Final Report

Nogales International Wastewater Treatment Plant Maximum Allowable Headworks Loading Development

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Acronyms and Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ADEQ	Arizona Department of Environmental Quality
AHL	allowable headworks loading
APP	Aquifer Protection Permit
AQL	aquifer quality limit
AZPDES	Arizona Pollutant Discharge Elimination System
CAAA	Clean Air Act Amendments
BOD_5	5-day biochemical oxygen demand
DL	discharge limit
EPA	U.S. Environmental Protection Agency
Guidance Manual	EPA *Local limits Development Guidance* (2004)
GQPP	Groundwater Quality Protection Permit
HAP	hazardous air pollutants
lb/day	pounds per day
MACT	maximum achievable control technology
MAHL	maximum allowable headworks loading
MLE	Modified Ludzack-Ettinger
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
mg/L	milligrams per liter
µg/L	micrograms per liter
mgd	million gallons per day
NIWTP	Nogales International Wastewater Treatment Plant
POC	pollutant of concern
TCLP	toxicity characteristic leaching procedure
TKN	Total Kjehldahl Nitrogen
tpy	tons per year

TSS	total suspended solids
TTO	total toxic organics
USIBWC	United Stated Section, International Boundary and Water Commission
VOC	volatile organic compound
WAS	waste activated sludge

SECTION 1

Introduction

The City of Nogales, Arizona and the International Boundary and Water Commission, United States Section (USIBWC) co-own the Nogales International Wastewater Treatment Plant (NIWTP). The NIWTP treats domestic, commercial and industrial flows from Nogales and Rio Rico, Arizona and Heroica Nogales, Sonora, Mexico. The City of Nogales, Arizona has an approximate population of 21,000, while the community of Rio Rico, Arizona comprises a population of 10,000. The City of Nogales, Sonora has an approximate population of 189,000 and the surrounding municipality has a population of 193,000. Currently, the USIBWC operates the NIWTP with approximately 75 percent of the plant's influent generated in Mexico and the remainder generated in Nogales and Rio Rico, Arizona. The NIWTP is currently undergoing an upgrade from advanced primary to secondary treatment in order to comply with regulatory water quality standards for discharge to the Santa Cruz River.

The upgrade of the plant commenced in November 2006 with the construction of a Modified Ludzack-Ettinger (MLE) secondary treatment plant with an optional bypass to an aerated lagoon to handle excessive loading. Startup of the plant is currently scheduled for July 2009. The biosolids produced at the new plant will be transferred to an aerobic digester and then dewatered with two belt presses using a polymer feed. The Arizona Department of Environmental Quality (ADEQ) issued the NIWTP a discharge permit under the Arizona Pollutant Discharge Elimination System (AZPDES) with an effective date of December 24, 2007 and an expiration date of December 24, 2012. The permit contains NIWTP effluent discharge limits for discharge into the Santa Cruz River. Additionally, ADEQ has issued an Aquifer Protection Permit (APP) for the current design and is in the process of developing a new APP for the upgraded plant that will require additional limits on specified parameters for the final effluent.

The NIWTP is required by the AZPDES permit (Part V.A.1.b) to develop mass influent loading objectives for pollutants that may cause or contribute to interference, pass through, or other problems at the treatment plant. The AZPDES permit requires that the list of pollutants considered in developing mass influent loading objectives include cadmium, copper, iron, lead, manganese, mercury and zinc. This report presents the development of new Maximum Allowable Headworks Loadings (MAHLs) to satisfy this requirement for the new upgraded plant.

The approach used in developing the new MAHLs follows the EPA Local Limits Development Guidance (2004) and consists of the following steps:

- Summarize treatment plant requirements. Treatment plant requirements are listed in Section 2.

- Identify potential pollutants of concern (POC) based upon treatment plant requirements. POCs are identified in Section 3.
- Gather and evaluate treatment plant POC data
- Calculate MAHLs for potential POC. The MAHLs are compared with influent plant loadings to determine the POCs and MAHLs to be used to prevent violations of applicable water quality standards and the AZPDES permit.

1.1 Wastewater Treatment Facility

The upgraded NIWTP will be designed to treat 14.74 mgd. Raw wastewater will enter the plant headworks through the existing influent structure and flow through the grit settlement basins and then through the coarse bar screens. The wastewater then flows through two parallel vortex grit removal units followed by fine bar screens. The wastewater will then flow through the existing flow meter piping, through the existing Diversion Structure No. 1 and through new piping to the Secondary Treatment facilities.

Secondary Treatment will consist of three parallel trains of activated sludge units designed in the MLE process configuration. The trains will consist of an anoxic basin followed by an aeration basin. Mixed liquor from the aeration basin then flows to secondary clarifiers where solids are settled and returned to the process. Effluent from the secondary clarifiers flows to existing filtration and disinfection facilities.

Excess activated sludge above the amount required for the activated sludge process will be removed as waste activated sludge (WAS). The WAS, along with scum removed from the splitter box and secondary clarifiers, will be sent to a rotary drum thickener. The thickened sludge will be discharged into a mixing chamber, where it will be mixed with digested sludge and pumped into aerobic digesters and then into the WAS storage pond. Sludge from the pond will be pumped to one of two belt filter presses for dewatering. Filtrate from the dewatering process will be pumped to the plant recycle station to combine with water from other processes prior to sending the water back to the front of the aeration system.

Dewatered sludge, or cake, will be transferred from the belt filter presses along a conveyor to a truck loading bin. The cake should be pressed to at least 20% total solids. The cake will then be deposited into sludge hauling trucks for disposal by a licensed sludge hauler for beneficial land application on non-human consumption crops. Based on the *Nogales International Wastewater Treatment Plant Biosolids Disposal Options Study* dated April 2008, the plant will produce an estimated 3,365 dry tons of biosolids per year, or 21,000 wet tons per year. The plant will be capable of meeting class B sludge based on the requirements in Appendix B of the 40 CFR 503.

1.2 Industrial Users

A list of industry types located in Nogales, Sonora that discharge to the NIWTP is presented in Table 1. The associated processes involving water are also presented for each industry type. There are no industrial dischargers in Nogales, Arizona.

TABLE 1
Summary of the City of Nogales, Sonora Industries

Industry Type	Processes with Water
Communication equipment manufacturer	Antenna leak test
Assembly of gardening products	Leak test for plastic tanks
Assembly of electronics	Electronic board wash
Metallic coating	Galvanization, silk screening
Denture manufacturer	Washing dental pieces
Mold injection	Water coolant for plastics
Manufacturer of metal products	Cutting and washing metals
Elevator manufacturer	Wash glues
Railroad cargo transportation	Washing
Manufacturer of polystyrene products	Steam generation
Assembly of electronic harnesses	Leak tests
Extraction and refining of vegetable oil	Steam generation, washing
Measure pressure	Reverse osmosis process
Beverage bottling	Water purification
Metallic coating	Metallic coating process
Manufacturer of ink jet cartridges	Ink cartridge washing
Trophy manufacturer	Acrylic washing
Assembly of aerospace and military connectors	Washing metal
Assembly and disposal of medical devices	Water coolant for plastics
Publisher	Film development
Assembly of electronics	Electroplating process
Manufacturer of cardboard boxes	Wash print rollers
Manufacturer of medical products	Cooling tower

1.3 Existing Local Limits

Table 2 summarizes the existing local limits adopted by Ordinance No. 92-09-12 for the City of Nogales, Arizona.

TABLE 2
The City of Nogales, Arizona Existing Local Limits

Parameter	Maximum for Any One Day (mg/L)	Monthly Average Shall Not Exceed (mg/L)
Cadmium	0.69	0.26
Chromium	2.77	1.71

TABLE 2
The City of Nogales, Arizona Existing Local Limits

Parameter	Maximum for Any One Day (mg/L)	Monthly Average Shall Not Exceed (mg/L)
Copper	3.38	2.07
Lead	0.69	0.43
Nickel	3.98	2.38
Silver	0.43	0.24
Zinc	2.61	1.48
Cyanide	1.20	0.65
Total toxic organics	2.13	--
Oil and grease	52	26
Total suspended solids	60	31
pH	6.0 – 9.0	6.0 – 9.0

mg/L = milligrams per liter

SECTION 2

Standards and Criteria

The development of local limits is based upon the regulatory requirements to meet discharge limitations, as well as the goals of preventing the inhibition of treatment processes, protecting the health and safety of facility employees and preventing the contamination of biosolids. The standards and criteria that relate to the NIWTP and served as the technical basis for identifying POCs include:

- Effluent Criteria
- Process Inhibition Criteria
- Sludge Disposal Criteria
- Air Emission Criteria
- Vapor Toxicity Criteria
- Water Quality

These criteria are discussed in the following paragraphs.

2.1 Effluent Criteria

2.1.1 Arizona Aquifer Protection Permit

The NIWTP operates under an Arizona APP for discharge of treated effluent to the Santa Cruz River. Discharge limits (DLs) established by the permit are summarized in Table 3. In addition to parameters with discharge limitations, the APP includes indicator parameters for which monitoring is required but no limits have been established.

TABLE 3
Summary of NIWTP's APP Discharge Limits

Parameter	NIWTP APP DLs (mg/L)
Antimony	0.006
Arsenic	0.05
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Cyanide	0.2
Fluoride	4.0
Lead	0.05
Mercury	0.002

TABLE 3
Summary of NIWTP's APP Discharge Limits

Parameter	NIWTP APP DLs (mg/L)
Nickel	0.1
Thallium	0.002
Benzene	0.005
Carbon tetrachloride	0.005
o-Dichlorobenzene	0.6
para-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
Cis-1,2-Dichloroethylene	0.07
Trans-1,2-Dichloroethylene	0.1
Dichloromethane	0.005
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
Styrene	0.1
Tetrachloroethyene	0.005
Toluene	1.0
Trihalomethanes (total)	0.1
1,1,1-Trichlorobenzene	0.20
1,1,2-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Trichloroethylene	0.005
Vinyl Chloride	0.002
Xylenes (total)	10.0
Total Nitrogen	10.0
Nitrate as N	10.0
Nitrate – Nitrite as N	10.0
Total Kjeldahl Nitrogen as N	Reserved
Fecal coliform, 30-d mean	200 CFU/100ml
Fecal coliform, single sample	800 CFU/100ml

DL = discharge limit
Reserved=Monitoring only

2.1.2 Arizona Pollutant Discharge Elimination System Permit

The NIWTP operates under an AZPDES permit with an effective date of December 2007. Regulated parameters in the permit are based on the Arizona Water Quality Standards issued by ADEQ. The regulated parameters contain limitations for toxic pollutants discharged to receiving waters on the basis of the receiving water designated uses. The AZPDES discharge limits are presented in Table 4.

TABLE 4
Summary of NIWTP's AZPDES Discharge Limits

Parameter	NIWTP AZPDES DLs Weekly Avg. (µg/L)	NIWTP AZPDES DLs Daily Max (µg/L)
Ammonia	--	8,400
CBOD	40,000	--
E. Coli	--	576 CFU/100ml
TSS	45,000	--
Total Residual Chlorine	--	0.008
Cadmium	2.42	4.86
Chromium Total	100	146
Chromium VI	7.97	16
Copper	9.57	19.2
Cyanide	5.5	16.9
Lead	3.13	6.23
Mercury	0.141	0.368
Nickel	58.6	117.7
Selenium	1.64	3.28
Silver	3.29	6.61
Sulfides	50	100
Thallium	105	276
Benzo(a)pyrene	0.02	0.291
Di (2-ethylhexl)Pthalate (DEHP)	199	400
Hexachlorocyclopentadiene	0.245	0.493
Chlordane	0.017	0.345
DDD	0.016	0.033
DDE	0.016	0.033
DDT	0.0008	0.0016
Dieldrin	0.0041	0.008
Endosulfan Sulfate	0.049	0.099
Endosulfan (total)	0.049	0.099
Endrin aldehyde	0.066	0.131
Heptachlor	0.011	0.021
Heptachlor epoxide	0.011	0.021
PCBs	0.016	0.033
2,3,7,8-(TCDD)	0.008	0.016
Toxaphene	0.016	0.033

TABLE 4
Summary of NIWTP's AZPDES Discharge Limits

Parameter	NIWTP AZPDES DLs Weekly Avg. (μg/L)	NIWTP AZPDES DLs Daily Max (μg/L)

DL = discharge limit
NIWTP = Nogales International Wastewater Treatment Plant

2.2 Process Inhibition Criteria

The activated sludge and aerated lagoon processes used at the NIWTP are potentially subject to toxic inhibition. The aerobic digestion process would also be subject to toxic inhibition if sludge other than waste activated was discharged directly to the digesters, but no such discharges are assumed.

Published threshold inhibition concentrations for the activated sludge process (which would also apply to the aerated lagoon process), as given in the EPA Guidance Manual (2004), are presented in Table 5. If a range of values was given the median value was used. The lower of the nitrification or activated sludge inhibition values was used.

TABLE 5
Summary of Process Inhibition Criteria Applicable for the NIWTP's Treatment Processes

Parameter	Activated Sludge Inhibition Threshold Level (mg/L)	Nitrification Inhibition Threshold Level (mg/L)	Selected Level (mg/L)
Ammonia	480	--	480
Arsenic	0.1	1.5	0.1
Cadmium	1-10	5.2	5.2
Chromium (III)	10-50	--	30
Chromium (VI)	1	1-10	1
Chromium (Total)	1-100	0.25-1.9	1.08
Copper	1	0.05-0.48	0.27
Cyanide	0.1-5	0.34-0.5	0.42
Lead	1-5	0.5	0.5
Mercury	0.1-1	--	0.55
Nickel	1-2.5	0.25-0.5	0.38
Sulfide	25-30	--	27.5
Zinc	0.3-5	0.08-0.5	0.29
Anthracene	500	--	500
Benzene	100-500	--	300
2-Chlorophenol	5	--	5
Chloroform	--	10	10

TABLE 5
Summary of Process Inhibition Criteria Applicable for the NIWTP's Treatment Processes

Parameter	Activated Sludge Inhibition Threshold Level (mg/L)	Nitrification Inhibition Threshold Level (mg/L)	Selected Level (mg/L)
1,2-Dichlorobenzene	5	--	5
1,3-Dichlorobenzene	5	--	5
1,4-Dichlorobenzene	5	--	5
2,4 Dichlorophenol	64	64	64
2,4 Dimethylphenol	40-200	--	120
Ethylbenzene	200	--	200
Hexachlorobenzene	5	--	5
Naphthalene	500	--	500
Nitrobenzene	30-500	--	265
Pentachlorphenol	0.95	--	0.95
Phenanthrene	500	--	500
Phenol	50-200	4	4
Toluene	200	--	200
2,4,6 Trichlorophenol	50-100	--	75
Surfactants	100-500	--	300
2,4-Dinitrophenol	--	150	150

mg/L = milligrams per liter

2.3 Sludge Disposal Criteria

Sludge generated at the NIWTP will be removed by truck under contract with a licensed sludge hauler for beneficial land application on non-human consumption crops. An option currently being pursued by the USIBWC is for the biosolids to be removed from the plant and transported to Mexico for beneficial land application. This disposal method is subject to compliance with the Arizona Administrative Code and 40 CFR 503 ceiling concentrations, which are summarized in the EPA Guidance Manual (2004) and presented in Table 6. In addition, USIBWC needs to comply with 40 CFR 503, Table 2 cumulative pollutant loading rates.

For all POC without a 40 CFR Part 503 ceiling limit, the Toxicity Characteristic Leaching Procedure (TCLP) regulatory limits were used to avoid requirements associated with managing the sludge as a hazardous waste. These regulatory limits are also presented in Table 6.

TABLE 6
Ceiling Concentration Limits and Toxicity Characteristic Leaching Procedure Regulatory Limits

Parameter	Ceiling Concentration Limit[a] (mg/kg)	TCLP Regulatory Limit[b] (mg/L)
Arsenic	75	5

TABLE 6
Ceiling Concentration Limits and Toxicity Characteristic Leaching Procedure Regulatory Limits

Parameter	Ceiling Concentration Limit[a] (mg/kg)	TCLP Regulatory Limit[b] (mg/L)
Barium	--	100
Cadmium	85	1
Chromium	3,000	5
Copper	4,300	--
Lead	840	5
Mercury	57	0.2
Molybdenum	75	--
Nickel	420	--
Selenium	100	1
Silver	--	5
Zinc	7,500	--
Endrin	--	0.02
Methoxychlor	--	10
2,4-D	--	10
Lindane	--	0.4
Toxaphene	--	0.5
2,4,5-TP	--	1
Benzene	--	0.5
Carbon tetrachloride	--	0.5
Chlordane	--	0.03
Chlorobenzene	--	100
Chloroform	--	6
o-Cresol	--	200
m-Cresol	--	200
p-Cresol	--	200
1.4-Dichlorobenzene	--	7.5
1,2-Dichloroethane	--	0.5
1,1-Dichloroethylene	--	0.7
2,4-Dinitrotoluene	--	0.13
Heptachlor	--	0.008
Heptachlor epoxide	--	0.008
Hexachlorobenzene	--	0.13
Hexachloro-1,2-butadiene	--	0.5
Hexachloroethane	--	3
Methyl ethyl ketone	--	200
Nitrobenzene	--	2
Pentachlorophenol	--	100
Pyridine	--	5
Tetrachloroethylene	--	0.7
Trichloroethylene	--	0.5
2,4,5-Trichlorophenol	--	400

TABLE 6
Ceiling Concentration Limits and Toxicity Characteristic Leaching Procedure Regulatory Limits

Parameter	Ceiling Concentration Limit[a] (mg/kg)	TCLP Regulatory Limit[b] (mg/L)
2,4,6-Trichlorophenol	--	2
Vinyl chloride	--	0.2

[a] Source: Arizona Administrative Code, Title 18, Chapter 9, Article 10, Table 1 (effective 2001).

[b] Source: 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA), March 29, 1990.

mg/kg = milligrams per kilogram

TCLP values exceeding the limits shown in Table 6 would classify the sludge as hazardous and prevent its use for land application or for disposal in conventional sanitary landfills. In practice, municipal sludge rarely fails TCLP criteria, even in heavily industrialized municipalities. Under the TCLP procedure, 1 mg/L of pollutant measured in the extract corresponds to approximately 20 milligrams per kilogram (mg/kg) in the sludge (dry weight basis), assuming that 100 percent of the pollutant is leached into the extract. The actual percentage that leaches into the extract will likely be substantially less than 100 percent and the percentage that will leach is unknown for the plant. To determine MAHLs, it was assumed that 20 percent of the pollutant leaches in the TCLP analysis, and the TCLP regulatory limits presented in Table 6 multiplied by 100 were used to convert from mg/L to mg/kg. The more conservative value, lower of the ceiling limits or calculated TCLP limits were used to calculate the MAHLs.

2.4 Air Emissions Criteria

Toxic air emissions at wastewater treatment facilities are regulated under the Federal Clean Air Act Amendments (CAAA) of 1990. Four titles under the CAAA of 1990 may apply to wastewater treatment facilities, but only one (Title III) has potential ramifications for developing and setting local limits. Title III requires implementation of maximum achievable control technology (MACT) for major sources of hazardous air pollutants (HAP) at wastewater treatment plants. Major sources are defined as those having the potential to emit at least 10 tons per year (tpy) of any individual HAP, or 25 tpy total HAPs. EPA designated 189 compounds and elements as federal HAPs; approximately 26 of these have been detected at wastewater treatment facilities. For practical purposes, the conventional priority pollutant scans address the HAPs of concern at wastewater treatment facilities.

EPA issued guidance to assist in determining whether a wastewater treatment facility is a major source of HAPs and, therefore, subject to implementation of MACT. Under this guidance, a wastewater treatment facility would be subject to installing MACT if it met two of the following criteria:

- Has a capacity greater than 50 mgd
- Accepts more than 30 percent industrial waste contribution
- Has influent priority pollutant volatile organic compound (VOC) concentrations greater than 5 mg/L

The NIWTP does not meet these criteria and, therefore, are not subject to Title III of the CAAA of 1990.

2.5 Vapor Toxicity Criteria

Discharges to sewers of toxic volatile pollutants can create hazardous conditions for workers who must enter the sewer system or work around open basins. The American Conference of Governmental Industrial Hygienists (ACGIH) developed exposure limits for VOCs. Likewise, EPA developed wastewater screening levels based on these exposure limits, assuming equilibrium conditions between the wastewater and atmosphere as presented in Table 7.

TABLE 7
Discharge Screening Levels Based on Vapor Toxicity

Pollutant	Exposure Limit[a] (mg/m^3)	Henry's Law Constant ($mg/m^3/mg/L$)	Discharge Screening Level (mg/L)
Acrolein	0.23	4.9	0.047
Acrylonitrile	21.7	4.5	4.822
Benzene	3.19	228	0.014
Bromoform	5.17	22.8	0.227
Carbon Tetrachloride	12.58	1185	0.011
Chlorobenzene	345.75	151	2.29
Chloroethane	2,640	449	5.88
Chloroform	9.76	163.5	0.06
1,1-Dichloroethane	405	240.4	1.685
1,2-Dichloroethane	8.1	48.1	0.168
1,1-Dichloroethylene	19.8	1202.1	0.016
Trans-1,2-Dichloroethylene	794	389.3	2.04
1,2-Dichloropropane	508.2	118.5	4.289
Ethylbenzene	542.5	327	1.659
Hydrogen cyanide	5.17	4.5	1.149
Hydrogen sulfide	14	414.4	0.034
Methyl bromide	77.8	255.5	0.305
Methyl chloride	207	371.6	0.557
Methylene chloride	433.75	104.8	4.139
1,1,2,2-Tetrachloroethane	34.35	18.6	1.847
Tetrachloroethylene	678	717.1	0.945
Toluene	565	272.5	2.075
1,1,2-Trichloroethane	54.6	34.1	1.601
1,1,1-Trichloroethane	1911	692.7	2.759

TABLE 7
Discharge Screening Levels Based on Vapor Toxicity

Pollutant	Exposure Limit[a] (mg/m^3)	Henry's Law Constant ($mg/m^3/mg/L$)	Discharge Screening Level (mg/L)
Trichloroethylene	10.74	408.7	0.026
Vinyl Chloride	12.8	1048	0.012

[a]Exposure limits are the lowest of acute toxicity data presented in Appendix J of the EPA *Guidance Manual* (2004).
mg/m^3 = milligrams per cubic meter

2.6 Other Considerations

2.6.1 Corrosivity

EPA's General Pretreatment Regulations prohibit any discharge with a pH lower than 5.0 because it may cause corrosive structural damage to sewers or treatment facilities. Besides the low-end pH limit specified in the General Pretreatment Regulations, EPA's *Guidance Manual* (2004) recommends an upper pH limit of 12.5 because wastewater with a pH greater than 12.5 meets the definition of a hazardous waste under 40 CFR 261.22.

2.6.2 Flow Obstructions

Most municipalities regulate discharges of oil and grease in order to help reduce flow obstructions in the sewer system. However, a national, technically-based, grease standard for this purpose does not exist. Local limits for polar grease, including grease of animal or vegetable origin, are typically in the 100 to 200 mg/L range, which is approximately the background concentration in raw domestic sewage.

An EPA amendment to the General Pretreatment Regulations (Federal Register, July 24, 1990) requires municipalities operating pretreatment programs to develop a standard prohibiting "petroleum oil, non-biodegradable cutting oil or products of mineral oil origin in amounts that will cause interference or pass through". In developing this general prohibition for non-polar grease, EPA stated that sufficient information does not presently exist upon which to promulgate a specific numeric limit of national applicability. However, as preliminary guidance, EPA suggested that a limit of 100 mg/L was frequently used by treatment plants for petroleum oils, non-biodegradable cutting oils or products of mineral oil origin, i.e., non-polar oil and grease.

SECTION 3

Determination of Pollutants of Concern

3.1 Sampling Program

Sampling is conducted weekly at the existing NIWTP in order to comply with the current APP and AZPDES permits. For the purposes of this report, only the influent samples were used. Effluent samples were not used from the existing plant because the effluent generated by the upgraded NIWTP will differ due to the improved treatment plant design. Additional sampling was conducted for possible POC's that were not part of the normal sampling procedure. Samples were collected once a week for three weeks as part of the additional sampling.

3.2 Criteria for Determining Pollutants of Concern

EPA has provided guidance for identifying POCs, which is described in EPA's Guidance Manual (2004). A pollutant may be classified as a POC if it meets any one of the following screening criteria:

1. Is on EPA's list of 15 national POCs that a wastewater treatment facility should assume to be of concern.
2. Has a pre-existing local limit.
3. Is limited by a permit or applicable standards or criteria.
4. Has caused operational problems in the past.
5. Has important implications for the protection of the treatment works, collection system, or the health and safety of POTW workers.

In addition, the AZPDES permit specifies that cadmium, copper, iron, lead, manganese, mercury and zinc be included in the list of potential POCs. These are the seven pollutants for which MAHL's were developed in *Development of Headworks Allocations for the Nogales International Wastewater Treatment Plant* (May 1997).

3.3 Pollutants of Concern Selection

This section describes the POC selection process based on the screening criteria. Pollutants were only considered POC's if the plant influent historical data showed a concentration above the detection limit. Two data sets were used for selecting potential POCs:

- Historical Data: Data collected during the regulatory monitoring events conducted from January 2006 through October 2008 at the NIWTP influent (See Appendix A).

- Sampling Data: Influent data collected during the weekly sampling from January 2009 to February 2009.

3.3.1 National Pollutants of Concern

The following 15 national potential POCs were identified as recommended by EPA's Guidance Manual (2004):

- Arsenic
- Cadmium
- Chromium (total)
- Copper
- Cyanide
- Lead
- Mercury
- Molybdenum
- 5-day Biochemical Oxygen Demand
- Total Suspended Solids
- Ammonia
- Nickel
- Selenium
- Silver
- Zinc

MAHLs were provided for selenium and molybdenum despite the fact that they were not present in detectable concentrations at the plant influent.

3.3.2 Previous Pollutants of Concern

Manganese and iron appear in this list based on the AZPDES requirement that they be evaluated in a new MAHL study along with the remainder of the existing pollutants that currently have MAHLs. Iron and manganese were determined to be POCs in the 1997 MAHL study due to the fact that they were regulated in the Groundwater Quality Protection Permit (GQPP) issued by ADEQ in 1989. The current APP issued in 2003 replaced the previous GQPP. Iron and manganese are not limited under the current APP or any other permit. Therefore, iron and manganese will not be included in the list of POCs because no effluent limit exists for either of these parameters.

3.3.3 Existing Pollutants of Concern

POCs not included above that are regulated by the Nogales, Arizona existing Wastewater Pretreatment Program Ordinance are listed below:

- Total Toxic Organics (TTO)
- Oil and Grease
- pH

However, because of the nature of oil and grease and pH, these two parameters are not amenable to analysis using the MAHL approach. However, the new plant will be adequately protected by the existing limits for these parameters and by prohibitions in the pretreatment ordinance against discharge of pollutants or wastewater which cause pass through or interference.

Individual toxic organic compounds are being considered as potential POCs. Therefore, the aggregate TTO parameter will not be retained as a POC.

3.3.4 Permit and Criteria

If a pollutant is limited by a permit or some other criteria and this pollutant is present in the influent in a detectable concentration, it was identified as a potential POC. From this screening analysis, the following pollutants that are not included in the above criteria are identified as potential POCs:

- 1,4-Dichlorobenzene
- Sulfides
- Trihalomethanes (total)
- Fluoride
- Dichloromethane

Dissolved sulfides were removed from the potential list of POCs because they are generated in the sewer system, not by industrial dischargers.

Trihalomethanes (including dichloromethane) were removed because they are generated by adding chlorine to the effluent, not by industrial dischargers.

The following pollutants were not identified as POCs because there were no detectable concentrations in the historical sampling period from January 2006 through December 2008 or in the sampling event from January 2009 through February 2009.

- Antimony
- Barium
- Beryllium
- Thallium
- Benzene
- Carbon tetrachloride
- o-Dichlorobenzene
- 1,2-Dichlrorethane
- 1,1-Dichlroethylene
- Cis-1,2-Dichlorothylene
- Trans-1,2-Dichlrorthylene
- 1,2-Dichloropropane
- Ethylbenzene
- Monochlorobenzene
- Styrene
- Tetrachloroethyene
- Toluene
- 1,1,1-Trichlorobenzene
- 1,1,2-Trichlorobenzene
- 1,1,2-Trichloroethane
- Trichloroethylene
- Vinyl Chloride
- Xylenes
- Chromium (VI)
- Benzo(a)pyrene
- Di (2-ethylhexl) Pthalate (DEHP)
- Hexachlorocyclopentadiene
- Chlordane
- DDD
- DDE
- DDT
- Dieldrin
- Endosulfan Sulfate
- Endosulfan (total)
- Endrin aldehyde
- Heptachlor
- Heptachlor epoxide
- PCBs
- 2,3,7,8-TCDD
- Toxaphene

3.3.5 Operational Issues

The following parameters have the potential to cause corrosion of the collection system (pH), obstruction of the flow in the collection system (oil and grease) and foaming at the NIWTP and in the effluent (surfactants):

- pH
- Total Grease and Oil
- Surfactants

As described in Section 3.3.3, pH and total grease and oil are already adequately controlled and will not be retained as POCs. Surfactants are not amenable to MAHL calculations because no existing regulatory limit exists. USIBWC should continue to monitor surfactant levels to see if foaming will be an issue with the operation of the new plant.

3.3.6 Health and Safety Considerations

If a volatile organic compound (VOC) is limited by the Vapor Toxicity Criteria and it is present in the influent in a detectable concentration, it was identified as a potential POC. Based on this screening analysis no VOC's were identified as potential POCs.

3.3.7 Pollutants without Standards or Criteria

No additional POCs were identified based on the list of dischargers and associated wastewater streams identified in Table 1.

3.3.8 Final Selection of Potential Pollutants of Concern

Based on the preceding screening analysis, the following pollutants were identified as potential POCs and selected for further evaluation:

- Arsenic
- Cadmium
- Chromium
- Copper
- Cyanide
- 1,4-Dichlorobenzene
- Fluoride
- Lead
- Molybdenum
- Mercury
- Nickel
- Selenium
- Silver
- Zinc
- BOD_5
- TSS
- Ammonia

SECTION 4

Calculation of Maximum Allowable Headworks Loadings (MAHL)

The general methodology used to calculate MAHLs are provided in EPA's Guidance Manual (2004).

4.1 Treatment Plant Removal Efficiencies

Removal efficiencies cannot be calculated for the NIWTP because plant operations have not yet commenced for the modified plant and therefore no effluent data is available. The removal efficiencies for each parameter and their source appear in Table 8. EPA recommended removal efficiencies were used where available. For POC's without EPA recommended removal efficiencies, typical removal rates from other activated sludge plants were used.

TABLE 8
Removal Efficiencies of Selected POCs

Parameter	Removal Efficiency – Activated Sludge (median)	Source
1,4-Dichlorobenzene	22	USD
Arsenic	45	Guidance
Cadmium	67	Guidance
Chromium	82	Guidance
Copper	86	Guidance
Cyanide	69	Guidance
Fluoride	0	No removal expected
Lead	61	Guidance
Mercury	60	Guidance
Molybdenum	10	Phoenix
Nickel	42	Guidance
Selenium	50	Guidance
Silver	75	Guidance
Zinc	79	Guidance

Guidance: 2004 EPA *Local limits Development Guidance*

USD: Union Sanitary District Plant removal data (1990)

Phoenix: City of Phoenix Plant removal data

4.2 Calculation of MAHLs

After selection of the plant removal efficiencies, the MAHL may be calculated. The MAHL of a treatment plant is the maximum pollutant load in pounds per day that the plant can receive without exceeding regulatory criteria. The MAHL for a given POC is the smallest value of the allowable headworks loadings (AHL) for that POC. A 25% safety factor was subtracted from each calculated MAHL. Calculation of the AHLs was based on the standards and criteria discussed in the Standards and Criteria Section. The equations are provided below:

<u>AHL based on effluent discharge criteria:</u>

$$AHL_{eff} = \frac{8.34 \times C_{eff} \times Q_{plant}}{1 - R_{plant}} \qquad (1)$$

Where:

C_{eff} = Effluent discharge criteria (mg/L)
Q_{plant} = Average daily treatment plant flow (mgd)
R_{plant} = Overall plant removal rate

<u>AHL based on inhibition criteria:</u>

$$AHL_{inh} = \frac{8.34 \times C_{inh} \times Q_{plant}}{1 - R_{primary}} \qquad (2)$$

Where:

C_{inh} = Inhibition criteria (mg/L)

Q_{plant} = Average daily treatment plant flow (mgd)

$R_{primary}$ = Primary settling removal rate (assumed at zero for local limit calculations because the NIWTP does not have primary clarifiers)

<u>AHL based on sludge disposal criteria:</u>

$$AHL_{solids} = \frac{C_{solids} \times M_{solids} \times 10^{-6}}{R_{plant}} \qquad (3)$$

Where:

C_{solids} = Sludge disposal criteria (mg/kg)
M_{solids} = Average daily sludge disposal rate (lb/day)
R_{plant} = Overall plant removal rate

As indicated previously, the more conservative of the calculated TCLP regulatory limits or the ceiling concentration limits were used for C_{solids}. It was assumed that 20 percent of the pollutant leaches in the TCLP analysis, and the TCLP regulatory limits presented were multiplied by 100 to convert from mg/L to mg/kg for C_{solids}. The calculations of AHLs and MAHLs for the NIWTP are summarized in Table 9.

MAHL's for BOD_5, TSS and Ammonia

EPA's Guidance Manual (2004) recommends that conventional pollutants such as BOD_5, TSS and ammonia should be based on the treatment plant's rated average design capacity and should be used as a "monthly average" based MAHL. The average design capacities were taken from the "*Engineering Report – Nogales International WWTP Facility Upgrade" (2007)* produced by STANTEC.

TABLE 9
Calculation of MAHLs

Pollutant	Q_{plant} (mgd)	M_{solids} (lb/day)	R_{plant}[1] (%)	C_{eff}[2] (mg/L)	AHL_{eff} (lb/day)	C_{inh}[3] (mg/L)	AHL_{inh} (lb/day)	C_{solids}[4] (mg/kg)	AHL_{solids} (lb/day)	MAHL (lb/day)	25% Safety Factor (lb/day)	MAHL - Safety (lb/day)
Arsenic	14.74	18,438	45	0.05	11.18	0.1	12.29	75	3.07	3.07	0.77	2.30
Cadmium	14.74	18,438	67	0.00486	1.81	5.2	639.24	20	0.55	0.55	0.14	0.41
Chromium	14.74	18,438	82	0.146	99.71	1.08	132.77	100	2.25	2.25	0.56	1.69
Copper	14.74	18,438	86	0.0192	16.86	0.27	33.19	4,300	92.19	16.86	4.21	12.64
Cyanide	14.74	18,438	69	0.0169	6.70	0.42	51.63	--	--	6.70	1.68	5.03
1,4-Dichlorobenzene	14.74	18,438	22	0.075	11.82	5	614.66	150	12.57	11.82	2.96	8.87
Fluoride	14.74	18,438	0	4	491.73	--	--	--	--	491.73	122.93	368.79
Lead	14.74	18,438	61	0.00623	1.96	0.5	61.47	100	3.02	1.96	0.49	1.47
Mercury	14.74	18,438	60	0.000368	0.11	0.55	67.61	4	0.12	0.11	0.03	0.08
Molybdenum	14.74	18,438	10	--	--	--	--	75	13.83	13.83	3.46	10.37
Nickel	14.74	18,438	42	0.1	21.2	0.38	46.71	420	18.44	18.44	4.61	13.83
Selenium	14.74	18,438	50	0.00328	0.81	--	--	20	0.74	0.74	0.18	0.55
Silver	14.74	18,438	75	0.00661	3.25	--	--	100	2.46	2.46	0.61	1.84
Zinc	14.74	18,438	79	--	--	0.29	35.65	7,500	175.04	35.65	8.91	26.74
BOD_5	14.74	18,438	--	--	--	--	--	--	--	28,324	--	28,324
TSS	14.74	18,438	--	--	--	--	--	--	--	30,040	--	30,040
TKN[5]	14.74	18,438	--	--	--	--	--	--	--	3,437	--	3,437

[1] Refer to Table 8 - Removal Efficiencies of Selected POCs.
[2] Refer to Table 3 - Summary of NIWTP's APP Discharge Limits (APP DLs), and Table 4 - Summary of NIWTP's AZPDES Discharge Limits (DL Daily Max).
[3] Refer to Table 5 - Summary of Process Inhibition Criteria Applicable for the NIWTP's Treatment Processes (Selected Level).
[4] Refer to Table 6 - Federal Ceiling Concentration Limits and Toxicity Characteristic Leaching Procedure Regulatory Limits (selected lower value).
[5] TKN MAHL was calculated because the plant was designed for this condition in lieu of ammonia.

4.3 Allocation of MAHLs

The MAHL's for each POC must be allocated between Mexico and the U.S. It is expected that Mexico's total flow will be reduced in the future after the construction of a new wastewater treatment plant. The upgraded NIWTP has a design flow of 14.74 mgd. Because flows from each country may change, the MAHL has been allocated on the basis of percentage of the total design flow. This allocation is shown in Table 10. A graphical representation of percentage of flow versus MAHL for each POC is contained in Appendix B.

TABLE 10

Allocation of MAHL on Basis of Flow

Pollutant	MAHL–Safety (lb/day)	10% Flow	20% Flow	30% Flow	40% Flow	50% Flow	60% Flow	70% Flow	80% Flow	90% Flow	100% Flow
Arsenic	2.30	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30
Cadmium	0.41	0.04	0.08	0.12	0.17	0.21	0.25	0.29	0.33	0.37	0.41
Chromium	1.69	0.17	0.34	0.51	0.67	0.84	1.01	1.18	1.35	1.52	1.69
Copper	12.64	0	1.26	2.53	3.79	5.06	6.32	7.58	8.85	10.11	11.38
Cyanide	0.50	1.01	1.51	2.01	2.51	3.02	3.52	4.02	4.52	5.03	0.50
1,4-Dichlorobenzene	8.87	0.89	1.77	2.66	3.55	4.43	5.32	6.21	7.09	7.98	8.87
Fluoride	368.79	36.88	73.76	110.64	147.52	184.40	221.28	258.16	295.04	331.92	368.79
Lead	1.47	0.15	0.29	0.44	0.59	0.74	0.88	1.03	1.18	1.33	1.47
Mercury	0.08	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.08
Molybdenum	1.04	2.07	3.11	4.15	5.19	6.22	7.26	8.30	9.33	10.37	1.04
Nickel	13.83	1.38	2.77	4.15	5.53	6.91	8.30	9.68	11.06	12.45	13.83
Selenium	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.55	0.06
Silver	1.84	0.18	0.37	0.55	0.74	0.92	1.11	1.29	1.48	1.66	1.84
Zinc	26.74	0	2.67	5.35	8.02	10.70	13.37	16.04	18.72	21.39	24.07
BOD_5	28,324	2,832	5,665	8,497	11,330	14,162	16,994	19,827	22,659	25,492	28,324
TSS	30,040	3,004	6,008	9,012	12,016	15,020	18,024	21,028	24,032	27,036	30,040
TKN	3,437	344	687	1,031	1,375	1,719	2,062	2,406	2,750	3,093	3,437

4.4 Comparison of MAHL's to Historical Influent Loads

The MAHL's for each POC were compared to the average historical loadings of the plant influent, Mexico influent, and Nogales and Rio Rico influent, and are shown in Table 11. The concentration of each POC was multiplied by the flow and converted to pounds per day for each sample result from January 2006 through May 2008 for the plant influent and the flow from Mexico. There were no sample results for the flow from the U.S. so these results were calculated by subtracting the loading from Mexico from the plant influent loading. These results were then averaged for the entire sample period from January 2006 through May 2008 and compared to the MAHL. Not all POC's contained sample results for the entire historical period. These POC's appear in Table 11, but contain footnotes with the sample period used.

TABLE 11
Comparison of MAHLs to Historical Influent Loadings

Pollutant	MAHL – Safety (lb/day)	Plant Influent Average Daily Loading (lb/day)	Mexico Average Daily Loading (lb/day)	Nogales & Rio Rico Average Daily Loading (Calculated) (lb/day)	Existing (1997) MAHL[3] – Safety (lb/day)
Arsenic [1]	2.30	0.093	0.034	0.001	8.93
Cadmium [1]	0.41	1.393	1.045	0.338	0.41
Chromium [1]	1.69	3.859	3.545	-0.010	19.05
Copper [1]	12.64	8.805	5.505	3.174	3.23
Cyanide [1]	0.50	0.891	0.568	-0.013	--
1,4-Dichlorobenzene [2]	8.87	0.11	--	--	--
Fluoride [2]	368.79	70.62	--	--	--
Lead [1]	1.47	0.615	0.533	0.078	0.69
Mercury [1]	0.08	0.008	0.007	0.002	0.05
Molybdenum [4]	1.04	ND	--	--	--
Nickel [1]	13.83	2.883	2.634	-0.009	21.75
Selenium [1]	0.06	ND	--	--	--
Silver [1]	1.84	0.262	0.209	0.000	2.40
Zinc [1]	26.74	27.147	22.918	4.054	31.50

Nondetects (ND) were assumed to have a value of zero when calculating averages.
[1] Sampling period from January 2006 – May 2008.
[2] Sampling period from February 2008 – October 2008.
[3] *Development of Headworks Allocations for the NIWTP* (May 1997).
[4] Sampling period from January 2009 – February 2009.

Based on the NIWTP influent average daily loading, cadmium, chromium, cyanide and zinc exceed the MAHL. In the event that MAHLs are not met, the controlling AHL in each MAHL calculation would predict the most rigorous regulation. For example, the controlling AHLs for cadmium and chromium are sludge disposal criteria. In this instance sludge regulations may be violated by exceeding the MAHLs for cadmium and chromium. The controlling AHL for cyanide is the effluent regulation. If this MAHL is exceeded, it may result in a violation of the NIWTP's AZPDES permit. The controlling AHL for zinc is inhibition criteria. An exceedance of this type may result in disruption of the NIWTP's biological treatment processes which may lead to the inability to remove numerous pollutants. This type of process impacts may result in effluent discharge violations. If a MAHL is exceeded by a considerable amount, numerous violations may occur.

4.5 Groundwater Impacts on MAHLs

The NIWTP monitoring well reports (monitoring wells 1, 4, 5 and 6) from 2003 to 2007 and the Comisión de Agua Potable y Alcantarillado (COAPES) well data reports titled, "Calidad de Agua de los Cuerpos Receptores de Nogales, Sonora" from 2000 to 2003 were reviewed in order to determine if groundwater intrusion into the collection system has impacts on the MAHL. No information on the quantity of infiltration was available. The following parameters that have MAHLs were sampled for in the NIWTP monitoring wells: arsenic, cadmium, chromium, cyanide, fluoride, lead, mercury, nickel, selenium, copper and zinc were not analyzed. Fluoride is the only parameter with a MAHL that was sampled in the COAPES well report. Table 12 lists the statistical averages for each parameter.

TABLE 12

STATISTICAL AVERAGE OF GROUNDWATER DATA

Pollutant	NIWTP Monitoring Well Data (1, 4, 5 and 6) (mg/L)	COAPES (mg/L)	NIWTP Influent (mg/L)
Arsenic	0.0058	NA	0.0016
Cadmium	0.0005	NA	0.011
Chromium	ND	NA	0.029
Cyanide	0.0027	NA	0.004
Fluoride	0.2717	ND	0.553
Lead	0.0017	NA	0.005
Mercury	ND	NA	0.0001
Nickel	ND	NA	0.022
Selenium	ND	NA	ND

ND = nondetect, NA-Not Available

[1] Sampling period from January 2006 – October 2008.

A cursory look at the groundwater quality data showed nondetectable concentrations for most of the parameters analyzed. Detectable concentrations of arsenic, cadmium, cyanide, fluoride and lead were present in the groundwater sampled at the NIWTP monitoring wells. Depending on the amount of groundwater infiltration in the collection, MAHLs for those parameters could be affected. However, without any data available on the amount of infiltration it is difficult to say how much the groundwater is impacting the MAHLs. It appears that high arsenic concentrations in the groundwater may have an impact on MAHL, since the NIWTP arsenic influent load is significantly lower than MAHL for arsenic, this may be a non-issue.

SECTION 5

Conclusions

5.1 Summary

A total of seventeen (17) pollutants qualified as POCs for the NIWTP based on screening criteria described in EPA's Guidance Manual (2004). MAHLs were calculated for these POCs and were compared to historical influent loads. Comparison of the new MAHLs to historical loading demonstrated that headworks loadings for cadmium, chromium, cyanide and zinc exceeded their MAHLs by wide margins. These results indicate that significant reductions in the discharge of these pollutants to the sewerage system will be required in the future.

5.2 Recommendations

The following items are recommended for USIBWC's consideration:

- Recalculate the MAHL after the new upgraded plant is in operation for a year with the new plant removal efficiencies.
- Continue to monitor POCs that were evaluated.
- Establish pretreatment limits using uniform concentration method or contributory flow method and based on the revised MAHLs with new plant operations. Develop local limits for cadmium, chromium, copper and zinc using EPA's Guidance Manual (2004).
- Monitor groundwater data on copper and zinc to evaluate impacts on MAHL
- Continue to monitor surfactants and the impact on new plant operations.
- Conduct industrial pretreatment survey in Nogales, Sonora.

Appendix A: NIWTP Historical Data

Appendix B: NIWTP MAHL Allocation