	120		121		*Non-detect		*Non-detect		10		*Non-detect	
MW3	122		57.0		*Non-detect		*Non-detect		*Non-detect		*Non-detect	
MW3d	121		57.3		*Non-detect		*Non-detect		*Non-detect		*Non-detect	

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Samples were collected from the lagoons by DSW during the quarterly sampling events Final effluent and individual lagoons.

Results for the lagoon samples are included in Appendix F - Surface Water Sample Results

Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

ID	Hardness mg/L	Hrd-qual	Iron µg/L	Fe-qual	Lead µg/L	Pb-qual	Magnesium mg/L	Mg-qual	Manganese µg/L	Mn-qual	Nickel µg/L	Ni-qual
C1	427		*Non-detect		*Non-detect		37		*Non-detect		*Non-detect	
C1	432		*Non-detect		*Non-detect		37		*Non-detect		*Non-detect	
MW1	6310	J	189000	J	140	J	630	J	9630	J	318	J
MW2	1020	J	15700		14.1		98		743		*Non-detect	
MW3	795	J	15600		13.0		70		337		*Non-detect	
C1	427		*Non-detect		*Non-detect		37		*Non-detect		*Non-detect	
MW1	488		75		*Non-detect		42		*Non-detect		*Non-detect	
MW1F	478		*Non-detect		*Non-detect		41		*Non-detect		*Non-detect	
MW2	461		*Non-detect		*Non-detect		41		337		*Non-detect	
MW2F	463		*Non-detect		*Non-detect		41		341		*Non-detect	
MW3	470		275		*Non-detect		39		*Non-detect		*Non-detect	
MW3F	461		*Non-detect		*Non-detect		38		*Non-detect		*Non-detect	
C1	438		*Non-detect		*Non-detect		39		*Non-detect		*Non-detect	
MW1	478		*Non-detect		*Non-detect		42		*Non-detect		*Non-detect	
MW1F	489		*Non-detect		*Non-detect		43		*Non-detect		*Non-detect	
MW2	419		*Non-detect		*Non-detect		38		341		*Non-detect	
MW2F	434		*Non-detect		*Non-detect		40		352		*Non-detect	
MW3	414		74		*Non-detect		35		*Non-detect		*Non-detect	
MW3F	405		*Non-detect		*Non-detect		34		*Non-detect		*Non-detect	
C1	430		*Non-detect		*Non-detect		37		*Non-detect		*Non-detect	
MW1	458		*Non-detect		*Non-detect		39		*Non-detect		*Non-detect	
MW2	441		*Non-detect		*Non-detect		41		364		*Non-detect	
MW2d	441		*Non-detect		*Non-detect		41		365		*Non-detect	
MW3	400		*Non-detect		*Non-detect		33		*Non-detect		*Non-detect	
C1	420		*Non-detect		*Non-detect		37		*Non-detect		*Non-detect	
MW1	458		*Non-detect		*Non-detect		39		*Non-detect		*Non-detect	
MW2	472		*Non-detect		*Non-detect		42		440		*Non-detect	
MW3	461		*Non-detect		*Non-detect		38		*Non-detect		*Non-detect	
MW3d	459		*Non-detect		*Non-detect		38		*Non-detect		*Non-detect	

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Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

ID	Nitrate mg/L	NO3- qual	Nitrite mg/L	NO2- qual	ORP mV	PH SU	Phosphorus mg/L	P-qual	Potassium mg/L	K- qual	Spec. Cond. µohm/cm	Selenium µg/L	Se- qual
C1	4.61				271	7.07	*Non-detect		2		991	*Non-detect	
C1	4.59		*Non-detect		242	7.00	*Non-detect		2		1031	*Non-detect	
MW1	0.32	J	*Non-detect		117	7.04	3.01	J	11	J	939	4.2	J
MW2	0.73		*Non-detect		9	7.26	1.57		13		1200	*Non-detect	
MW3	3.44		*Non-detect		8	7.06	0.180		4		970	*Non-detect	
C1	5.76				177	6.53	*Non-detect		2		965	*Non-detect	
MW1	4.57		*Non-detect		144	6.78	0.044		2		940	*Non-detect	
MW1F	4.58				144	6.78	0.025		2		940	*Non-detect	
MW2	5.52		*Non-detect		179	6.91	1.26		9		1177	*Non-detect	
MW2F	5.64				179	6.91	1.27		9		1177	*Non-detect	
MW3	6.68		*Non-detect		165	6.87	0.025		3		1133	*Non-detect	
MW3F	6.61				165	6.87	*Non-detect		3		1133	*Non-detect	
C1	5.49				381	6.69	*Non-detect		2		964	*Non-detect	
MW1	3.64				187	6.61	0.035		2		990	*Non-detect	
MW1F	3.57				187	6.61	0.015		2		990	*Non-detect	
MW2	5.22				151	7.10	1.25		7		1137	*Non-detect	
MW2F	5.28				151	7.10	1.28		7		1137	*Non-detect	
MW3	4.63				228	6.97	0.146		4		858	*Non-detect	
MW3F	4.56				228	6.97	*Non-detect		4		858	*Non-detect	
C1	5.76				270	6.99	*Non-detect		2		1002	*Non-detect	
MW1	3.13				141	6.78	*Non-detect		2		954	*Non-detect	
MW2	0.85				188	7.04	1.13		9		1166	*Non-detect	
MW2d	1.00				188	7.04	1.12		9		1166	*Non-detect	
MW3	4.32				199	6.87	*Non-detect		3		845	*Non-detect	
C1	5.12				497	6.95	*Non-detect		2		1031	*Non-detect	
MW1	3.93				265	6.93	*Non-detect		2		966	*Non-detect	
MW2	0.98				189	7.12	1.41		14		1220	*Non-detect	
MW3	3.53				242	7.03	*Non-detect		3		1015	*Non-detect	
MW3d	3.65				242	7.03	*Non-detect		3		1015	*Non-detect	

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Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

ID	Sodium mg/L	Na-qual	Strontium µg/L	Sr-qual	Sulfate mg/L	SO4-qual	TDS-Field mg/L	TDS- Lab mg/L	TDS-qual	Temperature C	TKN mg/L	TKN-qual
C1	44		768		32.6		687	566		13.4	*Non-detect	
C1	48		804		33.2		492	582		13.3	*Non-detect	
MW1	31	J	1440	J	31.3		649	570		15.4	1.34	J
MW2	78		770		36.3		826	702		16.3	2.62	
MW3	27		507		29.2		670	582		14.9	*Non-detect	
C1	44		745		30.4		667	534		13.7	0.30	
MW1	27		533		37.2		649	494		14.0	0.28	
MW1F	27		531		37.0		649	526		14.0	0.23	
MW2	76		672		61.6		815	650		16.6	1.43	
MW2F	77		677		61.5		815	578		16.6	1.50	
MW3	72		460		42.9		789	636		13.8	0.70	
MW3F	71		449		44.3		789	668		13.8	0.72	
C1	46		805		29.3		460	568		13.0	0.28	
MW1	30		544		35.6		473	556		13.1	0.46	
MW1F	30		555		35.5		473	574		13.1	0.36	
MW2	81		594		48.5		793	676		13.1	0.89	
MW2F	83		611		48.2		793	672		13.1	0.81	
MW3	31		403		28.7		589	500		14.1	0.20	
MW3F	31		399		28.5		589	508		14.1	0.21	
C1	39		621		31.1		478	560		12.8	*Non-detect	
MW1	24		492		31.9		453	518		15.0	*Non-detect	
MW2	75		602		33.2		558	640		13.3	0.37	
MW2d	75		604		33.6		558	642		13.3	0.48	
MW3	19		364		26.1		400	482		14.8	*Non-detect	
C1	45		669		32.7		492	610			0.30	
MW1	26		515		36.6		460	560		14.6	*Non-detect	
MW2	76		678		40.5		584	714		16.0	0.32	
MW3	40		454		37.3		484	578		13.6	*Non-detect	
MW3d	39		450		36.2		484	574		13.6	0.27	

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Samples were collected from the lagoons by DSW during the quarterly sampling events Final effluent and individual lagoons.

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Appendix B2 - Catalina MHP Quarterly Samples - Inorganic Sample Results

ID	TOC mg/L	TOC-qual	Turbidity ntu	Turb-qual	Zinc µg/L	Zn-qual	Filtered	Depth feet	Customerid	Field QC	Latitude -dec	Longitude-dec
C1	*Non-detect				*Non-detect		N	50?	C1		39.5515888	-84.3847444
C1	*Non-detect				*Non-detect		N	50?	C1		39.5515888	-84.3847444
MW1			241		1140	J	N	29.5	MW1		39.5506144	-84.38691
MW2			118		56		N	30	MW2		39.5491776	-84.38816
MW3			218		75		N	30.5	MW3		39.5491493	-84.389147
C1	*Non-detect				*Non-detect		N	50?	C1		39.5515888	-84.3847444
MW1	*Non-detect				*Non-detect		N	29.5	MW1		39.5506144	-84.38691
MW1F	*Non-detect				*Non-detect		Y	29.5	MW1F		39.5506144	-84.38691
MW2	*Non-detect				*Non-detect		N	30	MW2		39.5491776	-84.38816
MW2F	*Non-detect				*Non-detect		Y	30	MW2F		39.5491776	-84.38816
MW3	*Non-detect				*Non-detect		N	30.5	MW3		39.5491493	-84.389147
MW3F	*Non-detect				*Non-detect		Y	30.5	MW3F		39.5491493	-84.389147
C1	*Non-detect				*Non-detect		N	50?	C1		39.5515888	-84.3847444
MW1	*Non-detect				*Non-detect		N	29.5	MW1		39.5506144	-84.38691
MW1F	*Non-detect				*Non-detect		Y	29.5	MW1F		39.5506144	-84.38691
MW2	*Non-detect				*Non-detect		N	30	MW2		39.5491776	-84.38816
MW2F	*Non-detect				*Non-detect		Y	30	MW2F		39.5491776	-84.38816
MW3	*Non-detect				*Non-detect		N	30.5	MW3		39.5491493	-84.389147
MW3F	*Non-detect				*Non-detect		Y	30.5	MW3F		39.5491493	-84.389147
C1	*Non-detect				*Non-detect		N	50?	C1		39.5515888	-84.3847444
MW1	*Non-detect				*Non-detect		N	29.5	MW1		39.5506144	-84.38691
MW2	2.0				*Non-detect		N	30	MW2		39.5491776	-84.38816
MW2d	2.0				*Non-detect		N	30	MW2d	FD	39.5491776	-84.38816
MW3	*Non-detect				*Non-detect		N	30,5	MW3		39.5491493	-84.389147
C1	*Non-detect				*Non-detect		N	50?	C1		39.5515888	-84.3847444
MW1	*Non-detect				*Non-detect		N	29.5	MW1		39.5506144	-84.38691
MW2	2.0				*Non-detect		N	30	MW2		39.5491776	-84.38816
MW3	*Non-detect				*Non-detect		N	30.5	MW3		39.5491493	-84.389147
MW3d	*Non-detect				*Non-detect		N	30.5	MW3d	FD	39.5491493	-84.389147

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Results for the lagoon samples are included in Appendix F - Surface Water Sample Results

Appendix C - Nitrogen and Oxygen Isotope Sample Results

Appendix C1 presents a short summary of the basic principles of nitrogen and oxygen isotopes in nitrate. The analytical results for the Catalina MHP samples are presented in Appendices C2 and C3: C2 for the ground water boring samples; and C3 for the quarterly samples collected from the monitoring wells, the PWS wells and the wastewater lagoons.

Appendix C1 - Basics of Nitrogen and Oxygen Isotopes of Nitrate

Appendix C2 - Isotope Results for Geoprobe Boring Samples

Appendix C3 - Isotope Results for Quarterly Samples:
PWS Well, Lagoons, and Monitoring Well Samples

Appendix C1 - Basics of Nitrogen and Oxygen Isotopes of Nitrate

Analysis of the stable isotopes of nitrogen and oxygen in nitrate is performed on the samples to help identify the source and fate of the nitrate found in ground water. Isotopes are variations in elements which have the same number of protons, but a different numbers of neutrons in the nucleus; a stable isotope is one that does not undergo radioactive decay. Typically one isotope is most common, and one (or more) is less abundant. These more and less common isotopes are used as a pair to establish isotopic ratios that are used to compare the isotopic ratios of samples. Standard notation for isotope identification is to place the sum of the number of protons and neutrons in the upper left corner of the symbol used for the element. An example is nitrogen, represented by the symbol N; the ^{15}N isotope contains 15 protons and neutrons while the ^{14}N isotope contains 14 protons and neutrons. The lighter isotope, ^{14}N, is 273 times the more abundant than ^{15}N, which is heavier, rarer, and will preferentially accumulate in the residual product of a chemical reaction. Biological processes chemically prefer to use the lighter isotope. Information about the physical system can be determined by analyzing the slight mass differences between the isotopes, which can create large, systematic differences in isotope behavior.

Isotope pairs, such as ^{15}N and ^{14}N, are always presented with the heavier (less abundant) isotope in the numerator. Standard "delta" notation is used for nitrogen and other isotopes:

$$\delta^{15}N = \{[(^{15}N/^{14}N)_{sample} / (^{15}N/^{14}N)_{air}] - 1\} \times 1000$$

The δ-value is expressed as parts per thousand, or the per mil (‰) difference from a standard. For example, a $\delta^{15}N$ value of +15 per mil indicates that the sample has 15 parts per thousand (one and one half percent) more ^{15}N than the standard. A positive δ-value is said to be "enriched" or "heavy" and a negative δ-value is said to be "depleted" or "light". The reference standard for the stable isotopes of nitrogen ($^{15}N/^{14}N$) is atmospheric nitrogen (Clark and Fritz, 1997).

Oxygen isotopes are reported in the same manner. The heavier, less abundant oxygen isotope is ^{18}O, and its lighter, more common isotope is ^{16}O. The ratio is constructed in the same way as the nitrogen ratio. The standard for oxygen is Vienna Standard Mean Ocean Water (VSMOW). The lighter isotope, ^{16}O, is 500 times the more abundant than ^{18}O.

A number of steps in the nitrogen cycle can modify the stable isotope composition of a nitrogen bearing compound such as nitrate. These changes, called fractionation, occur due to physical and chemical changes acting upon the differences in mass of each isotope. Generally, these changes tend to cause the heavier isotope to remain in the starting material of the chemical reaction, leaving the source of the nitrogen compounds enriched in heavier isotopes, and the products depleted. The two main modifiers of nitrate isotope composition are the processes of denitrification and nitrification.

Denitrification is defined as the step-wise loss of oxygen from the nitrate molecule ($NO_3 \rightarrow NO_2 \rightarrow NO \rightarrow N$), which occurs generally in the presence of reducing (anoxic) conditions. For interpretation of nitrate isotopes, it is particularly important to identify and account for denitrification, which can greatly enrich (increase) the $\delta^{15}N/^{14}N$ values of the residual nitrate. This enrichment can be mistaken as having a septic/manure source, since the $\delta^{15}N/^{14}N$ isotope compositions of denitrified nitrate and a septic source can be similar. Using a dual-isotope approach (analyzing both nitrogen and oxygen of nitrate), in conjunction with nitrate concentrations, helps to clarify whether denitrification is a dominant process in the system being studied.

Nitrification is the multi-step process of converting, through microbial oxidation, the nitrogen source, in this case urea expressed as ammonia (NH_4^+), into an intermediate form, nitrite (NO_2^-) and finally into nitrate (NO_3^{2-}). These steps are accomplished through the microbial action of two main bacteria; oxidation to nitrite by *Nitrosomonas*, and oxidation to nitrate by *Nitrobacter*. Our bodies are slightly enriched in ^{15}N relative to our diets; this occurs due to the removal of slightly depleted urine in the waste stream. The effect of these transformations is a conversion to nitrate which leaves the residual fluid and solid waste material highly enriched in ^{15}N, with a typical range for $\delta^{15}N$ of +10 to +25 ‰ from an initial value of about +5 ‰. Volatilization of ammonia in the household sewage treatment system can further enhance this process. The final "product" of this nitrification is a sewage effluent rich in nitrate which has characteristic $\delta^{15}N$ values of from +10 to +25 ‰. Typical $\delta^{15}N$ values for common nitrogen sources are given in Table C1.

Nitrate is an ionic compound made up of one nitrogen and three oxygen atoms, which carries a negative two (-2) charge (NO_3^{2-}). For stable isotope analysis, the task is to determine the nitrogen composition of the ground water nitrate (see Table C1 for typical values expected). Because the $\delta^{15}N$ values in ground water nitrate can overlap each other (Table C1), a "dual isotope" approach is used – that is, to also determine the oxygen isotope composition of the same nitrate molecule, which then allows some separation between $\delta^{15}N$ values when they are plotted against $\delta^{18}O$ values for nitrate.

Table C1. δ-Nitrogen Values for Common Sources of Nitrogen Compounds Which May Impact Ground Water
(From Seiler, 1996).

Nitrogen source	$\delta^{15}N$ (‰)
Precipitation	-3
Commercial Fertilizer	-5 to +4
Organic Nitrogen in soil	+4 to +8
Animal or Human waste	+8 to +25

Figure B1 is the standard graph for plotting the stable isotopes of nitrogen and oxygen. The x-axis records the $\delta^{15}N$ values and the $\delta^{18}O$ values are plotted on the y-axis. The various boxes drawn on this graph indicate typical fields into which samples with a particular nitrogen source would fall. Note that the chemical fertilizer field (upper left) coincides with the value $\delta^{18}O$ of

+23.5 ‰ (orange line), indicating that the source of oxygen in nitrate chemical fertilizer is derived from the atmosphere. When results are plotted in this graph it is anticipated that the data will illustrate a mixing line, for example between septic waste and ground water.

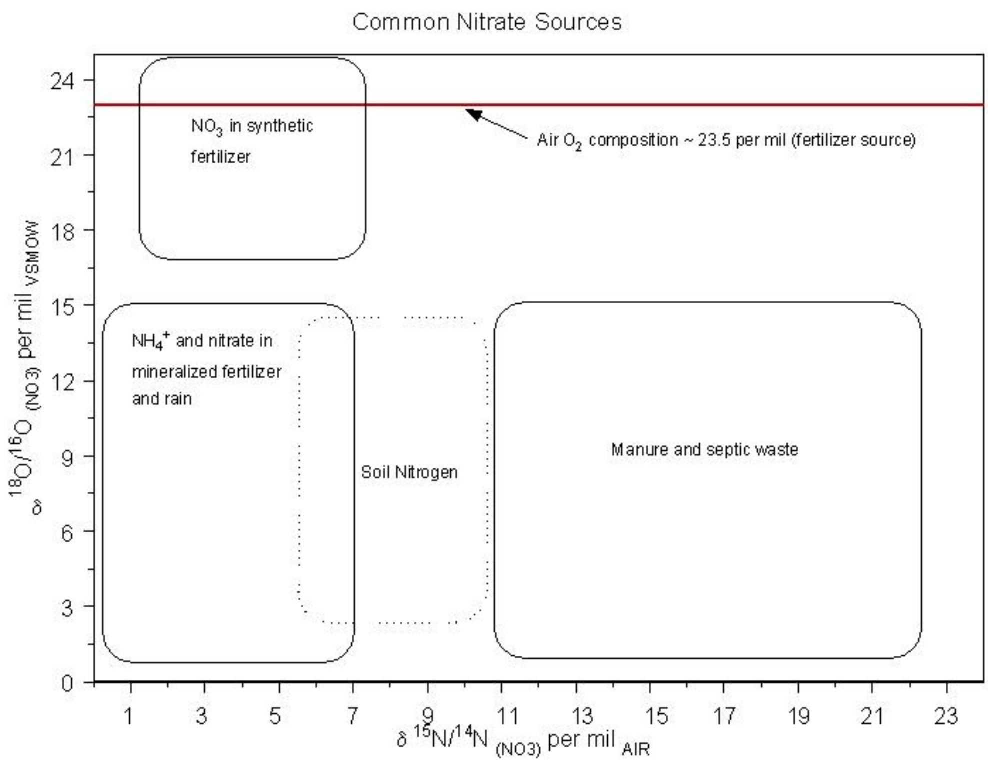

Figure C1. Oxygen and Nitrogen isotope ratios and areas of common nitrogen sources.

Appendix C2 - Isotope Results for Geoprobe Boring Samples

Sample analysis of Catalina MHP samples by COIL Lab, Cornell University

Sample Type	Sample Code*	Sample Boring and Depth	Sampling Date	O18/O16 (NO3) per mil	N15/N14 (NO3) per mil	Nitrate mg/L	Plume Position
Boring	B1S	B1-30	8/16/2005	1.457644378	8.02927363	3.26	outside
Boring	B1D	B1-51	8/16/2005	1.345633623	7.556273282	0.39	outside
Boring	B2S	B2-30	8/16/2005	1.823476437	7.36252628	0.55	core
Boring	B2M	B2-40	8/16/2005	3.28927232	8.823828272	4.63	core
Boring	B3S	B3-30	8/17/2005	2.734634834	9.340382372	3.6	outside
Boring	B3S dupe	B3-30 dupe	8/17/2005	2.5456373	9.017236362	3.58	outside
Boring	B3M	B3-42	8/17/2005	1.232356624	3.565747835	4.34	outside
Boring	B4S	B4-25	8/17/2005	3.239237478	10.12623732	3.87	outside
Boring	B4M	B4-35	8/17/2005	4.348734346	7.953783272	3.88	outside
Boring	B4D	B4-45	8/17/2005	2.564647349	6.234723723	3.78	outside
Boring	B5M	B5-37	8/17/2005	3.023834847	11.46347438	0.4	core
Boring	B5D	B5-47	8/17/2005	4.126236345	9.230282373	3.6	core
Boring	B6S	B6-32	8/17/2005	2.823634735	7.46347374	1.66	outside
Boring	B6M	B6-42	8/17/2005	3.034834835	7.165745783	3.55	outside
Boring	B7S	B7-31	8/17/2005	1.237634735	6.230238238	0	outside
Boring	B8S	B8-28	8/18/2005	1.945745746	7.018373478	3	outside
Boring	B8S dupe	B8-28 dupe	8/18/2005	1.853453463	7.462737239	3	outside
Boring	B8D	B8-51	8/18/2005	2.023823485	8.340238724	2.7	outside
Boring	B9S	B9-2	8/16/2005	2.773456346	9.055978568	1.94	outside
Boring	B9M	B9-40	8/16/2005	2.012937278	8.723562563	3.41	outside
Boring	B9D	B9-60	8/16/2005	2.453473784	8.776976857	3.4	outside
Boring	B10S	B10-30	8/17/2005	6.349234623	6.349834734	1.8	core
Boring	B10M	B10-42	8/17/2005	1.232623463	5.230289278	0	core
Boring	B10D	B10-52	8/17/2005	1.35376272	7.203837221	3.928	core
Boring	B11S	B11-30	8/18/2005	3.123237823	8.019178262	3.2555	extent
Boring	B11M	B11-38	8/18/2005	1.902382348	6.923827121	2.58415	extent
Boring	B11D	B11-47	8/18/2005	1.565784893	7.220192823	3.7	extent
Boring	B13S	B13-32	8/17/2005	2.353723721	11.56473923	5.35	extent
Boring	B13D	B13-48	8/17/2005	2.235623476	10.92782636	5.09	extent
Boring	B14S	B14-29	8/16/2005	2.037823822	7.012823733	2.95	extent
Boring	B14D	B14-52	8/16/2005	1.823762372	6.837633272	2.88	extent
Abandoned Well	WW	Wise Well	8/17/2005	5.348346235	7.362362365	3.92	
Equipment Blank	EQ Blank	EQ blank	8/18/2005	1.023823782	12.30473763	0.5	

* S = Shallow (< 35 feet); M = Medium (35 ≤ x ≤ 45); D = Deep (> 45)

Appendix C3 - Isotope Results for Quarterly Samples

Sample analysis of Catalina MHP samples by COIL Laboratory, Cornell University

Sample Type	Sample Location	Sample Date	18O/16O (NO3) per mil	15N/14N (NO3) per mil	Nitrate (mg/L)
Snowpack	Columbus OH	3/10/2005	1.726256819	4.092317128	0.853
PWS	CAT PWS	9/1/2005	3.019827826	7.915012823	4.678
MW1	CAT MW1	8/18/2005	3.234348343	12.57645746	0.3
Final Effluent	Final EFF	8/17/2005	1.897547645	15.34934738	11.2
Lagoon	CAT Lagoon2	8/17/2005	8.342734634	17.23476236	10.8
Lagoon	CAT Lagoon3	8/17/2005	7.647636635	12.23927633	11
MW2	CAT MW2	8/18/2005	6.756457635	10.76456348	4.2
MW3	CAT MW3	8/18/2005	6.345346347	9.623562352	4.4
PWS	CAT PWS	1/4/2006	3.726256128	7.441012928	4.904
MW1	CAT MW1	1/4/2006	2.514251718	7.52761819	4.047
Lagoon	CAT Lagoon	1/4/2006	3.918276157	9.226012892	5.989
MW2	CAT-MW2	1/4/2006	3.201928267	8.962521613	4.823
MW3	CAT MW3	1/4/2006	3.101892783	8.8883739	5.651
PWS	CAT-PWS	4/4/2006	3.019282771	9.1521	5.026
MW1	CAT MW1	4/4/2006	2.718128924	6.172892912	3.29
Lagoon	CAT Lagoon	4/4/2006	7.152627818	19.5377739	16.3
MW2	CAT MW2	4/4/2006	2.903552376	7.988615271	4.751
MW3	CAT MW3	4/4/2006	3.092826126	8.361782	4.168
PWS	PWS-1	7/10/2006	3.615263202	8.723821921	4.865
MW1	CAT MW1	7/10/2006	3.954667373	10.87533528	2.739
Lagoon	CAT Lagoon	7/10/2006	2.109282727	9.517278191	5.769
MW2	CAT MW2	7/10/2006	1.641521783	4.82916525	0.808
MW2	CAT MW2 dupe	7/10/2006	1.791936823	4.927826262	0.779
MW3	CAT MW 3	7/10/2006	3.019277626	8.920182762	3.769
PWS	CAT PWS	10/11/2006	2.615241262	7.920189172	4.19
MW1	CAT MW1	10/11/2006	2.018926257	6.674009278	3.437
Lagoon	CAT Lagoon	10/11/2006	5.291826376	8.162527629	5.405
MW2	CAT MW2	10/11/2006	2.564363738	5.0312739	0.794
MW3	CAT MW3	10/11/2006	2.525237618	6.019272722	3.388
MW3	CAT MW3 dupe	10/11/2006	2.192723627	6.156276273	3.396

MW = monitoring well
PWS = public water system

Appendix D - Microbiologic Sample Results

Microbiologic data are presented in two spreadsheets, one for the ground water Geoprobe boring samples and the second for the quarterly samples collected from the monitoring wells, the PWS wells, and the wastewater lagoons.

Appendix D1 – Microbiologic Results for Geoprobe Boring Samples

Appendix D2 - Microbiologic Results for Quarterly Samples:
PWS Well, Lagoons, and Monitoring Well Samples

Appendix D1 - Catalina MHP Boring Samples - Microbiologic Sample Results

Sample Analysis by U.S.EPA

					Colilert		Aerobic Spores	Heterotrophic Plate Counts	
Sample Location	**Depth interval**	**Depth - screen bottom ***	**QC Sample**	**Enterococcus #/100ml**	**Coliforms #/100 ml**	**Ecoli #/100 ml**	**CFU/100 ml**	**PCA (CFU/ml)**	**R2A (CFU/ml)**
B-1-30	Shallow	30		<1	<1		400	<1	1,050
B-1-51	Deep	51		1	<1		50	<1	40
B-2-30	Shallow	30		3	<1		50	2	90
B-2-40	Deep	40		<1	5		<1	5	400
B-3-30	Shallow	30		12	15		100	50	3,600
B-3-30	Shallow	30	Dupe	16	7		300	65	860
B-3-42	Deep	40		29	5		<1	105	1,500
B-4-25	Shallow	25		<1	<1		<1	53	300
B-4-35	Intermediate	35		<1	6		<1	14	150
B-4-45	Deep	45		<1	1		1,300	10	300
B-5-27	Shallow	27		1	6		<1	104	1,800
B-5-37	Intermediate	37		2	9		<1	67	600
B-5-47	Deep	47		<1	<1		<1	18	200
B-6-32	Shallow	32		<1	1		<1	7	100
B-6-42	Deep	42		<1	1		50	4	40
B-7-31	Shallow	31		7	7		2,800	35	8,800
B-8-28	Shallow	32	Dupe	<1	<1		200	13	70
B-8-28	Shallow	32		5	<1		400	37	210
B-8-51	Deep	51		<1	<1		50	<1	10
B-9-32	Shallow	32		<1	4		50	2	10
B-9-40	Intermediate	44		21	101		100	53	110
B-9-60	Deep	60		2	10		100	5	90
B-10-30	Shallow	30		<1	1		<1	7	450
B-10-42	Intermediate	42		<1	<1		<1	4	30
B-10-52	Deep	52		3	<1		<1	16	280
B-11-30	Shallow	30		<1	4		300	1	20
B-11-38	Intermediate	38		8	24		<1	7	40
B-11-47	Deep	47		231	204		<1	89	160
B-13-32	Shallow	32		<1	<1		<1	<1	50
B-13-48	Deep	48		<1	<1		<1	11	50
B-14-29	Shallow	33		<1	<1		<1	<1	340
B-14-52	Deep	52		9	17		250	<1	420
Equipment Blank			EB	<1	5		800	830	32,000
Wise Well		?		2,063	495		<1	430	4,400

Samples collected between August 16-18, 2005

* Four foot screen

Appendix D1 - Catalina MHP Boring Samples - Microbiologic Sample Results

Sample Analysis by U.S.EPA

Sample Location	**Somatic Phage (pfu/L)**	**F+ Phage (pfu/L)**	**Somatic Phage (pfu/50 mL)**	**F+ Phage (pfu/50 mL)**
B-1-30	0	0	0	0
B-1-51	0	0	0	0
B-2-30	0	0	0	0
B-2-40	0	0	0	0
B-3-30	0	0	0	0
B-3-30	0	0	0	0
B-3-42	0	0	0	0
B-4-25	40	80	2	4
B-4-35	180	20	9	1
B-4-45	80	0	4	0
B-5-27	40	60	2	3
B-5-37	100	40	5	2
B-5-47	0	40	0	2
B-6-32	0	0	0	0
B-6-42	20	20	1	1
B-7-31	40	40	2	2
B-8-28	340	0	17	0
B-8-28	200	0	10	0
B-8-51				
B-9-32	200	0	10	0
B-9-40	60	0	3	0
B-9-60	40	0	2	0
B-10-30	100	20	5	1
B-10-42	220	80	11	4
B-10-52	0	60	0	3
B-11-30	0	0	0	0
B-11-38	0	0	0	0
B-11-47	80	0	4	0
B-13-32	0	0	0	0
B-13-48	20	40	1	2
B-14-29	0	0	0	0
B-14-52	0	0	0	0
Equipment Blank	1000	0	50	0
Wise Well	100	60	5	3

Appendix D2 - Catalina MHP Quarterly Sampling - Microbiologic Sample Results

		Ohio EPA Analysis		U.S. EPA Analysis			
					Colilert		Aerobic Spores
Sample Location	**QC Sample**	**Coliforms #/100 ml**	**Ecoli #/100 ml**	**Enterococcus #/100ml**	**Coliforms #/100 ml**	**Ecoli #/100 ml**	**CFU/100 ml**
PWS Well - raw water							
9/1/2005							
1/4/2006				<1	<1	<1	<1
4/4/2006				<1	<1	<1	<1
7/10/2006				<1	<1	<1	30
10/11/2006				<1	<1	<1	30
MW1 - upgradient							
8/18/2005				16	<1		<1
1/4/2006				<1	<1	<1	<1
4/4/2006				<1	<1	<1	<1
7/10/2006				<1	<1	<1	110
10/11/2006				<1	<1	<1	64
MW2 - downgradient							
8/18/2005				2	<1		<1
1/4/2006				<1	5	<1	<1
4/4/2006				<1	<1	<1	<1
7/10/2006				<1	<1	<1	7
7/10/2006	Dupe			<1	<1	<1	9
10/11/2006				<1	387	4	120
MW3 - downgradient							
8/18/2005				<1	3		50
1/4/2006				<1	<1	<1	<1
4/4/2006				<1	<1	<1	<1
7/10/2006				<1	<1	<1	30
10/11/2006				<1	<1	<1	100
10/11/2006	Dupe			<1	<1	<1	80
MHP Final effluent - post aeration							
10/20/2004		280	2,700				
10/20/2004 (at lagoon inflow)		60*	440				
8/17/2005				2,723	198,600	27,230	11,000
Repeated (1:2 Dilution)							
Infiltration Lagoon - SE							
8/17/2006				7,701	198,280	30,900	33,000
Repeated (1:2 Dilution)							
1/4/2006		6000	860*	933	19,863	4,611	21,000
4/4/2006		540	150*	127	5,500	630	600
7/10/2006		11,000	6,300	23	579	62	600
10/11/2006 **				>2500	>2500	550	Not Done
Infiltration Lagoon - SW							
8/17/2005				5,794	198,628	32,550	15,000
Repeated (1:2 Dilution)							
Stormwater Lagoon							
10/20/2004		190*	400				

** 10/11/2006 Lagoon Sample 2/3 Sediment; results inaccurate

* Estimated result - Computed using a colony count that is not in acceptable range.

Samples with the the same color were collected during one quarterly sampling event.

Only some samples analyzed for Coliphage

TNTC - Too numerous to count

Appendix D2 - Catalina MHP Quarterly Sampling - Microbiologic Sample Results

U.S. EPA Analysis						
	Heterotrophic Plate Counts		Coliphage			
Sample Location	**PCA CFU/ml**	**R2A CFU/ml**	**Somatic Phage (pfu/L)**	**F+ Phage (pfu/L)**	**Somatic Phage (pfu/50 mL)**	**F+ Phage (pfu/50 mL)**
PWS Well - raw water						
9/1/2005						
1/4/2006	4	52				
4/4/2006	<1	20			0	1
7/10/2006	<1	20				
10/11/2006	13	260			0	0
MW1 - upgradient						
8/18/2005	75	510	160	0	8	0
1/4/2006	32	290				
4/4/2006	<1	140			0	4
7/10/2006	<1	250				
10/11/2006	26	620			0	0
MW2 - downgradient						
8/18/2005	5	180	180	0	9	0
1/4/2006	7	150				
4/4/2006	<1	40			0	0
7/10/2006	<1	290				
7/10/2006	<1	220				
10/11/2006	900	2,100			0	0
MW3 - downgradient						
8/18/2005	3	240	120	0	6	0
1/4/2006	4	180				
4/4/2006	4	330			0	0
7/10/2006	<1	350				
10/11/2006	39	940			0	0
10/11/2006	25	790			0	0
MHP Final effluent - post aeration						
10/20/2004						
10/20/2004 (at lagoon inflow)						
8/17/2005	20,900	400,000	TNTC	800	TNTC	40
Repeated (1:2 Dilution)			36880	320	922	8
Infiltration Lagoon - SE						
8/17/2006	82,000	740,000	TNTC	1080	TNTC	54
Repeated (1:2 Dilution)			45120	400	1128	10
1/4/2006	36,000	472,000				
4/4/2006	27,000	390,000			27	0
7/10/2006	32,000	490,000				
10/11/2006 **	120,000	770,000				
Infiltration Lagoon - SW						
8/17/2005	23,000	310,000	TNTC	700	TNTC	35
Repeated (1:2 Dilution)			38560	80	964	2
Stormwater Lagoon						

Appendix E - Pharmaceutical Sample Results

Pharmaceutical sample results from the Catalina MHP investigation.

Appendix E1 – Pharmaceutical Results for Geoprobe Boring Samples

Appendix E2 – Pharmaceutical Results for Quarterly Samples:
PWS Well, Lagoons, and Monitoring Well Samples

Appendix E1 - Catalina MHP Boring Samples - Pharmaceutical Sample Results

Sample analysis by U.S. EPA/USGS

USGS sample ID	Boring and Depth	ID*	Samp Date	1,7-dimethylxanthine	Acetaminophen	Albuterol	Caffeine	Carbamazepine	Codeine
OHEPACATB1D51	B1 deep 51'	B1D	8/16/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB1S30	B1shallow 30'	B1S	8/16/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB2D40	B2 deep 40'	B2M	8/16/2005	<0.021	<0.024	<0.014	E0.024	E0.194	<0.022
OHEPACATB2S30	B2 shallow 30'	B2S	8/16/2005	<0.021	<0.024	<0.014	<0.068	E0.212	<0.022
OHEPACATB3D42	B3 deep 42'	B3M	8/17/2005	<0.021	<0.024	<0.014	<0.015	E0.044	<0.022
OHEPACATB3S0D	B3 shallow 30 dupilcate	B3Sd	8/17/2005	<0.021	<0.024	<0.014	<0.016	E0.052	<0.022
OHEPACATB3S30	B3 shallow 30	B3S	8/17/2005	<0.021	<0.024	<0.014	<0.016	E0.050	<0.022
OHEPACATB4D45	B4 deep 45'	B4D	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB4I35	B4 intermediate 35'	B4M	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB4S25	B4 shallow 25'	B4S	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB5137	B5 intermediate 35'	B5M	8/17/2005	<0.021	<0.024	E0.005	<0.049	E0.264	<0.022
OHEPACATB5DA7	B5 deep 47'	B5D	8/17/2005	<0.021	E0.027	<0.014	E0.045	E0.212	<0.022
OHEPACATB5S27	B5 shallow 27'	B5S	8/17/2005	<0.021	<0.024	<0.014	<0.086	E0.242	<0.022
OHEPACATB6D42	B6 deep 42'	B6M	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB6S32	B6 shallow 32'	B6S	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB6S32D	B6 shallow 32' duplicate	B6Sd	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB7031	B7 only 31'	B7S	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB8D51	B8 deep 51'	B8D	8/18/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB8S28	B8 shallow 28'	B8S	8/18/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB8S28D	B8 shallow 28' duplicate	B8Sd	8/18/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB9D60	B9 deep 60'	B9D	8/16/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB9I40	B9 intermediate 40'	B9M	8/16/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB9S32	B9 shallow 32'	B9S	8/16/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB10D52	B10 deep 52	B10D	8/17/2005	<0.021	<0.024	<0.014	<0.030	E0.019	<0.022
OHEPACATB10D52D	B10 deep 52 duplicate	B10Dd	8/17/2005	<0.021	<0.024	<0.014	<0.029	E0.015	<0.022
OHEPACATB10I42	B10 intermediate 42'	B10M	8/17/2005	<0.021	<0.024	<0.014	<0.043	E0.056	<0.022
OHEPACATB10S30	B10 shallow 30'	B10S	8/17/2005	<0.021	<0.024	<0.014	<0.041	E0.189	<0.022
OHEPACATB11D47	B11 deep 47'	B11D	8/18/2005	<0.021	<0.024	<0.014	<0.015	E0.010	<0.022
OHEPACATB11I38	B11 intermediate 38'	B11M	8/18/2005	<0.021	<0.024	<0.014	<0.035	E0.169	<0.022
OHEPACATB11S30	B11 shallow 30'	B11S	8/18/2005	<0.021	<0.024	<0.014	<0.045	E0.180	<0.022
OHEPACATB1332	B13-32	B13S	8/17/2005	<0.021	E0.014	<0.014	<0.031	<0.018	<0.022
OHEPACATB13DEEP	B13 deep	B13D	8/17/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB14D52	B14 deep 52'	B14D	8/16/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATB14S29	B14 shallow 29'	B14S	8/1/2005	<0.021	<0.024	<0.014	<0.015	<0.018	<0.022
OHEPACATEQBLANK	Equipment Blank	EQ	8/18/2005	<0.021	<0.024	<0.014	E0.037	<0.018	<0.022
OHEPACATWISEW	Wise Well	W1	8/17/2005	<0.021	<0.024	<0.014	<0.015	E0.097	<0.022

All Values are in PPB (µg/L)

< Indicates non detect values with detection limit indicated

E Indicates an estimated value;

* Sample ID - depth range: S = shallow (< 35 feet); M = Mid-range (35 ≤ M ≤ 45 feet); and D=Deep (> 45 feet).

Appendix E1 - Catalina MHP Boring Samples - Pharmacutical Sample Results

Sample analysis by U.S. EPA/USGS

ID*	Cotinine	Dehydronifedipine	Diltiazem	Diphenhydramine	Fluoxetine	Ranitidine	Sulfamethoxazole	Thiabendazole	Trimethoprim	Warfarin
B1D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B1S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B2M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.037	<0.025	<0.020	<0.019
B2S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.214	<0.025	<0.020	<0.019
B3M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B3Sd	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.013	<0.025	<0.020	<0.019
B3S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.014	<0.025	<0.020	<0.019
B4D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B4M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B4S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B5M	E0.007	<0.022	<0.018	<0.023	<0.016	<0.025	E0.152	<0.025	<0.020	<0.019
B5D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.024	<0.025	<0.020	<0.019
B5S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.171	<0.025	<0.020	<0.019
B6M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B6S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B6Sd	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B7S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B8D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B8S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B8Sd	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B9D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B9M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B9S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B10D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.047	<0.025	<0.020	<0.019
B10Dd	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.054	<0.025	<0.020	<0.019
B10M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.176	<0.025	<0.020	<0.019
B10S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.236	<0.025	<0.020	<0.019
B11D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.094	<0.025	<0.020	<0.019
B11M	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.329	<0.025	<0.020	<0.019
B11S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.405	<0.025	<0.020	<0.019
B13S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.056	<0.025	<0.020	<0.019
B13D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.049	<0.025	<0.020	<0.019
B14D	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
B14S	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
EQ	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
W1	<0.028	<0.022	<0.018	<0.023	<0.016	<0.025	E0.019	<0.025	<0.020	<0.019

Appendix E2 - Catalina MHP Quarterly Sampling - Pharmacutical Sample Results

Sample analysis by U.S. EPA/USGS

Site	Date	QC Sample	1,7-dimethylxanthine	Acetaminophen	Albuterol	Caffeine	Carbamazepine	Codeine	Cotinine	Dehydronifedipine
PWS	9/1/05		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
FINAL EFFLUENT	8/17/05		<0.021	<0.024	<0.019	<0.015	E0.039	<0.022	<0.028	E0.011
SE LAGOON	8/17/05		<0.021	<0.024	0.02	<0.016	0.054	E0.016	<0.028	E0.009
SW LAGOON	8/17/05		<0.021	<0.024	<0.014	<0.015	E0.067	<0.022	<0.028	E0.007
MW1	8/18/05		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
MW2	8/18/05		<0.021	<0.024	<0.014	<0.150	0.513	<0.022	E0.003	E0.006
MW3	8/18/05		<0.021	<0.024	<0.014	<0.015	0.078	<0.022	<0.028	<0.022
PWS	1/4/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
SE LAGOON	1/4/06		<0.044	<0.024	0.018	0.025	0.031	0.084	0.102	<0.022
MW1	1/4/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
MW2	1/4/06		<0.021	<0.024	<0.014	<0.129	0.642	<0.022	<0.028	E0.01
MW3	1/4/06		<0.021	<0.024	<0.014	<0.043	0.096	<0.022	<0.028	<0.022
PWS	4/4/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
SE LAGOON	4/4/06		<0.021	<0.024	0.049	<0.015	0.02	0.075	E0.012	<0.022
MW1	4/4/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
MW2	4/4/06		<0.021	<0.024	<0.014	0.076	0.46	<0.022	<0.028	E0.01
MW3	4/4/06		<0.021	<0.024	<0.014	<0.015	0.072	<0.022	<0.028	<0.022
PWS	7/10/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
SE LAGOON	7/10/06		<0.021	<0.024	E0.013	<0.015	0.044	E0.018	E0.013	<0.022
MW1	7/10/06		<0.021	<0.024	<0.014	0.034	<0.018	<0.022	<0.028	<0.022
MW2	7/10/06		<0.021	<0.024	<0.014	<0.037	0.316	<0.022	<0.028	E0.005
MW2	7/10/06	Dupe	<0.021	<0.024	<0.014	<0.042	0.324	<0.022	<0.028	E0.006
MW3	7/10/06		<0.021	E0.008	<0.014	0.079	0.05	<0.022	<0.028	<0.022
PWS	10/11/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
SE LAGOON	10/11/06		<0.021	<0.024	<0.014	<0.015	E0.557	<0.022	<0.028	<0.022
MW 1	10/11/06		<0.021	<0.024	<0.014	<0.015	<0.018	<0.022	<0.028	<0.022
MW 2	10/11/06		<0.021	<0.024	<0.014	<0.015	E0.517	<0.022	<0.028	E0.012
MW 3	10/11/06		<0.021	<0.024	<0.014	<0.015	E0.063	<0.022	<0.028	<0.022
MW 3	10/11/06	Dupe	<0.021	<0.024	<0.014	<0.015	E0.063	<0.022	<0.028	<0.022

All Values in PPM

< Indicates nondetect; E Indicates estimated value.

Appendix E2 - Catalina MHP Quarterly Sampling - Pharmacutical Sample Results

Sample analysis by U.S. EPA/USGS

Site	Diltiazem	Diphenhydramine	Fluoxetine	Ranitidine	Sulfamethoxazole	Thiabendazole	Trimethoprim	Warfarin
PWS	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
FINAL EFFLUENT	<0.018	E0.190	E0.027	<0.179	E0.156	<0.025	<0.020	<0.019
SE LAGOON	<0.018	E0.133	<0.021	E0.106	0.188	<0.025	<0.020	<0.019
SW LAGOON	<0.018	<0.023	E0.018	E0.066	E0.237	<0.025	<0.020	<0.019
MW1	<0.018	<0.023	<0.016	<0.025	0.049	<0.025	<0.020	<0.019
MW2	<0.018	<0.023	<0.016	<0.025	0.354	<0.025	<0.020	<0.019
MW3	<0.018	<0.023	<0.016	<0.025	E0.020	<0.025	<0.020	<0.019
PWS	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
SE LAGOON	<0.018	0.17	<0.020	<0.076	1.77	<0.025	0.1	<0.019
MW1	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
MW2	<0.018	<0.023	<0.016	<0.025	0.266	<0.025	<0.020	<0.019
MW3	<0.018	<0.023	<0.016	<0.025	0.029	<0.025	<0.020	<0.019
PWS	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
SE LAGOON	<0.018	0.055	<0.016	E0.042	3.05	<0.025	0.095	<0.059
MW1	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
MW2	<0.018	<0.023	<0.016	<0.025	0.898	<0.025	<0.020	<0.019
MW3	<0.018	<0.023	<0.016	<0.025	0.03	<0.025	<0.020	<0.019
PWS	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
SE LAGOON	E0.027	0.055	E0.027	E0.074	1.63	<0.025	<0.020	<0.019
MW1	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
MW2	<0.018	<0.023	<0.016	<0.025	0.451	<0.025	<0.020	<0.019
MW2	<0.018	<0.023	<0.016	<0.025	0.465	<0.025	<0.020	<0.019
MW3	<0.018	<0.023	<0.016	<0.025	E0.011	<0.025	<0.020	<0.019
PWS	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
SE LAGOON	E0.018	<0.023	<0.016	<0.025	<0.127	<0.025	<0.020	<0.019
MW 1	<0.018	<0.023	<0.016	<0.025	<0.024	<0.025	<0.020	<0.019
MW 2	<0.018	<0.023	<0.016	<0.025	E0.127	<0.025	<0.020	<0.019
MW 3	<0.018	<0.023	<0.016	<0.025	E0.018	<0.025	<0.020	<0.019
MW 3	<0.018	<0.023	<0.016	<0.025	E0.016	<0.025	<0.020	<0.019

Appendix F - Surface Water Sample Results

Surface water sample results for the Catalina MHP investigation. Samples were collected from the storm water lagoon, the wastewater lagoons, and final effluent discharged to the wastewater lagoons. Samples are arranged by sample date.

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

Sample	70261				
Date Received	10/20/2004 2:43 PM	**Matrix**	WW	**Collected by**	MAHR, MARYANNE
	Begin	**End**		**Sample Type**	LITIGATION
Date Collected		10/20/2004 11:30 AM		**Station ID**	
Program	SWDO-DSW			**Customer ID**	MAM1020
Client	DSW_C			**External ID**	
Location	CATALINA MHP STORMWATER LAGOON				

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	8.8	2	mg/L	10/21/2004	
CBOD-5	CBOD5	P80082	5.8	2	mg/L	10/21/2004	
Conductivity	Conductivity	P95	71	1	umhos/cm	11/10/2004	RC
Solids_Diss	Total Dissolved Solids	P70300	70	10	mg/L	10/22/2004	RC
Solids_Susp	Total Suspended Solids	P530	<5	5	mg/L	10/22/2004	
TOC	TOC	P680	9.7	2	mg/L	11/02/2004	
pH	pH	P403	6.88		s.u.	10/21/2004	
ICP_(WAT)	Aluminum	P1105	233	200	ug/L	10/25/2004	
ICP_(WAT)	Barium	P1007	<15	15	ug/L	10/25/2004	
ICP_(WAT)	Calcium	P916	10	2	mg/L	10/25/2004	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	10/25/2004	
ICP_(WAT)	Copper	P1042	<10	10	ug/L	10/25/2004	
ICP_(WAT)	Hardness, Total	P900	33	10	mg/L	10/25/2004	
ICP_(WAT)	Iron	P1045	695	50	ug/L	10/25/2004	
ICP_(WAT)	Magnesium	P927	2	1	mg/L	10/25/2004	
ICP_(WAT)	Manganese	P1055	95	10	ug/L	10/25/2004	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	10/25/2004	
ICP_(WAT)	Potassium	P937	3	2	mg/L	10/25/2004	
ICP_(WAT)	Sodium	P929	<5	5	mg/L	10/25/2004	
ICP_(WAT)	Strontium	P1082	<30	30	ug/L	10/25/2004	
ICP_(WAT)	Zinc	P1092	42	10	ug/L	10/25/2004	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	10/26/2004	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	10/26/2004	
SIMAA_(WAT)	Cadmium	P1027	0.29	0.2	ug/L	10/26/2004	
SIMAA_(WAT)	Lead	P1051	2.0	2	ug/L	10/26/2004	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	10/26/2004	
E.coli	E.coli	P31648	400	10	#/100ml	10/20/2004	
Fecal Coliform	Fecal Coliform	P31616	190	10	#/100ml	10/20/2004	JL
Alkalinity	Alkalinity	P410	26.8	5	mg/L	10/27/2004	
COD	COD	P340	29	10	mg/L	11/15/2004	
Chloride	Chloride	P940	<5.0	5	mg/L	10/26/2004	
Fluoride	Fluoride	P951	<0.20	0.2	mg/L	11/10/2004	
NO3-NH3	Ammonia	P610	<0.050	0.05	mg/L	11/08/2004	
NO3-NH3	Nitrate+nitrite	P630	<0.10	0.1	mg/L	11/08/2004	
Nitrite	Nitrite	P615	<0.020	0.02	mg/L	10/21/2004	
Sulfate	Sulfate	P945	<5.0	5	mg/L	10/26/2004	
TKN-TP	TKN	P625	0.53	0.2	mg/L	11/01/2004	
TKN-TP	Total Phosphorus	P665	0.245	0.01	mg/L	11/01/2004	

Field Comments

Lab Comments

QC / Sample Comments

Approved By [illegible] **On** [illegible]

Definition Of Qualifiers is attached when required

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

Sample	70263				
Date Received	10/20/2004 2:43 PM	**Matrix**	WW	**Collected by**	MAHR, MARYANNE
	Begin	**End**		**Sample Type**	LITIGATION
Date Collected		10/20/2004 9:00 AM		**Station ID**	
Program	SWDO-DSW			**Customer ID**	MAM1020
Client	DSW_C			**External ID**	
Location	CATALINA MHP FINAL EFFLUENT				

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	12	2	mg/L	10/21/2004	
CBOD-5	CBOD5	P80082	7.0	2	mg/L	10/21/2004	J
Conductivity	Conductivity	P95	1250	1	umhos/cm	11/10/2004	
Oil&Grease	Oil & Grease	P556	5.7	2	mg/L	11/16/2004	
Solids_Diss	Total Dissolved Solids	P70300	644	10	mg/L	10/22/2004	
Solids_Susp	Total Suspended Solids	P530	18	5	mg/L	10/22/2004	
TOC	TOC	P680	11	2	mg/L	11/02/2004	
pH	pH	P403	7.73		s.u.	10/21/2004	
ICP_(WAT)	Aluminum	P1105	<200	200	ug/L	10/25/2004	
ICP_(WAT)	Barium	P1007	86	15	ug/L	10/25/2004	
ICP_(WAT)	Calcium	P916	106	2	mg/L	10/25/2004	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	10/25/2004	
ICP_(WAT)	Copper	P1042	<10	10	ug/L	10/25/2004	
ICP_(WAT)	Hardness, Total	P900	417	10	mg/L	10/25/2004	
ICP_(WAT)	Iron	P1045	96	50	ug/L	10/25/2004	
ICP_(WAT)	Magnesium	P927	37	1	mg/L	10/25/2004	
ICP_(WAT)	Manganese	P1055	<10	10	ug/L	10/25/2004	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	10/25/2004	
ICP_(WAT)	Potassium	P937	13	2	mg/L	10/25/2004	
ICP_(WAT)	Sodium	P929	84	5	mg/L	10/25/2004	
ICP_(WAT)	Strontium	P1082	630	30	ug/L	10/25/2004	
ICP_(WAT)	Zinc	P1092	53	10	ug/L	10/25/2004	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	10/26/2004	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	10/26/2004	
SIMAA_(WAT)	Cadmium	P1027	<0.20	0.2	ug/L	10/26/2004	
SIMAA_(WAT)	Lead	P1051	<2.0	2	ug/L	10/26/2004	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	10/26/2004	
E.coli	E.coli	P31648	2700	10	#/100ml	10/20/2004	
Fecal Coliform	Fecal Coliform	P31616	280	10	#/100ml	10/20/2004	
Alkalinity	Alkalinity	P410	329	5	mg/L	10/27/2004	
COD	COD	P340	27	10	mg/L	11/15/2004	
Chloride	Chloride	P940	136	5	mg/L	10/26/2004	
Fluoride	Fluoride	P951	<0.20	0.2	mg/L	11/10/2004	
NO3-NH3	Ammonia	P610	7.03	0.25	mg/L	11/08/2004	
NO3-NH3	Nitrate+nitrite	P630	6.09	0.1	mg/L	11/08/2004	
Nitrite	Nitrite	P615	5.38	0.14	mg/L	10/21/2004	
Sulfate	Sulfate	P945	44.2	20	mg/L	10/26/2004	
TKN-TP	TKN	P625	9.02	0.2	mg/L	11/01/2004	
TKN-TP	Total Phosphorus	P665	1.98	0.1	mg/L	11/08/2004	

Field Comments

Lab Comments

QC / Sample Comments CBOD5 estimated due to poor agreement between dilutions.

Approved By [illegible] **On** [illegible]

Definition Of Qualifiers is attached when required

Printed on Nov 18, 2004 10:42 am

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

Sample 70262

Date Received 10/20/2004 2:43 PM **Matrix** WW **Collected by** MAHR, MARYANNE

Begin **End** **Sample Type** LITIGATION

Date Collected 10/20/2004 10:30 AM **Station ID**

Program SWDO-DSW **Customer ID** MAM1020

Client DSW_C **External ID**

Location CATALINA MHP NORTHEAST LAGOON

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	17	2	mg/L	10/21/2004	
CBOD-5	CBOD5	P80082	3.8	2	mg/L	10/21/2004	
Conductivity	Conductivity	P95	1230	1	umhos/cm	11/10/2004	
Solids_Diss	Total Dissolved Solids	P70300	650	10	mg/L	10/22/2004	
Solids_Susp	Total Suspended Solids	P530	13	5	mg/L	10/22/2004	
TOC	TOC	P680	9.5	2	mg/L	11/02/2004	
pH	pH	P403	7.78		s.u.	10/21/2004	
ICP_(WAT)	Aluminum	P1105	<200	200	ug/L	10/25/2004	
ICP_(WAT)	Barium	P1007	85	15	ug/L	10/25/2004	
ICP_(WAT)	Calcium	P916	106	2	mg/L	10/25/2004	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	10/25/2004	
ICP_(WAT)	Copper	P1042	<10	10	ug/L	10/25/2004	
ICP_(WAT)	Hardness, Total	P900	417	10	mg/L	10/25/2004	
ICP_(WAT)	Iron	P1045	91	50	ug/L	10/25/2004	
ICP_(WAT)	Magnesium	P927	37	1	mg/L	10/25/2004	
ICP_(WAT)	Manganese	P1055	<10	10	ug/L	10/25/2004	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	10/25/2004	
ICP_(WAT)	Potassium	P937	13	2	mg/L	10/25/2004	
ICP_(WAT)	Sodium	P929	85	5	mg/L	10/25/2004	
ICP_(WAT)	Strontium	P1082	635	30	ug/L	10/25/2004	
ICP_(WAT)	Zinc	P1092	79	10	ug/L	10/25/2004	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	10/26/2004	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	10/26/2004	
SIMAA_(WAT)	Cadmium	P1027	<0.20	0.2	ug/L	10/26/2004	
SIMAA_(WAT)	Lead	P1051	<2.0	2	ug/L	10/26/2004	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	10/26/2004	
E.coli	E.coli	P31648	440	10	#/100ml	10/20/2004	
Fecal Coliform	Fecal Coliform	P31616	60	10	#/100ml	10/20/2004	JL
Alkalinity	Alkalinity	P410	331	5	mg/L	10/27/2004	
COD	COD	P340	30	10	mg/L	11/15/2004	
Chloride	Chloride	P940	136	5	mg/L	10/26/2004	
Fluoride	Fluoride	P951	<0.20	0.2	mg/L	11/10/2004	
NO3-NH3	Ammonia	P610	7.61	0.25	mg/L	11/08/2004	
NO3-NH3	Nitrate+nitrite	P630	6.02	0.1	mg/L	11/08/2004	
Nitrite	Nitrite	P615	4.73	0.14	mg/L	10/21/2004	
Sulfate	Sulfate	P945	44.5	20	mg/L	10/26/2004	
TKN-TP	TKN	P625	9.21	2	mg/L	11/15/2004	
TKN-TP	Total Phosphorus	P665	2.16	0.1	mg/L	11/15/2004	

Field Comments

Lab Comments

QC / Sample Comments

Approved By [illegible] **On** [illegible]

Definition Of Qualifiers is attached when required

OhioEPA Division of ·ironmental Services

Laboratory Inorganic Analysis Data Report

Sample	77353				
Date Received	08/18/2005 11:35 AM	**Matrix**	WW	**Collected by**	MAHR, MARYANNE
	Begin	**End**		**Sample Type**	LITIGATION
Date Collected		08/17/2005 9:40 AM		**Station ID**	
Program	SWDO-DSW			**Customer ID**	MAM0817
Client	DSW_C			**External ID**	
Location	CATALINA MHP FINAL EFFLUENT				

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	16	2	mg/L	08/18/2005	
CBOD-5	CBOD5	P80082	2.3	2	mg/L	08/18/2005	
Solids_Diss	Total Dissolved Solids	P70300	664	10	mg/L	08/22/2005	
Solids_Susp	Total Suspended Solids	P530	18	5	mg/L	08/22/2005	
TOC	TOC	P680	4.4	2	mg/L	09/13/2005	
pH	pH	P403	7.71		s.u.	08/18/2005	PS
ICP_(WAT)	Aluminum	P1105	<200	200	ug/L	08/25/2005	
ICP_(WAT)	Barium	P1007	104	15	ug/L	08/25/2005	
ICP_(WAT)	Calcium	P916	111	2	mg/L	08/25/2005	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	08/25/2005	
ICP_(WAT)	Copper	P1042	<10	10	ug/L	08/25/2005	
ICP_(WAT)	Hardness, Total	P900	438	10	mg/L	08/25/2005	
ICP_(WAT)	Iron	P1045	64	50	ug/L	08/25/2005	
ICP_(WAT)	Magnesium	P927	39	1	mg/L	08/25/2005	
ICP_(WAT)	Manganese	P1055	<10	10	ug/L	08/25/2005	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	08/25/2005	
ICP_(WAT)	Potassium	P937	8	2	mg/L	08/25/2005	
ICP_(WAT)	Sodium	P929	76	5	mg/L	08/25/2005	
ICP_(WAT)	Strontium	P1082	581	30	ug/L	08/25/2005	
ICP_(WAT)	Zinc	P1092	30	10	ug/L	08/25/2005	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	08/29/2005	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	08/30/2005	
SIMAA_(WAT)	Cadmium	P1027	<0.20	0.2	ug/L	08/30/2005	
SIMAA_(WAT)	Lead	P1051	<2.0	2	ug/L	08/30/2005	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	08/30/2005	
Alkalinity	Alkalinity	P410	370	5	mg/L	08/22/2005	
Ammonia	Ammonia	P610	0.768	0.05	mg/L	09/06/2005	
COD	COD	P340	12	10	mg/L	09/13/2005	
Chloride	Chloride	P940	109	5	mg/L	09/07/2005	
Conductivity	Conductivity	P95	1120	1	umhos/cm	08/22/2005	
Fluoride	Fluoride	P951	0.30	0.2	mg/L	08/31/2005	
Nitrate	Nitrate+nitrite	P630	9.40	0.1	mg/L	09/06/2005	
Nitrite	Nitrite	P615	0.122	0.02	mg/L	08/18/2005	
Sulfate	Sulfate	P945	42.9	20	mg/L	09/07/2005	
TKN	TKN	P625	2.08	0.2	mg/L	09/08/2005	
TP	Total Phosphorus	P665	1.93	0.05	mg/L	09/08/2005	

Field Comments

Lab Comments PH PHT when rec

QC / Sample Comments

Approved By SR **On** 9-16-05

Definition Of Qualifiers is attached when required

OhioEPA **Division of ' ironmental Services**

Laboratory Inorganic Analysis Data Report

Sample 77355

Date Received 08/18/2005 11:35 AM **Matrix** WW **Collected by** MAHR, MARYANNE

Begin **End** **Sample Type** LITIGATION

Date Collected 08/17/2005 10:15 AM **Station ID**

Program SWDO-DSW **Customer ID** MAM0817

Client DSW_C **External ID**

Location CATALINA MHP #2 LAGOON L2 SE LAGOON

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	20	2	mg/L	08/18/2005	
CBOD-5	CBOD5	P80082	2.5	2	mg/L	08/18/2005	
Solids_Diss	Total Dissolved Solids	P70300	668	10	mg/L	08/22/2005	
Solids_Susp	Total Suspended Solids	P530	51	5	mg/L	08/22/2005	
pH	pH	P403	7.56		s.u.	08/18/2005	PS
Alkalinity	Alkalinity	P410	370	5	mg/L	08/22/2005	
Chloride	Chloride	P940	108	5	mg/L	09/07/2005	
Conductivity	Conductivity	P95	1120	1	umhos/cm	08/22/2005	
Fluoride	Fluoride	P951	0.30	0.2	mg/L	08/31/2005	
Nitrite	Nitrite	P615	0.227	0.02	mg/L	08/18/2005	
Sulfate	Sulfate	P945	43.9	20	mg/L	09/07/2005	

Field Comments

Lab Comments NO HN03 OR H2S04, PH PHT WHEN REC

QC / Sample Comments

Approved By SR **On** 9-16-05

Definition Of Qualifiers is attached when required

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

Sample 77354

Date Received 08/18/2005 11:35 AM **Matrix** WW **Collected by** MAHR, MARYANNE

Begin **End** **Sample Type** LITIGATION

Date Collected 08/17/2005 11:00 AM **Station ID**

Program SWDO-DSW **Customer ID** MAM0817

Client DSW_C **External ID**

Location CATALINA MHP #3 LAGOON L3
SW LAGOON

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	13	2	mg/L	08/18/2005	
CBOD-5	CBOD5	P80082	2.0	2	mg/L	08/18/2005	
Solids_Diss	Total Dissolved Solids	P70300	660	10	mg/L	08/22/2005	
Solids_Susp	Total Suspended Solids	P530	32	5	mg/L	08/22/2005	
TOC	TOC	P680	4.6	2	mg/L	09/13/2005	
pH	pH	P403	7.64		s.u.	08/18/2005	PS
ICP_(WAT)	Aluminum	P1105	<200	200	ug/L	08/25/2005	
ICP_(WAT)	Barium	P1007	102	15	ug/L	08/25/2005	
ICP_(WAT)	Calcium	P916	110	2	mg/L	08/25/2005	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	08/25/2005	
ICP_(WAT)	Copper	P1042	<10	10	ug/L	08/25/2005	
ICP_(WAT)	Hardness, Total	P900	431	10	mg/L	08/25/2005	
ICP_(WAT)	Iron	P1045	163	50	ug/L	08/25/2005	
ICP_(WAT)	Magnesium	P927	38	1	mg/L	08/25/2005	
ICP_(WAT)	Manganese	P1055	11	10	ug/L	08/25/2005	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	08/25/2005	
ICP_(WAT)	Potassium	P937	8	2	mg/L	08/25/2005	
ICP_(WAT)	Sodium	P929	74	5	mg/L	08/25/2005	
ICP_(WAT)	Strontium	P1082	570	30	ug/L	08/25/2005	
ICP_(WAT)	Zinc	P1092	30	10	ug/L	08/25/2005	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	08/29/2005	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	08/30/2005	
SIMAA_(WAT)	Cadmium	P1027	<0.20	0.2	ug/L	08/30/2005	
SIMAA_(WAT)	Lead	P1051	<2.0	2	ug/L	08/30/2005	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	08/30/2005	
Alkalinity	Alkalinity	P410	373	5	mg/L	08/22/2005	
Ammonia	Ammonia	P610	1.06	0.05	mg/L	09/06/2005	
COD	COD	P340	15	10	mg/L	09/13/2005	
Chloride	Chloride	P940	110	5	mg/L	09/07/2005	
Conductivity	Conductivity	P95	1120	1	umhos/cm	08/22/2005	
Fluoride	Fluoride	P951	0.30	0.2	mg/L	08/31/2005	
Nitrate	Nitrate+nitrite	P630	8.50	0.1	mg/L	09/06/2005	
Nitrite	Nitrite	P615	0.182	0.02	mg/L	08/18/2005	
Sulfate	Sulfate	P945	43.2	20	mg/L	09/07/2005	
TKN	TKN	P625	2.04	0.2	mg/L	09/08/2005	
TP	Total Phosphorus	P665	1.80	0.05	mg/L	09/08/2005	

Field Comments

Lab Comments PH PHT when rec

QC / Sample Comments

Approved By SR **On** 9-16-05

Definition Of Qualifiers is attached when required

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

Sample 80881

Date Received 01/04/2006 2:48 PM **Matrix** WW **Collected by** MAHR, MARYANNE

Begin **End** **Sample Type** LITIGATION

Date Collected 01/04/2006 10:30 AM **Station ID**

Program SWDO-DSW **Customer ID** MAM010

Client DSW_C **External ID**

Location Catalina MHP Southeast Lagoon L2

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Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	17	2	mg/L	01/05/2006	
CBOD-5	CBOD5	P80082	2.5	2	mg/L	01/05/2006	
Solids_Diss	Total Dissolved Solids	P70300	594	10	mg/L	01/06/2006	
Solids_Susp	Total Suspended Solids	P530	83	5	mg/L	01/06/2006	
TOC	TOC	P680	7.5	2	mg/L	02/01/2006	
pH	pH	P403	7.67		s.u.	01/05/2006	
ICP_(WAT)	Aluminum	P1105	1180	200	ug/L	01/19/2006	
ICP_(WAT)	Barium	P1007	113	15	ug/L	01/19/2006	
ICP_(WAT)	Calcium	P916	116	2	mg/L	01/19/2006	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	01/19/2006	
ICP_(WAT)	Copper	P1042	<10	10	ug/L	01/19/2006	
ICP_(WAT)	Hardness, Total	P900	458	10	mg/L	01/19/2006	
ICP_(WAT)	Iron	P1045	2200	50	ug/L	01/19/2006	
ICP_(WAT)	Magnesium	P927	41	1	mg/L	01/19/2006	
ICP_(WAT)	Manganese	P1055	85	10	ug/L	01/19/2006	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	01/19/2006	
ICP_(WAT)	Potassium	P937	15	2	mg/L	01/19/2006	
ICP_(WAT)	Sodium	P929	78	5	mg/L	01/19/2006	
ICP_(WAT)	Strontium	P1082	673	30	ug/L	01/19/2006	
ICP_(WAT)	Zinc	P1092	124	10	ug/L	01/19/2006	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	01/20/2006	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	01/26/2006	
SIMAA_(WAT)	Cadmium	P1027	<0.20	0.2	ug/L	01/26/2006	
SIMAA_(WAT)	Lead	P1051	3.5	2	ug/L	01/26/2006	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	01/26/2006	
E.coli	E.coli	P31648	860	10	#/100ml	01/04/2006	3L
Fecal Coliform	Fecal Coliform	P31616	6000	10	#/100ml	01/04/2006	
Alkalinity	Alkalinity	P410	353	5	mg/L	01/05/2006	
Ammonia	Ammonia	P610	5.67	0.25	mg/L	01/09/2006	
COD	COD	P340	24	10	mg/L	01/20/2006	
Chloride	Chloride	P940	120	5	mg/L	01/09/2006	
Conductivity	Conductivity	P95	1150	1	umhos/cm	01/05/2006	
Fluoride	Fluoride	P951	0.30	0.2	mg/L	01/30/2006	
Nitrate	Nitrate+nitrite	P630	6.98	0.1	mg/L	01/09/2006	
Nitrite	Nitrite	P615	0.270	0.02	mg/L	01/04/2006	
Sulfate	Sulfate	P945	40.1	20	mg/L	01/09/2006	
TKN	TKN	P625	7.65	1	mg/L	01/19/2006	
TP	Total Phosphorus	P665	2.60	0.05	mg/L	01/19/2006	

Field Comments

Lab Comments

QC / Sample Comments

Approved By SR **On** 2-1-06

Definition Of Qualifiers is attached when required

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

RECEIVED ODAGW 06 MAY 15 PM 2:1

Sample	81556				
Date Received	04/04/2006 2:54 PM	**Matrix**	WW	**Collected by**	ZIMMERMAN, DIANA
	Begin	**End**		**Sample Type**	LITIGATION
Date Collected		04/04/2006 10:00 AM		**Station ID**	
Program	SWDO-DSW			**Customer ID**	BDZ0404
Client	DSW_C			**External ID**	
Location	Catalina MHP SE Lagoon L2				

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
BOD-5	BOD5	P310	4.0	2	mg/L	04/05/2006	
CBOD-5	CBOD5	P80082	<2.0	2	mg/L	04/05/2006	
Solids_Diss	Total Dissolved Solids	P70300	704	10	mg/L	04/06/2006	
Solids_Susp	Total Suspended Solids	P530	15	5	mg/L	04/06/2006	
TOC	TOC	P680	6.1	2	mg/L	04/20/2006	
pH	pH	P403	7.72		s.u.	04/05/2006	
ICP_(WAT)	Aluminum	P1105	1040	200	ug/L	04/07/2006	
ICP_(WAT)	Barium	P1007	80	15	ug/L	04/07/2006	
ICP_(WAT)	Calcium	P916	105	2	mg/L	04/07/2006	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	04/07/2006	
ICP_(WAT)	Copper	P1042	19	10	ug/L	04/07/2006	
ICP_(WAT)	Hardness, Total	P900	410	10	mg/L	04/07/2006	
ICP_(WAT)	Iron	P1045	1110	50	ug/L	04/07/2006	
ICP_(WAT)	Magnesium	P927	36	1	mg/L	04/07/2006	
ICP_(WAT)	Manganese	P1055	39	10	ug/L	04/07/2006	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	04/07/2006	
ICP_(WAT)	Potassium	P937	11	2	mg/L	04/07/2006	
ICP_(WAT)	Sodium	P929	81	5	mg/L	04/07/2006	
ICP_(WAT)	Strontium	P1082	595	30	ug/L	04/07/2006	
ICP_(WAT)	Zinc	P1092	72	10	ug/L	04/07/2006	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	04/17/2006	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	04/07/2006	
SIMAA_(WAT)	Cadmium	P1027	<0.20	0.2	ug/L	04/07/2006	
SIMAA_(WAT)	Lead	P1051	3.8	2	ug/L	04/07/2006	
SIMAA_(WAT)	Selenium	P1147	<2.0	2	ug/L	04/07/2006	
E.coli	E.coli	P31648	150	10	#/100ml	04/04/2006	JL
Fecal Coliform	Fecal Coliform	P31616	540	10	#/100ml	04/04/2006	
Ammonia	Ammonia	P610	4.73	0.05	mg/L	04/17/2006	
COD	COD	P340	27	10	mg/L	04/14/2006	
Chloride	Chloride	P940	113	5	mg/L	04/13/2006	
Conductivity	Conductivity	P95	1140	1	umhos/cm	04/17/2006	
Fluoride	Fluoride	P951	0.23	0.2	mg/L	04/07/2006	
Nitrate	Nitrate+nitrite	P630	11.0	0.5	mg/L	04/17/2006	
Nitrite	Nitrite	P615	0.317	0.02	mg/L	04/05/2006	
Sulfate	Sulfate	P945	43.3	10	mg/L	04/14/2006	
TKN	TKN	P625	6.68	1	mg/L	04/19/2006	
TP	Total Phosphorus	P665	2.58	0.05	mg/L	04/19/2006	

Field Comments AMPULES USE FOR PRESERVATIVES, PLANT IS CHLORINATING H2SO4 LOT #453763 HNO3 LOT # 453297

Lab Comments

QC / Sample Comments

Approved By JK **On** 4-28-06

Definition Of Qualifiers is attached when required

RECEIVED OHIO EPA
MAY 09 2006
SOUTHWEST DISTRICT

Diana, noted that Lead + Aluminum may be a little bit high as compared to other similar settings
SL

Printed on Apr 28, 2006 2:25 pm

OhioEPA Division of Environmental Services

Laboratory Inorganic Analysis Data Report

Sample 83901

Date Received 07/10/2006 1:52 PM **Matrix** WW **Collected by** MAHR, MARYANNE

Begin **End** **Sample Type** LITIGATION

Date Collected 07/10/2006 9:50 AM **Station ID**

Program SWDO-DSW **Customer ID** MAM0710

Client DSW_C **External ID**

Location Catalina MHP - southeast lagoon L2

RECEIVED OHIO EPA AUG 14 2006 SOUTHWEST DISTRICT

Analysis	Parameter	Storet	Result	RL	Units	Date	Qualifier
CBOD-5	CBOD5	P80082	85	2	mg/L	07/11/2006	
Solids_Susp	Total Suspended Solids	P530	480	5	mg/L	07/11/2006	
TOC	TOC	P680	110	2	mg/L	07/19/2006	
ICP_(WAT)	Aluminum	P1105	2100	200	ug/L	07/18/2006	
ICP_(WAT)	Barium	P1007	251	15	ug/L	07/18/2006	
ICP_(WAT)	Calcium	P916	179	2	mg/L	07/18/2006	
ICP_(WAT)	Chromium	P1034	<30	30	ug/L	07/18/2006	
ICP_(WAT)	Copper	P1042	41	10	ug/L	07/18/2006	
ICP_(WAT)	Hardness, Total	P900	628	10	mg/L	07/18/2006	
ICP_(WAT)	Iron	P1045	3140	50	ug/L	07/18/2006	
ICP_(WAT)	Magnesium	P927	44	1	mg/L	07/18/2006	
ICP_(WAT)	Manganese	P1055	77	10	ug/L	07/18/2006	
ICP_(WAT)	Nickel	P1067	<40	40	ug/L	07/18/2006	
ICP_(WAT)	Potassium	P937	33	2	mg/L	07/18/2006	
ICP_(WAT)	Sodium	P929	76	5	mg/L	07/18/2006	
ICP_(WAT)	Strontium	P1082	864	30	ug/L	07/18/2006	
ICP_(WAT)	Zinc	P1092	186	10	ug/L	07/18/2006	
Mercury_(WAT)	Mercury	P71900	<0.20	0.2	ug/L	07/12/2006	
SIMAA_(WAT)	Arsenic	P1002	<2.0	2	ug/L	07/14/2006	
SIMAA_(WAT)	Cadmium	P1027	0.38	0.2	ug/L	07/14/2006	
SIMAA_(WAT)	Lead	P1051	5.4	2	ug/L	07/14/2006	
SIMAA_(WAT)	Selenium	P1147	2.5	2	ug/L	07/14/2006	
E.coli	E.coli	P31648	6300	10	#/100ml	07/10/2006	
Fecal Coliform	Fecal Coliform	P31616	11000	10	#/100ml	07/10/2006	JL
Ammonia	Ammonia	P610	0.379	0.05	mg/L	07/14/2006	
COD	COD	P340	259	10	mg/L	07/19/2006	
Chloride	Chloride	P940	115	5	mg/L	07/31/2006	
Conductivity	Conductivity	P95	1080	1	umhos/cm	07/19/2006	
Nitrate	Nitrate+nitrite	P630	12.7	0.5	mg/L	07/14/2006	
Sulfate	Sulfate	P945	44.8	10	mg/L	07/31/2006	
TKN	TKN	P625	12.5	1	mg/L	07/18/2006	
TP	Total Phosphorus	P665	11.6	0.2	mg/L	07/18/2006	

Field Comments

Lab Comments

QC / Sample Comments

Approved By SK **On** 8-7-06

Definition Of Qualifiers is attached when required