The Aquifer Protection Permit and BADCT requirements apply to both new and existing mining operations. The designations "new", "existing", and "closed" are specifically defined in A.R.S. 49-201. New facilities began construction or contracting after August 13, 1986. Facilities that have undergone major modifications after August 13, 1986 are deemed new facilities, as well. Existing facilities began construction or contracting on or before August 13, 1986. Closed facilities are those which ceased operation before January 1, 1986 with no intent to resume. Facilities which ceased operation after January 1, 1986 are regarded as existing facilities and are required to meet BADCT and other Aquifer Protection Permit requirements. Closed facilities are not required to obtain an Aquifer Protection Permit and are, therefore, not subject to BADCT requirements.

Some types of mining facilities are not required to obtain an Aquifer Protection Permit since they do not engage in "discharge" which means (according to A.R.S. 49-201.10) "the addition of a pollutant from a facility either directly to an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer." The following specific exemptions apply to some mining operations:

"Mining overburden returned to the excavation site, including any common material which has been excavated and removed from the excavation site and has not been subjected to any chemical or leaching agent or process of any kind". (A.R.S. 49-250.B.5)

"Wash water from sand and gravel operations, or placer mining operations, if only physical processes are employed and no hazardous substances are added during processing". (A.A.C. R18-9-103.2)

If an applicant is uncertain of the applicability of the rules or statutes to their facility, the applicant is encouraged to consult with the Department.

C. How To Use This Document

This guidance document is meant to be used by the permit applicant to develop BADCT for his facility. If you have additional questions, do not hesitate to contact the Water Permits Unit. It will also be used by the ADEQ reviewing permit writer to prepare the permit. Chapter II outlines the ADEQ process for reviewing the BADCT portion of a permit application.

Chapter III describes "How to Determine BADCT For Your Facility". This chapter discusses the process involved in selecting control technologies to assure that they represent BADCT for a specific facility.

Chapter IV identifies the control strategies which will be used in conjunction with Chapter III. The control strategies have been selected specifically for facilities common to Arizona's mining industry. The applicability and effectiveness of various pollutant control strategies are discussed for each mine facility type. Here, also, is included a description of individual discharge control components that are available for use at mine sites.

Chapter V addresses the "Site Characteristics and Other Considerations", including hydrogeologic characteristics, other environmental factors, water conservation and economics of other alternatives which may affect the BADCT selection for a facility.

Chapter VI is devoted to existing facilities and the special considerations for them.

A list of references and a list of "Frequently Asked Questions About BADCT" are incorporated into this document.

D. Other Permits and Regulations

Other approvals and permits may be required by Federal, State or Local governments. A list of possible permits that may be required is included in Table I. This is not an exhaustive list; additional permits may be necessary. It is the permittee's responsibility to obtain and comply with all applicable laws and regulations.

TABLE I: Other Permits/Approvals & Agencies

Federal	Various Federal Agencies	E.I.S.
	BLM	Reclamation Plan
	Forest Service	Operation & Reclamation Plan
	E.P.A. - Water	N.P.D.E.S. - Clean Water Act
	E.P.A. - RCRA	Hazardous Waste Permit
	E.P.A. - Air	Air Quality Permit
	Corps of Engineers	Dredge & Fill 404 Permit
	E.P.A.	UIC Regulations (In-situ leach)
	E.P.A.	UMTRA & other programs
	N.R.C.	UMTRA & other programs
State	DEQ - Water	Reuse Permit
	DEQ - NPDES	Discharge permit-surface water
	DEQ - Waste	Hazardous Waste Permit
	DEQ - Air Quality	Air Emissions Permit
	DEQ - Solid Waste	Solid waste disposal/ operational Plan Approval
	DEQ - WQARF	Remedial Action (closed facilities)

(Cont.)

DWR - Wells	Well construction/water withdrawal permit (potable and monitoring wells)
DWR - Wells	Poor Water Quality Withdrawal Permit
State Lands	If on or near State Lands
State Historic Preservation Office	Approval to Proceed
State Mine Inspector	Registration/Safety
County/City	Land use - zoning approval
County	Engineering/construction approval
Local District	Flood control approval
DWR	Dam Safety & Stability

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II. BADCT REVIEW PROCESS

The BADCT review process is a part of the Aquifer Protection Permitting process. This Chapter will deal only with the BADCT process. For a description of the permitting process, and how BADCT fits in, the reader is directed to the Aquifer Protection Permits Guidance Manual. Figure 1 is a flow chart of the BADCT review process described here.

When an applicant submits an application for an Aquifer Protection Permit, it must include a proposal of what BADCT is to be at that facility. The proposal should describe the optimal design for the facility as selected from Chapters IV & V of this manual. The applicant should then include a description of the site specific design proposal, and justification for any deviations from the optimal design. The justification should address any of the following which figure into the deviation: site specific hydrologic and geologic characteristics, other environmental factors, water conservation or augmentation, or economic impacts of the use of alternative technologies, processes or operating methods on an industry wide basis.

DEQ's review (initiated by the permit writer) begins with an accuracy check of the optimal design. Is the one presented for this facility correctly chosen from the guidance document? If DEQ determines that it is not, the applicant will be notified of the need to make the appropriate corrections and resubmit. Depending on the degree of deficiency, this notification and resubmittal process may be more or less formal, but in all cases any final determination must be documented in the Department's files.

If the optimal design is represented, the permit writer checks the proposed BADCT for the facility. If the proposed design provides a similar level of protection, or is more effective than the optimal design as presented in this document, the permit writer approves the design and can proceed with the remainder of the permit application review.

The permit writer will examine the information provided to determine if the greatest degree of discharge reduction will be achieved, i.e. that the proposed BADCT design will yield a performance similar to that achieved by the optimal design.

When evaluating a BADCT proposal, the permit writer must ask, "Is this the <u>best available demonstrated</u> control technology? Since at this point, the applicant has deviated from optimal design, the permit writer must determine why, and if the deviation is valid. The permit writer will examine the information provided to determine if the greatest degree of discharge reduction will be achieved, i.e. that the proposed BADCT design will yield the same performance as the optimal design. If the information is deficient or inadequate to make this judgement, the applicant will be so advised, and will be asked to make the necessary corrections or additions for the submittal. It should be noted that there is much opportunity for negotiation during this stage of review.

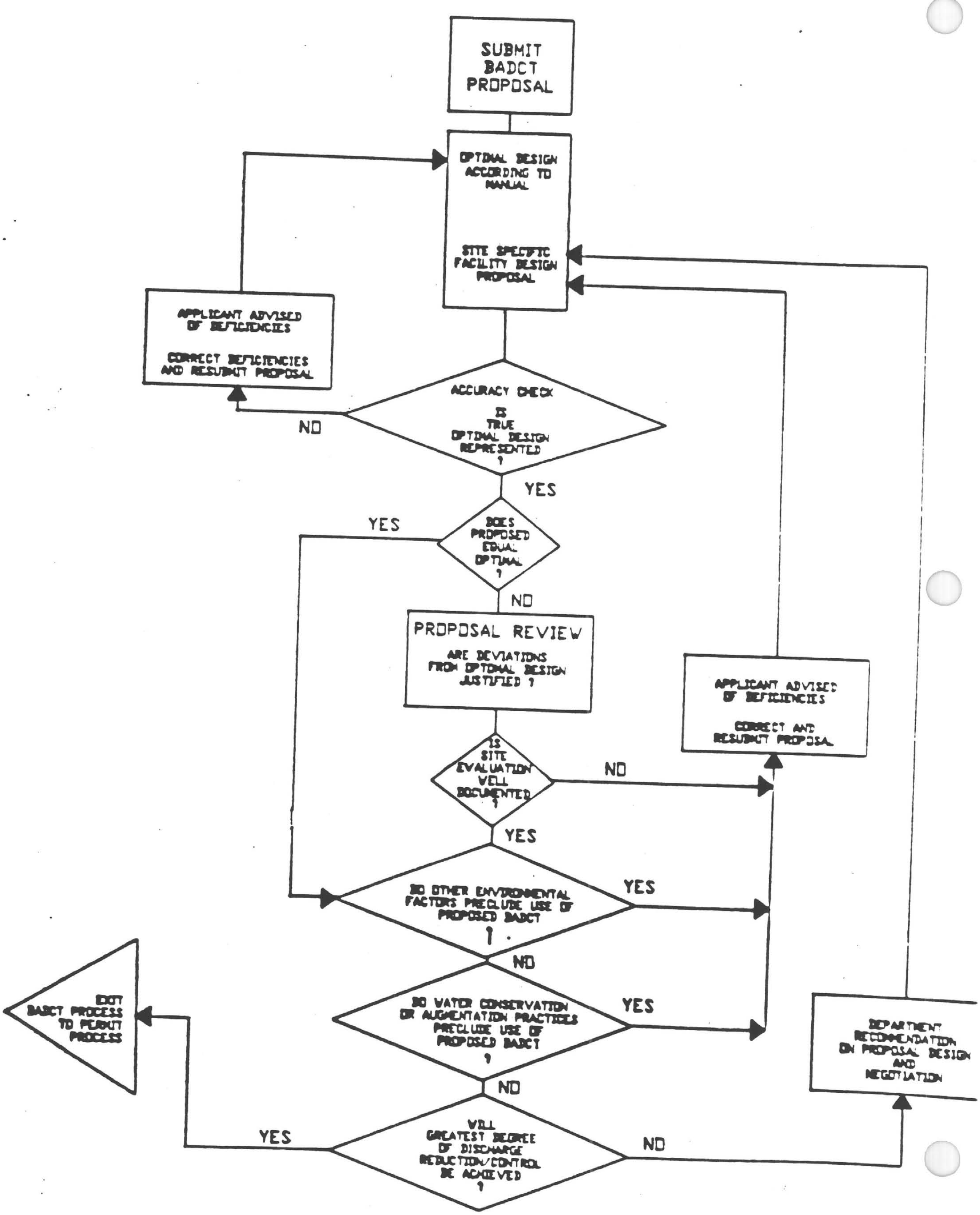

FIGURE 1: BADCT REVIEW PROCESS

At this stage in the review process the proposed design will be evaluated for other environmental factors and water conservation. These other impacts will be weighed against discharge reductions achieved in the design. Conflicting environmental and conservation goals should be resolved at this point.

Following these determinations, the final decision point for DEQ is, "Will the greatest degree of discharge reduction or control be met by these conditions?" This decision is really a culmination of the previous review steps, but is symbolically represented here as the endpoint of the process. If the Department determines that the intent of the law as stated in this decision point will not be met, there is still the opportunity for negotiation combined with a recommendation on the proposed design from the Department. Of course, if the answer is yes, application review proceeds through the remainder of the permit process.

III. HOW TO DETERMINE BADCT FOR YOUR FACILITY

This chapter discusses the process involved in selecting control technologies to assure that they represent BADCT for your specific mining facility. The process outlined in Table II involves starting with a design that incorporates all of the most effective discharge controls available. Once this "optimal" system design is established, the applicant evaluates its performance at the specific site. The applicant may then use site characteristics as "trade-offs" to substitute for specific discharge control design elements of the "optimal" design. These "trade-offs" should achieve a similar level of discharge control to that of the "optimal" design. In Chapter IV.E., Alternate System Designs are presented which may be substituted for the optimal systems when justified by site-specific conditions to achieve a similar level of pollutant control. In this way the performance of the "optimal" design is preserved using lower-cost technologies.

TABLE II: Steps in BADCT Determination

1) Select "optimal" system design applicable to your facility type from Chapter IV.

2) Determine the performance of the "optimal" system design in discharge control. Consider how the system would be fit to the site, to the required capacity, and to the specific characteristics of potential discharges.

3) Evaluate site characteristics for their effectiveness in discharge control.

4) Use discharge control aspects of site characteristics to justify using less than optimal discharge control design components or an alternate system from Chapter IV.E. in final design.

5) Determine whether other environmental factors or water conservation preclude implementing portions of BADCT design.

6) Propose final design.

You can establish the optimal system design for your facility by using the various mining operation discharge control components described in Chapter IV. You should select the most effective: a) containment liner systems; b) leachate collection systems; c) tailings disposal systems; d) mine water disposal systems; e) processing and refining discharge controls; f) mine workings; and g) closure plan; or other control strategies by following the guidance of the discussion of optimal systems presented in Chapter IV. This "optimal" design may appear dramatically "over-engineered" for your facility, but it is intended as a starting point from which you can pare down design elements to arrive at BADCT. Once the optimal system is established, you should determine the system's performance for pollutant control. This performance is the target for the performance level to be achieved in the final design proposed as BADCT.

In order to use site characteristics as a part of BADCT, you must thoroughly understand and quantify the performance of these features. A careful site study, and perhaps, laboratory scale tests may be necessary. Site characteristics and other considerations which may aid in discharge control at a mining operation are discussed in Chapter V along with a summary of the types of data to collect to document their performance.

The process of making a "trade-off" to substitute for an optimal system applicable to your facility type and replace it with an alternate system incorporating site characteristics involves three steps:

1. First, quantify the performance of the design component(s) to be removed, replaced, or modified.

2. Second, quantify the performance of the site characteristic(s) to be substituted.

3. Finally, show how the site characteristic(s), alone or in conjunction with a less-effective design element(s), will achieve similar performance to your "optimal" design.

As an example of this process, consider an "optimal" design for a precious metal heap-leach operation that includes a double flexible membrane pad liner with leachate collection below the top liner. The performance of the bottom liner from manufacturer's data is a permeability of 10^{-7} cm/sec., and the secondary leachate collection system effectively achieves no discharge. At the site, we have a substrate of unfractured, clay-rich, weathered volcanic bedrock for a thickness of 100 feet above the water table. Laboratory leach tests with solutions equivalent to the anticipated leachate concentrations show that the bedrock reacts totally with the leach solution removing contaminants to levels below their detection limits at a depth of 10 feet. We can conclude that removing the bottom liner and leachate collection system from the design still achieves the same performance because of the bedrock unit. The volcanic bedrock unit, then, is part of the proposed BADCT design.

Each site will require a different approach to establishing BADCT. The design process will require some creative thinking and careful weighing of design components and site characteristics. The proposed BADCT should include as much quantitative justification of the use of site characteristics as possible. It is recognized, however, that some of these judgements will be subjective and subject to negotiation between the applicant and the department.

IV. SELECTION OF CONTROL STRATEGIES

A. Introduction

This chapter outlines many of the discharge control strategies available for ten facility types: Base Metal Dump and Heap Leaching; Base Metal Tailings Impoundments; Precious Metals Heap Leaching; Precious Metal Vat Leaching; Precious Metal Tailings Impoundments; Smelting, Electrolytic Processing and Refining; Uranium Mining and Processing; Industrial Minerals; Placer Mining; and In-situ Leaching. We have identified those general design elements or components of mines and mineral processing facilities which are widely used to control discharge: Liners, Leachate collection systems; Surface water diversion features; Impoundments; Tailings dam systems; Chemical storage protection; Minewater treatment and disposal; Leak and spill containment in processing areas; Pipelines; Pits, shafts, adits, and other mine workings; and Closure procedures. Section D discusses some of the characteristics of the design components. Section E presents ways in which some of these components fit into recommended system designs.

The first two sections of this chapter discuss waste type and disposal site selection. These factors are not design components, but they greatly influence the design of the facility. For instance, design elements such as liners must be compatable with the waste type, and the availability of site characteristics used to control discharge will depend on site selection. Thus, while not part of BADCT, waste type and site selection will affect the BADCT determination for a particular facility.

B. Waste Type and Characterization

The types of wastes generated at the mining facility will have considerable impact on design. It is important that the design components be selected to be compatible with the waste type and expected chemical and physical characteristics of any leachate. This necessity for compatibility is the reason that specific materials, thicknesses, etc., cannot be mandated in this document for liner selection or for other features at mining facilities.

A portion of the BADCT proposal prepared by the applicant must define the waste type or mix of types including projected leachate compositions to be generated at the facility. Data that should be presented for waste material should include:

1. Bulk waste analysis.

2. Leach testing (EP toxicity, TCLP, or other methods as appropriate).

3. % Liquid.

4. Volume to be generated on a daily/monthly/yearly basis.

5. Chemical concentrations of liquids.

6. Other relevant parameters.

Examples of typical mine waste, process water, and leachate are given in Tables III - VI. While not fully complete, these tables reflect the general type and format of information to be submitted.

The applicant should show that the projected waste or leachate composition has guided selection of compatible control design elements. For example, if a highly acidic leachate is anticipated, an applicant should choose a liner material that resists acidic attack and should present in the BADCT proposal manufacturer's data that confirm this feature. The life expectancy of the liner under expected leachate conditions should also be taken into account.

Where solutions, wastes, or leachates contain any of the organic pollutants referenced in A.R.S. 49-243.D., the statute requires that BADCT for a new facility be limitation of discharge to "the maximum extent practicable regardless of cost".

TABLE III

Example of Waste Characteristics - Gold Mine

Carbon-in-pulp cyanide vat leach processing is used. Tailings are treated prior to disposal. Leachate is collected and reclaimed for use in mill circuit.

Reagents used in mill circuit:	Consumption (lbs/ton ore)
Sodium Cyanide (NaCN)	1.20
Calcium Hydroxide (CaOH - Lime)	2.00
Sodium Hydroxide (NaOH)	0.05
Nitric Acid (HNO3)	0.10
Fluxes (silica, sand, borax, fluorospar, etc.)	0.02
Carbon	0.03

Treated tailings slurry	Total Cyanide	40 mg/l
	Free Cyanide	30 mg/l
Untreated tailings slurry	Total Cyanide	1461 mg/l
	Free Cyanide	577 mg/l

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TABLE IV

Example of Waste Characteristics - Copper Heap Leaching Operations (Mined Rock)

Constitutent	Mine Rock (mg/l)	Raffinate (mg/l)
Arsenic	< 0.003	0.07
Barium	0.280	< 0.1
Cadmium	< 0.008	6.2
Chromium (Total)	< 0.001	0.19
Lead	< 0.084	< 0.01
Mercury	< 0.0005	< 0.0004
Nitrate (as N)	No Data	0.1
Selenium	0.0004	0.02
Silver	< 0.002	< 0.01
Fluoride	No Data	0.02
Copper		197
Cyanide		< 0.1
Nickel		2.8
Zinc	0.05	700
Potassium		1
HCO_3		< 0.01
Aluminum		1265
Boron		< 0.1
Cobalt		13.2
Molybdenum		0.19
Strontium		0.72
Silicon		134
Tin		< 0.1
SiO_2	67-72	
Al_2O_3	11.5-15	
CaO	0.24-0.40	
MgO	0.24-0.60	
Na_2O	0.13-0.34	
K_2O	3.0-5.4	
Sulfur	2.3-6.0	
MoS_2	0.005-0.02	
Calcium		556
Chloride		2
Hardness		0.25
Iron	3.2-4.5	1195
Magnesium		770
pH		1.8
Sodium		38
Sulfate		18800
Total Dissolved Solids		28800
Phenol		< 0.001
Other Organic Substances		Not Detected

TABLE V

Example of Waste Characteristics - Copper Tailings Vat Leach Reprocessing

Constituent	Reprocessed Tailings Disposal Concentration mg/l
Arsenic	0.22
Barium	0.34
Cadmium	0.15
Chromium	1.84
Lead	Not Detected
Mercury	0.01
Nitrate (as N)	58
Selenium	0.12
Silver	0.07
Calcium	51.1
Chloride	32
Copper	271
Hardness	1928
Magnesium	437
Manganese	42
pH	2.55
Sodium	211
Sulfate	15800
Total Dissolved Solids	23,990
Zinc	7.14
Organic Substances	Not Detected

TABLE VI
Example of Waste Characteristics - Uranium Breccia Pipe Ore and Waste Rock - No Processing on Site

Ore Pile:	0.7% U308		
Waste Pile:	0.1% U308		
Radioactivity in water on-site:			
Ra-226	Gross Alpha	Gross Beta	K-40
Minewaters:	No Data		
Runon from waste piles:		No data	

C. Site Selection

For mining projects, siting is often dictated by the ore body configuration and local topography. However, for certain facets of the surface operations, such as location of tailings ponds, limited siting choices may be available. Site selection and site characteristics will greatly influence BADCT determination since BADCT is site specific. To some extent, the site will control the design of the facility. In addition, some of the site characteristics may be used as a part of BADCT for that site. However, BADCT is not intended to impose specific siting criteria on facilities, nor can site characteristics alone constitute BADCT.

Site selection influences the design of a facility in that each design element must be adapted, or fit, to the dimensions and layout of the chosen site. The adaptation to the site affects the performance of the particular design component being used.

Site selection may influence what the final BADCT design will be for a project. As outlined in Chapter III, site characteristics can be used as "trade-offs" for design components if they serve to control discharge. An ideal site, then, might be one that had an abundance of characteristics which act as discharge controls. If a site is selected where hydrologic and geologic characteristics cannot be used as "trade-offs", then the "optimal" system will be required. If, on the other hand, a site is chosen with many "trade-offs", a less stringent design than the "optimal" system may be proposed as BADCT. The site-specific characteristics which may be used as a part of BADCT and may, therefore, enter into site selection decisions, are described in Chapter V.

D. Discharge Control Component Used at Mining Facilities

1. Liners

The effectiveness of the liner system is an integral part of BADCT for a mining project. Liner design is a rapidly changing technology, and new applications are being found in the mining industry. For this reason the most effective liner design and what is reagrded as BADCT at a site is evolving. The BADCT configuration can be selected by starting with an evaluation of the most effective liner system. If site conditions will allow for a similar level of leachate containment or attenuation, an alternate technology incoropratíng site characteristics may be proposed.

The selection of liner materials should be matched to the waste type and leachate characteristics. Flexible membrane liners are available in a variety of materials. The material and thickness should be selected to have resistance to chemical action, retention of tensile strength, and maintenance of low permeability through time. Soils used as liner systems should be selected to resist swelling, shrinkage, or cracking. They should be capable of achieving permeabilities of less than 10^{-7} cm/sec. Soils should be compacted and covered immediately to prevent desiccation. All soil liners should be tested for permeability after installation. Seams in geomembrane liners should be routinely inspected for quality control of the installation method. ASTM methods should be followed.

Leachate collection is included among the better liner system configurations because leachate collection works in conjunction with a liner. Leachate collection serves both to remove a source of groundwater contamination and to reduce hydraulic pressure on the liner. Thus, leachate collection improves liner efficiency.

Similarly, an overliner of porous sand or geonet/geotextile is necessary in heap leach designs for protecting the top liner. Drainage pipes may also be necessary to reduce head on the top liner, and promote collection of pregnant leach solutions. Figure 2 depicts the typical components of a liner and leachate collection system. It may be necessary to perform compression tests to determine the type of overliner required to protect the geomembrane.

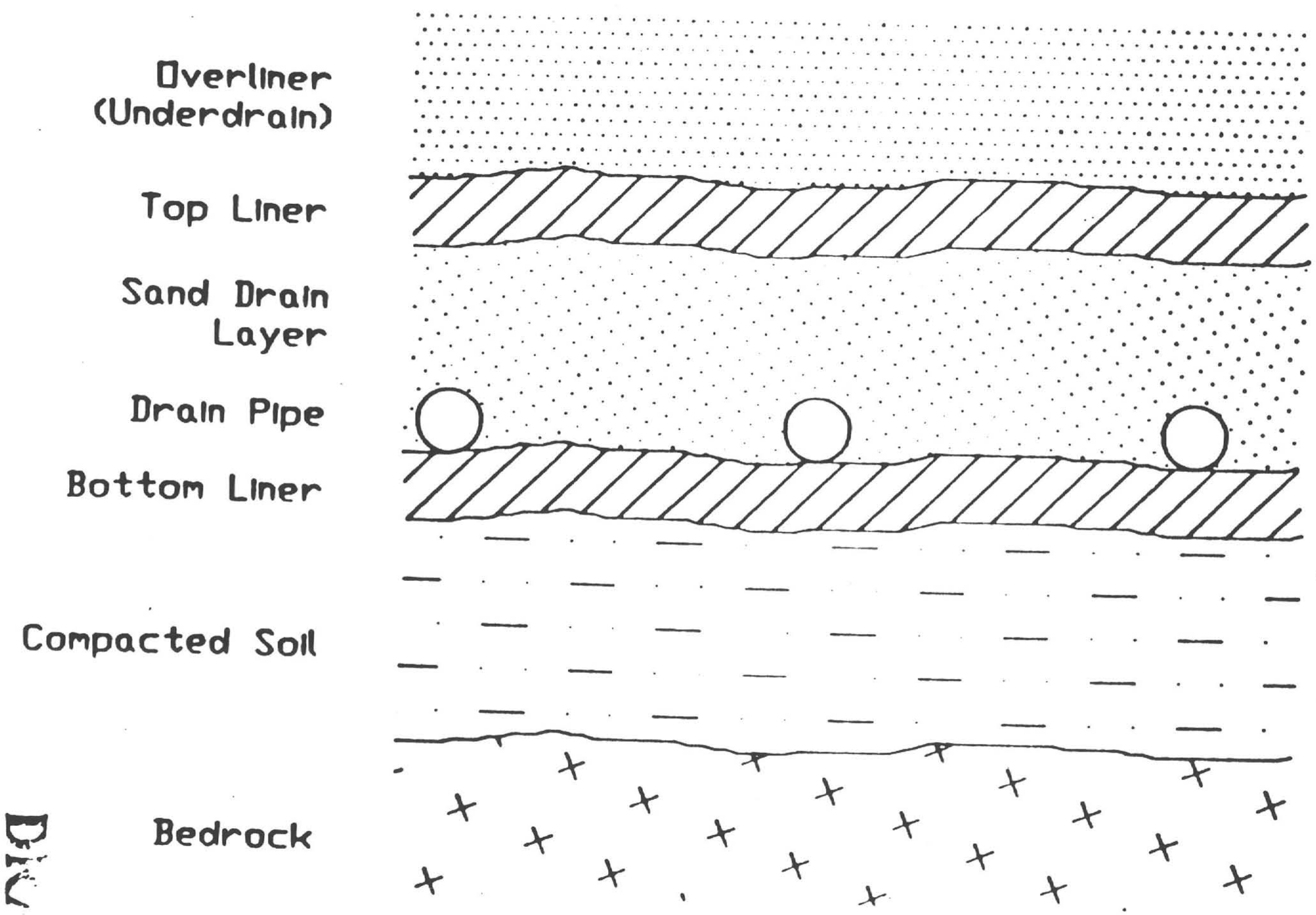

FIGURE 2: LINER COMPONENTS

2. Leachate Collection Systems

Water that percolates through a heap leach or mine waste pile area is assumed to eventually reach the base of the pile as leachate. A variety of design decisions are necessary to best handle this leachate. The amount of leachate that drains from the base will depend upon the type of liner and the design selected for removing leachate. To assure liner effectiveness and to reduce hydraulic pressure on the liner, some method of underdrain catchment is essential to guard against groundwater contamination. Obviously, for pond liners a catchment system to reduce head on the top liner is not possible.

A leachate collection and removal system should be designed and operated to maintain a leachate depth of one foot or less (U.S. EPA, 1988) above the top liner. A similar drainage system should be used for liquids in the space between dual liners. The design elements presented in this guidance document are expected to accomplish that performance.

The following is a partial list of factors that affect liquid transmission in the drainage layer:

- Impingement rate of liquid on the collection drain layer.
- Drain layer slope.
- Size and spacing of the drainage pipe.
- Hydraulic conductivity of the saturated sand, gravel, or geotextile.

A minimum thickness of 12 inches for the drainage layers is recommended to allow sufficient cross sectional area for transport of drainage leachate. A three-percent minimum slope is also recommended to promote drainage. However, stability of overlying materials may be a competing concern. Materials used as drainage media are commonly coarse enough that their hydraulic conductivity is greater than 1×10^{-2} cm/sec. In many leaching applications, the ore may be coarse enough to act as this drainage layer. Drain pipe diameter, length, and spacing are important because they control the head that builds up on the liner. The pipe diameter should be large enough to efficiently carry off the collected leachate. The length of drainage pipe should be no longer than the maximum length which a clean-out device can effectively reach. However, if clean out is not provided for int he design, a degree of redundancy may compensate for pipe plugging. The spacing of the drainage pipe depends on characteristics of the drainage layer, and on the impingement rate of liquids. DEQ is, therefore, not specifying minimum spacing or pipe diameter in this guidance.

Secondary containment, such as collection sump, is essential for leachate which has been collected and drained from the impoundment. A monitoring proposal for the secondary containment structure must be included in the application. Leachate management shall be addressed to include the method for final disposal use or reuse of the leachate.

Alternative leachate collection systems that provide a similar level of protection, or are more effective than the granular system described preciously, may be used. These alternative systems such as plastic nets can be very thin and still have the drainage capacity of a sand layer one foot thick. These systems should be capable of maintaining a leachate head of one foot or less.

The following features should be evaluated when substituting a non-granular leachate collection system for a granular medium:

- Ability to verify performance
- Hydraulic transmissivity
- Compressibility
- Compatibility with liners and leachate
- Ability to collect leachate and leachate storage
- Useful life of the system

3. Surface Water Diversions

The configuration of surface water diversions for a mining facility depends on the climate and topography of the site area. One major key to controlling leachate generation is design and operation of a mine or mineral processing activity in a manner to exclude surface water from areas where infiltration may affect groundwater quality. During the active stage of operation, prior to closure, uncontrolled runoff may flood the site and increase the potential for leachate generation. The remedy to this problem usually requires a surface water diversion and drainage system, properly designed, operated, and maintained for the specific site. Computer models, such as the HEC series, may guide the assessment of surface water effects.

In general, surface water runoff may be diverted and drained from the mine and process site by using engineered features such as dikes and/or channels. Dikes are usually designed to protect lowlands and excavated areas against periodic inundation by storm flow or high water. They are most commonly constructed with earth, although other materials such as concrete are also used. Open channels or ditches are an alternative to dikes for the diversion of surface water runoff. The choice between dikes and channels mainly depends on topography of the site. Use of a combination of dikes and channels may be necessary for certain sites.

The design considerations of surface water diversions are influenced by: precipitation (intensity, duration, distribution), watershed characteristics (size, shape, topography, geology, vegetation), runoff (peak rate, volumes, time distribution), and degree of protection warranted. Timely maintenance is necessary for the continued satisfactory operation of surface water diversions. The principal causes for failure of surface water diversions are channel and bank erosion, sedimentation, and excessive growth of vegetation. Poor design may also result in failure of these systems if they are not built to handle large enough flows.

Off-site runoff controls prevent stormwater from entering the site while on-site runoff controls prevent discharge caused by precipitation on the facility site It is recommended that natural or constructed features be capable of handling the 100-year, 24-hour, stormwater event, either through containment or diversion.

4. Tailings Treatment, Depositional Processes, and Collection Systems in Tailings Impoundments.

Tailings treatment and depositional processes can effectively reduce potential contaminant levels in tailings leachate, reduce tailings permeability, and reduce the hydraulic head within the tailings pile. Both treatment and depositional processes will depend on the nature of the tailings produced.

All tailings should be thickened prior to deposition to remove the maximum amount of water practical for reuse in the mineral processing operation, using as little water as necessary to transport the tailings to the impoundment yet enough water to minimize pipeline wear. Depending on composition, the thickened tailings may require treatment to neutralize pH, reduce contaminant levels, or neutralize cyanide in the case of precious metal leaching operations.

The thickened tailings should be deposited upstream of the tailings dam in a manner that achieves maximum size separation. In this way, coarse, pervious material may be used as beach deposits near the dam, while fine silt and clay size material is deposited further away from the dam. Cycloning can achieve effective size separation. Deposition through spigoting alone represents a less effective technology because it does not generally accomplish the best and most efficient size separation.

To reduce seepage through the waste material, water should be recycled from the tailings pond where fine sediment has settled out. Several methods are available to collect this water. Removal of the water from the tailings pond and from deposited tailings can lessen the hydraulic head within the tailings pile and can help prevent the infiltration of leachate below the pile.

The use of decant towers respresents a very effective method of collecting tailings pore water and surface fluid from the tailings pond. The systems, usually consist of one or more towers raised progressively to remain operational during the lifetime ofthe facility and into the closure period. In the most effective design, drainage from decant towers is connected to a collection system under the tailings impoundment that drains into a collection pond for subsequent reuse in processing, evaporation, or treatment and disposal. Other decanting systems include the barge-pump method, and the syphon-reclaim system. Both of these methods require more maintenance and do not dewater tailings in-place as the decant towers can.

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Leachate collection systems at the base of the tailings impoundment are also employed to carry leachate from the tailings through the dam to a collection pond for reuse or treatment and disposal, to further reduce the hydraulic head and infiltration potential below the pile.

5. Tailings Dam Systems

Dam systems should be designed and constructed to prevent failure resulting in a surface discharge. Surface discharges have the potential of adversely affecting groundwater quality through the migration of tailings and wastewaters off-site. The dam must be located in a structurally stable area. The stable substrate must be able to bear the weight of the dam system. All unstripped portions of the site should be cleared and grubbed. If stripping is not practical, control measures should be employed to reduce infiltration beneath the dam. The soil beneath the dam site should be stripped to bedrock where practical.

Tailings dams are commonly constructed in zones or layers, with an impervious dike or zone, and compacted materials consisting of native soils, borrowed fill, overburden, tailings sand, or a combination of these (Figure 3). The types of materials used to construct the dam should be chosen so that when compacted they prevent seepage through the dam. As mentioned previously, leachate can be collected through a drain system, and separated fluids can be decanted from the tailings pond.

Dam height must be sufficient to maintain enough freeboard to allow for the retention of water in the tailings pond and runon. Dam embankment stability must be ensured through an analysis of the proposed lifetime of the facility and the storage volume needed, dam height, slopes required, construction methods, strength of construction materials, and the potential for earthquakes. Dams should also be protected from erosion and re-vegetated after closure, and where practical, during the operational lifetime of the facility.

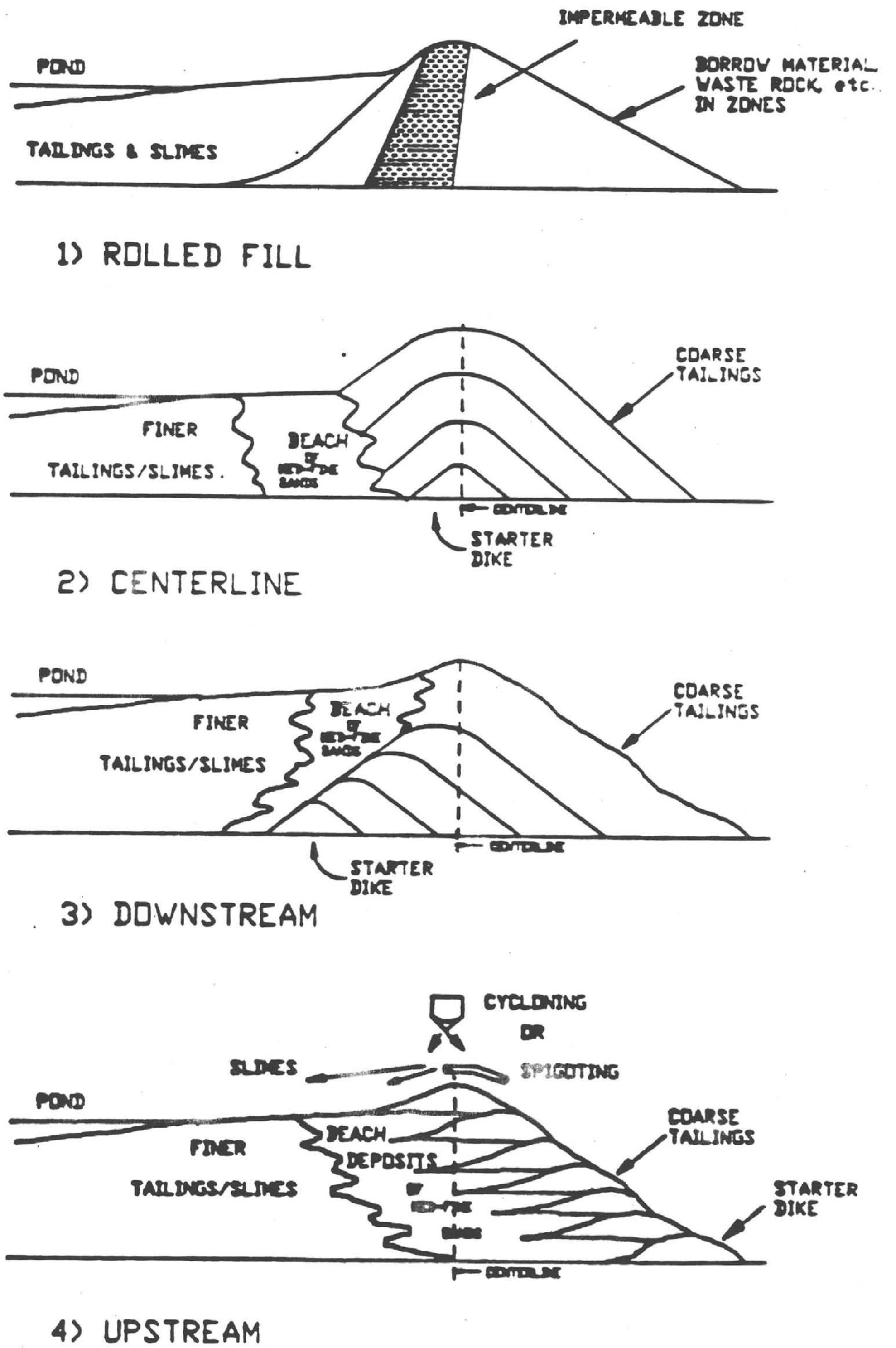


FIGURE 3: TAILINGS DAM CONFIGURATIONS

TABLE VII

Description of Tailings Dam Systems

1. Substrate: Impermeable or sealed to achieve 10^{-6} cm/sec.

   Construction Materials: Native soils, borrowed fill, or overburden. Tailings not used as dam material.

   Impermeable Zones: Forming the dam core and/or on the upstream side of the dam.

   Construction Method: Rolled Fill.

   Hydrologic Controls: Including the following:

   a. Leachate collection, decant, or other tailings water extraction upstream of the dam.

   b. Toe drain or pressure relief system on the downstream side of the dam.

   c. Collection of fluids in pond downstream of the dam.

2. Substrate: As listed in No. 1 above.

   Construction Materials: Native soils, borrowed fill, or overburden, with coarse separated tailings used in the upper portions of the dam.

   Impermeable Zones: Starter dike constructed to ensure dam stability and prevent seepage through the toe of the dam.

   Construction Method: Centerline, Downstream, or Rolled Fill.

   Hydrologic Controls: As listed in No. 1 above.

(Cont.)

3. Substrate: As listed in No. 1 above.

   Construction Materials: Starter dike of native materials. Compacted sand dikes overlying starter dike. Coarse separated tailings deposited adjacent to dikes. Slimes deposited upstream from the dam.

   Impermeable zones: Compacted tailings sand and slimed layers only.

   Construction Method: Upstream Method where dam wall is progressively raised upstream, building onto deposited coarse tailings fraction. Height is controlled such that the failure radius is maintained within the coarse deposits (beach zone).

   Hydrologic Controls: As listed in No. 1 above.

4. Other dam systems similar to Numbers 1, 2, or 3, with fewer hydrologic controls.

5. Other dam systems similar to Numbers 1, 2, or 3, with fewer hydrologic controls and a more permeable substrate.

6. Dewatering and Pumped Mine Water

Many active mine facilities require dewatering and disposal of pumped mine water. The type of containment or method of discharge, for water produced from mining operations depends on the water quality. Disposal of water pumped from mines or wells to dewater shafts and adits, and reduce infiltration potential should be accomplished in a manner that minimizes pollutant discharge. NPDES permits may be required for this disposal.

7. Pits, Shafts, Adits, and Other Mine Workings

Pits, shafts, adits, and other mine workings should be designed and operated with consideration given to controlling seepage and preventing discharge from these mined areas to the groundwater. The following control measures may be appropriate depending on technical feasibility, cost factors for existing facilities, and the concentration of pollutants in water coursing through mine workings:

a. Underground mine workings sloped for water drainage to lined sumps and/or to the surface where it may be contained or discharged in an acceptable manner based on pollutant concentrations. In many cases, this water may be reused within the mine operation.

b. Major permeable zones such as faults or permeable bedrock sealed where these zones represent potential paths of pollutant migration to groundwater.

c. Drill holes properly abandoned in a manner consistant with Arizona Department of Water Resources specifications.

d. Surface access restricted to prevent illegal dumping or discharge.

e. Pits designed, maintained, and closed in a manner to minimize hydrologic connection with aquifers.

f. Surface water diverted.

8. General Closure Considerations

An Aquifer Protection Permit will include a closure plan. The plan should assure that the closed facility will have no adverse impact on groundwater quality in the future. The design features for discharge control involved in closure are a part of BADCT for the facility. Other portions of the closure plan such as post-closure monitoring are discussed in the closure section of the Aquifer Protection Permit Guidance Document.

a. Tailings Impoundments (All Tailings Disposal Areas)

Post-closure discharge control at a tailings impoundment is accomplished by limiting the amount of water entering the pile and/or treating or neutralizing the tailings to reduce constituent concentrations in the rinsate. For organic substances referenced under A.R.S. 49-243.D., concentrations must be reduced to the maximum extent praticable regardless of cost. Cover design and maintenance of cover integrity are the focus of BADCT for closure. There are four main components to the design of an effective impoundment cover: 1) Cap Material (acting as a hydraulic barrier); 2) Final Cover Material; 3) Vegetation and other erosion protection; 4) Final Surface Configuration. If the tailings are treated or neutralized, the selection or use of a cover material is not as critical. However, the final surface configuration of the impoundment and revegetation remain as important parts of BADCT for the facility.

The cover material forms a hydraulic barrier to prevent entrance of surface water and precipitation. The performance of a cover material is judged by its permeability. The objective of having a lower permeability in the cover than in the tailings impoundment liner is to prevent accumulation of water in the tailings impoundment. The hydraulic barrier should be installed with grades that will conduct drainage away from the center of the facility to the outer edges where it may leave the site. The barrier should be field-tested for permeability after installation.

The final cover material serves two purposes: to allow water excluded by the hydraulic barrier to flow off-site and to act as a substrate for vegetative stabilization. Also, the final cover can serve to control dust. The most effective cover design includes two layers to perform these functions. The bottom layer is a permeable sand unit. The upper layer should be a cohesive soil that will support plant growth and resist erosion.

The vegetation on a tailings impoundment cover can provide dust control and protect the various layers in the design from erosion. It can also act to transpire moisture out of the soil. It is important to match the vegetation to the climate and soil so that it will grow with minimum irrigation and maintenance. It is also important to select vegetation that does not have deep root penetration because roots may breach the hydraulic barrier. Plans for vegetation may include a scheme to use annual vegetation early to achieve soil stabilization and change to perenials for long-term protection. Additionally, engineered erosion protection using fabrics, etc. can be effective working in conjunction with planned revegetation.

The final surface configuration of a tailings impoundment should be designed to conduct surface water runoff away from the facility. However, grades should not be so steep that they cause excessive erosion of the cover soil. Any future surface land use must be consistent with a strategy to maintain the impoundment cover integrity.

b. Ponds, Ditches, Trenches, Piping, Tanks, Processing, and Storage Areas

For closure of all ponds, ditches, trenches, piping, tanks, processing and storage areas containing leachate, raffinate, make-up solutions, pregnant solutions, or any other liquids, solutions may be disposed either by discharge or containment and evaporation. If discharge is the chosen option, solutions should be treated or neutralized. For organic substances referenced under A.R.S. 49-243.D, concentrations must be reduced "to the maximum extent practicable regardless of cost". In many cases the solutions may be disposed of by evaporation. Following evaporation, any remaining residues or sludges must be analyzed prior to disposal at an approved site.

All liners should be inspected for holes, tears, rips, or gaps prior to removal and/or backfilling to identify whether site remediation might be necessary. After backfilling, the ground should be restored to its original surface configuration and revegetated. Tanks and piping should be inspected after solutions have been removed to determine integrity prior to closure.

Chemicals should be removed to a safe area for subsequent use, sale, or disposal. All emptied containers should be rinsed, treated, and neutralized, and returned to the supplier or disposed of in an appropriate manner at an approved landfill.

9. Other Recommended Control Features (Not Part of BADCT)

a. Chemical Storage

Chemical storage areas must be designed to prevent the discharge of liquids to the vadose zone. Discharge control at chemical storage facilities should consist of construction of an impervious cement or asphalt pad, compatable with the liquid chemicals stored in containers within the area. The pad should be surrounded by berms or walls made of cement or asphalt. The pad and berms or walls should be free of gaps and cracks, and underlain by a synthetic liner. The berms or walls should be capable of containing at least 10% by volume of the total liquids stored, or the volume of largest liquid container, whichever is greater. The facility should be constructed to protect containers from the weather. Protection should be provided for the entire storage area against run on from the 100-year, 24-hour storm-water event. Dry chemical storage areas, if separated from liquid chemical storage, need only be protected from the weather and run on from the 100-year, 24-hour stormwater event. Incompatible materials, such as acids and bases, should be kept in separate areas.

b. Processing Areas

All processing areas, such as vat leaching, solvent extraction, concentrating, and refining, must be designed to prevent any discharge to the vadose zone. Ideally, containment systems should be sufficient to hold the processing fluids from the largest vessel, vat, or tank within each drainage area or 10% of the total fluid volume, whichever is greater. If the area is uncovered, the volume should also be sufficient to hold the precipitation from a 100-year, 24-hour stormwater event. The areas should be constructed of an impervious cement or asphalt pad compatable with the liquids used in processing, surrounded by berms or walls of the same material free of gaps and cracks, and underlain by a synthetic liner.

c. Pipelines

Pipeline systems should be constructed to contain or recover leaks that may reach the vadose zone with the potential of adversely affecting groundwater quality. In instances requiring maximum protection, the pipeline should be placed within or over a trench or area lined with concrete, asphalt free of gaps or cracks, or synthetic material. The liner system should have lined collection and recovery ponds at low points along the pipeline, with sufficient capacity to contain gravity flow of fluids from adjacent high points. The pipeline should be protected from flows resulting from the 100-year, 24-hour stormwater event. At all water or dry wash crossings the pipeline should be encased in a liner pipe. An automatic pipeline failure - shut down or warning system should be installed for leak prevention.

d. Barrier or Recovery Wells

Some facilities operate a series of wells to reclaim tailings water from the subsurface prior to its intercepting an aquifer or in areas where no natural aquifer exists. These wells are located within the plume of seepage of the tailings pond. The water can be pumped directly to the mill circuit, or it may first be held in a pond or tank. Pump back systems can be used as a secondary or backup control measure as a contingency in the event that discharge has occurred. Because this type of control acts to keep the facility within Aquifer Water Quality Standards at the point(s) of compliance, pump back systems only help the facility comply with A.R.S. 49-243.B.2. and 3.

E. System Design Elements

1. Optimal System: Double lining; leak detection/collection between liners; prepared and compacted subgrade; surface water controls

The optimal technology for precious and base metal leaching and tailings facilities consists of the above elements for those segments and components listed in Section a., Applicability. While all these elements are present in the optimal design, the specific design of any single element is dependent on: 1) site suitability for the design element and technical feasibility; 2) extent to which site characteristics can function to control discharge; 3) discharge control performance level of other design elements; and 4) the chemical characteristics of the discharge, particularly if constituents referenced in A.R.S. 49-243.D are present. As an example, systems using two synthetic liners and those using a synthetic and clay liner may both be considered as optimal, as could leachate collection systems installed with or without perforated piping, depending on the specific application. In some cases, the relative merits of various technologies may be in direct conflict: the greater impermeability of a synthetic secondary liner may be offset by the cyanide attenuation potential of a clay secondary liner. Additionally, the sophistication of one element of the system, such as the leachate collection system.

a. Applicability: Demonstrated for base and precious metals solution ponds; used on some precious metals leach pads; generally available for solution ditches.

b. Types of Systems

1) Primary liners generally consist of synthetic materials such as high or low density polyethylene (HDPE, LDPE) or polyvinyl chloride (PVC), varying in thickness from 30 to 100 mil depending on the application. Secondary liners may be constructed of these same materials or of natural materials such as clays and silts compacted to achieve 1 x 10^{-6} cm/s or less (see Section D.1. for discussion of liner design and compatability). More information regarding liner selection for specific facility types is found in Section IV.F.

2) Leak detection/collection systems may consist of a layer of sand, gravel, geotextile or other permeable material located between the two liners and connected to a system capable of removing any collected fluid before significant hydraulic head is imposed on the secondary liner. Perforated pipes can be placed within this layer when necessary to promote drainage, however, such piping is not required for an optimal design if hydraulic performance of the permeable layer is sufficient. Further information regarding leak collection design elements for specific facility types is found in Section IV.F.

3) Site preparation must precede installation of any liner system. Subgrade requirements vary depending on the nature of the liner and the facility type. Further guidance on the optimal level of site preparation is found in Section IV.F.

4) Surface water run-on controls include ditches, berms or other such structures which limit the run-on of precipitation to a facility. The objective of run-on controls should be to control or contain up to the 100-year, 24-hour storm event in such a manner that pollutant

discharge is avoided. While included as part of the optimal technology, the extent and complexity of surface water controls is highly dependent on topography, and also dependent on the sophistication of the other design elements. Section IV.F. offers further guidance of selection of the optimal level of surface water diversion.

2. Alternate System: Single lining; localized double lining and/or leak detection/collection; prepared and compacted subgrade; surface water controls

These technologies represent both the optimal system for the industry segments and components listed below under "Applicability". Also, they represent an alternate system to the optimal one listed previously, when justified by site-specific conditions to achieve a similar level of pollutant control.

a. Applicability: Demonstrated for precious metals leach pads if a synthetic liner is used, precious metals tailings ponds

b. Types of Systems

1) Single liners may consist of synthetic or natural materials. Liners of natural materials may be constructed with imported clays or silts installed in 6 inch lifts or may consist of scarified and recompacted in-situ material, if suitable. Bentonite or other clay minerals can be added to natural soils to reduce their permeability. Additional information on consideration involved in lining of facilities is found in Section IV.F.

Some facility types are amenable to localized double lining and leak collection/dectection systems. Two applications of this technology have been demonstrated for precious metals leach operations. Pads with drains internal to a heap can be constructed with a double liner beneath these drains. A pervious material such as sand, and where necessary, perforated pipes, can be placed between the layers to remove this solution and eliminate significant hydraulic head from the secondary liner. When solution ditches are external from the heap, and therefore subject to inspection and repair, a simplified system of double lining and leachate collection is the optimal technology. In such a case, the compacted subgrade serves as the secondary liner and a perforated pipe can be placed directly between the primary and secondary liner without use of a sand or gravel drainage layer.

Some precious metals tailing ponds are also amenable to localized double lining and seepage collection. When topography and the physical characteristics of the tailings allow use of the sub-areal deposition technique, a localized double lining and leachate collection system can be installed. In this application, the subgrade of the impoundment is reworked to provide a low permeability liner on the order of 1 x 10^{-6} cm/s or less. A blanket drain is then placed on top of the liner. In the area where the pond will be maintained, an additional soil liner can be installed. However, this liner is not meant to be "impermeable"; rather, it is tight enough to maintain a pond so that water may be reclaimed for reuse in the mill. Some seepage is transported by the blanket drain to a toe drain pipe and is then piped through the dam to a collection pond.

Another type of double lining for precious metals tailings ponds also involves a compacted subgrade as the bottom liner. A series of finger drains is then cut into the basin and these trenches are filled with drain rock. These drains are then routed to a toe drain and solution is piped throught the dam for collection. A geotextile may be used to prevent clogging with fine material. If the ore and milling practices allow, a layer of tailings slimes should then be deposited in the basin to provide an additional liner. Additional information of leakage or seepage detection/collection systems and their implementation is found in Section IV.F.

2) Regardless of the type of liner system used, some level of site preparation is necessary. See Section IV.F. for further information.

3) See Section IV.F. for a discussion of surface water run-on controls.

3. Alternate System: Single lining; prepared subgrade, surface water controls

This technology represents the optimal system for the facility types listed below and may also be used as alternate system for previously listed facilities if justified by site-specific conditions to achieve a similar level of pollutant control.

a. Applicability: Demonstrated for base metals heap leach pads and tailings impoundments.

b. Types of Systems

1) The single liner for base metals heap leach pads and tailings impoundments may be natural or synthetic material. General information on liners is included in Section IV.F. For base metals tailings impoundments, a base layer of tailings slimes deposited within the impoundment may be adequate to form part of the liner system. The effectiveness of tailings slimes as a barrier to seepage is dependent on the physical characteristics of the ore, the fineness of the grind, and the hydraulics of the impoundment.

2) As with more complex liner systems, subgrade preparation is necessary for single lined facilities. See Section IV.F. for additional information. Some level of site preparation may also be necessary prior to slime sealing of base metal tailings ponds.

3) Control of surface water run-on is routinely practiced except in cases where topography limits the feasibility of such diversions, or where the upgradient water shed does not contribute significant amounts of run-on. However, in water short areas, the facility may be designed to enhance the run-on of surface flows. Section IV.F. provides further guidance on the application of surface water diversions.

4. Alternate System: Prepared subgrade; surface water control

These technologies represent the optimal systems for the industry segments and components listed below. They may also be substituted for previously listed optimal technolgies if justified by site-specific conditions to achieve a similar level of pollutant control.

a. Applicability: Demonstrated for dump leach facilities and base metals tailings impoundments.

b. Types of Systems

1) In applications where liners have not been demonstrated as available technology, such as existing base metals dumps to be leached and tailings impoundments, facilities may be constructed on prepared subgrade. Where dump leach operations make use of near-surface bedrock to promote recovery of leach solution, the level of subgrade preparation may be minimal. Demonstration of low permeability subgrade will be necessary.

2) Control of surface water is an important technique in some cases where lining of existing dumps is not feasible. The technique may have minimal importance for dump leaching, where the run-on of precipitation may in fact aid in the leaching process.

5. Alternate System: Natural subgrade; surface water control

These technologies represent the optimal systems for the industry segments and components listed below. They may also be substituted for previously listed optimal technologies if justified by site-specific conditions.

a. Applicability: Demonstrated for dump leach facilities and base metals tailings ponds.

b. Types of Systems

1) In applications where subgrade preparation is not necessary or feasible, such as where the subgrade is of sufficiently low permeability and where the topography is extreme, the subgrade may be used in its natural state.

2) Control of surface water is an important technique in some cases where lining is not a demonstrated technology. The technique may have minimal importance for dump leaching, where the run-on of precipitation may in fact aid in the leaching process.

F. Specific Design Elements

1. Base Metal Dump and Heap Leaching Systems

a. Facility Description

Within the base metals subcategory, copper leaching facilities extract copper by passing a solution of sulfuric acid or water through a pile of run of mined or crushed ore. The solution dissolves the copper bearing minerals and the leachate is collected at the base of the pile. This pregnant solution is then typically sent to a solvent extraction plant where it is mixed with an organic solvent, usually kerosene based, containing chelating agents to wrest the copper (and some other metals) from the immiscible water based leachate. A concentrated sulfuric acid solution is then used to recover the metals from the organic solvent. The solvent is recycled through the process. The concentrated sulfuric acid becomes the electrolyte for the electrowinning process, which plates the copper out of solution onto cathodes. The leaching solution (raffinate) from the solvent extraction process is recirculated back onto the top of the ore pile for continued leaching.

Copper may also be extracted from pregnant solution in a precipitation plant. In this process, copper is precipitated on scrap iron, and the resulting material is then introduced to a smelter.

Low grade sulfide ores which do not justify the costs of crushing, milling and flotation are subjected to dump leaching. Natural topography and the site geology are employed for collection of the leachate and protection of aquifer quality. Its low grade also requires that haul distance be kept to a minimum, and these dumps are normally constructed adjacent to a pit. Some sulfide dump leach operations require only water to extract copper, as the ore generates its own acid from the oxidation of pyrite and chalcopyrite. Oxide ores require the addition of acid in order to leach effectively.

The key BADCT components in copper leaching operations are those design elements, operating practices and closure measures which control pollutant discharge. These include leach pile liners and leachate collection system, collection ponds and ditches, ponds associated with the solvent extraction and electrowinning operations, disposal of spent solutions, surface water controls, contouring and covering. Each of these components is discussed in detail below.

b. Design, Construction and Operation of Leach Pads

The technologies discribed in this section are generally only feasible for new leaching facilities. Those technologies also applicable to existing facilities are so indicated.

1) Site Preparation: Clearing and grubbing is normally done as preparation for compaction of liner installation in order to minimize the potential pathways for seepage of solution to the subsurface and to groundwater. In some cases, the ground is then treated with a biocide to eliminate plant growth which could affect liner performance. Compaction may serve to inhibit discharge of leaching solutions and to provide a firm, smooth subgrade for installation of liners where necessary. For leach pads, the need for and extent of compaction required is dependent on several factors: a) soil type; b) ability of soil to funtion as liner; and c) chemical attenuation. Installation of synthetic liners requires a smooth, stiff subgrade to avoid punctures and tears of the liner, geotextiles beneath the liner may also protect liner integrity. The degree to which subgrade preparation is necessary is dependent on the liner materials and the thicknesses and the physical characteristics of any overliner (drainage blanket) as well as the characteristics of the ore itself.

   In all cases, environmental factors must be considered in developing the appropriate site-specific BADCT. The depth to groundwater along with pollutants attenuation characteristics of the site and the presence of natural barriers to seepage, such as bedrock or relatively impermeable strata, may be factored in to the level of site preparation necessary to control discharge to aquifers.

2) Liners

   i. Design: Specific design elements are dependent on the conditions existing at the site. The topography of the available leach site generally determines the pad configuration. In some steep terrain, construction or installation of a liner may be technically infeasible and may not be necessary if site characteristics achieve performance similar to a liner system. In relatively flat areas, pads can be designed to drain to a single solution collection ditch external to the heap. In mountainous or rolling terrain, modified valley-fill pads take advantage of the existing topography and the leachate is collected in internal ditches which follow the natural drainages. The need for and characteristics of an overliner, which can protect a liner from punctures and promote drainage of the heap, is dependent on the ore size and angularity, and the method of initial pad loading.

ii. Materials: Many leach operations utilize synthetic liners to maximize leach solution recovery. Liner type and thickness should be determined to maximize liner integrity based on consideration of the loading weight of the heap, the puncture properties of the subgrade and the overliner, and the resistance to chemical degradation by the leaching solution. Soils of suitable texture may be reworked and compacted in place to form an effective in-situ liner. Where the native soils cannot be reworked, the choice of a liner material is based on the availability of low permeability natural materials and the physical and chemical properties required of the liner.

iii. Quality Control and Quality Assurance: The effectiveness of any liner can be increased by a program of quality control and quality assurance so that the liner functions as it was designed. Specifics of such a program are dependent on the site itself, the materials being used, and the method of installation. In general, parameters such as density and permeability of soil liners and seam integrity of synthetic liners should be specified and monitored during construction.

3) Leak Detection and Collection: Leak detection and collection methods can be applied to both new and existing facilities. For existing leach pads, seepage can only be detected by aquifer monitoring. These facilities should determine their current impacts on aquifer quality through use of monitoring wells. Although not a part of BADCT, mitigation strategies such as pump-back wells must be considered in the context of the existing aquifer water quality and the requirements of A.R.S. 49-243.B.2. and 3. For new leaching operations at existing dumps, leak detection is likewise only possible through monitoring wells. Leak collection may be accomplished through interceptor systems.

New heap leach facilities constructed on pads can be designed to incorporate leak detection and collection systems. In assessing the potential for significant hydraulic head to form on the liner, consideration must be given to the leaching cycle, the leach solution application rates, the drainage characteristics of the ore and the overliner, the gradient of the pad, and whether or not the pad was segmented with internal berms to direct leachate to the collection ditches. In most cases it is only beneath the leachate collection ditches that significant hydraulic head is exerted on the liner. A leak detection and collection system can be as simple as the placement of a perforated pipe under the liner of the ditch or as complex as a double liner system with sand or other pervious layer and piping installed to collect any seepage. Internal ditches may require the more elaborate of these designs, since it will not be feasible to repair them if leakage is detected. Solution collected in these systems should be returned to the recovery circuit.

As with all other BADCT determinations, the selection of any leak detection and recovery system may consider site specific factors including the depth to groundwater and the nature of the strata beneath the facility.

4) Surface Water Control: The use of surface water run-on control is generally applicable to both new and existing facilities. Design considerations are influenced by precipitation (intensity, duration, distribution), water shed characterizations (size, shape, topography, geology, vegetation), run-off (peak rate, volume, time distribution), and the degree of protection warranted. A facility's need to "harvest" additional water should be considered. Proper maintenance is necessary for the continued satisfactory operation of surface water run-on controls.

c. Design, Construction and Operation of Solution Ponds and Ditches

The technologies presented in this section are generally appropriate for new facilities. However, it may be feasible at some existing sites to employ some of these controls depending on the amount of discharge reduction which could be achieved.

1) Liners

i. Design: Ponds may be designed and constructed with double liners and leak detection systems installed between the liners, unless site conditions allow use of alternate technologies. A single liner may be installed in solution ditches.

ii. Materials: Solution ponds requiring double liners may be lined with two synthetic liners or with a primary synthetic liner and a natural secondary liner. The choice of synthetic liner material and thickness, and soil liner specifications should be based on site conditions and required chemical and physical parameters.

iii. Quality Control and Quality Assurance: In general, quality control and quality assurance considerations for pond and ditch liners is the same as that for pad liners.

2) Leak Detection and Collection: All new ponds should be designed with leak detection and collection systems. For double lined ponds, these generally consist of a pervious layer between the liners, with any seepage collected and returned to the system. Specifics of the design depend on the site topography. For single lined solution ditches, a more rudimentary system is adequate, since inspection and repair is easier than for ponds.

d. Closure of Pads, Ponds and Ditches

The closure technologies presented below apply to both new and existing copper leach pads, ponds and ditches. Few, if any, copper leaching operations have yet undergone closure, and therefore, these technologies may not be considered to be demonstrated specifically for this type of operation. However, these methods have been used as environmental controls at mine facilities other than copper heap leach operations.

1) Surface Water Diversions: The diversion of run-on around a spent ore pile can limit the amount of infiltration and seepage upon closure of the facility. The need for and type of diversions is dependent on the topography of the site, the area of the watershed above the facility, the relative rates of precipitation and evaporation, and the water retention ability of the spent ore.

2) Flushing of Heaps: Spent oxide ore may be flushed with water to rinse out residual acid. This technique will only be workable if no significant sulfide mineralogy is present. It should be noted that this technique has not been demonstrated in the copper segment of the industry. However, rinsing of residual cyanide is routinely practiced in the precious metals segment.

3) Contouring: Contouring of leach piles can reduce the potential for discharge of seepage to aquifers by reducing ponding on the surface and promoting controlled surface run-off. This is especially true when benches or cells have been constructed on the ore piles to maximize infiltration during the operational phase of the facility. Ponds and ditches can be graded to prevent ponding and infiltration when necessary.

4) Cover: In cases where the diversion of run-on and the removal of cells and benches from spent ore piles is ineffective in controlling pollutant discharge, some type of cover may be appropriate. Covers may range from soil caps to soil and vegetation and in some cases, synthetic membranes. It should be noted that none of these covering

techniques have ever been used for these specific facility types. Therefore, they are not demonstrated and may not be technically or economically feasible.

2. Base Metal Tailings Impoundments

a. Facility Description

Tailings impoundments are used for the disposal of waste material from ore concentrating facilities. In the copper industry, concentrating generally includes the processes of dry crushing, wet grinding and froth flotation. The product of the flotation process, copper concentrate, is then sent to a smelter for further processing, while the waste material, tailings, is sent to a tailings pond for disposal. The concentrate must be dewatered prior to its introduction into the smelter; the water is in almost all cases recycled to the milling circuit. The tailings are normally thickened prior to deposition in the tailings pond, and the excess water is also recycled to the mill. This minimizes the amount of water placed on the pond and thereby minimizes the amount of water lost to evaporation or required to be pumped back to the mill. The thickened tailings must retain sufficient water to allow their continued flow without undue wear on the tailings pipelines. The supernatent pond of water which forms on the tailings after deposition is normally recycled to the mill either directly via a barge mounted pump or after it has been decanted to a separate decant pond.

The disposal of mill tailings and any water associated with the ore concentrating process are subject to application of BADCT. The key elements include depositional practices, tailing dam and impoundment design and construction, reuse of tailings water, and surface water control.

b. Design, Construction and Operation of Copper Tailings Impoundments

The following technologies are generally applicable to both new and existing copper tailings disposal facilities:

1) Thickening: Tailings generally should be thickened prior to deposition to remove the maximum amount of water practical for reuse in the mineral processing operation, and using as little water as necessary to transport the tailings to the impoundment. The abrasive characteristics of the thickened tailings slurry must be considered so as to avoid excessive wear on the tailings pipeline which could shorten the life of the pipeline or lead to pipeline ruptures.

2) Depositional Practices: There are a number of techniques which can be used for deposition of tailings. To varying degrees, these techniques achieve a size separation of the tailings solids. The coarse solids can be deposited on or

near the dam, while the finer silt and clay size fractions can be placed further from the dam and beneath the ponded water. Such practices can aid in minimizing seepage through the tailings and in ensuring the structural stability of the dam itself. The effectiveness of each in reducing the potential for discharge to an aquifer is dependent on a number of parameters, including the physical characteristics of the ore, the fineness of grind in the mill, and the design of the tailings dam and impoundment. The applicability of these techniques is also dependent on the materials and method of dam construction and whether the facility is new or existing. The following methods are typically used in the industry:

i. Cycloning: This technique can be quite effective in achieving a size separation between fine silts and clays and coarse sands but is normally used only in conjunction with dam construction because of the large localized build-up of sands surrounding the cyclones. Once the cyclones are used to raise the dam, the tailings may be deposited by some other technique which spreads the tailings out more evenly across the entire impoundment. The applicability of cycloning is also highly dependent on the particle size distribution of the tailings solids and the pressure head available to operate the cyclones.

ii. Spigots: Spigoting utilizes the differential settling of particles to perform a size separation as tailings are deposited in an impoundment. Its relative effectiveness is dependent on the slope on which deposition takes place and the velocity of the discharge, as well as the grain size distribution of the tailings solids. Spigoting may also be used to direct the ponded water to the selected location within the impoundment.

3) Tailings Dam Design

Tailings dam design considerations for BADCT are applicable only to new facilities. In this industry segment there is no single dam system which can be judged optimal. However, the optimal system is one which meets the objectives of:

i. Retention of waste material under the most intense storm event expected during the life of the facility.

ii. Operation of the pond system to restrict seepage through coarse fraction of the tailings pile and dam.

iii. Integration of the dam design with leachate collection systems.

The specific design of a tailings dam must accomodate a variety of factors, including the topography of the site, the availability and cost of materials, and the required storage capacity of the impoundment.

4) Tailings Impoundment Design

BADCT for copper tailings ponds may include the use of the fines fraction of the tailings, called slimes, as part of the liner system to seal the floor of the impoundment. Depending on the topography and the texture of the soils, preparation of the site such as clearing of vegetation and grubbing of the surface provides an added benefit in seepage reduction. The effectiveness of using slimes as a liner is dependent on the particle size distribution of the tailings solids. Laboratory or, perhaps, pilot-scale tests, can verify that tailings slimes will perform as a low-permeability liner for the impoundment.

If organic pollutants referenced in A.R.S. 49-243.D., such as carbon disulfide, remain in the tailings and will be discharged to the tailings impoundment, the lining and leachate collection system for that impoundment must be designed to limit the discharge of these pollutants to the maximum extent practicable, regardless of cost.

5) Reuse of Tailings Water

As part of BADCT, water should be recycled from the tailings pond where fine sediment has settled out. Removal of water from the tailings pond and from the deposited tailings can lessen the hydraulic head within the tailings pile and can help prevent the infiltration of leachate below the pile. Several methods are available to collect this water, and the relative effectiveness of each is dependent on a number of site-specific factors, the chief one being the configuration of the impoundment itself. Proper maintenance is required for any of these systems to operate effectively.

i. Decant Towers: This system consists of one or more towers which must be continually raised during the operation to prevent inflow of tailings solids. The pond must therefore be sufficiently deep so that raising the tower can be done on a reasonable schedule. The tower is normally connected to a pipeline which transmits the water to a collection pond from which it can be recycled to the milling circuit.

ii. Barge Mounted Pumps: In this system, a pump is mounted on a barge which floats on the pond and recycles tailings water either directly to the mill circuit or to a reclaim pond for subsequent return to the mill. The required pond depth is dependent on the design of the barge and on the configuration of the pump. A variation on this system is a skid mounted pump. In this arrangement, a side draft pump is used, and it is mounted on a skid which can be advanced up the impoundment as the pond advances.

iii. Siphon Systems: These systems consist of one or more siphon lines to remove tailings water from the pond to a reclaim pond down gradient of the tailings impoundment.

6) Surface Water Controls

Controlling the inflow of surface waters to a tailings impoundment can limit the potential for seepage by reducing the total hydraulic head exerted on the floor of the impoundment. The specific considerations involved in surface water controls for copper tailings ponds are similar to those given in Section E.1.b.4) for leaching operations, with one exception. Because of their size and configuration, tailings impoundments can be effective in collecting surface water for operational purposes, thereby reducing the amount of groundwater which must be pumped. However, the impoundment liner must be capable of handling the excess solution. Where tailings impoundments are designed to capture surface run-on for operational purposes, it is necessary to include the upgradient watershed in calculating the size of the impoundment and in allowing for sufficient freeboard during operations.

c. Closure of Base Metal Tailings Impoundments

The objective in closure is to restrict future leachate generation and migration from tailings disposal facilities. Several techniques can be used depending on site specific conditions. Also, a balance must be struck between the need to control discharge and other non-water quality related issues such as fugitive dust. In areas of low precipitation and high evaporation, limiting the run-on of surface water from the surrounding topography may be sufficient to eliminate significant recharge to the impoundment. In some cases, recontouring of the tailings surface may be necessary to reduce ponding and promote evaporation of direct precipitation.

Most effective in controlling leachate in a closed configuration is the restriction of infiltration from precipitation and run-on. The use of natural or synthetic covers and/or revegetation has been used mainly to address air quality and aesthetic concerns, its effectiveness in reducing seepage over and above that of surface water control and recontouring has not been well documented at this type of facility. Other facilities, such as solid waste landfills, have effectively used capping, cover, and revegetation technologies to control post-closure pollutant discharge.

However, vegetation established either directly in tailings or on a cover of natural materials can be considered as BADCT to minimize erosion from dam faces and the subsequent potential for impacts on groundwater. The need for irrigation to establish the vegetation must also be considered as it effects the opportunity for water conservation. Recontouring the slopes and/or the construction of benches and check dams can also aid in the control of erosion and sediment transport. Continued operation and maintenance of leachate collection systems are also important aspects of a closed facility.

3. Precious Metals Heap Leaching

a. Facility Description

In the process of precious metals heap leaching, ore is crushed and often agglomerated to bind the fines and minimize channeling before it is placed on a leach pad. Water is usually mixed with caustic soda and sodium cyanide keeping the pH at 10 or higher to keep the formation of hydrogen cyanide gas to a minimum. The solution is then applied or sprayed onto the heap and pregnant solution is collected as it flows down the sloped lined pad base into a collection system of ditches or trenches feeding into a lined pond. The precious metals are stripped from the pregnant solution as it is circulated through beds of activated carbon. The barren solution which flows out of the carbon processing plant is normally held in a lined pond before being brought back to the approprate cyanide strength and recirculated back to the heap (Figure 4). Integrated facilities which have a tailings pond on site, or those with sufficient excess capacity in their pregnant pond, may not employ a barren solution pond.

Leaching may be conducted on single use ("dedicated") or multiple use ("restackable") pads. On a dedicated pad, spent ore is left in place upon closure. A restackable pad is loaded, leached, and the spent ore ("spoil") is rinsed and removed from the pad for disposal elsewhere. The pad can then be used for further leaching. The decision on which type of pad to use is based on a number of parameters including ore mineralogy and available terrain. Ores which can be leached rapidly may be leached on restackable pads. These pads are also utilized where available space for new leaching pads is at a minimum. In most other cases, the use of dedicated pads usually has a distinct economic advantage.

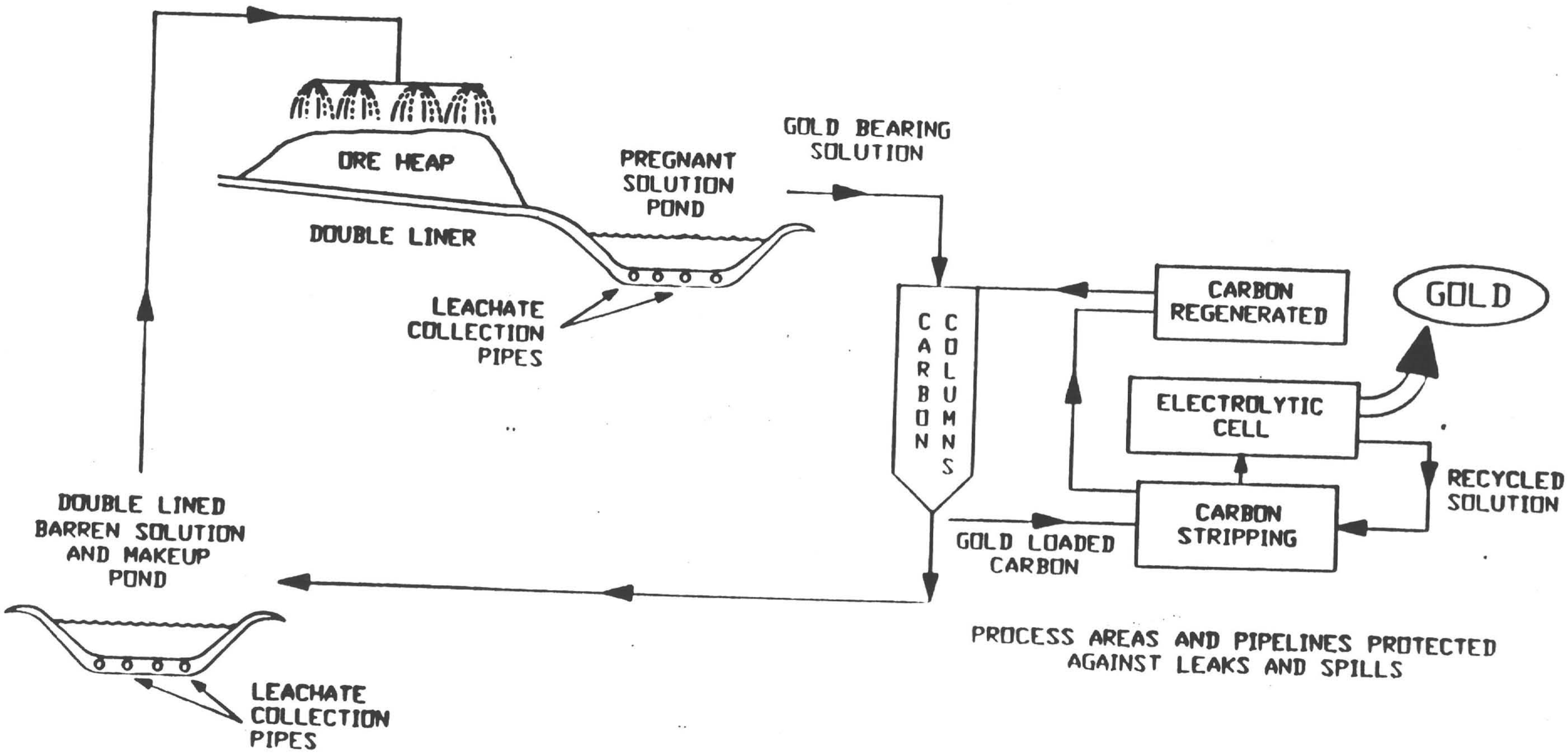


FIGURE 4: CYANIDE HEAP LEACH FLOW DIAGRAM

The key BADCT components in precious metals leaching operations are those design elements, operating practices and closure measures which eliminate the potential for significant discharge to an aquifer. These include liners and leachate collection systems for leach pads, ditches and solution ponds, surface water controls contouring and covering. Two items must be noted in regard to BADCT for precious metals leaching facilities. First, while it is commonplace to categorize these facilities as having "zero discharge" to groundwater, it must be recognized that all materials do in fact leak, and that the concept of a totally non-leaking facility is technically infeasible. These facilities can, however, be constructed such that they present no significant potential to discharge in a manner which could adversely impact aquifer quality. Secondly, in determining BADCT for this segment of the mining industry, cyanide compounds are not considered to be organic chemicals subject to the requirements of A.R.S. 49-243.D.

b. Design, Construction and Operation of Leach Pads

The technologies described in this section are generally only feasible for new leaching facilities. Those technologies also applicable to existing facilities are so indicated.

1) Site Preparation

Clearing and grubbing is generally necessary in preparation for installation of a synthetic liner. Compaction of the surface serves to inhibit discharge of leaching solution and to provide a firm, smooth subgrade on which to install the liner and construct the heap. The extent of surface preparation required is dependent on the characteristics of the liner (including whether the pad is dedicated or restackable), the nature of the overliner material, and the weight of ore which will be placed on the heap. The surface can then be treated with a biocide to eliminate plant growth which could adversely affect liner performance.

2) Liners

i. Design: In most cases, an overliner or drainage blanket must be place on top of the liner of a dedicated pad in order to protect it from punctures and to promote flow of pregnant solution to the collection ditch. Specific design elements are dependent on the conditions existing at the site. The topography of the available leach site generally determines the pad design. In relatively flat areas, pads can be designed to drain to a single collection ditch external to the heap. In such cases, internal berms can be constructed to segment the pad so that solution flows to the ditch as directly as possible. Perforated piping can also be installed within the drainage blanket to further promote flow to the collection ditches.

In mountainous or rolling terrain, valley-fill or modified valley-fill pads can be constructed. Valley-fill pads take advantage of existing topography; rather than constructing the pad as a "tabletop" sloped to one corner, the pad follows the contours of the natural ground surface and the pregnant solution is collected in internal ditches which are built in the natural drainages. The lay of the land and the existing natural gradients can eliminate the need for internal berms and piping. The valley-fill design also uses the pad as the pregnant pond. The downgradient end of the pad is constructed against a berm which functions as a dam. The pregnant solution is collected and stored within the heap, and is either extracted by a pipe through the liner and berm, or is pumped out along the upstream face of the berm. In this design, that portion of the pad which functions as an impoundment must be constructed with the same technology as a pond (See Section IV.E.). The valley-fill design is only feasible where the ore will not degrade the cyanide holding the gold or otherwise "rob" the pregnant solution. In the modified valley-fill design, the pad is similarly constructed, but the pregnant solution is stored in an external pond.

ii. Materials: Pad liners may be constructed from natural or synthetic materials. The type and thickness of a liner should be determined to maximize liner integrity based on consideration of the loading weight of the heap, the puncture properties of the subgrade and the resistance of the liner to chemical and ultraviolet degradation. For restackable pads, the liner must be constructed to withstand the stress of repeated vehicle traffic as the pad is loaded and unloaded. These types of pads are commonly constructed in layers using asphalt and rubberized membranes, and may be 6 inches or more in thickness.

The angularity of the material used as overliner, and the manner in which the pad will be loaded are also factors in determining the liner to be used. The overliner material must be sufficiently permeable to readily transport the pregnant solution with minimal head build-up, and must also be subangular to rounded so as not to risk puncturing the liner during loading of the pad. In some cases, run of mine or crushed and screened ore can provide a suitable drainage blanket.

iii. Quality Control and Quality Assurance: The effectiveness of any liner system can be increased by a program of quality control and quality assurance so that the liner functions as it was designed. Specifications and procedures for parameters such as the density testing of soil liners, and such activities as seaming of synthetic liners, should be determined, and a program should be established to monitor and document these activities and parameters during construction.

3) Operations of Restackable Pads: The operation of restackable pads involves a special BADCT consideration because spent leach ore is removed from these pads and disposed of prior to closure. Depending on the potential of the spoils to release residual cyanide, and their method of disposal, the spoils may require rinsing before they can be removed from the pad. In cases where the spoils will be placed within a lined facility such as a tailings pond, no rinsing or further pollutant removal is needed. However, in cases where the spent ore is to be disposed of on unlined ground, it will be necessary to rinse or otherwise detoxify the waste in a manner similar to that described below for closure of dedicated pads.

4) Leak Detection and Collection: Leak detection and collection systems for precious metals heap leach pads have only been demonstrated for dedicated pads. These systems generally focus on those areas of the pad upon which a significant hydraulic head is exerted. Since most pads are designed to promote the rapid flow of pregnant solution to the collection ditches, leak detection and collection systems are normally limited to these portions of the facility. The most sophisticated designs have been used on modified valley-fill pads where the internal collection ditches can neither be visually inspected nor easily repaired. These designs employ a second synthetic membrane beneath the primary liner under the solution collection ditches. Placed between these two liners is a drainage layer of sand or some other pervious material, and corrugated perforated piping is placed within the drainage layer. The system is arranged so that the operator is able to sample any solution found and to quantify the amount of flow prior to routing the solution back to the circuit.

Less elaborate systems may be appropriate in cases where the collection ditches are external to the pad and allow for visual inspection and repair. Perforated piping can be installed beneath the ditch's primary liner and the compacted subgrade, and routed so that sampling and quantification of any flow is possible prior to routing the solution back to the circuit.

5) Surface Water Control: Control of surface water run-on is generally applicable to both new and existing precious metals heap leach operations. Design considerations are influenced by precipitation (intensity, duration, distribution), water shed characteristics (size, shape, topography, geology, vegetation), runoff (peak rate, volume, time distribution), and the degree of protection

warranted. Berms or ditches should be constructed capable of protecting a leach pad from the 100-year, 24-hour storm event.

c. Design, Construction and Operation of Solution Ponds and Ditches

The technologies presented in this section are generally appropriate for new facilities. However, it may be feasible at some existing sites to employ some of these controls depending on the amount of discharge reduction which could be achieved.

1) Liners

i. Design: A system consisting of two liners and a leak detection and collection system is normally considered to represent BADCT for precious metals pregnant and barren solution ponds. The pond must be of sufficient size to contain the operating volume of solution and the run-on and direct precipitation resulting from the 100-year, 24-hour storm event. For pregnant solution ponds, the area where the collection ditch enters the pond may be subject to extra stress, and energy dissipation measures or reinforcement may be necessary.

ii. Materials: Both liners used for these ponds are normally constructed of synthetic materials. Where site conditions allow, it may be possible to substitute a liner of natural materials for the secondary synthetic liner. The primary liner must be selected to be resistant to ultraviolet light.

iii. Quality Control and Quality Assurance: Quality control and quality assurance considerations for ponds and ditch liners are the same as for pad liners, but are more critical because hydraulic head is exerted on these components at all times.

2) Leak Detection and Collection: New ponds should be designed with leak detection and collection systems. These systems normally consist of a pervious layer installed between the liners, with any seepage collected in a manner which allows sampling and quantification of the flow. The drainage layer may consist of sand, fine gravel, geonet or other similar material. The system should be designed to maximize the volume of leakage which can be withdrawn so that hydraulic head is not transferred to the secondary liner.

3) Surface Water Controls: Ponds and ditches should be protected by berms, dikes or other diversion features capable of withstanding the 100-year, 24-hour storm event.

d. Closure of Precious Metals Leach Pads, Ponds and Ditches

In addition to protecting groundwater quality, the objective in closure of cyanide facilities should incorporate protection of the public from future exposure to this toxic substance. The following closure technologies are applicable to both new and existing precious metals leach pads, ponds and ditches.

1) Leach Pads: Upon closure of a dedicated leach pad, the spent ore must be left in a condition which will not result in a discharge with the potential to cause an exceedance of aquifer quality standards. In many cases, the potential for impacts to groundwater may be mitigated by the intact liner beneath the heap.

   The environment in which the heap is located, and the nature of the waste must also be assessed to determine approprate closure measures. The potential of a closed heap to discharge fluid depends in part on the amount and distribution of precipitation and evaporation, the proximity and pathways to surface waters, the depth to groundwater, and the nature of the subsurface lithology. The moisture retaining capacity of the spoils themselves may be factored in to assess the potential for any seepage from the closed heap.

   If a potential for seepage exists, the chemical nature of the potential seepage becomes an item of concern. Residual cyanide concentrations within the heap are normally reduced by rinsing with water or rinsing with water followed by a hypochlorite solution. In this manner, most facilities are able to achieve free cyanide concentrations below 0.2 mg/l in the rinsate.

   As noted above, rinsing prior to unloading the pad is important for restackable pads, particularly when their disposal will be in an unlined facility. It should also be noted that the process of unloading the pad will result in further degradation of cyanide. Physical agitation of the material will break down some of the more weakly held cyanide complexes, and the exposure of the waste to the air and its contained carbon dioxide will reduce pH and result in volatilization of hydrogen cyanide. Prior to land surface disposal, representative samples of the material must first be analyzed to confirm that soil cleanup levels specifed by ADEQ are met.

   Where sediment loading to surface water and subsequent impacts on groundwater are of concern, recontouring of the heap or construction and maintenance of berms may be necessary to limit erosion.

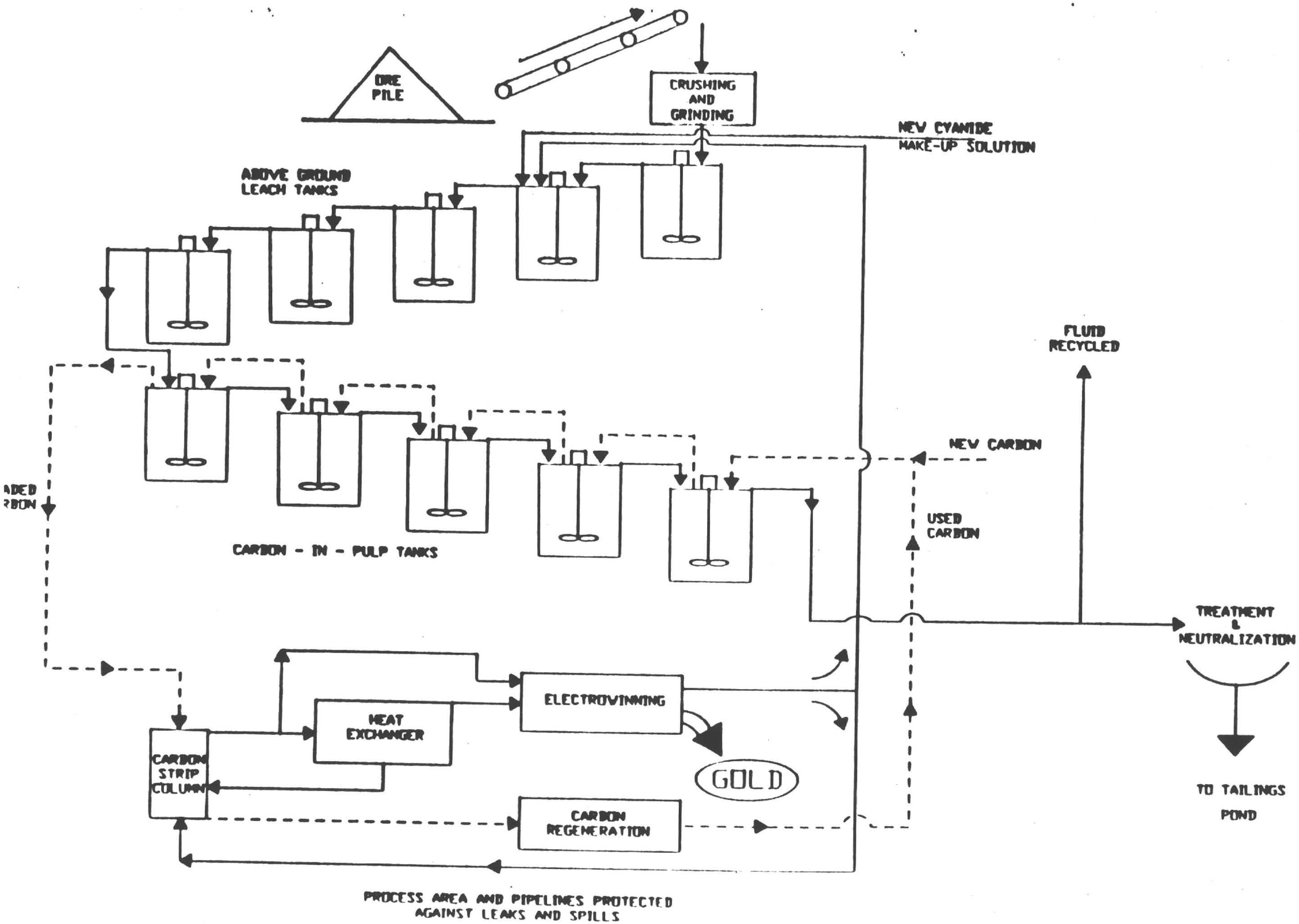
2) Ponds and Ditches: Solutions remaining in ponds after cessation of operations and rinsing of the heap can be allowed to evaporate. Pond liners may then be folded over

upon themselves, thereby encapsulating any solids which are left after evaporation of the solutions. The pond can then be backfilled to avoid future ponding and reduce the potential for any leaching from the liner or the solids. Ditches may be closed in a similar manner. Alternately, liners may be removed and disposed of in accordance with applicable solid waste regulations.

4. Precious Metals Vat Leaching

In the vat leaching process, after crushing and grinding, the finely pulverized ore enters a closed circuit system of cyanide leaching and carbon in pulp (CIP) absorption (Figure 5). The spent ore is carried via pipeline to a tailings disposal area. The optimum technology involves reuse of cyanide in the system, including the use of leachate collection systems in the tailings disposal area with recirculation back to the processing circuit. If the contaminant concentrations and water volume is reduced before the tailings are sent to the tailings disposal area, the potential for affecting groundwater quality will be reduced even further.

Many of the other features associated with vat leaching have been discussed earlier under the Chemical Storage, Processing Areas, Pipelines, and General Closure Considerations sections of this document. (Sections IV.D.8. and 9.).


ORE PILE
CRUSHING AND GRINDING
NEW CYANIDE MAKE-UP SOLUTION
ABOVE GROUND LEACH TANKS
FLUID RECYCLED
NEW CARBON
USED CARBON
CARBON - IN - PULP TANKS
TREATMENT & NEUTRALIZATION
ELECTROWINNING
HEAT EXCHANGER
CARBON STRIP COLUMN
GOLD
CARBON REGENERATION
TO TAILINGS POND
PROCESS AREA AND PIPELINES PROTECTED AGAINST LEAKS AND SPILLS

5. Precious Metals Tailings Impoundments

a. Facility Description

Tailings ponds are used for the disposal of waste material from precious metals vat leaching facilities. After crushing and grinding, the finely pulverized ore enters a closed circuit system of tanks where cyanide added to the slurry leaches the gold from the ore. Several different variations of the process are in practice, but the features common to all are the use of activated carbon to remove the gold from the cyanide solution, and the disposal of thickened tailings slurry carrying residual cyanide.

The disposal of cyanide bearing tailings are subject to the application of BADCT. The key elements which must be addressed include depositional practices, tailings dam and impoundment design and construction, reuse of tailings water and surface water control.

b. Design, Construction and Operation of Tailings Ponds

The following technologies are applicable to both new and existing precious metals tailings disposal facilities within the constraints of A.R.S. 49-243.B.1., with the exception of dam and impoundment design, which are applicable to new facilities only.

1) Depositional Practices

Depositional practices in the precious metals segment of the mining industry are generally equivalent to those listed in Section E.2.b.2) for the copper segment. However two significant differences exist. First, the technique of thin layer depostion described below is a demonstrated technology for precious metals tailings disposal. Second, since precious metals tailings ponds are generally much smaller in size than copper tailings ponds, they are normally constructed with a higher degree of engineered containment in terms of the impoundment lining and solution reclaim systems. This fact lessens the relative importance of depositional practices as they affect overall seepage reduction in precious metals compared to copper tailings disposal.

The technique of thin layer deposition is applicable to new precious metals tailings disposal facilities. Also known as subareal deposition, the method involves a deposition scheme whereby a series of spigots is used to discharge a thin layer of tailings in one area of the impoundment, and the discharge is then moved to a new area as the previous area is allowed to dry. This rapid drying, due both to the draining of the tailings to the ponded area as well as the enhanced evaporation resulting from the thin layering, can result in an unsaturated mass of tailings which reduces the potential for seepage. The technique requires large areas in order to effectively rotate the deposition of tailings, and also involves trade-offs in terms of water conservation and potential air quality impacts. Depending on the evaporation rate and the moisture holding capacity of the tailings, this procedure may result in a loss in the amount of water available for reuse in the mill, thereby increasing the facility's total water consumption. These same factors, as well as the tendency of the tailings to form a crust, are important in considering the potential for the tailings to generate excessive amounts of fugitive dust. Additionally, this deposition method is maintenance intensive and requires that tailings slurries be kept at a high solids content.

2) Tailings Dam Design

Tailings dam design considerations for BADCT are applicable only to new facilities. For dam design and construction, the focus of BADCT is to prevent dam failures which could result in a surface discharge with the potential to adversely affect groundwater quality. Dam embankment stability must be insured through an analysis of the proposed lifetime of the facility and the storage volume needed, dam height, slopes required, construction methods, strength of construction materials, and the potential for earthquakes. Dam height must be sufficient to maintain adequate freeboard to allow for the retention of water in the tailings pond and run-on and direct precipitation resulting from the 10-year, 24-hour storm event.

The specific design of a tailings dam must integrate a variety of factors, including the topography of the site, the availability and cost of materials, and the required storage capacity of the impoundment. There is no "optimal" design which is superior to all other designs in all cases.

3) Tailings Impoundment Design

A variety of designs exist for tailings impoundments in the precious metals segment. The design must take into account the complete tailings disposal system, as the dam, liner, reclaim and seepage collection components are all interdependent. The selection of a particular design is also dependent on the depth to groundwater and the nature of the geologic material beneath the impoundment.

The key design feature of any precious metals tailings impoundment is a system which minimizes seepage by a combination of a relatively impermeable liner and a solution recycling or seepage collection system. Both natural and synthetic liners have been demonstrated in this application. Natural liners may consist of the native foundation materials which are scarified and recompacted to achieve a specified permeability, or they may be constructed of imported clays and silts. A combination of these two techniques may also be used. Synthetic liners of high and low density polyethylene have also been used. The selection of a liner material is based on economics, materials availability, compatability with the waste, hydraulic conductivity in conjuction with expected hydraulic head at the base of the tailings, and engineering considerations. Natural materials may be selected for their capability to attenuate cyanide concentrations while the objective of synthetic lining is to contain leachate for collection.

Most tailings ponds are designed with some sort of drainage system on the floor of the impoundment. This may consist of a series of finger drains cut into a liner of natural material which act to direct solution to a toe drain along the upstream toe of the dam. The finger drains are filled with coarse rock to allow solution flow, and may be covered or encapsulated in filter fabric to exclude fine material from blocking off the drain. The toe drain directs solution to a pipe which penetrates the dam and carries the collected solution to a lined pond from which the water can be recycled to the milling circuit. As an alternate to piping through the dam, solution collected in the toe drain can be pumped out along the upstream face of the dam.

Where a more elaborate drainage system may be required, such as with tailings having a high water content, a full blanket drain can be installed over a natural or synthetic liner. A fabric filter cover may be needed to keep fine tailings from entering the blanket drain. Perforated piping within the rock drain can enhance its capacity to transmit solution. These pipes are connected to a toe drain and routed either through the dam to a lined solution collection and recycle pond or pumped up the face of the dam.

While the above impoundment designs are comprised of solution reclaim systems above the liner, it may sometimes be necessary to install a collection system beneath the liner. Such systems are normally limited to directly below the solution pond or area of saturated tailings, as these areas present the greatest potential for seepage due to their hydraulic head. In these cases, the primary liner can be either natural or synthetic, while the secondary liner is normally made from reworked in-place materials. Piping installed within the drainage blanket between the liners is connected to a collector pipe along the upstream toe of the dam and the solution is either piped through the dam to a lined reclaim pond or pumped up the dam face.

The systems described above should be considered to be solution recycling systems. They are installed for the purpose of collecting and recycling process solution both for water conservation and to limit hydraulic head on the liner. Therefore, the presence of solution in these systems is to be expected.

4) Reuse of Tailings Water

Reuse of tailings water reduces the hydraulic head exerted on the liner, thereby limiting the amount of seepage potentially reaching an aquifer. Recycling of this solution is normally achieved in two ways. First, water is routed directly from the tailings pond back to the circuit by use of barge mounted pumps or syphons. However, these systems can only remove the supernatent liquid from the ponded area. Therefore, the reclaim systems described above are necessary to collect solution which has percolated through the tailing to the interface with the liner. This solution can then be directed through or over the tailings dam to a lined pond from which it can be returned to the milling circuit.

The reclaim ponds used to collect water from under-drain and over-liner systems should be of a similar design and construction as that considered BADCT for solution ponds in the precious metals leaching segment, described in Section 3.c.

5) Surface Water Controls

Since the potential for seepage is directly related to the hydraulic head exerted on the liner, BADCT for precious metals tailings ponds involves the minimization of the volume of solution stored in the impoundment. It is therefore generally advisable to control surface drainage to limit the inflow of water resulting from precipitation on the surrounding terrain by use of trenches, dikes and/or berms. However, when determining the applicability of these controls at any given site, consideration must be given to the over-all design of the impoundment and its liner and collection system, and the need to conserve groundwater, as well as engineering considerations.

c. Closure of Precious Metals Tailings Impoundments

The closure of both new and existing precious metals tailings ponds involves the same technologies as listed under Section 2.g. for copper tailings impoundments. Reclaim ponds should be closed in a manner similar to that described in Section 3.d.2).

6. Smelting, Electrolytic Processing and Refining

Base metal smelting, electrolytic processing and refining is a sequence of processes that takes ore concentrate or metal bearing solutions and produce the final pure metallic product. BADCT design should be incorporated in those portions of the process involving industrial chemical storage, waste discharge, waste storage and disposal, or wastewater treament. Chemicals or waste products that require discharge control include slag, acid plant waste or byproduct, primary electrolyte component chemicals, electrolytic slimes, spent electrolyte, and water used for cooling, washdown, or blowdown.

a. Slag

Base metal slag generated from the smelting process can be disposed of by carrying it to the slag dump or by granulating, mixing with water, and sluicing to a tailings disposal area. Some operations use granulated slag as road construction material. If disposed of on-site, slag waste should be characterized by testing for leachable metalic pollutants, and if a potential for groundwater contamination exists, an appropriate liner system may be required. In the granulation method of disposal, water reuse is considered an optimal technology.

b. Acid Plant

The primary waste or byproduct from acid plants is sulfuric acid. Acid is typically stored on-site and later reused, sold, or disposed of. Acid storage facilities should apply BADCT considerations discussed in the chemical storage section of this document (Section IV.D.6.). Recycling or sale are preferrable discharge control options since they achieve zero discharge.

If disposal is the chosen option, then waste must be treated to neutralize pH and to reduce pollutants such as metals and sulfate. Simple lime addition does not necessarily reduce arsenic, cadmium, lead, mercury, selenium, tellurium, and sulfate to acceptable levels (EPA, 1975). Chemical precipitation, reverse osmosis, ion exchange, or evaporation in a pond design in accordance with BADCT should be employed to eliminate the discharge of pollutants to the groundwater. The specific method employed must be tailored to the waste characteristics. Concentrations in the water discharged to unlined impoundments or surface waters must be below the state action limits. Precipitated and settled solids must be removed to an approved disposal facility on- or off-site.

c. Electrolytic Refining and Electrowinning

Acid solutions used in the electrolytic process should be stored and handled in a manner consistent with the chemical storage BADCT considerations (Section IV.D.6.).

section of this document. Once excess water is evaporated, sludge should be removed to an approved waste disposal facility on or off-site.

Spent electrolyte from the refining cells should be reused or treated and recycled. A less optimal technology would be to dry this waste and dispose of the solid residue in an approved disposal facility.

In base metal leaching operations, spent electrolyte may be used to produce cement copper. Cementation basins should be designed to control discharge in a manner consistent with liner configurations discussed in Section IV.D.1. Electrolyte from the cementation basins should be recycled to the leaching circuit.

d. Water

Water is used in the smelting/refining process for acid plant blowdown, contact cooling, refined product washdown, and washdown of working areas. In all cases where water is used, BADCT shall consist of reuse or treatment and recycling of the water back into the operation. The appropriate treatment to meet the intended industrial reuse application should be applied where treatment is required. Thus, BADCT for the disposition of process water involves no discharge through reuse or recycling. An alternative, less-than-optimal method to dispose of water used in the smelting/refining process is to treat with lime and settling and to collect the water in an evaporation pond designed in accordance with BADCT. Sludges should be removed to an approved on- or off-site disposal facility.

7. Uranium Mining and Concentrating

a. Uranium Mines

Uranium mines should be operated so that there is zero discharge of pollutants to groundwater. The key to achieving this performance at most sites is four fold, including:

- Proper dewatering and sealing of mine shafts, adits, and pits.
- Containment by liners and leachate collection systems for leachate from ore and gangue storage piles and for pumped mine water.
- Surface water diversions.
- Closure considerations.

Pollutants of concern are not restricted to Uranium and the decay products of Uranium, but may also include vanadium, silver, barium, and base metals. Uranium is of particular concern because of its ready solubility under oxidizing conditions and over a wide range of pH.

1) Dewatering

Many of the uranium mines in Arizona are underground with shafts and adits that may transect partially saturated formations or even aquifers. Section IV.D.7. discusses BADCT design considerations for sealing and dewatering. Water should be collected within the mine in lined sumps and pumped to the surface for disposal in a lined impoundment.

2) Containment

All water that contacts metal bearing materials and pumped mine water should be contained at the surface in lined impoundments.

Piles of ore and waste should be stored on a base or "pad" composed of natural materials of a type and thickness necessary to reduce infiltration potential and precipitate out Uranium from leachate thereby restricting the flow of uranium bearing fluid to the subsurface. The pad should be sloped to carry any rainwater falling on the pad toward the lined impoundment.

3) Surface Water Diversion

All surface waters should be prevented from entering mine workings or from flowing onto ore and waste piles, in keeping with the BADCT considerations outlined in Section IV.D.3.

4) Closure

For most of the Uranium mines operating or under consideration in Arizona, it is practical to return all uranium bearing waste rock material to the mine upon closure. Barren rock containing leachable pollutants may also need to be returned to the mine upon closure. If sealing has been completed properly during closure, this backfilling technique should essentially achieve zero discharge. The pad beneath the ore and waste rock storage piles should be excavated and removed for processing as ore or returned to the mine if it is below ore grade. Removal of all mine materials from the surface upon closure ensures that environmental effects other than groundwater concerns will also be kept to a minimum.

b. Ore Concentrating Facilities

For facilities that include ore concentrating and tailings disposal at the surface, including any facilities that produce Uranium concentrate as a byproduct in conjunction with base metal concentration, all BADCT considerations outlined in Section IV.D. and Section IV.E.2. should be followed with the objective of achieving zero discharge. Wastewater discharged as a result of the ion exchange process is of particular concern in Uranium concentration facilities. Wastewater discharged as raffinate and from flushing of the columns must be contained in a lined impoundment consistent with the hierarchy in Table VII. As with base metal leaching operations, the presence or absence of organic pollutants in the wastewater or tailings, as referenced in A.R.S. 49-243.D. will determine the type of liners and leachate collection systems required for containment.

8. Industrial Minerals

BADCT design for industrial minerals will be developed on a facility-by-facility basis due to the widely varying character of such operations. Although specific guidance is not offered here, many of the BADCT considerations outlined in the general sections of this document can be applied to analogous design elements for discharge control at industrial mineral extraction operations.

Sand and gravel mining facilities may be operated under general permit for discharge of wash water, under conditions specified in the Aquifer Protection Permit Rules. Facilities varying from the conditions of the general permit must obtain an individual permit and must propose a BADCT design in the application process.

9. Placer Mining

Placer mining facilities may be operated under a general permit for wash water discharge, specified in the Aquifer Protection Permit Rules. Facilities varying from the conditions of the general permit must obtain an individual permit and propose a BADCT design in the application process.

If a placer recovery facility involves chemical separation or extraction of metals from concentrates on-site, an individual Aquifer Protection Permit for this part of the facility may be required. Sections of this document that may apply to chemical separation or extraction are General Closure Considerations; Chemical Storage; Processing Areas; and Precious Metal Leaching Facilities (Section IV.D.8., 9.a., and 9.b. and Section IV.F.).

10. In-Situ Leaching

In-situ leaching is a relatively new and innovative concept in mineral extraction, and, as such, does not lend itself to development of a well defined BADCT at this time. In-situ leach operations are those in which mineralized rock is left in place, sometimes fractured or altered to increase porosity and permeability, and subjected to infiltration of solutions to dissolve metals for recovery. The in-situ extraction process often involves a purposeful discharge of pollutants to groundwater and recovery of contaminated fluids. The ore zone targeted for leaching may be located above or within the aquifer used for recovery of metal-bearing solution. In some cases, injection is used to extract metals from an ore zone beneath another aquifer. In such a setting, pollutant discharge may also result from the migration of contaminants from one aquifer to another.

Controlling vertical migration of injected leach fluids within and between aquifers is an important consideration and should be incorporated into a BADCT design. To help reduce the potential for vertical migration, the following items should be considered in the system design:

a. Abandonment of old exploration holes, or wells completed in several aquifers. If left unplugged these wells could serve as conduits for pollutant migration to adjacent aquifers.

b. Proper grout sealing of injection and recovery wells used in project operation.

c. Controlling recovery volumes so that they exceed injection volumes and act to contain injected fluids within a restricted area of the aquifer.

d. Predictive groundwater modelling in conjunction with pilot testing should be used to determine well placement and injection and recovery rates.

Since the objective of the leach process is the enhanced discharge of metals such as Copper, Lead, Zinc, Silver, Gold, and possibly other heavy metals, these constituents that are meant for economic recovery will not be subject to BADCT considerations. However, BADCT for the leaching process should incorporate technologies and operating methods designed to limit the discharge of all other pollutants by controlling the chemistry of the leaching solution.

Surface facilities for processing recovered fluids at an in-situ leaching operation should meet BADCT limitations as outlined in this document for other metal leaching and processing facilities. Additionally, in-situ leach operations, like all other discharging facilities, must meet the point of compliance requirements for an Aquifer Protection Permit, as discussed in the General Guidance Document for Aquifer Protection Permits. In most circumstances, in-situ leach operations will have to maintain groundwater elevations and flow directions by pumping to meet Aquifer Water Quality Standards at the appropriate points of compliance around the facility.

In block-cave leach operations, care should be taken to design and operate the systems to minimize the amount of leach solutions that by-pass the recovery zones. Because the leaching is done in disturbed, highly fractured ore above the water table, controlling the path and subsequent recovery of leach solutions may be much more diffcult than in underground injection leaching.

Upon closure, special consideration should be given to aquifer restoration. The zone affected by leach solutions should be flushed with water or other neutralizing solutions. Metals and other pollutants mobilized by the injection and recirculation of water and lixiviant should be reduced to their ambient concentrations upon closure.

Further guidance will be developed as more information is gathered about in-situ methods and the environmental affects. The U.S. Bureau of Mines, Twin Cities Research Center in Minneapolis, Minnesota, is conducting research in this area through a pilot project in the State of Arizona. A Draft Generic Design Mannual for in-situ operations has been developed by them, and is currently available.

G. Other Alternatives

Many alternatives are available for the handling of wastes from mineral extraction and processing. These alternative methods may or may not be technically or economically feasible for specific situations. There may also be significant environmental impacts that preclude the use of alternatives. The Environmental Quality Act (ARS 49-243 B.1) requires that alternatives be considered along with BADCT.

Applicants should submit, with their proposed BADCT facility design, feasibility studies showing that they have evaluated the following alternatives, if applicable:

- Recycling of fluids
- Reclaiming waste material (raffinate, spent electrolyte, etc.)
- Reclaim metals from tailings leachate
- Selling byproducts rather than disposal as waste
- Alternative extraction or concentrating processes, ie. vat leach vs. heap leach vs. in-situ leach, or precipitation vs. solvent extraction
- Underground mining vs. open pit
- Using slag or other solid waste as road or building material
- Backfilling mine workings with tailings material and waste rock

This constitutes a partial list of the many alternatives that may be available. If one or a combination of these alternatives are feasible, they should be incorporated into the proposed BADCT facility plan. If they are judged to be infeasible, the reasoning behind this judgement should be discussed in the application.

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V. SITE CHARACTERISTICS AND OTHER CONSIDERATIONS

A. Site Specific Hydrogeologic Characteristics

In order to obtain an Aquifer Protection Permit, an applicant must make two demonstrations (A.R.S. 49-243 B.):

1. That the best available demonstrated control technology (BADCT), processes, operating methods, or other alternatives are applied to the discharge; and

2. That pollutants discharged will not cause or contribute to a violation of Aquifer Water Quality Standards at the applicable point of compliance, or if standards are already violated that no further degradation will occur.

Site characteristics are a part of BADCT only to the extent that they control the quality and/or quantity of discharge before it reaches groundwater.

In evaluating BADCT for a given site, the permit applicant may consider site specific hydrologic and geologic characteristics which may contribute to reduction in the amount of discharge or may reduce contaminant levels in the discharge. If site characteristics are to be used as part of BADCT for a facility, the applicant must provide specific data regarding those characteristics and must demonstrate the degree of discharge reduction that will be accomplished.

The site specific characteristics which may be considered as part of the BADCT determination along with data requirements are discussed below. This discussion is not intended to cover all site aspects of a permit application, but only those relative to BADCT determination. Additional site specific characteristics will be needed in a permit application to determine point of compliance and compliance with standards at that point. These aspects of a permit application are discussed in the Aquifer Protection Permit Guidance Document.

Site specific characteristics for the determination of BADCT include: (1) soil properties, (2) vadose zone properties in conjunction with vadose zone thickness, (3) surface water, and (4) climate. A discussion of each characteristic follows:

1. Soil Properties

Soil is the upper portion of the vadose zone characterized by: relatively high organic content, biologic activity by roots and microorganisms, and concentration of weathering products left by leaching, evaporation, or transportation.

Soils may reduce discharge by limiting infiltration due to low permeability, by physically removing pollutants through filtration, by chemically removing pollutants through precipitation, adsorption, ion exchange or other chemical reactions, or by biodegradation due to microbial interaction with the pollutant.

Soil properties which indicate a soil's potential to reduce discharge include: soil type, distribution, and thickness at the site, soil structure, grain-size distribution, organic carbon content, chemical composition, mineralogy and permeability. The applicant should evaluate any changes to soil characteristics that may result from interaction with the discharge.

Data which may be presented to support soil properties as a factor in BADCT determination includes:

a. Soil boring logs with location map.

b. Batch or column tests showing quality of discharge after reaction with soil material.

c. Infiltration tests.

d. Permeability tests.

e. Chemical analyses (pH, EC, inorganic analyses, organic analyses).

f. Material property tests (grain size analyses, moisture content, bulk density, Atterburg Limits).

g. Maps of soil distribution and depth.

h. Biodegradation studies.

i. Other pertinent soil information including reference to published research data regarding pollutant attenuation.

2. Vadose Zone Properties and Depth to Groundwater

Properties of the vadose zone, the unsaturated zone between the soil surface and the saturated zone, may reduce discharge in a number of ways. The presence of impervious layers within the zone may retard the movement of the discharge to the water table; fine grained layers within the zone may physically remove some types of pollutants; chemical reactions between the discharge and materials in the zone may remove some pollutants; or biodegradation due to microbial interaction with the pollutant may degrade the pollutant.

If the vadose zone consists of layers or lenses of different materials, such as stratified soil horizons or rock units, the properties of each unit considered for BADCT evaluation must be considered separately in addition to describing the general properties of the vadose zone. The lateral and vertical extent of the geologic units and the type of contacts between the units should be identified (i.e. gradational, fault, unconformity, facies change).

Data which may be submitted to support the vadose zone or any unit of the vadose zone for consideration in determining BADCT include:

a. Borings and/or well logs describing, where applicable, rock-type, grain-size distribution, degree of sorting, type and degree of cementation and thickness of unit.

b. Description of structure including any faults, fractures, joints, folds, or bedding orientation.

c. Geologic maps and cross-sections which identify significant strata/formations, structural features, strategraphic contacts.

d. Geophysical well logs.

e. Surface geophysical surveys.

f. Lateral and vertical permeability and porosity measurements.

g. Chemical analyses (pH, Ece, inorganic and/or organic analyses).

h. Results of batch or column tests showing quality of discharge after reacting with vadose zone material.

i. Material property tests (grain size analyses, moisture content, Atterburg limits, bulk density).

j. Analyses of fluid movement and/or chemical transport through the zone e.g., lysimeter or neutron log measurements.

The thickness of the vadose zone or depth to groundwater may be a factor in determining whether or not a discharge will reach groundwater. Thickness also may control the amount of pollutant removal that will occur prior to a discharge reaching groundwater. Long residence time in the vadose zone, in many cases, produces greater potential for pollutant removal. However, a large depth to groundwater alone is not sufficient to assure protection of the groundwater quality. The degree of protection provided by depth will depend on several variables including: depth, the volume and rate of discharge, the properties of the pollutants in the discharge, the properties of the vadose zone (discussed above), and the length of time a discharge may continue. Any considerations of depth to water as a part of BADCT will have to show how the hydrologic and geochemical character of the vadose zone in conjunction with its thickness will act to control discharge.

Data for evaluating the effectiveness of depth to water include:

a. Static water elevation measurements (date of measurement, location of well, location of measuring point).

b. Well hydrographs to document long term and seasonal trends.

c. Location of pumping wells in vicinity of measured well.

d. Well construction data (total depth and location of perforations).

e. Geophysical surveys such as seismic and resistivity.

3. Surface Water

Surface water mixing with a facility discharge represents an increased potential for the discharge to reach groundwater. Therefore, documentation that surface water is not likely to mix with the discharge may be of consideration in determining BADCT.

Data that may be presented to evaluate the potential for surface water mixing include:

a. Location of any perennial or ephemeral water bodies including unlined surface impoundments, ponds or ditches, irrigation canals or conduits.

b. Flow characteristics, volumes, and rates.

c. Location of 100 year flood plain.

d. Site topography.

4. Climate

In areas where precipitation is low and/or evaporation is high the potential for some surface discharges to impact groundwater is reduced. For many solid waste disposal facilities, the relationship between precipitation and evaporation rates will determine the potential for leachate generation.

Data that may be presented to support that the climate at a site should be considered in the BADCT determination include:

a. Precipitation values (monthly mean and annual mean);

b. Evaporation (monthly mean and annual mean);

c. Site modifications to divert rainfall and run off from discharge areas and prevent ponding;

d. Transpiration rates (if appropriate);

e. Water balance calculations.

B. Environmental Factors

In the process of determining BADCT for a facility, most of the water quality environmental impact factors will be addressed in the site specific hydrologic and geologic characteristics and design elements section. However, non-water quality environmental impact factors will also have to be addressed. The non-water quality environmental impact factors will be site specific and may or may not effect the determination of BADCT for a proposed facility site. Some non-water quality environmental impact factors which may need to be addressed depending on the site selected are: air quality, land usages, aesthetics, environmentally sensitive areas, endangered species, noise, etc. If the optimal design or proposed BADCT have a direct impact on any non-water quality environmental factors, an alternative BADCT may need to be developed.

C. Water Conservation

Because mining generally necessitates the use of large quantities of water, conservation plays a major role in the BADCT design. Water conservation is based on the efficient use of the available water and recycling of water used in processing. Recycling of process water should be maximized in the BADCT design. Pumped mine water should be used in operational practices wherever possible. While dust control is a primary concern, the use of water for this purpose should be kept to a minimum. Where evaporation is chosen as the method of disposal, justification must be provided that recycling or treatment and recharge are not viable options. If another method of disposal is chosen, the simple dilution of a waste stream to achieve lower discharge concentrations will not meet BADCT. Technologies which consume or alter the quality of large amounts of water will not be considered appropriate.

D. Economics

In regard to new facilities, the statute directs DEQ only to consider the economic impact of the application of BADCT on an industry-wide basis. Thus, costs of implementing BADCT at a specific facility are not relevant to the permit decision. Financial feasibility is judged by the economic impact of a particular BADCT on the typical facility representing an industry class of that facility type. DEQ considers that use of a technology at many other similar facilities nationwide indicates financial feasibility. In preparing the list of design elements for Section IV.D. and E. of this guidance document, DEQ has selected technologies that are in widespread use. Thus, DEQ considers all of these technologies to be economically feasible on an industry-wide basis.

VI. EXISTING FACILITIES

A. Introduction

In contrast to new facilities, the EQA statute provides a different approach for determining BADCT for an existing facility. A facility is considered existing, (rather than new) if it was constructed, under construction, or had binding contracts for construction prior to August 13, 1986. Major modifications to existing facilities are considered to be new facilities.

Basically, the difference in BADCT determination for an existing facility involves evaluating the technical and economic feasibility of retrofitting the facility with more effective discharge controls. To do this, an applicant must first identify their waste and the control technologies currently in use. Next, the applicant should evaluate the discharge control performance of their facility. Steps toward more advanced discharge control technology must then be considered, taking into account engineering feasibility, water conservation, non-groundwater environmental effects, amount of performance gain, and cost.

B. Assessment of Current Control Technology

As with new facilities, BADCT determination for existing facilities depends on an adequate characterization of the waste quantity and type. Please refer to Section IV.B. for discussion of this task.

The applicant should provide a description of the industrial practices and the control processes presently in use at the existing facility. The control processes can be identified according to the design elements described in Section IV.D. and E. The applicant should rank each currently utilized discharge control design element according to where they fall in the hierarchies presented in Section IV.D. Placement in the hierarchy will indicate which higher levels of control technologies are available, i.e., those having a higher position on the list.

Once the control processes are identified, the applicant should evaluate the overall discharge control performance of the facility. Where practicable, this step should involve direct measurement of discharge quantity and quality. Otherwise, the applicant may calculate expected performance based on industry standards for the engineered controls, on manufacturers' test data for components, and on site characteristics (discussed in Section V.A.) determined from field or laboratory testing.

If it can be shown that the combination of pollutant concentrations, discharge quality, discharge control technology, and site characteristics, assures that there is no reasonable probability of pollutants reaching the water table, then the application of BADCT at that site has been demonstrated. If this performance is not being achieved, the applicant must evaluate whether more effective technologies can be implemented.

C. Considering New Control Technologies

The BADCT design for an existing facility may involve instituting new technologies that rank higher on the hierarchies from Section IV.D. and E. than those in current use. The applicant should establish whether implementing a higher technology on each list of design elements is feasible from an engineering standpoint. In many situations, new controls are not feasible, such as installation of a new liner system for an existing tailings pile. In such cases, an applicant should look to other design elements to achieve increased discharge control. In cases where the change to more effective discharge controls is feasible from an engineering standpoint, the applicant should proceed to determining the complete ramifications of the new design regarding water conservation, other non-water environmental factors, performance gain in discharge control, and costs, as outlined below.

Water conservation may be a factor for deciding whether or not a change in discharge control technology is favorable and should be implemented as BADCT. The dilution of a waste stream for the sole purpose of achieving lower discharge concentrations will not meet BADCT. Technologies which consume or alter the quality of large amounts of water will not be considered appropriate.

Use of a new discharge control technology at an existing facility may have other environmental impacts that are not directly related to aquifer water quality. An example of such a technology is air stripping to remove volatile substances from water and mobilize them in the air. These environmental trade-offs must be assessed on a case-by-case basis and judgements about whether they outweigh discharge reduction are likely to be subjective, such as evaluating the impact of contaminants in the groundwater versus their impact in the air. Some of the additional environmental impacts which should be assessed are air quality, surface water impacts, noise levels, land use, aesthetics, environmentally sensitive areas, and endangered species.

D. Economic Aspects - Weighing Costs and Discharge Reduction

Economic evaluation plays an important role in determining BADCT for an existing facility. The law requires that the Department compare the cost of retrofitting the facility against the reduction in discharge that would be achieved by a particular control strategy. This section describes how the costs and benefits of a discharge control technology will be estimated. Methods for weighing costs with discharge reduction are also discussed.

Cost Estimation Method

Costs will be broken down into three separate categories: capital and development costs; operation and maintenance costs; and closure and post-closure care costs (Table VIII). Keep in mind that only the costs for installing the discharge control technology under consideration are applicable. Other costs, such as transportation, land acquisition (except as described below), local taxes, and other site specific costs that are not related to the installation or implementation of the technology should not be included in the cost estimate. While the inapplicable costs are important for economics of the particular mining activity, they should be the same, regardless.

Capital and development costs include all costs necessary to develop the facility up to the point that it becomes operational. The costs of obtaining the permit are not applicable, as these costs would be the same for any alternative for a facility. The cost for developing technical plans for plan review by the Department are applicable. Costs of land acquisition are only applicable if it can be shown that instituting a new discharge control technology requires land acquisition to achieve special site characteristics. All capital and development costs will be amortized using current market rates.

The stream of operation and maintenance (O&M) costs will be considered in terms of current dollars only, for the life of the facility. Care should be taken to include increased costs of maintenance on and replacement for depreciated equipment. Costs will be tracked in terms of industry-wide experience for O&M for a facility of similar configuration and age. Labor, energy and materials necessary for O&M will be estimated based on current market value, applied for the life of the facility.

Closure and post-closure care costs will be estimated based on what it would cost to currently close a simliar facility, plus perpetual care costs. The salvage value of the facility in current dollars must be subtracted from the closure cost. Perpetual care costs will be estimated on the same basis as O&M costs. These costs may be discounted if the permittee creates a closure/post-closure care surety bond or other similiar financial mechanism for assuring that closure and post-closure will be adequately funded. In this case, discounting will be estimated based on compounded interest, at current market rates, that may be accrued in such an account, rather than through the use of standard present-value techniques.

Discounting, using present-value techniques, is not acceptable because these methods, by definition, undervalue future costs. This overemphasizes current costs, and has a tendency to favor BADCTs with high closure, post-closure costs and low capital costs. This is not felt to be appropriate for preservation of groundwater as a renewable resource.

Table VIII

Cost Components

Capital and Development Costs

Site planning and design

Materials and equipment

Site preparation and construction

Debt retirement and management

Operation and Maintenance

Depreciation

Labor, Energy, and Materials

Facility renovation

Equipment replace

Closure and Post-Closure

Construction and closure

Remedial activities

Perpetual care and monitoring

Costs may be classified on a qualitative basis as High, Medium, or Low based on comparison with cost data for the entire industry. DEQ will consider the cost of implementing a discharge control technology on a per-unit basis above the ninetieth percentile (greater than two standard deviations above the average using normalized data) for the industry as being High. Any cost that is above the mean industry cost and below the ninetieth percentile will be considered Medium. Any cost below the mean for the industry will be considered Low. The permittee may propose an alternate analysis demonstrating that the cost for the particular BADCT is significantly above the industry average. In this event, the permittee must justify why a cost below the ninetieth percentile is significantly higher than the industry average, and why their comparative analysis is a method. The Department may choose to reject the alternate analysis if it is found to be methodologically flawed.

DEQ recognizes that there may be some difficulty in separating pollution control costs from overall costs for an industry. A good faith effort to estimate cost is acceptable. Alternative cost analyses methods to those presented here, such as methods not using current market rates or current dollars, may be presented if adequate justification is supplied.

E. Estimating Amount of Discharge Reduction for Existing Facilities

Estimation of the amount of discharge reduction achieved by instituting a new control technology is a qualitive judgement. This section outlines a means of classifying the predicted discharge reduction as either High, Medium, or Low based on the category of pollutant and current pollutant concentrations in the facility's discharge. A strategy of non-degradation of aquifer water quality is intended. Categories for classifying the amount of discharge reduction are presented in Table IX.

First, the applicant must determine the type and concentration of pollutants in the facility's discharge in it's current configuration. The discharge pollutant type and concentration place the facility in one of three categories: 1) Carcinogens and acute organic hazardous substances with concentrations above standards; 2) Other pollutants with concentrations above standards; 3) All pollutants with concentrations below standards. The applicant should next, quantify the expected discharge concentrations achievable through new discharge control technologies. The concentrations can be projected using industry standards, manufacturers test data for components, and site characteristics determined from field or laboratory tests. The projected new discharge concentrations allow the discharge reduction to be classified as High, Medium, or Low with the appropriate category on Table IX.

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Table IX

Categories for Evaluating the Amount of Discharge Reduction

Note: Your facility with its current operational scheme will fall into either category A, B, or C. Under these categories, find the reduction you expect to achieve by instituting a new discharge control technology being considered for BADCT. The classification as High, Medium, or Low can be used in the decision matrix with cost factors in Table X.

A. For known or suspected carcinogens and acute organic hazardous substances listed, in A.R.S. 49-243.D. where current discharge exceeds MCLs or Action Levels:

High - Reduction to same order of magnitude as MCL or Action Level or to below MCL or Action Level

Medium - Any other reduction

Low - No change in discharge concentrations

B. For all other pollutants where current discharge is above MCL's or Action Levels:

High - Reduction to below MCL or Action Level

Medium - Reduction to same order of magnitude as MCL or Action Level

Low - Any other reduction

C. For all other pollutant levels:

High - Reduction to ambient groundwater quality

Medium - Reduction by one order of magnitude

Low - Any other reduction

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F. Comparing Cost to Discharge Reduction

Table X shows a decision matrix identifying how to evaluate the cost and discharge reduction factors when considering a new design for BADCT. Scenarios involving Low Costs and Medium to High Discharge Reductions or Medium Costs with High Discharge Reduction should be proposed as BADCT. Scenarios involving High or Medium Cost and Low Discharge Reduction should not be required at existing facilities and their current configuration will be considered BADCT. Implementing other combinations such as High Cost with Medium Discharge Reduction or Medium Cost with Medium Discharge Reduction should be negotiated between DEQ and the applicant.

Table X

Decision Matrix for

Discharge Reduction vs. Cost

		Discharge		
		High	Medium	Low
C				
O	High	Negotiate	Negotiate	Design is Not BADCT
S	Medium	Propose Design as BADCT	Negotiate	Design is Not BADCT
T	Low	Propose Design as BADCT	Propose Design as BADCT	Negotiate

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VIII. FREQUENTLY ASKED QUESTIONS ABOUT BADCT

1. <u>What are the constituents referenced in A.R.S. 49-243.D.?</u>

   These are organic substances from the following lists:

   1) 42 U.S. Code Subsection 241(b)(4) - known carcinogens or reasonably anticipated to be carcinogens.

   2) 40 CFR, Subsection 261.33(e).

   3) Additional organic toxic pollutants listed by the Director by rule in the future.

   ADEQ is in the process of compiling one common list of the compounds from 1) and 2) above.

2. <u>Are cyanide - metal compounds in 243.D. constituents?</u>

   No.

3. <u>After closure of a disposal site, and following that period of time during which monitoring of groundwater must be performed, will there be any additional required monitoring following that post-closure period as found in the operation permit?</u>

   No. Monitoring falls under the point of compliance portion of an Aquifer Protection Permit and has little to do with BADCT requirements.

4. <u>As new groundwater quality standards arise, will any portion of the permits be amended?</u>

   Once issued, an Aquifer Protection Permit, will only be amended if it comes up for review. In general, existing permits are a low priority for permit review by DEQ. However, if there is a change in the analytical standards or contamination problem or other permit violation at a facility, DEQ will examine that facility's permit and recommend amendments.

5. <u>If there is no evidence of groundwater contamination at a given site, and compliance with BADCT was achieved in the past, is it required that a facility meet an amended BADCT?</u>

   An existing facility with no evidence of groundwater contamination may be considered BADCT. BADCT criteria changes would apply only to long term projects, and would be applicable as long as there was no problem with deposited wastes.

6. <u>Has it been decided when the point of compliance definition will be finalized?</u>

   This definition will be made by the time new regulations for the Aquifer Protection Program are issued. Point of compliance is defined in ARS 49-244 and is site-specific for non-hazardous discharge. Point of compliance is not a part of BADCT.

7. Will the facility applying for an Aquifer Protection Permit be required to complete a hydrogeological study, or will similar studies previously undertaken by DEQ or other agencies be regarded as sufficient?

It will be the Director's decision to determine adequacy of existing studies. If site conditions are to be used as a part of the BADCT for a facility, a hydrogeologic study will be necessary.

8. Are there requirements from other DEQ programs that are being pulled into BADCT? Is other statutory authority being used to bolster this program?

Yes, most of the sections within DEQ will participate in the development of BADCT. These aspects of other programs which relate to groundwater discharge control will be integrated into BADCT.

9. Are closure, hydrogeological analysis, and other costs being considered in economic impacts associated with BADCT?

No, not as far as an economical burden to the applicant of a new facility. Yes, in the category of existing facilities.

10. How will post closure financial responsibility be addressed?

Facilities may be required to post bonds guaranteeing post closure compliance to permit provisions.

11. Can site characteristics alone constitute BADCT?

Site characteristics which lend themselves to discharge reduction at a disposal site do not in themselves constitute BADCT.

12. When is a facility regarded as existing and when is it regarded as closed?

A disposal facility is regarded as existing if constructed, under construction, or plans were approved for construction prior to August 13, 1986. A facility is considered closed if closed prior to January 1, 1986 with no intent to reopen.

13. What is the purpose of the BADCT Guidance Document?

This information is a guidance document not a rule or a law -- The BADCT Guidance Document is designed to help both the permittee as well as the permit writer.

14. What constitutes a "major modification" that will cause an existing facility to be treated as a new facility for BADCT determination?

The rules currently being developed will clarify this point.

IX. APPENDIX

Exemptions, Facilities Requiring Permits, and Draft General Permit Criteria Related to the Mining Industry

A. Exemptions

Certain exemptions that may apply to segments of the mining industry, as listed under A.R.S. Title 49, Section 250.B, are noted below. The following classes of facilities are exempt from the aquifer protection permit requirements.

Subsection B.5. "Mining overburden returned to the excavation site, including any common material which has been excavated and removed from the excavation site and has not been subjected to any chemical or leaching agent or process of any kind".

Subsection B.6. "Facilities used soley for surface transportation or storage of waters for beneficial uses, or pumped from the groundwater, if effluent from any waste treatment facility is not added after the original point of diversion."

Subsection B.8. "Facilities which are defined and required to obtain a permit to reuse reclaimed wastewater".

Subsection B.9. "Leachate resulting from the direct, natural infiltration of precipation through undisturbed regolith or bedrock if pollutants are not added to the leachate as a result of any material or activity placed or conducted by man on the ground surface".

Subsection B.10. "Surface impoundments used soley to contain storm runoff."

Subsection B.11 " Closed facilities. However, if the facility ever resumes operation, the facility shall obtain an aquifer protection permit and the facility shall be treated as a new facility for the purposes of 49-243".

Section 49-243, referenced above, pertains to the information and criteria for issuing an individual permit.

B. Facilities requiring permits

Under A.R.S. Title 49, Section 241.A. and B. those facilities that are required to obtain a permit are defined. Section 241.A. states that "unless otherwise provided by this article, any person who discharges or who owns or operates a facility that discharges shall obtain an aquifer protection permit from the director". Section 24.B. states that "unless exempted under 49-250, the following are considered to be discharging facilities and shall be operated pursuant to either an individual permit or general permit, including agricultural general permits, under this article:

1. Surface impoundments including holding, storage settling, treatment, or disposal pits, ponds, or lagoons.

2. Solid waste disposal facilities.

3. Injection wells.

4. Land treatment facilities.

5. Facilities which add a pollutant to a salt dome formation, salt bed formation, dry well, or underground cave or mine.

6. Mine tailings piles or ponds.

7. Mine leaching operations.

8. Septic tank systems with a capacity of greater than two thousand gallons per day.

9. Groundwater recharge projects and underground storage and recovery projects.

10. Point source discharges to navigable waters.

11. Sewage or sludge ponds and wastewater treatment facilities.".

Many of these facilities may be included in a mining operation.

C. Draft General Permit Criteria

1. Sand and Gravel Placer Mining

The draft rules state that "a general permit is issued for the discharge of wash water from sand and gravel operations, and placer mining operations, if only physical processes are employed and no hazardous substances have been added or exposed during the processing or removal of the sand and gravel".

2. Pipeline and Well Testing

According to the draft rules a general permit may also be issued for discharges from hydrostatic tests of pipelines provided that certain conditions are met. These conditions depend on whether or not the pipeline has been previously used. General permits may also be issued for surface impoundments receiving waters from well testing and development, provided that the discharged water does not violate Aquifer Water Quality Standards or further degrade the quality of water in the effected aquifer.

REGS. - H_2O POLLU

ARTICLE 7. REGULATIONS FOR THE REUSE OF WASTEWATER

R18-9-701. Definitions

Definitions given in R18-9-802, R9-20-203, and applicable state statutes will apply to those words and phrases when used in this Article. In addition, the following apply:

1. "Reuse of reclaimed wastewater" means the use of reclaimed wastewater transported from the point of treatment to the point of use without an intervening discharge to the surface waters of the state for which water quality standards have been established.
2. "Effluent" means a wastewater that has completed its passage through a wastewater treatment plant.
3. "Gray water" means wastewater that originates from clothes washers, dishwashers, bathtubs, showers, and sinks, except kitchen sinks and toilets.
4. "Industrial wastewater" means all wastes that enter a collection, treatment or disposal system from an industrial process.
5. "Irrigation" means the application of water or wastewater or both for growing agricultural crops or for landscaping purposes.
6. "NPDES permit" means a permit issued by the United States Environmental protection Agency for discharge to the waters of the United States as required by the Clean Water Act, as amended.
7. "On-site wastewater treatment plant" encompasses all of the processes, devices, structures, and earthworks used for treating wastewater for disposal and reuse other than septic tanks with a hydraulic capacity less than two thousand (2,000) gallons per day that possess a N.S.F. Class I rating.
8. "Open access" means that access to the reuse site by the general public is uncontrolled.
9. "Partially treated wastewater" means wastewater which has received a minimum of primary treatment but does not meet the allowable limits contained in R18-9-703 for release to a reuse, or for discharge into the waters of the United States.
10. "Primary treatment" is a treatment process which accomplishes removal of sewage solids by physical means so that the effluent contains no more than 1.0 milligram of settleable solids per liter of wastewater.
11. "Reclaimed wastewater" is effluent which meets the standards for the specific reuses contained in R18-9-703.
12. "Restricted access" means that the access to the reuse site by the general public is controlled.
13. "Reuse" means the use of reclaimed wastewaters.
14. "Reuse site" means that area where reclaimed wastewater is applied to and/or impounded upon.
15. "Secondary treatment" is a treatment process that produces treated wastewater containing no more than 30 milligrams per liter of five-day biochemical oxygen demand, 30 milligrams per liter of suspended solids, a pH between the limits of 6.0 to 9.0 and a fecal coliform standard based on the uses of the wastewater. Aerobic stabilization ponds shall be considered as providing secondary treatment if the effluent contains no more than 30 milligrams per liter of five-day biochemical oxygen demand, 90 milligrams per liter of suspended solids for pond systems treating less than or equal to two million gallons per day, plus the same pH and fecal coliform standards given above. Pond systems with a design capacity of greater than two million gallons per day must meet the 30 milligram per

liter standard for suspended solids.

16. "Wastewater" means sanitary wastes of human origin, sewage, gray water, and industrial wastes that contain sanitary wastes or are used in the production or processing of any crop or substance which may be used as human or animal food.

17. "Wastewater reclamation system" means the wastewater treatment plant and the entire reuse and distribution system for the reclaimed wastewater.

18. "Wastewater treatment plant" encompasses all of the processes, devices, structures, and earth-works which are used for treating wastewater for disposal and reuse, but does not include septic tanks, wastewater treatment plants serving singly family residences, industrial unit processes, or industrial impoundments for process waters within the industrial property.

R18-9-702. General requirements for reuse of wastewater

A. The application of reclaimed wastewater shall be consistent with the goals and policies of the Council.

B. Irrigation with untreated wastewater is prohibited.

C. No wastewater treatment plant owner shall release reclaimed wastewater for reuse without a permit issued by the Department.

D. Food crops which may be consumed raw by humans that are irrigated with reclaimed wastewater shall be considered adulterated foods in accordance with A.R.S. § 36-904(A)(5), unless the reclaimed wastewater conforms with the limits and conditions of R18-9-703. The production, sale or delivery of such adulterated food crops is prohibited and the Director may detain, remove, or destroy such adulterated food crops pursuant to A.R.S. § 36-910.

E. A reuser may accept reclaimed wastewater and provide additional treatment for a more restrictive reuse. Under such conditions, the plant providing the additional treatment is subject to the same requirements as other wastewater treatment plants and will be permitted separately.

F. When no means of reuse, discharge, or disposal of reclaimed wastewater are available other than surface irrigation, a minimum of five days storage shall be provided to prevent the necessity of irrigation when the soil is saturated or during a period when the reclaimed wastewater does not meet the minimum water quality standards for the specific reuse. The irrigation site shall be designed to contain the runoff from a 10-year, 24-hour precipitation event unless the reclaimed wastewater meets the standards and conditions of a valid NPDES permit for discharge into waters of the United States. These provisions shall not apply to agricultural irrigation return flows, and runoff from highway landscaping or golf courses when the Department determines that such a flow does not present a danger to the health of the public.

G. Discharges of effluent into waters of the United States require a NPDES permit and are not regulated by this Article.

H. In determining allowable uses of reclaimed wastewater, the Department will consider the effects of blending secondary effluent with waters of higher quality or the effects of additional treatment prior to reuse if requested by the applicant. In cases where blending or additional treatment of secondary effluent is provided, the user shall submit to the Department, as a minimum, a plan of operation, a description of any additional treatment process, blending volumes, and an estimation of final quality at the point of reuse.

I. The wastewater treatment plant owner or the reclaimed wastewater owner shall be responsible and liable for meeting the conditions of the wastewater reuse permit. The treatment plant owner will not be liable for misapplication of reclaimed wastewater by reusers. To identify the responsibilities of the wastewater treatment plant owner and the reclaimed wastewater owner there shall be a legally enforceable contract which sets forth as a minimum:

1. The quality and maximum quantity of wastewater to be released for reuse by the wastewater treatment plant.

2. The specific reuse(s) for which the reclaimed wastewater will be used by the reuser.

3. The method of disposal of any reclaimed wastewater left over from the reuse activity by the reuser.

4. The responsibility for compliance with additional requirements for specific reuses as contained in R18-9-703(C) by the reuser.

J. In those cases where the reclaimed wastewater is owned by someone other than the wastewater treatment plant owner, the reclaimed wastewater owner may apply for the reuse permit pursuant to R18-9-705(A) and perform any of the other functions required by this Article so long as the reclaimed wastewater owner, in a form acceptable to the Director, commits to perform any or all of the duties required in this Article and/or produces a legally enforceable contract with the wastewater treatment plant owner which commits performance to any or all of the duties required in this Article. The intent of this policy is that the wastewater treatment plant owner and the reclaimed wastewater owner, either together or separately, agree to commit to all of the requirements of this Article, as shown in a legally enforceable contract.

K. In cases where someone other than the wastewater treatment plant owner makes an actual reuse of the reclaimed wastewater, each succession of ownership shall be governed by a legally enforceable contract, filed with the Department, which notifies the succeeding reclaimed wastewater owner of the requirements of this Article and which requires the succeeding owner to so contract with any additional succeeding reclaimed wastewater owners.

L. Nothing in this Article is intended to exempt disposal of reclaimed wastewater from the requirements of A.A.C. Title 9, Chapter 20, Article 2.

M. The use of reclaimed wastewater for direct human consumption is prohibited.

R18-9-703. Specific standards and permit monitoring requirements for the reuse of wastewater

A. Numerical parameter limits pertaining to specific reuse categories are contained in Table I of this Article and A.A.C. Title 18, Chapter 11, Article 2. Concentrations of trace substances, organic chemicals, toxic substances, and radiochemicals in waters used for agricultural irrigation, livestock watering, and recreation must meet the allowable limits contained in the state surface water quality standards, A.A.C. Title 18, Chapter 11, Article 2. Permit monitoring requirements for specific reuses are given in Table II of this Article. The regulations in this part apply to effluent flow at a point in the wastewater reclamation system just prior to release for reuse.

B. Permittees are not required to monitor routinely for enteric viruses, entamoeba histolytica, giardia lamblia, ascaris lumbricoides, common large tapeworm, trace substances, organic chemicals, toxic substances, or radiochemicals for which no sampling frequency is specified. However, should the Department find or have reason to believe such contaminants are present in excess of the allowable limits given in Table I of this Article and A.A.C. Title 18, Chapter 11, Article 2, corrective action including monitoring will be required to eliminate or reduce the contaminants to meet these limits.

TABLE I -- ALLOWABLE PERMIT LIMITS FOR SPECIFIC REUSES

PARAMETER	A ORCHARDS	B FIBER, SEED & FORAGE	C PASTURES	D LIVESTOCK WATERING	E PROCESSED FOOD	F LANDSCAPED AREAS RESTRICTED ACCESS	G OPEN ACCESS	H FOOD CONSUMED RAW	I INCIDENTAL HUMAN CONTACT	J FULL BODY CONTACT
pH	4.5-9	4.5-9	4.5-9	6.5-9	4.5-9	4.5-9	4.5-9	4.5-9	6.5-9	6.5-9
FECAL COLIFORM (CFU/100 ml) [a]										
geometric mean (5 sample minimum)	1000	1000	1000	1000	1000	200	25	2.2	1000	200
single sample not to exceed	4000	4000	4000	4000	2500	1000	75	25	4000	800
TURBIDITY (NTU) [b]	--	--	--	--	--	--	5	1	5	1
ENTERIC VIRUS [c]	--	--	--	--	--	--	125 per 40 liters	1 per 40 liters	125 per 40 liters	1 per 40 liters
ENTAMOEBA HISTOLYTICA	--	--	--	--	--	--	--	none detectable	--	none detectable
GIARDIA LAMBLIA	--	--	--	--	--	--	--	none detectable	--	none detectable
ASCARIS LUMBRICOIDES	--	--	--	--	--	--	none detectable	none detectable	none detectable	none detectable
COMMON LARGE TAPEWORM	--	--	none detectable	none detectable	--	--	--	--	--	--

Notes:

a. CFU = colony forming units

b. NTU = nephelometric turbidity units

c. expressed as PFU, plaque forming units; MPN, most probable numbers; or immunofluorescent foci per liter

d. "None detectable" means no pathogenic microorganisms observed during examination

TABLE II -- MINIMUM PERMIT MONITORING REQUIREMENTS FOR SPECIFIC REUSES

PARAMETER	Frequency									
	A	B	C	D	E	F	G	H	I	J
	ORCHARDS	FIBER, SEED & FORAGE	PASTURES	LIVESTOCK WATERING	PROCESSED FOOD	LANDSCAPED AREAS RESTRICTED ACCESS	OPEN ACCESS	FOOD CONSUMED RAW	INCIDENTAL HUMAN CONTACT	FULL BODY CONTACT
pH	1/month	1/month	1/month	1/month	1/month	1/month	1/month	1/month	1/month	1/month
FECAL COLIFORM	1/month	1/month	1/month	1/month	1/month	1/week	1/day	1/day	1/week	1/day
TURBIDITY	--	--	--	--	--	--	continuous	continuous	continuous	continuous

C. Additional requirements for specific uses.

1. Irrigation of orchard crops and crops not subject to rotation (Table I, Column A). Irrigation shall be by a method which minimizes contact of the reclaimed wastewater with the fruit or foliage.

2. Irrigation of pastures (Table I, Column C). Pastures must be maintained to prevent incidental ponding or standing water except where local farming conditions and the use of accepted irrigation delivery systems and cropping patterns are such that, as an unavoidable consequence of such conditions, systems, and patterns, there will be standing water.

3. Irrigation of landscaped areas, cemeteries, highway medians, golf courses, and other areas where public access is restricted (Table I, Column F). Golf courses in residential areas which are separated by a fence or barrier of at least four feet in height will be included in this category. Golf courses contiguous with a residential area primarily restricted to adults or which strictly enforce nonaccess for anyone other than players will be included in this category.

a. Spray irrigation of fairways shall be limited to such times of the day as to reasonably preclude direct contact of the spray with golfers.

b. Irrigation spray shall not reach any privately-owned premises or public drinking fountains.

c. Hose bibbs discharging reclaimed wastewater shall be posted with signs reading "Reclaimed Water, Do Not Drink", or similar warnings, or be secured to prevent access by the public.

d. Signs reading "Irrigation with reclaimed wastewater" or similar warning shall be prominently displayed on the premises. Score cards shall include the same warning.

e. Irrigation pipe shall be color coded, buried with colored tape, or otherwise suitably marked to indicate nonpotable water. 4. Irrigation of landscaped areas including playgrounds, lawns, parks, golf courses not covered by paragraph (3) above, and other areas where public access is not restricted (Table I, Column G). a. Hose bibbs discharging reclaimed wastewater shall be secured to prevent any use by the public.

b. Irrigation pipe shall be color coded, buried with colored tape, or otherwise suitably marked to indicate nonpotable water. c. These areas shall be irrigated only at such time as to minimize contact with the public and be reasonably dry and free from standing water during normal usage periods.

d. Signs reading "Irrigated with reclaimed wastewater" or similar warnings shall be prominently displayed on the premises. 5. On-site wastewater treatment plants.

a. For surface irrigation, on-site wastewater treatment plant effluent must meet the allowable limits listed in Table III of this Article. Surface irrigation sites shall be designed to contain a 10-year, 24-hour rainfall event. On-site wastewater treatment plants which use reclaimed wastewater within common areas or discharge to areas off the reuse site are subject to quality, monitoring, management, and operation requirements which pertain to all other wastewater treatment plants.

b. This Section does not apply to on-site wastewater treatment plants that dispose effluent through the following means:

i. Conventional leach trenches designed in accordance with Department engineering bulletins.

ii. Mound disposal systems.

iii. Evapotranspiration beds designed in accordance with Department engineering bulletins.

6. Gray water from single and multi-family residences may be used for surface irrigation under the following conditions:

a. The design and construction of the system are approved by the Department in accordance with A.A.C. Title 18, Chapter 9, Article 8.

Design guidelines and information on suitable plantings and irrigation methods are available from the Department.

b. Such irrigation sites shall be designed to contain a 10-year, 24-hour rainfall event.

c. The gray water must meet the allowable limits for surface irrigation in Table III.

TABLE III
ALLOWABLE LIMITS AND MONITORING REQUIREMENTS FOR SURFACE IRRIGATION WITH ON-SITE WASTEWATER TREATMENT PLANT EFFLUENT AND GRAY WATER

Parameters	Allowable Limits	Samples Required
Fecal Coliform (CFU/100ml)		
geometric mean	25	Series of 5 in one calendar month; 1 series per year
minimum single sample not to exceed	75	
Chlorine Residual, mg/l	2.0	1/month minimum

7. Wetlands marsh.

a. Formation of a wetlands marsh is an allowable reuse of reclaimed wastewater under conditions and design criteria outlined in Engineering Bulletin No. 11, available from the Department.

b. Table IV of this Article contains minimum effluent standards and monitoring requirements for formation of a wetlands marsh or addition of reclaimed wastewater to an existing man-made wetlands marsh.

TABLE IV
ALLOWABLE LIMITS AND MONITORING REQUIREMENTS FOR RECLAIMED WASTEWATER RELEASED TO WETLANDS MARSHES

Parameters	Allowable Limits	Samples Required
FECAL COLIFORM (CFU/100 ml, 30-day period)		
FLOWS LESS THAN 1 MILLION GALLONS PER DAY		
geometric mean	1000	5/month
single sample not to exceed	4000	
FLOWS 1 MILLION GALLONS PER DAY OR ABOVE		
geometric mean	1000	10/month
single sample not to exceed	4000	
pH, units	6.5 - 8.6	1/week
pH CHANGE, units/day, maximum change per day in receiving waters	0.5	
DISSOLVED OXYGEN, receiving waters shall not be lowered beyond this limit (mg/l)	6	2/week
TEMPERATURE	shall not interfere with aquatic life and wildlife	2/week
TRACE SUBSTANCES	per A.A.C. Title 18, Chapter 11, Article 2 "aquatic and wildlife"	

8. Industrial reuse.

a. All wastewater reclamation systems that contain industrial wastewater will be subject to these rules, if they either:

i. Totally or partially consist of or originated as a sanitary waste of human origin; or,

ii. Are used for the production and processing of any crops or substance which may be used as human or animal food.

b. Reuse of reclaimed wastewater for industrial purposes is exempt from these rules under the following circumstances:

i. The industrial wastewater did not originally contain sanitary wastes of human origin; or,

ii. The wastewater is not used for the production or processing of any crop or substance which may be used as human or animal food.

c. If not exempt, each industrial reuse will be considered on an individual basis to determine applicable quality criteria. The variety of industrial reuses is so extensive that establishing specific criteria governing all industrial reuses is not practicable. In fixing such treatment requirements and quality criteria the Department shall give consideration to:

i. The degree of potential contact with the reclaimed wastewater by the general public.

ii. The degree of potential contamination of the products or byproducts being produced or handled in the industrial process.

d. The use of secondary treated reclaimed wastewater for use in industrial cooling processes shall be allowed.

R18-9-704. Irrigation as part of the wastewater treatment process

Irrigation with partially treated wastewater is considered a part of the treatment process and is subject to the same Department controls as other wastewater treatment processes. Such irrigation is allowable only under all of the following conditions:

1. The person having administrative control over the wastewater treatment plant or the reclaimed wastewater owner has direct physical and administrative control over the irrigation site and process.
2. The entire treatment process, including irrigation and harvesting, is under the direct supervision of a wastewater treatment plant operator certified by the Department under A.A.C. Title 18, Chapter 4, Article 1.
3. The irrigation site, cropping, application rates, irrigation practices, harvesting, and a plan of operation shall have been approved by the Department.
4. Land to which partially treated wastewater is applied shall not be used for crops requiring higher quality irrigation water until such land use is approved in writing by the Department.
5. Any discharge of partially treated wastewater from the irrigation site shall be from a designated discharge point or points and shall meet the limits and conditions of NPDES permit or a groundwater permit issued under A.A.C. Title 9, Chapter 20, Article 2.

R18-9-705. Permit for reuse of reclaimed wastewater

A. To effectuate R18-9-702(C), above, the following shall apply:

1. Application for a permit and signatories.

a. The owner or operator of any wastewater treatment plant or reclaimed wastewater owner who proposes to allow the reclaimed wastewater to be reused for any of the purposes authorized by these rules shall complete, sign and submit to the Director information requested in an application form provided by the Department.

b. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. Time allowed for application submittal. A person proposing a reuse facility shall submit an application not less than 120 days before the date on which the reuse is to commence, unless permission for a lesser period has been granted by the Director.

3. Reissuance of permit: time allowed for application submittal. A person who expects to continue to release reclaimed wastewater for reuse after expiration of the permit shall apply for reissuance not less than 120 days before the expiration date of the present permit.

4. Duration of permits and continuation of expiring permits.

a. All permits shall be issued for fixed terms not to exceed five years. Permits may be modified, transferred, reissued, or revoked by the Director.

b. The term and conditions of an expired permit are automatically continued under the provisions of A.R.S. § 41-1012(B) pending issuance of a new permit if:

i. The permitted activity is of a continuing nature.

ii. The permittee has submitted a timely and sufficient application for a new permit.

iii. The Department is unable, through no fault of the permittee, to issue a new permit before the expiration date of the previous permit.

5. Public comment and hearings, public notice regarding permits and permit hearings.

a. Notices shall be circulated in a manner designed to inform interested persons of a hearing or determination dealing with permit denial or issuance. Notice of draft permit shall allow at least 30 days for public comments and notice of hearing shall be given 30 days before the hearing.

b. Notice of the formulation of any draft permit and notice of all hearings shall be given by the Department:

i. By mailing a copy to the applicant, to interested state and county agencies, and to any person on request.

ii. By any of the following methods:

(1) By publication of a notice in a daily or weekly newspaper within the area affected by the wastewater reuse activity or discharge; or,

(2) By posting a copy of the information required at the principal office of the municipality or political subdivision affected by the wastewater reuse activity or discharge, and by posting a copy at the United States Post Office serving those premises.

(3) In any other manner constituting legal notice under state law.

B. Public notices issued under this Section will contain the following information:

1. Name and address of the office processing the application or conducting the hearing.

2. Name and address of the applicant and the wastewater treatment plant owner (if different from the applicant) and a general description of the location of each existing or proposed reuse facility.

3. Name of person, and an address and telephone number where interested persons may obtain further information, including copies of the draft permit.

C. Transfer of permits. A permit may be transferred to another person by a permittee if:

1. The permittee notifies the Director of the proposed transfer.

2. A written agreement containing a specific date for transfer of permit responsibility and coverage between the current and new permittees (including acknowledgment that the existing permittee is liable for violations up to that date, and that the new permittee is liable for violations from that date on) is submitted to the Director.

3. The Director, within 30 days of receiving a transfer notice, does not notify the current permittee and the new permittee of the intent to modify revoke and reissue, or terminate the permit and to require that a new application be filed rather than agreeing to the transfer of the permit.

D. Permit compliance. To assure compliance with permit terms and conditions, the permittee shall monitor:

1. The amount, concentration, or other measurement for each contaminant from Table II of this article and A.A.C. Title 18, Chapter 11, Article 2 specified in the permit.

2. The volume of reclaimed wastewater released for reuse.

3. Other parameters specifically required in the permit.

4. The Director will specify the following monitoring requirements in the permit:

a. Requirements concerning proper installation, use and maintenance of monitoring equipment or methods (including biological monitoring methods where appropriate).

b. Monitoring frequency, type and intervals sufficient to yield continuing data representative of the volume of reclaimed wastewater flow and the quantity of contaminant discharged.

c. Test procedures for the analysis of contaminant meeting the requirements of this Section.

5. Test procedures identified in 40 CFR Part 136 shall be utilized for contaminants or parameters listed in the permit unless an alternative test procedure has been approved by the Director.

E. Recording of monitoring results.

1. Any permittee required to monitor shall maintain records of all monitoring information and monitoring activities, including:

a. The date, exact place and time of sampling or measurements;

b. The person who performed the sampling or measurements;

c. The date analyses were performed;

d. The person who performed the analyses;

e. The analytical techniques or methods used;

f. The results of such analyses.

2. All records of monitoring activities and results (including all original strip chart recordings for continuous monitoring instrumentation and calibration and maintenance records shall be retained by the permittee for three years. The three-year period shall be extended:

a. Automatically during the course of any unresolved litigation regarding the discharge of contaminants by the permittee;

b. As requested in writing by the Director.

F. Access to records. The manager of the wastewater treatment plant shall allow any and all of the reusers to have access to the records of physical, chemical and biological quality of the reclaimed wastewater.

G. Availability of records. Water quality records of the wastewater facility will be available for public inspection at the Department.

H. Reuses requiring lower quality reclaimed wastewater than that allowed by permit. It is expressly allowed that a reuser of reclaimed wastewater may use the water for any purpose included in these rules which requires a lower quality than that set forth in the permit.

R18-9-706. Enforcement and penalties

Any person who releases reclaimed wastewater for reuse without a permit or contrary to provisions of a permit or this Article, falsifies data or information submitted to the Department as a result of the requirements of this Article, or otherwise violates the provisions of this Article, shall be subject to enforcement and penalties pursuant to A.R.S. §§ 49-262 and 49-263 and any other applicable and appropriate provisions of the Arizona Revised Statutes.

R18-9-707. Severability

If any provision of this Article is finally adjudicated invalid, the remaining provisions of this Article shall not be affected thereby.

ARTICLE 1. WATER QUALITY STANDARDS FOR NAVIGABLE WATERS

R18-11-101. Definitions

In addition to the definitions prescribed in A.R.S. §§ 49-101 and 49-201, the terms of Article 1 and Article 2 shall have the following meanings:

1. "Acute toxicity" means toxicity involving a stimulus severe enough to rapidly induce a response. In aquatic toxicity tests, an effect observed in 96 hours or less is considered acute.
2. "AgI" means agricultural irrigation.
3. "AgL" means agricultural livestock watering.
4. "Agricultural irrigation" means the use of a navigable water for the irrigation of crops.
5. "Agricultural livestock watering" means the use of a navigable water as a supply of water for consumption by livestock.
6. "Annual mean" means the arithmetic mean of monthly values determined over a consecutive 12 month period, provided that monthly values are determined for at least 3 months. The monthly value shall be the arithmetic mean of all values determined in a calendar month.
7. "Aquatic and wildlife (cold water fishery)" means the use of a navigable water by animals, plants or other organisms, including salmonids, for habitation, growth or propagation.
8. "Aquatic and wildlife (effluent dominated water)" means the use of an effluent dominated water by animals, plants or other organisms for habitation, growth or propagation.
9. "Aquatic and wildlife (ephemeral)" means the use of an ephemeral water by animals, plants or other organisms, excluding fish, for habitation, growth or propagation.
10. "Aquatic and wildlife (warm water fishery)" means the use of a navigable water by animals, plants or other organisms, excluding salmonids, for habitation, growth or propagation.
11. "A&Wc" means aquatic and wildlife (cold water fishery).
12. "A&We" means aquatic and wildlife (ephemeral).
13. "A&Wedw" means aquatic and wildlife (effluent dominated water).
14. "A&Ww" means aquatic and wildlife (warm water fishery).
15. "Clean Water Act" means the Federal Water Pollution Control Act, as amended by the Water Quality Act of 1987 (and no future amendments), which is incorporated by reference and on file with the Office of the Secretary of State and the Department.
16. "Criteria" means elements of water quality standards that are expressed as pollutant concentrations, levels or narrative statements representing a water quality that supports a designated use.
17. "Designated use" means a use specified in Appendix B of this Article for a navigable water.
18. "Domestic water source" means the use of a navigable water as a potable water supply. Coagulation, sedimentation, filtration, disinfection or other treatments may be necessary to yield a finished water suitable for human consumption.
19. "DWS" means domestic water source.
20. "EDW" means effluent dominated water.
21. "Effluent dominated water" means a navigable water that consists primarily of discharges of treated wastewater and that has been classified as an effluent dominated water by the Director pursuant to A.A.C. R18-11-113.
22. "Ephemeral water" means a navigable water that has a channel that is at all times above the water table, that flows only in direct response to

precipitation and that does not support a self-sustaining fish population.

23. "Existing use" means a use that is actually attained in a navigable water on or after November 28, 1975 or a use that the existing water quality of a navigable water will allow.

24. "FBC" means full body contact.

25. "FC" means fish consumption.

26. "Fish consumption" means the use of a navigable water by humans for harvesting aquatic organisms for consumption. Harvestable aquatic organisms include, but are not limited to fish, clams, turtles, crayfish and frogs.

27. "Full body contact" means the use of a navigable water which causes the human body to come into direct contact with the water to the point of complete submergence. The use is such that ingestion of the water is likely to occur and certain sensitive body organs, such as the eyes, ears or nose may be exposed to direct contact with the water.

28. "Geometric mean" means the nth root of the product of n items or values. The geometric mean is calculated using the following formula:

$$G.M.(y) = \sqrt[n]{(Y(1))\ (Y(2))\ (Y(3))\ \ldots\ (Y(n))}$$

29. "Hardness" means the sum of the calcium and magnesium concentrations, expressed as calcium carbonate ($CaCO_3$), in milligrams per liter.

30. "Mixing zone" means a prescribed area or volume of a navigable water that is contiguous to a point source discharge where initial dilution of a discharge takes place.

31. "National Pollutant Discharge Elimination System" means the point source discharge permit program established by § 402 of the Clean Water Act.

32. "Navigable waters" means the waters of the United States.

33. "Ninetieth percentile" means the value which may not be exceeded by more than ten percent of the observations in a consecutive 12 month period. A minimum of ten samples, each taken at least ten days apart, are required to determine a ninetieth percentile.

34. "Oil" means petroleum in any form, including but not limited to crude oil, gasoline, fuel oil, diesel oil, lubricating oil or sludge.

35. "Partial body contact" means the use of a navigable water which may cause the human body to come into direct contact with the water, but normally not to the point of complete submergence. The use is such that ingestion of the water is not likely to occur, nor will sensitive body organs such as the eyes, ears or nose normally be exposed to direct contact with the water.

36. "PBC" means partial body contact.

37. "Practical quantitation limit" means the lowest level of quantitative measurement that can be reliably achieved during routine laboratory operations.

38. "Recreational uses" means the full body contact and partial body contact designated uses.

39. "Regional Administrator" means the regional administrator of Region 9 of the Environmental Protection Agency.

40. "Total nitrogen" means the sum of the concentrations of ammonia (NH_3), ammonium ion (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-) and dissolved and particulate organic nitrogen expressed as elemental nitrogen.

41. "Total phosphorus" means all the phosphorus present in the sample, regardless of form, as measured by a persulfate digestion procedure.

42. "Toxic" means those pollutants, or combination of pollutants, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by

precipitation and that does not support a self-sustaining fish population.

23. "Existing use" means a use that is actually attained in a navigable water on or after November 28, 1975 or a use that the existing water quality of a navigable water will allow.

24. "FBC" means full body contact.

25. "FC" means fish consumption.

26. "Fish consumption" means the use of a navigable water by humans for harvesting aquatic organisms for consumption. Harvestable aquatic organisms include, but are not limited to fish, clams, turtles, crayfish and frogs.

27. "Full body contact" means the use of a navigable water which causes the human body to come into direct contact with the water to the point of complete submergence. The use is such that ingestion of the water is likely to occur and certain sensitive body organs, such as the eyes, ears or nose may be exposed to direct contact with the water.

28. "Geometric mean" means the nth root of the product of n items or values. The geometric mean is calculated using the following formula:

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30. "Mixing zone" means a prescribed area or volume of a navigable water that is contiguous to a point source discharge where initial dilution of a discharge takes place.

31. "National Pollutant Discharge Elimination System" means the point source discharge permit program established by § 402 of the Clean Water Act.

32. "Navigable waters" means the waters of the United States.

33. "Ninetieth percentile" means the value which may not be exceeded by more than ten percent of the observations in a consecutive 12 month period. A minimum of ten samples, each taken at least ten days apart, are required to determine a ninetieth percentile.

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36. "PBC" means partial body contact.

37. "Practical quantitation limit" means the lowest level of quantitative measurement that can be reliably achieved during routine laboratory operations.

38. "Recreational uses" means the full body contact and partial body contact designated uses.

39. "Regional Administrator" means the regional administrator of Region 9 of the Environmental Protection Agency.

40. "Total nitrogen" means the sum of the concentrations of ammonia (NH_3), ammonium ion (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-) and dissolved and particulate organic nitrogen expressed as elemental nitrogen.

41. "Total phosphorus" means all the phosphorus present in the sample, regardless of form, as measured by a persulfate digestion procedure.

42. "Toxic" means those pollutants, or combination of pollutants, which after discharge and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by

ingestion through food chains, may cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

43. "Unique water" means a navigable water which has been classified as an outstanding state resource water by the Director pursuant to A.A.C. R18-11-112.

44. "Use attainability analysis" means a structured scientific assessment of the factors affecting the attainment of a designated use which may include physical, chemical, biological, and economic factors.

45. "Waters of the United States" means:

A. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

B. All interstate waters, including interstate wetlands;

C. All other waters such as intrastate lakes, rivers, streams (including intermittent and ephemeral streams), creeks, washes, draws, mudflats, sandflats, wetlands, sloughs, backwaters, prairie potholes, wet meadows, playa lakes, reservoirs, or natural ponds, the use degradation or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

1. Which are or could be used by interstate or foreign travelers for recreational or other purposes;

2. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

3. Which are used or could be used for industrial purposes by industries in interstate or foreign commerce;

D. All impoundments of waters otherwise defined as waters of the United States under this definition;

E. Tributaries of waters otherwise defined as waters of the United States under this definition; and

F. Wetlands adjacent to waters (other than waters that are themselves wetlands) otherwise defined as waters of the United States under this definition.

46. "Wetlands" means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, cienegas, tinajas and similar areas.

47. "Zone of passage" means a continuous water route of volume, cross-sectional area and quality necessary to allow passage of free-swimming or drifting organisms with no toxic effect produced on the organisms.

R18-11-102. Applicability

The water quality standards prescribed in this Article apply to all navigable waters.

R18-11-103. Exclusions

The water quality standards prescribed in this Article do not apply to:

1. Waste treatment systems, including ponds, lagoons and constructed wetlands that are a part of such waste treatment systems. This exclusion applies only to manmade bodies of water which neither are originally created in a navigable water nor result from the impoundment of a navigable water.

2. Man-made surface impoundments and associated ditches and conveyances

used in the extraction, beneficiation and processing of metallic ores, including pregnant leach solution ponds, raffinate ponds, tailing impoundments, decant ponds, concentrate or tailing thickeners, blowdown water ponds, ponds and sumps in mine pits associated with dewatering activity, ponds holding water that has come in contact with process or product and that is being held for recycling, spill or upset catchment ponds or ponds used for on-site remediation provided that any discharge from any such surface impoundment to a navigable water is permitted under the National Pollutant Discharge Elimination System program.

R18-11-104. Designated uses

A. The Director shall adopt or remove designated uses and subcategories of designated uses by rule.

B. Designated uses of navigable waters include full body contact, partial body contact, domestic water source, fish consumption, aquatic and wildlife (cold water fishery), aquatic and wildlife (warm water fishery), aquatic and wildlife (ephemeral), aquatic and wildlife (effluent dominated water), agricultural irrigation and agricultural livestock watering. Designated uses for specific navigable waters are listed in Appendix B of this Article.

C. Numeric water quality criteria to protect the designated uses are prescribed in Appendix A, R18-11-109, R18-11-110 and R18-11-112. Narrative standards to protect all navigable waters are prescribed in R18-11-108.

D. A navigable water that is not listed in Appendix B but that is tributary to a listed navigable water shall be protected by the water quality standards that have been established for the nearest downstream navigable water listed in Appendix B that is not an effluent dominated water. Where the nearest downstream listed water is an ephemeral water, the A&We and PBC standards shall apply only to that portion of the tributary that is an ephemeral water. The A&Ww and FBC standards shall apply to that portion of the tributary that is not an ephemeral water.

E. If a navigable water has more than one designated use listed in Appendix B, the applicable water quality criterion for a pollutant is the most stringent of those prescribed to protect the designated uses of the navigable water.

F. The Director shall revise the designated uses of a navigable water if water quality improvements result in a level of water quality which permits a use that is not currently listed as a designated use in Appendix B.

G. In designating uses of a navigable water and in establishing water quality criteria to protect those designated uses, the Director shall take into consideration the applicable water quality standards for downstream navigable waters and shall ensure that the water quality standards provide for the attainment and maintenance of the water quality standards of downstream navigable waters.

H. A use attainability analysis shall be conducted prior to removal of a designated use or adoption of a subcategory of a designated use that requires less stringent water quality criteria.

I. The Director may remove a designated use or adopt a subcategory of a designated use that requires less stringent water quality criteria provided the designated use is not an existing use and it is demonstrated through a use attainability analysis that attaining the designated use is not feasible for any of the following reasons:

1. Naturally occurring pollutant concentrations prevent the attainment of the use;

2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of a sufficient volume of treated

wastewater without violating water conservation or other applicable requirements. Nothing herein shall be construed to require releases of treated wastewater;

3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;

4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the navigable water to its original condition or to operate such modification in a way that would result in attainment of the use. Nothing herein shall be construed to require the releases of water from dams;

5. Physical conditions related to the natural features of the navigable water, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life designated uses; or

6. Controls more stringent than those required by §§ 301(b) and 306 of the Clean Water Act are necessary to attain the use and implementation of such controls would result in substantial and widespread economic and social impact.

R18-11-105. Reserved

R18-11-106. Reserved

R18-11-107. Antidegradation

A. The determination of whether there is any degradation of water quality in a navigable water shall be on a pollutant by pollutant basis.

B. The level of water quality necessary to protect existing uses shall be maintained and protected. No degradation of existing water quality is permitted in a navigable water where the existing water quality does not meet applicable water quality standards.

C. Where existing water quality in a navigable water is better than applicable water quality standards, the existing water quality shall be maintained and protected. The Director may allow limited degradation of existing water quality in such navigable waters, except unique waters, provided that the Department has held a public hearing on whether degradation should be allowed pursuant to the general public hearing procedures prescribed at R18-1-401 and R18-1-402 and the Director makes all of the following findings:

1. The level of water quality necessary to protect existing uses is fully protected.

2. The highest statutory and regulatory requirements for all new and existing point sources as set forth in the Clean Water Act are achieved.

3. All cost-effective and reasonable best management practices for nonpoint source control are implemented.

4. Allowing lower water quality is necessary to accommodate important economic or social development in the area in which the navigable water is located.

D. Existing water quality shall be maintained and protected in a navigable water that is classified as a unique water or that the Director has proposed for classification as a unique water pursuant to A.A.C. R18-11-112. The Director shall not allow limited degradation of a unique water pursuant to subsection (C) of this Section.

E. Nothing in this Section or in the implementation of this Section shall be inconsistent with § 316 of the Clean Water Act where a potential water quality impairment associated with a thermal discharge is involved.

R18-11-108. Narrative water quality standards

A. Navigable waters shall be free from pollutants in amounts or combinations that:

1. Settle to form bottom deposits that inhibit or prohibit the habitation, growth or propagation of aquatic life or that impair recreational uses;
2. Cause objectionable odor in the area in which the navigable water is located;
3. Cause off-taste or odor in drinking water;
4. Cause off-flavor in aquatic organisms or waterfowl;
5. Are toxic to humans, animals, plants or other organisms;
6. Cause the growth of algae or aquatic plants that inhibit or prohibit the habitation, growth or propagation of other aquatic life or that impair recreational uses;
7. Cause or contribute to a violation of an aquifer water quality standard prescribed in A.A.C. R18-11-405 or A.A.C. R18-11-406; or
8. Change the color of the navigable water from natural background levels of color.

B. Navigable waters shall be free from oil, grease and other pollutants that float as debris, foam, or scum; or that cause a film or iridescent appearance on the surface of the water; or that cause a deposit on a shoreline, bank or aquatic vegetation. The discharge of lubricating oil or gasoline associated with the normal operation of a recreational watercraft shall not be considered a violation of this narrative standard.

R18-11-109. Numeric water quality standards

A. The water quality standards prescribed in this Section and in Appendix A apply to navigable waters listed in Appendix B and their tributaries. Additional numeric water quality standards for unique waters are prescribed in R18-11-112.

B. The following water quality standards for fecal coliform, expressed in colony forming units per 100 milliliters of water (cfu/100 ml), shall not be exceeded:

1. Fecal Coliform	FBC,	DWS, PBC, A&W{1}, AgI, AgL
30-day geometric mean (5 sample minimum)	200	1000
10% of samples for a 30-day period	400	2000
Single sample maximum	800	4000

2. Fecal coliform in effluent dominated waters	All designated uses
30-day geometric mean (5 sample minimum)	200
10% of samples for a 30-day period	400
Single sample maximum	800

C. The following water quality standards for pH, expressed in standard units, shall not be violated:

pH	DWS	FBC,PBC,A&W{2}	AgI	AgL
Maximum	9.0	9.0	9.0	9.0
Minimum	5.0	6.5	4.5	6.5
Maximum change due to discharge	NNS	0.5	NNS	NNS

D. The following maximum allowable increase in ambient water temperature, expressed in degrees Celsius, shall not be exceeded:

Temperature(3)	A&Ww, A&Wedw	A&Wc
Maximum increase due to a discharge(4)(5)	3.0	1.0

E. The following water quality standards for turbidity, expressed as a maximum concentration in nephelometric turbidity units (NTU), shall not be exceeded:

Turbidity	FBC, PBC, A&Ww, A&Wedw	A&Wc
Rivers, streams and other flowing waters	50	10
Lakes, reservoirs, tanks and ponds	25	10

F. The following are the water quality standards for dissolved oxygen, expressed in milligrams per liter (mg/L). The dissolved oxygen concentration in a navigable water shall not fall below the following minimum concentrations:

Dissolved oxygen(6)	A&Ww	A&Wc	A&Wedw
Single sample minimum(7)(8)	6.0	7.0	1.0

G. The following water quality standards for total phosphorus and total nitrogen, expressed in milligrams per liter (mg/L), shall not be exceeded:

	Annual mean	90th percentile	Single Sample Maximum
Verde River and its tributaries from headwaters to Bartlett Lake			
Total phosphorus	0.10	0.30	1.00
Total nitrogen	1.00	1.50	3.00
White River, Black River, Tonto Creek and their tributaries			
Total phosphorus	0.10	0.20	0.80
Total nitrogen	0.50	1.00	2.00
Salt River and its tributaries, except Pinal Creek, from the confluence of the White and Black Rivers to Theodore Roosevelt Lake			
Total phosphorus	0.12	0.30	1.00
Total nitrogen	0.60	1.20	2.00
Theodore Roosevelt, Apache, Canyon and Saguaro Lakes			
Total phosphorus	0.03(a)	NNS	0.60(b)
Total nitrogen	0.30(a)	NNS	1.00(b)
Salt River below Stewart Mountain Dam to confluence with the Verde River			
Total phosphorus	0.05	NNS	0.20
Total nitrogen	0.60	NNS	3.00
Little Colorado River and its tributaries above River Reservoir in Greer; South Fork of Little Colorado River above South Fork Campground; Water Canyon Creek above Apache-Sitgreaves National Forest boundary			
Total phosphorus	0.08	0.10	0.75
Total nitrogen	0.60	0.75	1.10
Little Colorado River at crossing of Apache County Road No. 124			
Total phosphorus	NNS	NNS	0.75
Total nitrogen	NNS	NNS	1.80
Little Colorado River above Lyman Lake to above Amity Ditch diversion near crossing of Arizona Highway 273 (applies only when in-stream turbidity is less than 50 NTU)			

Total phosphorus	0.20	0.30	0.75
Total nitrogen	0.70	1.20	1.50
Colorado River, at Northern International Boundary near Morelos Dam			
Total phosphorus	NNS	0.33	NNS
Total nitrogen	NNS	2.50	NNS
San Pedro River, from Curtiss to Benson			
Total phosphorus	NNS	NNS	NNS
Total nitrate as N	NNS	NNS	10.00

H. The following water quality standards for radiochemicals shall not be exceeded:

1. In all navigable waters, the concentration of radiochemicals shall not exceed the limits established by the Arizona Radiation Regulatory Agency in Title 12, Chapter 1, Article 4, Appendix A, Table II, Column 2 of the Arizona Administrative Code, (effective June 30, 1977 and no future amendments), which is incorporated by reference and on file with the Office of the Secretary of State and with the Department.

2. In navigable waters that are designated as domestic water sources, the following water quality standards for radiochemicals shall not be exceeded:

a. The concentration of gross alpha particle activity, including radium-226 but excluding radon and uranium, shall not exceed 15 picocuries per liter of water.

b. The concentration of combined radium-226 and radium-228 shall not exceed 5 picocuries per liter of water.

c. The concentration of strontium-90 shall not exceed 8 picocuries per liter of water.

d. The concentration of tritium shall not exceed 20,000 picocuries per liter of water.

e. The average annual concentration of beta particle activity and photon emitters from man-made radionuclides shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year.

Footnotes:

{1} Includes A&Wc, A&Ww and A&We.

{2} Includes A&Wc, A&Ww, A&Wedw and A&We.

{3} There is no water quality standard for temperature for the A&We designated use.

{4} Does not apply to Cholla Lake.

{5} Does not apply to a wastewater treatment plant discharge to a dry watercourse that creates an effluent dominated water.

{6} There is no dissolved oxygen standard for the A&We designated use.

{7} Or 90% saturation, whichever is less.

{8} The dissolved oxygen water quality standard for a lake shall apply below the surface but not at a depth greater than 1 meter. {a} means annual mean of representative composite samples taken from the surface and at 2 and 5 meter depths.

{b} means maximum for any set of representative composite samples taken from the surface and at 2 and 5 meter depths. "NNS" means no numeric standard.

R18-11-110. Salinity of the Colorado River

The flow-weighted average annual salinity in the lower main stem of the Colorado River shall be maintained at or below the following concentrations:

Location	Total Dissolved Solids
Below Hoover Dam	723 mg/L

Below Parker Dam	747 mg/L
At Imperial Dam	879 mg/L

R18-11-111. Analytical Methods

A. Analysis of a sample taken to determine compliance with a water quality standard shall be in accordance with an approved analytical method prescribed in Title 9, Chapter 14, Article 6 of the Arizona Administrative Code or an alternative analytical method that is approved by the Director of the Department of Health Services pursuant to A.A.C. R9-14-607(B).

B. A test result from a sample taken to determine compliance with a water quality standard shall be valid only if the sample has been analyzed by a laboratory that is licensed by the Arizona Department of Health Services for the analysis performed.

R18-11-112. Unique waters

A. The classification of a navigable water as a unique water shall be by rule.

B. The Director may adopt, by rule, site-specific water quality standards to maintain and protect existing water quality in a unique water.

C. Any person may nominate a navigable water for classification as a unique water by filing a petition for rule adoption with the Department. A petition for rule adoption to classify a navigable water as a unique water shall include:

1. A map and a description of the navigable water;
2. A written statement in support of the nomination, including specific reference to the applicable criteria for unique waters classification as prescribed in subsection (D) of this Section;
3. Supporting evidence demonstrating that one or more of the applicable unique waters criteria prescribed in subsection (D) of this Section has been met; and
4. Relevant water quality data.

D. A navigable water may be classified as a unique water by the Director upon a finding that the navigable water is an outstanding state resource water based upon one of the following criteria:

1. The navigable water is of exceptional recreational or ecological significance because of its unique attributes, including but not limited to, attributes related to the geology, flora, fauna, water quality, aesthetic values or the wilderness characteristics of the navigable water.
2. Threatened or endangered species are known to be associated with the navigable water and the existing water quality is essential to the maintenance and propagation of a threatened or endangered species or the navigable water provides critical habitat for a threatened or endangered species. Endangered or threatened species are identified on the following lists which are hereby incorporated by reference and on file with the Office of the Secretary of State and with the Department:

a. Endangered and Threatened Wildlife and Plants, 50 CFR, §§ 17.11 and 17.12 (revised as of July 15, 1991);
b. "Threatened Native Wildlife of Arizona," Arizona Game and Fish Department (July 21, 1988);
c. List of protected groups of plants prescribed in A.A.C. R3-1-615 and A.A.C. R3-1-616 (January 17, 1989);
d. List of Migratory Birds, 50 CFR § 10.13 (April 5, 1985);
e. "Endangered and Threatened Species of Arizona," U.S. Fish & Wildlife Service (Summer 1991).

E. The following navigable waters are classified as unique waters:

1. The West Fork of the Little Colorado River, above Government Springs;

2. Oak Creek, including the West Fork of Oak Creek;
3. People's Canyon Creek, tributary to Santa Maria River;
4. Burro Creek, above its confluence with Boulder Creek;
5. Francis Creek, Mohave and Yavapai counties;
6. Bonita Creek, tributary to the upper Gila River;
7. Cienega Creek, from I-10 bridge to Del Lago Dam, Pima County. F.

The following water quality standards apply to the listed unique waters. Water quality standards prescribed in this subsection supplement or supersede the water quality standards prescribed pursuant to R18-11-109.

1. The West Fork of the Little Colorado River, above Government Springs:

Parameter	Standard
Fecal Coliform{a}	200 cfu/100 ml (single sample maximum)
pH (standard units){b}	no change due to discharge
Temperature{b}	no increase due to discharge
Dissolved oxygen{b}	no decrease due to discharge
Total dissolved solids{b}	no increase due to discharge
Chromium (D){a}	10 µg/L
Zinc (D){a}	110 µg/L

2. Oak Creek, including the West Fork of Oak Creek:

Parameter	Standard
Fecal coliform{a}	150 cfu/100 ml*
pH (standard units){b}	no change due to discharge
Nitrogen (T){a}	1.00 mg/L (annual mean) 1.50 mg/L (90th percentile) 2.50 mg/L (single sample maximum)
Phosphorus (T){a}	0.10 mg/L (annual mean) 0.25 mg/L (90th percentile) 0.30 mg/L (single sample maximum)
Chromium (D){a}	5 µg/L
Zinc (D){a}	50 µg/L
Turbidity change due to discharge{b}	3 NTU

* Geometric mean of a random set of a minimum of ten samples in any calendar month.

3. People's Canyon Creek, tributary to Santa Maria River:

Parameter	Standard
Temperature{b}	no increase due to discharge
Dissolved oxygen{b}	no decrease due to discharge
Turbidity change due to discharge{b}	5 NTU
Arsenic (T){b}	20 µg/L
Manganese (T){a}	500 µg/L

4. Burro Creek, above its confluence with Boulder Creek:

Parameter	Standard
Fecal coliform{a}	500 cfu/100 ml (single sample maximum)
Manganese (T){a}	500 µg/L

5. Francis Creek, Mohave and Yavapai Counties:

Parameter	Standard
Fecal coliform{a}	500 cfu/100 ml (single sample maximum)
Manganese (T){a}	500 µg/L

Abbreviations:

(D) means dissolved fraction
(T) means total recoverable
NTU means nephelometric turbidity unit
mg/L means milligrams per liter
µg/L means micrograms per liter
cfu/ml means colony forming units per milliliter
{a} means that the numeric water quality standard supersedes a water quality standard prescribed in R18-11-109 or Appendix A.
{b} means that the numeric water quality standard supplements the water quality standards prescribed in R18-11-109 and Appendix A.

R18-11-113. Effluent dominated waters

A. The classification of a navigable water as an effluent dominated water shall be by rule.
B. The Director may adopt, by rule, site-specific water quality standards for an effluent dominated water.
C. Any person may submit a petition for rule adoption requesting that the Director classify a navigable water as an effluent dominated water. The petition for rule adoption shall include:
1. A map and a description of the navigable water.
2. Information that demonstrates that the navigable water consists primarily of discharges of treated wastewater.
D. The following navigable waters are classified as effluent dominated waters:
1. In the Colorado River Main Stem Basin:
a. Bright Angel Wash from Grand Canyon wastewater treatment plant (WWTP) outfall to confluence with Cataract Creek.
b. Cataract Creek from Williams WWTP outfall to 3 kilometers downstream from the outfall.
c. Holy Moses Wash from Kingman WWTP outfall to 5 kilometers downstream from the outfall.
d. Unnamed wash, tributary to Bright Angel Creek, from Grand Canyon-North Rim WWTP outfall to 1 kilometer downstream from the outfall.
2. In the Little Colorado River Basin:
a. Black Creek from Ft. Defiance WWTP outfall to the confluence with Rio Puerco River.
b. Dry Lake.
c. Lake Humphreys.
d. Lower Walnut Canyon Lake.
e. Ned Lake.
f. Pintail Lake.
g. Rio de Flag from City of Flagstaff WWTP outfall to confluence with Little Colorado River.
h. Telephone Lake.
3. In the Middle Gila River Basin:
a. Agua Fria River from Surprise WWTP outfall to 5 kilometers downstream from the outfall.
b. Agua Fria River from El Mirage WWTP outfall to 8 kilometers downstream from the outfall.
c. Agua Fria River from Avondale WWTP outfall to confluence with the

Gila River.

d. Agua Fria River (Below confluence with unnamed wash receiving treated wastewater from Prescott Valley WWTP to State Route 169).

e. Unnamed wash (From Town of Prescott Valley WWTP outfall to confluence with Agua Fria River).

f. Gila River from Florence WWTP outfall to 5 kilometers downstream from the outfall.

g. Gila River from confluence with the Salt River to Gillespie Dam.

h. Queen Creek from Superior WWTP to 8 kilometers downstream from the outfall.

i. Unnamed wash from Gila Bend WWTP outfall to confluence with Gila River.

j. Unnamed wash from Luke AFB WWTP outfall to the confluence with Agua Fria River.

k. Unnamed wash from Queen Valley WWTP outfall to 3 kilometers downstream from the confluence with Queen Creek.

4. In the Rio Yaqui Basin:

a. Mule Gulch, from Bisbee WWTP to confluence with Whitewater Draw.

b. Unnamed wash from Bisbee-Douglas International Airport WWTP outfall to Whitewater Draw.

5. In the Salt River Basin:

a. Pinal Creek from Globe WWTP outfall to 5 kilometers downstream from the outfall.

b. Salt River from 23rd Avenue WWTP outfall to confluence with the Gila River.

6. In the San Pedro River Basin:

a. Unnamed wash from Oracle WWTP outfall to confluence with Big Wash.

b. Walnut Gulch from Tombstone WWTP outfall to confluence with the San Pedro River.

7. In the Santa Cruz River Basin:

a. North Branch of the Santa Cruz Wash from the Casa Grande WWTP outfall to confluence with the Santa Cruz Wash.

b. Santa Cruz River from City of Nogales WWTP outfall to Josephine Canyon.

c. Santa Cruz River from Roger Road WWTP outfall to Baumgartner Road crossing.

8. In the Upper Gila River Basin:

a. Bennet Wash from Arizona Dept. of Corrections-Safford WWTP outfall to Gila River.

b. Cammerman Wash from Arizona Dept. of Corrections-Globe WWTP outfall to 3 kilometers downstream from the outfall.

9. In the Verde River Basin:

a. American Gulch from Payson WWTP outfall to the East Verde River.

b. Bitter Creek from Jerome WWTP outfall to 2.5 kilometers downstream from the outfall.

c. Jack's Canyon Wash from Big Park WWTP outfall to confluence with Dry Beaver Creek.

R18-11-114. Mixing Zones

A. The Director may, by order, establish a mixing zone in a navigable water. Mixing zones are prohibited in ephemeral waters or where there is no water for dilution.

B. The owner or operator of a point source seeking the establishment of a mixing zone shall submit a mixing zone application to the Department on a standard form that is available from the Department. The application shall include:

1. Identification of the pollutant for which the mixing zone is

requested;

2. A proposed outfall design;

3. A definition of the boundary of the proposed mixing zone. For purposes of this subsection, the boundary of a mixing zone means the location where the concentration of treated wastewater across a transect of the navigable water differs by less than five percent.

4. A complete and detailed description of the existing physical, biological and chemical conditions of the receiving water and of the predicted impact on such conditions from the proposed mixing zone.

5. Information which demonstrates that there will be no acute toxicity in the proposed mixing zone.

C. The Department shall review the application for a mixing zone to determine whether the application is complete. If the application is incomplete, the Department shall identify in writing the additional information that must be submitted to the Department before the Department can take administrative action on the application for a mixing zone.

D. When the application for a mixing zone is complete, the Department shall make a preliminary determination of whether to establish the mixing zone. The Department shall give public notice and conduct a public hearing on whether to establish a mixing zone pursuant to the administrative procedures prescribed in A.A.C. R18-1-401 and A.A.C. R18-1-402.

E. In making the determination of whether to grant or deny the request for the establishment of a mixing zone, the Director shall consider the following factors: sediment deposition, bioaccumulation, bioconcentration, predicted exposure of biota and the likelihood that resident biota will be adversely affected, whether there will be acute toxicity in the mixing zone, the known or predicted safe exposure levels for the pollutant of concern, the likelihood of adverse human health effects, the size of the mixing zone, location of the mixing zone relative to biologically sensitive areas in the navigable water, concentration gradient within the mixing zone, the physical habitat, the potential for attraction of aquatic life to the mixing zone, and the cumulative impacts of other mixing zones and other discharges to the navigable water.

F. The Director shall deny the request to establish a mixing zone if water quality standards outside the boundaries of the proposed mixing zone will be violated or if concentrations of pollutants within the proposed mixing zone will cause acute toxicity to aquatic life. Denials of applications for a mixing zone shall be in writing and shall state the reasons for the denial. If the Director determines that a mixing zone should be established, he shall issue an order to establish the mixing zone. The Director may include conditions in the order that the Director deems are necessary to protect human health and the designated uses of the navigable water. A copy of the Director's decision and order shall be sent by certified mail to the applicant.

G. Any person who is adversely affected by an order of the Director pertaining to a mixing zone may appeal the Director's decision to an administrative law judge pursuant to A.R.S. § 49-321.

H. A mixing zone shall be reevaluated upon issuance, reissuance or modification of the National Pollutant Discharge Elimination System permit for the point source or modification of the outfall structure.

I. The length of the mixing zone shall not exceed 500 meters in flowing streams. The total horizontal area allocated to all mixing zones on a lake shall not exceed 10% of the surface area of the lake. Adjacent mixing zones in a lake shall be no closer than the greatest horizontal dimension of any of the individual mixing zones.

J. A mixing zone shall provide for a zone of passage of not less than 0% of the cross-sectional area of the river or stream.

K. The discharge outfall shall be designed to maximize initial dilution of the treated wastewater in a navigable water.

R18-11-115. Nutrient waivers

A. The water quality standards for total phosphorus and total nitrogen may be waived on a discharger-specific basis for a discharge to an ephemeral water which is tributary to a navigable water for which water quality standards for total nitrogen or total phosphorus are prescribed in A.A.C. R18-11-109(G).

B. A discharger who seeks a nutrient waiver shall submit an application to the Department on a standard form that is available from the Department. The application shall include:

1. Identification of the applicant.
2. Information on the discharging facility, including:
a. Date the facility was placed in service;
b. Location of the facility;
c. Location of the discharge point;
d. Wastewater treatment method; and
e. Discharge flow.
3. Information on the receiving navigable water, including:
a. Name of the receiving water;
b. Months of the year the receiving water is normally dry;
c. Distance in river miles to the nearest downstream navigable water with perennial flow; and
d. Distance from the point of discharge to the point where the flow goes subsurface during an average dry season.
4. Information which demonstrates that the navigable water is free from pollutants in amounts or combinations which cause the growth of algae or aquatic plants that inhibit or prohibit the habitation, growth or propagation of other aquatic life or that impair recreational uses.
5. Water quality data, including:
a. Monthly average, ninetieth percentile and single sample maximum concentrations of total phosphorus and total nitrogen as measured at the point of discharge;
b. Monthly average, ninetieth percentile and single sample maximum concentrations of total phosphorus and total nitrogen as measured at a downstream control point established by the Department; and
c. Discharge flow at the time of sampling.

C. The Department shall review the application for completeness and shall notify the applicant in writing whether the application is complete or whether additional information needs to be submitted to the Department.

D. Once an application for a nutrient waiver is complete, the Department shall make a preliminary determination of whether to grant or deny the nutrient waiver. The Department shall issue public notice and conduct a public hearing on whether the request for a nutrient waiver should be granted pursuant to procedures prescribed in A.A.C. R18-1-401 and A.A.C R18-1-402.

E. The Director may, by order, grant a nutrient waiver provided the discharge will not cause a violation of a water quality standard for total phosphorus or total nitrogen in any downstream, perennial navigable water or cause a violation of narrative standards prescribed in R18-11-108. A copy of the Director's decision and order shall be sent by certified mail to the applicant.

F. Any person who is adversely affected by an order granting or denying a nutrient waiver may appeal the decision to an administrative law judge pursuant to A.R.S. § 49-321.

G. A nutrient waiver shall be for a fixed term not to exceed five years. A nutrient waiver shall be reevaluated upon issuance, reissuance or modification of the National Pollutant Discharge Elimination System permit for the point source.

R18-11-116. Resource management agencies

Nothing in this Article shall be construed to prohibit fisheries management activities by the Arizona Game and Fish Department or the U.S. Fish and Wildlife Service. This provision does not exempt fish hatcheries from National Pollutant Discharge Elimination System permit requirements.

R18-11-117. Canals and municipal park lakes

A. Nothing in this Article shall be construed to prevent the routine physical or mechanical maintenance of canals and the municipal park lakes identified in Appendix B. Physical or mechanical maintenance includes dewatering, lining, dredging and the physical, biological or chemical control of weeds and algae. Increases in turbidity that result from physical or mechanical maintenance activities are permitted in canals and the municipal park lakes identified in Appendix B.

B. The discharge of lubricating oil that is associated with the start-up of well pumps which discharge to canals shall not be considered a violation of R18-11-108(B).

R18-11-118. Dams and flood control structures

A. Increases in turbidity that result from the routine physical or mechanical maintenance of dams and flood control structures shall not be construed as violations of this Article.

B. Nothing in this Article shall be construed to require a person who operates a dam or flood control structure to operate such structure so as to cure or mitigate an exceedance of a water quality standard caused by another person.

R18-11-119. Natural background

Where the concentration of a pollutant exceeds a water quality standard and the exceedance is not caused by human activity but is due solely to naturally-occurring conditions, the exceedance shall not be considered a violation of the water quality standard.

R18-11-120. Enforcement

A. Any person who causes a violation of a water quality standard or any provision of this Article is subject to the enforcement provisions prescribed in Title 49, Chapter 2, Article 4 of the Arizona Revised Statutes.

B. A numeric water quality standard may be established at a concentration that is below the practical quantitation limit. In such cases, the water quality standard is enforceable at the practical quantitation limit. The applicable practical quantitation limits are prescribed in Appendix C of this Article.

C. Compliance with acute aquatic and wildlife criteria shall be determined from the analytical test result of either a one-hour composite sample or a grab sample. Compliance with chronic aquatic and wildlife criteria shall be determined from the arithmetic mean of the analytical results of samples collected over a period of four consecutive days at a minimum rate of one sample per day.

D. A person is not subject to penalties for violation of a water quality standard provided that such person is in compliance with the provisions of a compliance schedule issued pursuant to R18-11-121.

R18-11-121. Schedules of compliance

A. A schedule to bring an existing point source into compliance with a water quality standard adopted after August 13, 1986 may be established in a National Pollutant Discharge Elimination System permit for the existing point source. A compliance schedule for an existing point source shall require compliance with a discharge limitation based upon a water quality standard no later than three years after the effective date of the water quality standard. In order for a schedule of compliance to be granted, the owner or operator of the point source shall demonstrate that all requirements under § 301(b) and § 306 of the Clean Water Act have been achieved and that the point source cannot comply with a discharge limitation based upon the water quality standard through the application of existing water pollution control technology, operational changes or source reduction.

B. A schedule of compliance shall not be established in a National Pollutant Discharge Elimination System permit for a new point source. For purposes of this subsection, a new point source means a point source, the construction of which commences after the effective date of a water quality standard. Commencement of construction means that the owner or operator of the point source has obtained the federal, state and local approvals or permits necessary to begin physical construction of the point source and either:

1. On-site physical construction program has begun; or
2. The owner or operator has entered into a contract for physical construction of the point source and the contract cannot be cancelled or modified without substantial loss. For purposes of this paragraph, "substantial loss" means in excess of ten percent of the total cost incurred for physical construction.

C. A schedule to bring a point source discharge of storm water into compliance with a water quality standard may be established in a National Pollutant Discharge Elimination System permit. A compliance schedule for a storm water discharge shall require implementation of all reasonable and cost-effective best management practices to control the discharge of pollutants in storm water. A compliance schedule shall require compliance with a water quality standard but no later than ten years after the effective date of the water quality standard.

PARAMETERS		DWS(1) (ug/L)	FC(1) (µg/L)	FRC(1) (µg/L)	PCR(1) (µg/L)	A&Wc Acute(2) (µg/L)	A&Wc Chronic(3) (µg/L)	A&Ww Acute(2) (µg/L)	A&Ww Chronic(3) (µg/L)	A&Wedw Acute(2) (µg/L)	A&Wedw Chronic(3) (µg/L)	A&We Acute(2) (µg/L)	A&We Chronic(3) (µg/L)	AgI(1) (µg/L)	AgI(1)
Acenaphthene		420	2600	8400	8400	850	550	850	550	850	550	NNS	NNS	NNS	NNS
Acenaphthylene		0.003	0.002	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Acrolein		110	750	1300	1300	34	30	34	30	34	30	NNS	NNS	NNS	NNS
Acrylonitrile	c	0.06	0.64	2.6	1400	3800	250	3800	250	3800	250	NNS	NNS	NNS	NNS
Alachlor	c1	2	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Aldrin	c	0.002	0.0003	0.08	4.2	2.0	NNS	2.0	NNS	2.0	NNS	4.5	NNS	1	1
Ammonia		NNS	NNS	NNS	NNS	b	b	b	b	NNS	NNS	NNS	NNS	NNS	NNS
Anthracene		2100	6300	420000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Antimony (as Sb)		2.8 I	140 I	56 I	56 I	88 D	30 D	88 D	30 D	1000 D	600 D	NNS	NNS	NNS	NNS
Arsenic (as As)	c2	50 I	3.1 I	50 I	2800 I	360 D	190 D	360 D	190 D	360 D	190 D	440 D	230 D	2000 I	200 I
Asbestos	c	a	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Atrazine		3	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Barium (as Ba)		1000 D	NNS	1000 D	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzene	c1	5	120	48	470	2700	180	2700	180	11000	700	NNS	NNS	NNS	NNS
Benzidine	c	0.0002	0.0007	0.006	420	1300	89	1300	89	1300	89	10000	640	0.01	0.01
Benzo (a) anthracene	c	0.003	0.00008	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (a) pyrene	c	0.003	0.002	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (ghi) perylene		0.003	0.00001	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Benzo (k) fluoranthene	c	0.003	0.00001	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
3,4 Benzofluoranthene	c	0.003	0.00004	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Beryllium (as Be)	c	0.008 I	0.21 I	0.33 I	700 I	65 D	5.3 D	65 D	5.3 D	65 D	5.3 D	NNS	NNS	NNS	NNS
BHC-alpha	c	0.006	0.03	0.22	NNS	1600	130	1600	130	1600	130	1600	130	NNS	NNS
BHC beta	c	0.02	0.02	0.78	NNS	1600	130	1600	130	1600	130	1600	130	NNS	NNS
BHC delta	c	NNS	NNS	NNS	NNS	1600	130	1600	130	1600	130	1600	130	NNS	NNS
BHC-gamma (lindane)	c	0.20	0.02	1	2500	2.0	0.08	3.4	0.28	7.6	0.61	11	0.9	NNS	NNS
Bis(2-chloroethoxy) methane		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Bis(2-chloroethyl) ether	c	0.03	1.4	1.3	NNS	120000	6700	120000	6700	120000	6700	NNS	NNS	NNS	NNS
Bis(2-chloroisopropyl) ether		280	15000	5600	5600	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Bis-(2-ethylhexyl) phthalate	c	2.5	7.4	100	280000	400	360	400	360	400	360	3100	360	NNS	NNS
Boron (as B)		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	1000 I	NNS
Bromoform		TTHM	80	180	2800	15000	10000	15000	10000	15000	10000	NNS	NNS	NNS	NNS
4 Bromophenyl phenyl ether		NNS	NNS	NNS	NNS	180	14	180	14	180	14	NNS	NNS	NNS	NNS
Butyl benzyl phthalate		1400	5000	28000	28000	1700	130	1700	130	1700	130	NNS	NNS	NNS	NNS
Cadmium (as Cd)		5 I	83 I	70 I	70 I	d D	d D	d D	d D	d D	d D	d D	d D	50 I	50 I
Carbofuran		40	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Carbon tetrachloride	c2	5	5.5	11	8000	18000	1100	18000	1100	18000	1100	NNS	NNS	NNS	NNS
Chlordane	c3	2	0.001	2	110	2.4	0.004	2.4	0.21	2.4	0.21	3.2	0.45	NNS	NNS
Chlorine (total residual)		NNS	NNS	NNS	NNS	11	5.0	11	5.0	11	5.0	NNS	NNS	NNS	NNS
Chlorobenzene		100	500	2800	2800	9800	620	9800	620	NNS	NNS	NNS	NNS	NNS	NNS
Chlorodibromomethane		TTHM	12	17	2800	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Chloroethane		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
2 Chloroethyl vinyl ether		NNS	NNS	NNS	NNS	180000	9800	180000	9800	180000	9800	NNS	NNS	NNS	NNS
Chloroform		TTHM	590	230	1400	14000	900	14000	900	14000	900	NNS	NNS	NNS	NNS
2-Chloronapthalene		560	13000	11000	11000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
2 Chlorophenol		35	2100	700	700	2200	150	2200	150	2200	150	NNS	NNS	NNS	NNS
3 methyl-4-Chlorophenol		NNS	NNS	NNS	NNS	15	4.7	15	4.7	15	4.7	48000	15000	NNS	NNS
4 Chlorophenyl phenyl ether		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS

Chromium (as Cr)		100 I	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	1000 I	1000 I
Chromium (as Cr III)		NNS	67000 I	140000 I	140000 I	e D	e D	e D	e D	e D	e D	e D	e D	NNS	NNS
Chromium (as Cr VI)		NNS	3400 I	700 I	700 I	16 D	11 D	16 D	11 D	16 D	11 D	34 D	23 D	NNS	NNS
Chrysene	c	0.003	0.0001	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Copper (as Cu)		1000 D	NNS	5200 D	5200 D	f D	f D	f D	f D	f D	f D	f D	f D	5000 I	500 I
Cyanide		140 I	210000 I	3100 I	3100 I	22 I	5.2 I	41 I	9.7 I	41 I	9.7 I	84 I	19 I	NNS	200 I
DDD	c	0.15	0.0009	5.8	NNS	1.1	0.001	1.1	0.02	1.1	0.02	1.1	0.02	0.001	0.001
DDE	c	0.1	0.0006	4.1	NNS	1.1	0.001	1.1	0.02	1.1	0.02	1.1	0.03	0.001	0.001
DDT	c	0.1	0.0005	4.1	700	1.1	0.001	1.1	0.001	1.1	0.001	1.1	0.006	0.001	0.001
Dibenzo (ah) anthracene	c	0.003	0.00003	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Dichlorobenzene		600	2800	13000	13000	790	300	1200	470	1200	470	5900	2300	NNS	NNS
1,3 Dichlorobenzene		94	1200	13000	13000	2500	970	2500	970	2500	970	NNS	NNS	NNS	NNS
1,4 Dichlorobenzene		75	1200	13000	13000	560	210	2000	780	2000	780	6500	2500	NNS	NNS
3,3 Dichlorobenzidine	c	0.08	0.09	3.1	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Dichlorobromomethane		11NM	10	11	2800	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Dichlorobromopropane	c3	0.2	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,1 Dichloroethane		NNS	NNS	14000	14000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-Dichloroethane	c4	5	120	15	10000	59000	41000	59000	41000	59000	41000	NNS	NNS	NNS	NNS
1,1-Dichloroethylene	c5	7	4.5	7	1300	15000	950	15000	950	15000	950	NNS	NNS	NNS	NNS
1,2-cis Dichloroethylene		70	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2-trans-Dichloroethylene		100	13000	2800	2800	68000	3900	68000	3900	68000	3900	NNS	NNS	NNS	NNS
2,4-Dichlorophenol		21	810	420	420	1000	88	1000	88	1000	88	NNS	NNS	NNS	NNS
Dichlorophenoxyacetic acid		70	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2 Dichloropropane	c6	5	NNS	200	200	26000	9200	26000	9200	26000	9200	NNS	NNS	NNS	NNS
1,3-Dichloropropene		2.1	360	60	60	3000	1100	3000	1100	3000	1100	NNS	NNS	NNS	NNS
Dieldrin	c	0.002	0.0002	0.07	7	2.5	0.002	2.5	0.002	2.5	0.005	4.0	0.9	1	1
Diethyl phthalate		5600	110000	110000	110000	26000	1600	26000	1600	26000	1600	NNS	NNS	NNS	NNS
Dimethyl phthalate		70000	2800000	14000000	NNS	17000	1000	17000	1000	17000	1000	NNS	NNS	NNS	NNS
2,4-Dimethylphenol		140	2200	28000	NNS	1000	310	1000	310	1100	310	150000	43000	NNS	NNS
2,4 Dinitrophenol		14	5400	280	280	110	9.2	110	9.2	110	9.2	NNS	NNS	NNS	NNS
2 methyl-4,6 Dinitrophenol		2.7	120	550	NNS	310	24	310	24	310	24	NNS	NNS	NNS	NNS
2,4-Dinitrotoluene	c	0.009	0.02	0.38	NNS	15000	970	15000	970	15000	970	NNS	NNS	NNS	NNS
2,6 Dinitrotoluene		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
2,3,7,8 TCDD (Dioxin)	c	0.0000002	0.000000004	0.000009	NNS	0.01	0.005	0.01	0.005	0.12	0.01	0.1	0.01	NNS	NNS
1,2-Diphenylhydrazine	c	0.04	0.25	1.8	NNS	130	11	130	11	130	11	NNS	NNS	NNS	NNS
Di-n butyl phthalate		700	2300	14000	14000	470	35	470	35	470	35	1100	84	NNS	NNS
Di-n-octyl phthalate		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Endosulfan sulfate		0.35	0.78	70	NNS	0.22	0.06	0.22	0.06	0.22	0.06	3.0	1.5	NNS	NNS
Endosulfan-alpha		0.35	0.92	70	NNS	0.22	0.06	0.22	0.06	0.22	0.06	3.0	1.5	NNS	NNS
Endosulfan-beta		0.35	0.92	70	NNS	0.22	0.06	0.22	0.06	0.22	0.06	3.0	1.5	NNS	NNS
Endrin		0.2	1.1	40	40	0.18	0.002	0.2	0.08	0.2	0.08	0.7	0.3	0.004	0.004
Endrin aldehyde		2.1	0.81	420	NNS	0.18	0.002	0.2	0.08	0.2	0.08	0.7	0.3	NNS	NNS
Ethlybenzene		700	110000	64000	64000	23000	1400	23000	1400	23000	1400	NNS	NNS	NNS	NNS
Ethylene dibromide	c7	0.05	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Fluoranthene		280	130	5600	5600	2000	1600	2000	1600	2000	1600	NNS	NNS	NNS	NNS
Fluorene		280	580	5600	5600	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Fluoride		4000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Heptachlor	c8	0.400	0.0002	0.31	20	0.52	0.004	0.52	0.004	0.58	0.013	0.9	0.1	NNS	NNS
Heptachlor epoxide	c8	0.200	0.0001	0.15	2	0.52	0.004	0.52	0.004	0.58	0.013	0.9	0.1	NNS	NNS
Hexachlorobenzene	c	0.02	0.002	0.83	100	6.0	3.7	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Hexachlorobutadiene	c	0.45	0.52	18	280	45	8.2	45	8.2	45	8.2	NNS	NNS	NNS	NNS
Hexachlorocyclopentadiene		49	550	1000	1000	3.5	0.3	3.5	0.3	3.5	0.3	NNS	NNS	NNS	NNS
Hexachloroethane	c	2.5	4.8	100	140	490	350	490	350	490	350	850	610	NNS	NNS
Indeno (1,2,3-cd) pyrene	c	0.003	0.000003	0.12	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Isophorone	c	8.5	520	340	28000	59000	43000	59000	43000	59000	43000	NNS	NNS	NNS	NNS
Lead (as Pb)		50 I	NNS	NNS	NNS	e D	e D	e D	e D	e D	e D	e D	e D	10000 I	100 I
Manganese (as Mn)		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	10000	NNS

(Unofficial ADEQ copy; current as of 2/1/93)

Mercury (as Hg)		2.1 I	0.6 I	42 I	42 I	2.4 D	0.01 D	2.4 D	0.01 D	2.6 D	0.2 D	5.0 D	2.7 D	NNS	10 I
Methoxychlor		40	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Methyl bromide		9.8	7500	200	200	5500	360	5500	360	5500	360	NNS	NNS	NNS	NNS
Methyl chloride	c	5.7	1800	230	2800	270000	15000	270000	15000	270000	15000	NNS	NNS	NNS	NNS
Methylene chloride	c	4.7	480	190	27000	97000	5500	97000	5500	97000	5500	NNS	NNS	NNS	NNS
Naphthalene		NNS	NNS	560	560	1100	210	3300	600	3300	600	NNS	NNS	NNS	NNS
Nickel (as Ni)		140 I	400 I	2800 I	2800 I	h D	h D	h D	h D	h D	h D	h D	h D	NNS	NNS
Nitrate (as N)		10000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Nitrate/nitrite (Total as N)		10000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Nitrite (as N)		1000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Nitrobenzene		3.5	600	70	70	13000	850	13000	850	13000	850	NNS	NNS	NNS	NNS
2-Nitrophenol		NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
4 Nitrophenol		NNS	NNS	NNS	NNS	4100	3000	4100	3000	4100	3000	NNS	NNS	NNS	NNS
N nitrosodimethylamine	c	0.0007	2.1	0.03	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
N nitrosodiphenylamine	c	7.1	12	290	NNS	2900	200	2900	200	2900	200	NNS	NNS	NNS	NNS
N nitrosodi-n-propylamine	c	0.005	0.51	0.2	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
PCBs	c9	0.5	0.00009	0.18	NNS	2.0	0.01	2.0	0.02	2.0	0.02	11	2.5	0.001	0.001
Pentachlorophenol		210	29000	2000	2000	i	i	i	i	i	i	i	i	NNS	NNS
Phenanthrene		0.003	0.0005	0.12	NNS	30	6.3	30	6.3	54	6.3	NNS	NNS	NNS	NNS
Phenol		4200	6500000	84000	84000	5100	730	7000	1000	7000	1000	180000	26000	NNS	NNS
Pyrene		210	1100	4200	4200	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Selenium (as Se)		50 I	9000	420	420 I	20 I	2.0 I	20 I	2.0 I	50 I	2 I	33 I	2.0 I	20 I	50 I
Silver (as Ag)		NNS	NNS	NNS	NNS	J D	NNS	J D	NNS	J D	NNS D	J D	NNS D	NNS	NNS
Styrene	c9	100	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Sulfides		NNS	NNS	NNS	NNS	100	NNS	100	NNS	100	NNS	100	NNS	NNS	NNS
1,1,2,2-Tetrachloroethane	c	0.17	11	7	450	4700	3200	4700	3200	4700	3200	NNS	NNS	NNS	NNS
Tetrachloroethylene	c10	5.00	11	35	4000	7600	280	6500	680	6500	680	15000	1600	NNS	NNS
Thallium (as Tl)		0.63 I	44 I	3700 I	3700 I	700 D	150 D	700 D	150 D	700 D	150 D	NNS	NNS	NNS	NNS
Toluene		1000	90000	42000	42000	8700	180	8700	180	8700	180	NNS	NNS	NNS	NNS
Toxaphene	c9	3.0	0.0008	3.0	1000	0.73	0.0002	0.73	0.02	0.73	0.02	11	1.5	0.005	0.005
2,4,5-TP (m)		50	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
1,2,4-Trichlorobenzene		NNS	NNS	2800	2800	750	130	1700	300	NNS	NNS	NNS	NNS	NNS	NNS
1,1,1-Trichloroethane		200	160000	13000	13000	2600	1600	2600	1600	2600	1600	NNS	NNS	NNS	NNS
1,1,2-Trichloroethane	c11	0.61	31	25	560	18000	12000	18000	12000	18000	12000	NNS	NNS	NNS	NNS
Trichloroethylene	c12	5.0	78	110	NNS	20000	1300	20000	1300	20000	1300	NNS	NNS	NNS	NNS
2,4,6-Trichlorophenol	c	3.2	4.9	130	NNS	160	25	160	25	160	25	3000	440	NNS	NNS
Trihalomethanes, Total	c	100	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Uranium (as Ur)		35 D	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Vinyl chloride	c13	2.0	620	80	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Xylenes (Total)		10000	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS	NNS
Zinc (as Zn)		5000 I	NNS	28000	28000	k D	k D	k D	k D	k D	k D	k D	k D	10000 I	25000 I

µg/L -- micrograms per liter
a -- The standard to protect this use is 7 million fibers (longer than 10 micrometers) per liter.
b -- Values for ammonia are contained in separate tables located at the end of Appendix A.
c -- Indicates that the parameter is a known, probable or possible human carcinogen and that the standards to protect DWS, FC and FBC are based on carcinogenicity. A "c" by itself indicates that the excess cancer risk level for the DWS designated use is 1 x 10(-6). A "c" followed by a number indicates that the excess cancer risk level for the DWS designated use only is greater than 1 x 10(-6). These excess cancer risk levels,

multiplied by 10[-6] are: c1 = 5; c2 = 17; c3 = 67;
c4 = 13; c5 = 117; c6 = 10; c7 = 125; c8 = 50; c9 = 100;
c10 = 7; c11 = 8; c12 = 2; and c13 = 133. The excess
cancer risk level for the FC and FBC designated uses is
1 x 10[-6].

d -- Cadmium --
- A&Wc acute standard: e[(1.128 [ln(Hardness)] - 3.828)]
- A&Wc chronic standard: e[(0.7852 [ln(Hardness)] - 3.490)]
- A&Ww acute standard: e[(1.128 [ln(Hardness)] - 2.0149)]
- A&Ww chronic standard: e[(0.7852 [ln(Hardness)] - 3.490)]
- A&Wedw acute standard: e[(1.128 [ln(Hardness)] - 2.0149)]
- A&Wedw chronic standard: e[(0.7852 [ln(Hardness)] - 3.490)]
- A&We acute standard: e[(1.128 [ln(Hardness)] - 0.9691)]
- A&We chronic standard: e[(0.7852 [ln(Hardness)] - 3.490)]
- (See Footnote 4)

e -- Chromium III --
- A&Wc acute standard: e[(0.8190 [ln(Hardness)] + 3.688)]
- A&Wc chronic standard: e[(0.8190 [ln(Hardness)] + 1.561)]
- A&Ww acute standard: e[(0.8190 [ln(Hardness)] + 3.688)]
- A&Ww chronic standard: e[(0.8190 [ln(Hardness)] + 1.561)]
- A&Wedw acute standard: e[(0.8190 [ln(Hardness)] + 4.9361)]
- A&Wedw chronic standard: e[(0.8190 [ln(Hardness)] + 1.561)]
- A&We acute standard: e[(0.8190 [ln(Hardness)] + 3.688)]
- A&We chronic standard: e[(0.8190 [ln(Hardness)] + 1.561)]
- (See Footnote 4)

f -- Copper --
- A&Wc acute standard: e[(0.9422 [ln(Hardness)] - 1.464)]
- A&Wc chronic standard: e[(0.8545 [ln(Hardness)] - 1.465)]
- A&Ww acute standard: e[(0.9422 [ln(Hardness)] - 1.464)]
- A&Ww chronic standard: e[(0.8545 [ln(Hardness)] - 1.465)]
- A&Wedw acute standard: e[(0.9422 [ln(Hardness)] - 1.464)]
- A&Wedw chronic standard: e[(0.8545 [ln(Hardness)] - 1.465)]
- A&We acute standard: e[(0.9422 [ln(Hardness)] - 1.1514)]
- A&We chronic standard: e[(0.8545 [ln(Hardness)] - 1.1448]
- (See Footnote 4)

g -- Lead --
- A&Wc acute standard: e[(1.2730 [ln(Hardness)] - 1.460)]
- A&Wc chronic standard: e[(1.2730 [ln(Hardness)] - 4.705)]
- A&Ww acute standard: e[(1.2730 [ln(Hardness)] - 1.460)]
- A&Ww chronic standard: e[(1.2730 [ln(Hardness)] - 4.705)]
- A&Wedw acute standard: e[(1.2730 [ln(Hardness)] - 1.460)]
- A&Wedw chronic standard: e[(1.2730 [ln(Hardness)] - 4.705)]
- A&We acute standard: e[(1.2730 [ln(Hardness)] - 0.7131)]
- A&We chronic standard: e[(1.2730 [ln(Hardness)] - 3.9518)]
- (See Footnote 4)

h -- Nickel --
- A&Wc acute standard: e[(0.8460 [ln(Hardness)] + 3.3611)]
- A&Wc chronic standard: e[(0.8460 [ln(Hardness)] + 1.1644)]
- A&Ww acute standard: e[(0.8460 [ln(Hardness)] + 3.3611)]
- A&Ww chronic standard: e[(0.8460 [ln(Hardness)] + 1.1644)]
- A&Wedw acute standard: e[(0.8460 [ln(Hardness)] + 3.3611)]
- A&Wedw chronic standard: e[(0.8460 [ln(Hardness)] + 1.1644)]
- A&We acute standard: e[(0.8460 [ln(Hardness)] + 4.4389)]
- A&We chronic standard: e[(0.8460 [ln(Hardness)] + 2.2417)]
- (See Footnote 4)

i -- Pentachlorophenol --
- A&Wc acute standard: e[(1.005 (pH) - 4.830)]

A&Wc chronic standard: e((1.005 (pH) - 5.290))
A&Ww acute standard: e((1.005 (pH) - 4.830))
A&Ww chronic standard: e((1.005 (pH) - 5.290))
A&Wedw acute standard: e((1.005 (pH) - 4.830))
A&Wedw chronic standard: e((1.005 (pH) - 5.290))
A&We acute standard: e((1.005 (pH) - 3.4306))
A&We chronic standard: e((1.005 (pH) - 3.9006))
(See footnote 5)

j -- Silver --
A&Wc acute standard: e((1.72 [ln(Hardness)] - 6.52))
A&Ww acute standard: e((1.72 [ln(Hardness)] - 6.52))
A&Wedw acute standard: e((1.72 [ln(Hardness)] - 6.52))
A&We acute standard: e((1.72 [ln(Hardness)] - 6.52))
(See footnote 4)

k -- Zinc --
A&Wc acute standard: e((0.8473 [ln(Hardness)] + 0.860))
A&Wc chronic standard: e((0.8473 [ln(Hardness)] + 0.761))
A&Ww acute standard: e((0.8473 [ln(Hardness)] + 0.860))
A&Ww chronic standard: e((0.8473 [ln(Hardness)] + 0.761))
A&Wedw acute standard: e((0.8473 [ln(Hardness)] + 0.860))
A&Wedw chronic standard: e((0.8473 [ln(Hardness)] + 0.761))
A&We acute standard: e((0.8473 [ln(Hardness)] + 3.1342))
A&We chronic standard: e((0.8473 [ln(Hardness)] + 3.0484))
(See footnote 4)

l -- The standard to protect this use is 0.003 ug/l aldrin/dieldrin.

m -- 2,4,5-trichlorophenoxyacetic acid

(1) The numeric standards to protect this use shall not be exceeded.

(2) Determination of compliance with acute standards shall be as prescribed in R18-11-120.C.

(3) Determination of compliance with chronic standards shall be as prescribed in R18-11-120.C.

Footnote 4 -- Hardness is determined pursuant to the methods specified for the definition of hardness Section 101. Hardness is determined from a sample taken at the same time and place that the sample for the metal is taken. Hardness, expressed as mg/l CaCO3, is then inserted into the equation where it says "Hardness".

Footnote 5 -- The pH at the time and location that the sample for pentachlorophenol was taken is inserted into the equation where it says "pH".

NNS -- No numeric standard.
D -- Dissolved
T -- Total recoverable
TTHM -- Indicates that the chemical is a trihalomethane. See trihalomethanes for DWS standard.

AWQc -- ACUTE

Total Ammonia mg-N/l (or mg NH3-N/liter)

pH	Temperature in Degrees Celsius 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	30 and above	pH
6.5	29	28	28	27	27	27	27	26	26	26	25	25	25	25	25	24	24	24	24	24	24	16.8	11.8	6.5
6.6	28	27	27	27	26	26	26	25	25	25	25	24	24	24	24	24	24	23	23	23	23	16.2	11.4	6.6
6.7	27	27	26	26	26	25	25	25	24	24	24	24	23	23	23	23	23	23	23	22	22	15.6	11.1	6.7
6.8	26	25	25	25	24	24	24	24	23	23	23	23	23	22	22	22	22	22	22	22	21	15.0	10.6	6.8
6.9	25	24	24	24	23	23	23	22	22	22	22	22	21	21	21	21	21	21	21	21	20	14.3	10.1	6.9
7.0	23	23	22	22	22	22	21	21	21	21	20	20	20	20.0	19.9	19.7	19.6	19.5	19.4	19.3	19.2	13.4	9.5	7.0
7.1	22	21	21	21	20	20	19.9	19.6	19.5	19.3	19.1	18.9	18.8	18.6	18.5	18.4	18.3	18.2	18.1	18.0	17.9	12.5	8.9	7.1
7.2	19.8	19.6	19.2	19.0	18.8	18.5	18.4	18.1	17.9	17.8	17.6	17.5	17.3	17.2	17.0	16.9	16.8	16.7	16.7	16.6	16.5	11.6	8.2	7.2
7.3	18.0	17.8	17.5	17.3	17.1	16.9	16.7	16.5	16.3	16.2	16.0	15.9	15.8	15.6	15.5	15.4	15.3	15.2	15.2	15.1	15.0	10.6	7.5	7.3
7.4	16.2	16.0	15.7	15.5	15.3	15.1	15.0	14.8	14.6	14.5	14.4	14.3	14.1	14.0	13.9	13.8	13.8	13.7	13.6	13.6	13.5	9.5	6.7	7.4
7.5	14.3	14.1	13.9	13.7	13.6	13.4	13.3	13.1	13.0	12.8	12.7	12.6	12.5	12.4	12.4	12.3	12.2	12.1	12.1	12.1	12.0	8.4	6.0	7.5
7.6	12.5	12.3	12.2	12.0	11.9	11.7	11.6	11.5	11.4	11.2	11.2	11.1	11.0	10.9	10.8	10.8	10.7	10.6	10.6	10.5	10.5	7.4	5.3	7.6
7.7	10.8	10.7	10.5	10.4	10.3	10.1	10.0	9.9	9.8	9.7	9.6	9.6	9.5	9.5	9.3	9.3	9.2	9.2	9.2	9.1	9.1	6.4	4.6	7.7
7.8	9.2	9.1	9.0	8.9	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.2	8.1	8.1	8.0	8.0	7.9	7.9	7.9	7.8	7.8	5.5	4.0	7.8
7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.2	7.1	7.0	7.0	6.9	6.9	6.8	6.8	6.7	6.7	6.7	6.7	6.6	6.6	4.7	3.4	7.9
8.0	6.5	6.4	6.4	6.3	6.2	6.1	6.1	6.0	5.9	5.9	5.8	5.8	5.8	5.7	5.7	5.7	5.6	5.6	5.6	5.6	5.6	4.0	2.9	8.0
8.1	5.2	5.1	5.1	5.0	4.9	4.9	4.8	4.8	4.8	4.7	4.7	4.6	4.6	4.6	4.6	4.5	4.5	4.9	4.5	4.5	4.5	3.2	2.3	8.1
8.2	4.2	4.1	4.0	4.0	4.0	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.7	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.6	2.6	1.89	8.2
8.3	3.3	3.3	3.2	3.2	3.1	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.1	1.55	8.3
8.4	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.4	2.4	1.71	1.27	8.4
8.5	2.1	2.1	2.1	2.0	2.0	2.0	1.98	1.96	1.95	1.94	1.93	1.92	1.91	1.90	1.90	1.90	1.90	1.90	1.90	1.91	1.92	1.41	1.05	8.5
8.6	1.68	1.66	1.65	1.63	1.61	1.60	1.59	1.58	1.57	1.56	1.55	1.55	1.54	1.54	1.54	1.54	1.54	1.55	1.55	1.56	1.57	1.16	0.88	8.6
8.7	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.26	1.25	1.25	1.25	1.25	1.25	1.25	1.26	1.26	1.27	1.28	1.29	0.96	0.74	8.7
8.8	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.04	1.05	1.06	1.07	0.81	0.63	8.8
8.9	0.87	0.86	0.86	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.84	0.84	0.84	0.85	0.85	0.86	0.87	0.88	0.89	0.69	0.55	8.9
9.0	0.70	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.69	0.69	0.70	0.70	0.71	0.72	0.73	0.74	0.75	0.59	0.48	9.0

NOTES:

1. pH and temperature are field measurements taken at the same time and location as the water samples destined for the laboratory analysis of ammonia.

2. If field measured pH and/or temperature values fall between the AWQc Acute Total Ammonia tabular values, round field measured values according to standard rounding procedures to nearest tabular value to determine ammonia standard.

A&W -- ACUTE

Total Ammonia mg N/liter (or mg NH3-N/liter)

pH	Temperature in Degrees Celsius 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	pH
6.5	29	28	28	27	27	27	27	26	26	26	25	25	25	25	25	6.5
6.6	28	27	27	27	26	26	26	25	25	25	25	25	24	24	24	6.6
6.7	27	27	26	26	26	25	25	25	24	24	24	24	23	23	23	6.7
6.8	26	25	25	25	24	24	24	24	23	23	23	23	23	22	22	6.8
6.9	25	24	24	24	23	23	23	22	22	22	22	22	21	21	21	6.9
7.0	23	23	22	22	22	22	21	21	21	21	20	20	20	20	20	7.0
7.1	22	21	21	21	20	20	20	20	19.5	19.3	19.1	18.9	18.8	18.6	18.5	7.1
7.2	20	20	19.2	19.0	18.8	18.5	18.4	18.1	17.9	17.8	17.6	17.5	17.3	17.2	17.0	7.2
7.3	18.0	17.8	17.5	17.3	17.1	16.9	16.7	16.5	16.3	16.2	16.0	15.9	15.8	15.6	15.5	7.3
7.4	16.2	16.0	15.7	15.5	15.3	15.1	15.0	14.8	14.7	14.5	14.4	14.3	14.1	14.0	13.9	7.4
7.5	14.3	14.1	13.9	13.7	13.6	13.4	13.3	13.1	13.0	12.8	12.7	12.6	12.5	12.4	12.4	7.5
7.6	12.5	12.3	12.2	12.0	11.9	11.7	11.6	11.5	11.4	11.3	11.2	11.1	11.0	10.9	10.8	7.6
7.7	10.8	10.7	10.5	10.4	10.3	10.1	10.0	9.9	9.8	9.7	9.6	9.6	9.5	9.5	9.3	7.7
7.8	9.2	9.1	9.0	8.9	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.2	8.1	8.1	8.0	7.8
7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.2	7.1	7.0	7.0	6.9	6.9	6.8	6.8	7.9
8.0	6.5	6.4	6.4	6.3	6.2	6.1	6.1	6.0	5.9	5.9	5.8	5.8	5.8	5.7	5.7	8.0
8.1	5.2	5.1	5.1	5.0	4.9	4.9	4.8	4.8	4.8	4.7	4.7	4.6	4.6	4.6	4.6	8.1
8.2	4.2	4.1	4.0	4.0	4.0	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.7	3.7	3.6	8.2
8.3	3.3	3.3	3.2	3.2	3.1	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.0	2.9	2.9	8.3
8.4	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	8.4
8.5	2.1	2.1	2.1	2.0	2.0	2.0	2.0	2.0	1.95	1.94	1.93	1.92	1.91	1.90	1.90	8.5
8.6	1.68	1.66	1.65	1.63	1.61	1.60	1.59	1.58	1.57	1.56	1.55	1.55	1.54	1.54	1.54	8.6
8.7	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.26	1.25	1.25	1.25	1.25	1.25	8.7
8.8	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	8.8
8.9	0.87	0.86	0.86	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.83	0.83	0.84	0.84	0.84	8.9
9.0	0.70	0.70	0.69	0.69	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.69	0.69	0.70	9.0

NOTES:

1. pH and temperature are field measurements taken at the same time and location as the water samples destined for the laboratory analysis of ammonia.
2. If field measured pH and/or temperature values fall between the A&W Acute Total Ammonia tabular values, round field measured values according to standard scientific rounding procedures to nearest tabular value to determine the ammonia standard.

A&Ww -- ACUTE

Total Ammonia mg-N/liter (or mg NH3-N/liter) -- (cont.)

pH	Temperature in Degrees Celsius 15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 and above	pH
6.5	24	24	24	24	24	24	24	24	24	24	23	22	20	19.1	17.8	16.6	6.5
6.6	24	24	23	23	23	23	23	23	23	23	23	21	20	18.5	17.3	16.1	6.6
6.7	23	23	23	23	22	22	22	22	22	22	22	21	19.2	17.9	16.7	15.6	6.7
6.8	22	22	22	22	22	21	21	21	21	21	21	20	18.4	17.2	16.1	15.0	6.8
6.9	21	21	21	21	21	20	20	20	20	20	20	18.8	17.5	16.4	15.3	14.3	6.9
7.0	20	20	20	19.4	19.3	19.2	19.2	19.1	19.1	19.0	19.0	17.7	16.5	15.4	14.4	13.4	7.0
7.1	18.4	18.3	18.2	18.1	18.0	17.9	17.9	17.8	17.8	17.7	17.7	16.5	15.4	14.4	13.4	12.6	7.1
7.2	16.9	16.8	16.7	16.7	16.6	16.5	16.5	16.4	16.4	16.4	16.3	15.2	14.2	13.3	12.4	11.6	7.2
7.3	15.4	15.3	15.2	15.2	15.1	15.0	15.0	15.0	14.9	14.9	14.9	13.9	12.9	12.0	11.3	10.6	7.3
7.4	13.8	13.8	13.7	13.6	13.6	13.5	13.5	13.5	13.4	13.4	13.4	12.5	11.6	10.9	10.2	9.5	7.4
7.5	12.3	12.2	12.2	12.1	12.1	12.0	12.0	12.0	11.9	11.9	11.9	11.1	10.4	9.7	9.1	8.5	7.5
7.6	10.8	10.7	10.6	10.6	10.5	10.5	10.5	10.4	10.4	10.4	10.5	9.8	9.1	8.5	8.0	7.4	7.6
7.7	9.3	9.2	9.2	9.2	9.1	9.1	9.1	9.1	9.1	9.1	9.1	8.5	7.9	7.4	6.9	6.5	7.7
7.8	8.0	7.9	7.9	7.9	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.3	6.8	6.4	6.0	5.6	7.8
7.9	6.7	6.7	6.7	6.7	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.2	5.8	5.4	5.1	4.8	7.9
8.0	5.7	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.2	4.9	4.6	4.3	4.0	8.0
8.1	4.5	4.5	4.9	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.2	4.0	3.7	3.5	3.3	8.1
8.2	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.4	3.2	3.0	2.8	2.7	8.2
8.3	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	2.8	2.6	2.5	2.3	2.2	8.3
8.4	2.4	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.1	2.0	1.90	1.80	8.4
8.5	1.90	1.90	1.90	1.90	1.91	1.92	1.92	1.93	1.95	1.96	1.99	1.86	1.77	1.66	1.57	1.49	8.5
8.6	1.54	1.54	1.55	1.55	1.56	1.57	1.58	1.58	1.60	1.62	1.63	1.55	1.46	1.38	1.31	1.24	8.6
8.7	1.25	1.26	1.26	1.27	1.28	1.29	1.30	1.31	1.33	1.34	1.36	1.29	1.22	1.16	1.10	1.05	8.7
8.8	1.03	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.11	1.12	1.14	1.09	1.03	0.98	0.94	0.90	8.8
8.9	0.85	0.85	0.86	0.87	0.88	0.89	0.91	0.92	0.93	0.95	0.97	0.93	0.88	0.84	0.81	0.77	8.9
9.0	0.70	0.71	0.72	0.73	0.74	0.75	0.77	0.78	0.80	0.81	0.83	0.80	0.76	0.73	0.70	0.68	9.0

NOTES:

1. pH and temperature are field measurements taken at the same time and location as the water samples destined for the laboratory analysis of ammonia.

2. If field measured pH and/or temperature values fall between the A&Ww Acute Total Ammonia tabular values, round field measured values according to standard scientific rounding procedures to nearest tabular value to determine the ammonia standard.

Navigable water	Designated Use
COLORADO MAIN STEM RIVER BASIN	
A-10 Backwater	A&Ww, FBC, FC
A-7 Backwater	A&Ww, FBC, FC
Agate Creek	A&Wc, FBC, DWS, FC
Alamo Lake	A&Ww, FBC, FC
Big Sandy River	A&Ww, FBC, FC, AgL
Big Springs Tank	A&Wc, FBC, FC, AgL
Bill Williams River	A&Ww, FBC, FC, AgL
Blue Tank	A&Ww, FBC, FC, AgL
Boucher Creek	A&Wc, FBC, DWS, FC
Boulder Creek	A&Ww, FBC, FC, AgI, AgL
Bright Angel Creek	A&Wc, FBC, DWS, FC
Bright Angel Wash{1} (Grand Canyon WWTP to Cataract Creek)	A&Wedw, PBC
Bull Rush Canyon Wash	A&We, PBC
Burro Creek{2} (above confluence with Boulder Creek)	A&Ww, FBC, FC, AgL
Cataract Creek (Headwaters to Williams WWTP)	A&Wc, FBC, DWS, FC, AgI, AgL
Cataract Creek{1} (Williams WWTP to 3 km downstream)	A&Wedw, PBC
Cataract Creek (Below 3 km downstream of Williams WWTP)	A&Wc, FBC, FC, AgI, AgL
Cataract Lake	A&Wc, FBC, DWS, FC, AgL
Chuar Creek	A&Wc, FBC, DWS, FC
Cibola Lake	A&Ww, FBC, FC
City Reservoir	A&Ww, FBC, DWS, FC
Clear Creek	A&Wc, FBC, DWS, FC
Colorado River (Lake Powell to Topock)	A&Wc, FBC, DWS, FC, AgI, AgL
Colorado River (Topock to Mexico)	A&Ww, FBC, DWS, FC, AgI, AgL
Coors Lake	A&Ww, FBC, FC
Cottonwood Creek	A&Ww, FBC, DWS
Crystal Creek	A&Wc, FBC, DWS, FC
Deer Creek	A&Wc, FBC, DWS, FC
Detrital Wash	A&We, PBC
Diamond Creek	A&Wc, FBC, FC, AgL
Dogtown Reservoir	A&Wc, FBC, DWS, FC, AgI, AgL
Dragon Creek	A&Ww, FBC, DWS, FC
Francis Creek{2}	A&Ww, FBC, DWS, FC, AgL
Garden Creek	A&Wc, FBC, DWS, FC
Gila River (See listing in Middle Gila River Basin)	
Grand Wash	A&We, PBC
Granite Park Canyon Creek	A&Wc, FBC, FC
Grapevine Creek	A&Wc, FBC, DWS, FC
Grapevine Wash	A&We, PBC
Hakatai Creek	A&Wc, FBC, DWS, FC
Hance Creek	A&Wc, FBC, DWS, FC
Havasu Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Hermit Creek	A&Wc, FBC, DWS, FC
Holy Moses Wash{1} (Kingman	A&Wedw, PBC

WWTP to 5 km downstream)

Horn Creek	A&Wc, FBC, DWS, FC
Hualapai Wash	A&Ww, PBC
Hunter's Hole Backwater	A&Ww, FBC, FC
Imperial Reservoir	A&Ww, FBC, DWS, FC, AgI, AgL
Jacob Lake	A&Ww, FBC
Kaibab Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Kaibito Creek	A&Ww, FBC, FC, AgL
Kanab Creek	A&Ww, FBC, DWS, FC, AgL
Kirkland Creek	A&Ww, FBC, FC, AgI, AgL
Kwagunt Creek	A&Wc, FBC, DWS, FC
Laguna Reservoir	A&Ww, FBC, DWS, FC, AgI, AgL
Lake Havasu	A&Ww, FBC, DWS, FC, AgI, AgL
Lake Mead	A&Wc, FBC, DWS, FC, AgI, AgL
Lake Mohave	A&Wc, FBC, DWS, FC, AgI, AgL
Lake Powell	A&Wc, FBC, DWS, FC, AgI, AgL
Lonetree Canyon Creek	A&Ww, PBC, DWS
Martinez Lake	A&Ww, FBC, FC, AgI, AgL
Matkatamiba Creek	A&Wc, FBC, DWS, FC
Mittry Lake	A&Ww, FBC, FC
Mohave Wash	A&We, PBC
Monument Creek	A&Ww, FBC, DWS, FC
Nankoweap Creek	A&Wc, FBC, DWS, FC
National Canyon Creek	A&Wc, FBC, DWS, FC
Navajo Creek	A&Ww, FBC, FC, AgL
North Canyon Creek	A&Wc, FBC, DWS, FC
Olo Creek	A&Ww, FBC, DWS, FC
Paria River	A&Wc, FBC, DWS, FC
Peeple's Canyon Creek{2}	A&Ww, FBC, AgL
Phantom Creek	A&Wc, FBC, DWS, FC
Pipe Creek	A&Wc, FBC, DWS, FC
Pretty Water Lake	A&Ww, FBC, FC
Quigley Ponds	A&Ww, FBC, FC
Red Canyon Creek	A&Ww, FBC, DWS
Redondo Lake	A&Ww, FBC, FC
Roaring Springs Creek	A&Wc, FBC, DWS, FC
Royal Arch Creek	A&Wc, FBC, DWS, FC
Ruby Creek	A&Wc, FBC, DWS, FC
Sacramento Wash	A&We, PBC
Saddle Canyon Creek	A&Wc, FBC, FC
Santa Fe Reservoir	A&Wc, FBC, DWS, FC
Santa Maria River	A&Ww, FBC, FC, AgI, AgL
Sapphire Creek	A&Wc, FBC, DWS, FC
Sawmill Wash	A&Ww, PBC, AgL
Serpentine Creek	A&Wc, PBC, DWS, FC
Shinumo Creek	A&Wc, FBC, DWS, FC
Short Creek	A&We, PBC
Slate Creek	A&Wc, FBC, DWS, FC
Spencer Canyon Creek	A&Wc, FBC, FC
Spring Canyon Creek	A&Wc, FBC, DWS, FC
Stone Creek	A&Wc, FBC, DWS, FC
Tapeats Creek	A&Wc, FBC, DWS, FC
Three Springs Creek	A&Wc, FBC, DWS, FC
Thunder River	A&Wc, FBC, DWS, FC, AgL
Topock Marsh	A&Ww, FBC, DWS, FC, AgI, AgL
Trail Canyon Creek	A&Wc, FBC, DWS, FC
Travertine Falls Creek	A&Wc, FBC, DWS, FC
Trout Creek	A&Ww, FBC, FC, AgL

Turquoise Creek	A&Wc, FBC, DWS, FC
Unkar Creek	A&Wc, FBC, DWS, FC
Unnamed Wash{1} (Grand Canyon, North Rim WWTP to 1 km downstream)	A&Wedw, PBC
Upper City Reservoir	A&Ww, FBC, FC
Vasey's Paradise	A&Wc, FBC, DWS, FC
Virgin River	A&Ww, FBC, FC, AgI, AgL
Vishnu Creek	A&Wc, FBC, DWS, FC
Warm Springs Creek	A&Ww, FBC, DWS
Wellton Canal	DWS, AgI, AgL
Wellton Ponds	A&Ww, FBC, FC
White Creek	A&Ww, FBC, DWS, FC
Wia Manua Park Lake	A&Ww, FBC, FC
YPG Pond	A&Ww, FBC, FC
Yuma Area Canals above municipal water treatment plant intakes	DWS, AgI, AgL
Yuma Area Canals below water treatment plant intakes and all drains	AgI, AgL

LITTLE COLORADO RIVER BASIN

Antelope Lake	A&Ww, FBC, FC, AgI, AgL
Ashurst Lake	A&Wc, FBC, FC, AgI, AgL
Barbershop Canyon Creek	A&Wc, FBC, FC, AgL
Bear Canyon Creek (Tributary to Blue Ridge Reservoir)	A&Wc, FBC, FC, AgL
Bear Canyon Creek (Tributary to Willow Creek)	A&Wc, FBC, FC, AgL
Bear Canyon Lake	A&Wc, FBC, FC, AgI, AgL
Becker Lake	A&Wc, FBC, FC, AgL
Billy Creek	A&Wc, FBC, FC, AgL
Black Canyon Creek	A&Wc, FBC, FC, AgI, AgL
Black Canyon Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Black Creek (New Mexico Border to Fort Defiance WWTP)	A&Ww, FBC, AgI, AgL
Black Creek{1} (Fort Defiance WWTP to the Puerco River)	A&Wedw, PBC
Blue Ridge Reservoir	A&Wc, FBC, FC, AgI, AgL
Boot Lake	A&Ww, FBC, AgL
Buck Springs Canyon Creek	A&Wc, FBC, FC, AgL
Bunch Reservoir	A&Wc, FBC, FC, AgI, AgL
Camillo Tank	A&Ww, FBC, AgL
Carnero Lake	A&Wc, FBC, FC, AgL
Chevelon Canyon Lake	A&Wc, FBC, FC, AgI, AgL
Chevelon Creek	A&Wc, FBC, FC, AgI, AgL
Chevelon Creek, West Fork	A&Wc, FBC, FC, AgL
Chilson Tank	A&Ww, FBC, AgL
Cholla Lake	A&Ww, FBC, FC, AgL
Clear Creek	A&Wc, FBC, DWS, FC, AgL
Clear Creek Reservoir	A&Wc, FBC, FC, AgI, AgL
Coconino Reservoir	A&Wc, FBC, FC, AgI, AgL
Colter Creek	A&Wc, FBC, FC, AgL
Colter Reservoir	A&Wc, FBC, FC, AgL
Concho Creek	A&Ww, FBC, FC, AgL
Concho Lake	A&Wc, FBC, FC, AgI, AgL
Cow Lake	A&Ww, FBC, AgL
Coyote Creek	A&Wc, FBC, FC, AgI, AgL

Crisis Lake (Snake Tank #2)	A&Ww, FBC, AgL
Dane Canyon Creek	A&Wc, FBC, FC, AgL
Daves Tank	A&Ww, FBC, AgL
Deep Lake	A&Ww, FBC, AgL
Dry Lake{1}	A&Wedw
East Clear Creek	A&Wc, FBC, FC, AgI, AgL
Fish Creek	A&Wc, FBC, FC
Fool's Hollow Lake	A&Wc, FBC, FC, AgL
Ganado Lake	A&Ww, FBC, FC, AgI
General Springs Creek	A&Wc, FBC, FC, AgL
Hall Creek	A&Wc, FBC, FC, AgI, AgL
Hart Canyon Creek	A&Wc, FBC, FC, AgL
Hidden Lake	A&Ww, FBC, FC, AgI, AgL
Horse Lake	A&Ww, FBC, AgL
Huffer Tank	A&Ww, FBC, FC, AgL
Hulsey Creek	A&Wc, FBC, FC
Hulsey Lake	A&Wc, FBC, FC
Jack's Canyon Creek	A&Ww, FBC, FC, AgI, AgL
Kinnikinick Lake	A&Wc, FBC, FC, AgL
Knoll Lake	A&Wc, FBC, FC, AgL
Lake Humphreys{1}	A&Wedw, PBC
Lake Mary, lower	A&Wc, FBC, FC, AgL
Lake Mary, upper	A&Wc, FBC, DWS, FC, AgL
Lake of the Woods	A&Wc, FBC, FC, AgI, AgL
Lee Valley Creek	A&Wc, FBC, FC, AgL
Lee Valley Reservoir	A&Wc, FBC, FC, AgI, AgL
Leonard Canyon Creek	A&Wc, FBC, FC, AgL
Leonard Canyon Creek, East Fork	A&Wc, FBC, FC, AgL
Leonard Canyon Creek, Middle Fork	A&Wc, FBC, FC, AgL
Leonard Canyon Creek, West Fork	A&Wc, FBC, FC, AgL
Little Colorado River (Below Lyman Reservoir)	A&Ww, FBC, DWS, FC, AgI, AgL
Little Colorado River (West Fork below Government Springs)	A&Wc, FBC, FC, AgI, AgL
Little Colorado River{2} (West Fork above Government Springs)	A&Wc, FBC, FC
Little Colorado River, East Fork	A&Wc, FBC, FC, AgI, AgL
Little Colorado River, South Fork	A&Wc, FBC, FC, AgI, AgL
Little George Reservoir	A&Ww, FBC, FC, AgI
Little Mormon Lake	A&Ww, FBC, FC, AgI, AgL
Little Ortega Lake	A&Ww, FBC, FC
Long Lake, lower	A&Wc, FBC, FC, AgI, AgL
Long Lake, upper	A&Ww, FBC, AgL
Long Tom Tank	A&Wc, FBC, FC, AgL
Lower Walnut Canyon Lake{1}	A&Wedw, PBC
Lyman Reservoir	A&Wc, FBC, FC, AgI, AgL
Mamie Creek	A&Wc, FBC, FC, AgI, AgL
Marshall Lake	A&Wc, FBC, FC, AgL
Merritt Draw Creek	A&Wc, FBC, FC, AgL
Mexican Hay Lake	A&Wc, FBC, FC, AgI, AgL
Milk Creek	A&Wc, FBC, FC
Miller Canyon Creek	A&Wc, FBC, FC, AgL
Miller Canyon Creek, East Fork	A&Wc, FBC, FC, AgL
Mineral Creek	A&Wc, FBC, FC, AgI, AgL
Mormon Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Morton Lake	A&Wc, FBC, FC, AgL
Mud Lake	A&Ww, FBC, AgL
Ned Lake{1}	A&Wedw, PBC

Nelson Reservoir	A&Wc, FBC, FC, AgI, AgL
Nutrioso Creek	A&Wc, FBC, FC, AgI, AgL
Paddy Creek	A&Wc, FBC, FC
Pasture Canyon Lake	A&Ww, FBC, FC, AgI
Phoenix Park Wash	A&We, PBC
Pine Tank	A&Ww, FBC, AgL
Pintail Lake{1}	A&Wedw, PBC
Porter Creek	A&Wc, FBC, FC
Potato Lake	A&Wc, FBC, AgL
Pratt Lake	A&Wc, FBC, FC
Puerco River	A&Ww, FBC, AgI, AgL
Quarter Circle Bar Tank	A&Ww, FBC, AgL
Rainbow Lake	A&Wc, FBC, FC, AgI, AgL
Red Lake	A&Ww, FBC, FC, AgI
Rio de Flag{1}	A&Wedw, PBC
River Reservoir	A&Wc, FBC, FC, AgI, AgL
Rogers Reservoir	A&Ww, FBC, AgL
Russell Tank	A&Wc, FBC, FC, AgL
Sawmill Lakes	A&Ww, FBC, FC, AgI, AgL
Scott's Reservoir	A&Wc, FBC, FC, AgI, AgL
Show Low Creek	A&Wc, FBC, FC, AgI, AgL
Show Low Lake	A&Wc, FBC, FC, AgI, AgL
Silver Creek	A&Wc, FBC, FC, AgI, AgL
Soldiers Annex Lake	A&Wc, FBC, FC, AgI, AgL
Soldiers Lake	A&Wc, FBC, FC, AgI, AgL
Spaulding Tank	A&Ww, FBC, FC, AgL
Sponseller Lake	A&Ww, FBC
St Johns Reservoir (Little Reservoir)	A&Ww, FBC, FC, AgI, AgL
Telephone Lake{1}	A&Wedw, PBC
Trout Lake	A&Ww, FBC, FC, AgL
Tunnel Lake	A&Wc, FBC, FC, AgI, AgL
Turkey Creek	A&Wc, FBC, FC, AgL
Vail Lake	A&Wc, FBC, AgL
Walnut Creek	A&Wc, FBC, FC
Water Canyon Creek	A&Ww, FBC, FC, AgL
Whipple Lake	A&Ww, FBC, FC, AgL
White Mountain Lake	A&Wc, FBC, FC, AgI, AgL
White Mountain Reservoir	A&Wc, FBC, FC, AgI, AgL
Willow Creek	A&Wc, FBC, FC, AgL
Willow Springs Creek	A&Wc, FBC, FC, AgL
Willow Springs Lake	A&Wc, FBC, FC, AgI, AgL
Woodland Reservoir	A&Wc, FBC, FC, AgI, AgL
Woods Canyon Creek	A&Wc, FBC, FC
Woods Canyon Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Zuni River	A&Ww, FBC, AgI, AgL

MIDDLE GILA RIVER BASIN

Agua Fria River (Above confluence with unnamed wash receiving treated wasetwater from Prescott Valley WWTP)	A&We, PBC, AgI, AgL
Unnamed wash (From Prescott Valley WWTP to confluence with Agua Fria River)	A&Wedw, PBC
Agua Fria River (Below confluence with unnamed wash receiving	A&Wedw, PBC, AgI, AgL

treated wastewater from Prescott Valley WWTP to State Route 169)	
Agua Fria River (State Route 169 to Lake Pleasant)	A&Ww, FBC, DWS, FC, AgI, AgL
Agua Fria River (Lake Pleasant to the Surprise WWTP)	A&Ww, FBC, FC, AgI, AgL
Agua Fria River{1} (Surprise WWTP to Camelback Road)	A&Wedw, PBC
Agua Fria River (Camelback Road to Avondale WWTP)	A&Ww, PBC, AgI, AgL
Agua Fria River{1} (Avondale WWTP to Gila River confluence)	A&Wedw, PBC
Antelope Creek	A&Ww, PBC, AgI, AgL
Ash Creek	A&Ww, FBC, FC, AgI, AgL
Beehive Tank	A&Ww, FBC, AgL
Big Bug Creek	A&Ww, FBC, FC, AgI, AgL
Black Canyon Creek	A&Ww, FBC, AgI, AgL
Blind Indian Creek	A&Ww, FBC, FC, AgI, AgL
Cave Creek (Headwaters to Cave Creek Dam)	A&Ww, FBC, FC, AgL
Cave Creek (Cave Creek Dam to the Arizona Canal)	A&We, PBC
Centennial Wash	A&We, PBC
Centennial Wash Ponds	A&Ww, FBC, AgL
Galena Gulch	A&Ww, PBC, AgL
Gila River (Ashurst-Hayden Dam to the Florence WWTP)	A&Ww, FBC, FC, AgL
Gila River{1} (Florence WWTP to Felix Road)	A&Wedw, PBC
Gila River (Felix Road to the Salt River)	A&Ww, PBC, AgL
Gila River{1} (Salt River to the Gillespie Dam)	A&Wedw, PBC, FC, AgI, AgL
Gila River (Gillespie Dam to the Painted Rock Dam)	A&Ww, FBC, FC, AgI, AgL
Gila River (Painted Rock Dam to the Colorado River)	A&Ww, PBC, AgI, AgL
Groom Creek	A&Wc, FBC, DWS, FC
Hank Raymond Lake	A&Ww, FBC, FC, AgI, AgL
Hassayampa Lake	A&Wc, FBC, DWS
Hassayampa River (Headwaters to 8 miles south of Wickenburg)	A&Ww, FBC, FC, AgI, AgL
Hassayampa River (from 8 miles south of Wickenburg to the Buckeye Irrigation Company canal)	A&We, PBC
Hit Tank	A&Ww, FBC, AgL
Horsethief Basin Lake	A&Wc, FBC, DWS, FC, AgL
Lake Pleasant	A&Ww, FBC, FC, AgI, AgL
Little Ash Creek	A&Ww, FBC, FC, AgL
Lynx Creek	A&Ww, PBC, AgL
Lynx Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Martinez Creek	A&Ww, FBC, FC, AgI, AgL
New River	A&Ww, FBC, FC, AgI, AgL
Painted Rock Lake	A&Ww, FBC, AgI, AgL
Painted Rock Reservoir	A&Ww, FBC, FC, AgI, AgL
Perry Mesa Tank	A&Ww, FBC, AgL
Picacho Reservoir	A&Ww, FBC, FC, AgI, AgL
Queen Creek (Headwaters to the	A&Ww, PBC, DWS, AgL

Superior WWTP)	
Queen Creek{1} (Superior WWTP to Potts Canyon)	A&Wedw, PBC
Queen Creek (Below Potts Canyon)	A&Ww, PBC, AgL
Sycamore Creek	A&Wc, FBC, FC, AgL
Turkey Creek	A&Ww, FBC, AgI, AgL
Unnamed Wash{1} (Gila Bend WWTP to the Gila River)	A&Wedw, PBC
Unnamed Wash{1} (Luke Air Force Base WWTP to the Agua Fria River)	A&Wedw, PBC
Unnamed Wash{1} (Queen Valley WWTP to Queen Creek)	A&Wedw, PBC

RED LAKE BASIN

Red Lake	A&Ww, FBC
Rock Canyon Creek	A&We, PBC
Truxton Wash	A&We, PBC
Wright Canyon Creek	A&We, PBC

RIO MAGDALENA BASIN

Holden Canyon Creek	A&Ww, PBC
Sycamore Canyon Creek	A&Ww, FBC, AgL

RIO SONOITA BASIN

San Simon Wash	A&We, PBC
Vamori Wash	A&We, PBC

RIO YAQUI BASIN

Abbot Canyon	A&Ww, FBC, DWS, AgI, AgL
Blackwater Draw	A&Ww, FBC, DWS, AgI, AgL
Buck Canyon	A&Ww, FBC, DWS, AgI, AgL
Dixie Canyon	A&Ww, FBC, DWS, AgI, AgL
Dry Canyon	A&Ww, FBC, DWS, AgI, AgL
Gadwell Canyon	A&Ww, FBC, DWS, AgI, AgL
Glance Creek	A&Ww, FBC, AgI, AgL
Gold Gulch	A&Ww, FBC, AgI, AgL
Johnson Canyon	A&Ww, FBC, DWS, AgI, AgL
Leslie Creek	A&Ww, FBC, DWS, FC, AgL
Mexican Canyon	A&Ww, FBC, DWS, AgI, AgL
Mule Gulch (Headwaters to Bisbee WWTP)	A&Ww, PBC, AgI, AgL
Mule Gulch{1} (Below Bisbee WWTP)	A&Wedw, PBC, AgL
Rucker Canyon Creek	A&Wc, FBC, DWS, FC, AgL
Rucker Canyon Lake	A&Wc, FBC, FC, AgL
Soto Canyon	A&Ww, FBC, DWS, AgI, AgL
Unnamed Wash{1} (Bisbee-Douglas International Airport WWTP to Whitewater Draw)	A&Wedw, PBC
Whitewater Draw	A&Ww, FBC, FC, AgI, AgL

SALT RIVER BASIN

A-1 Lake	A&Wc, FBC, FC, AgI, AgL
Ackre (Judge) Lake	A&Wc, FBC, FC, AgI, AgL

Alvord Park Lake{3}	A&Ww, PBC, FC
Apache Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Arlington Canal (above Wilson Avenue)	AgL
B.S. Gap Tank	A&Ww, FBC, FC, AgL
Ball Tank	A&Ww, FBC, FC, AgL
Basin Creek	A&Wc, FBC, FC
Baskin Tank	A&Ww, FBC, FC, AgL
Bear Cienega Creek	A&Wc, FBC, FC
Bear Creek	A&Wc, FBC, FC, AgI, AgL
Bear Wallow Creek	A&Wc, FBC, FC, AgI, AgL
Bear Wallow Creek, North Fork	A&Wc, FBC, FC
Bear Wallow Creek, South Fork	A&Wc, FBC, FC
Beaver Creek	A&Wc, FBC, FC, AgI, AgL
Becker Creek	A&Wc, FBC, FC, AgI, AgL
Big Bonito Creek	A&Wc, FBC, FC, AgI, AgL
Big Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Black River	A&Wc, FBC, DWS, FC, AgI, AgL
Black River, East Fork	A&Wc, FBC, DWS, FC, AgI, AgL
Black River, North Fork of East Fork	A&Wc, FBC, DWS, FC, AgI, AgL
Black River, West Fork	A&Wc, FBC, DWS, FC, AgI, AgL
Bloody Tanks Wash (Headwaters to Schultze Ranch)	A&We, PBC, AgL
Bloody Tanks Wash (Schultze Ranch to Miami Wash)	A&We, PBC
Blue Lake	A&Wc, FBC, FC, AgL
Bobcat Tank	A&Ww, FBC, FC, AgL
Bog Creek	A&Wc, FBC, FC
Bog Tank	A&Wc, FBC, FC, AgI, AgL
Boggy Creek	A&Wc, FBC, FC, AgI, AgL
Boneyard Creek	A&Wc, FBC, FC, AgI, AgL
Bonsall Park Lake{3}	A&Ww, PBC, FC
Bootleg Lake	A&Wc, FBC, FC, AgI, AgL
Canal Park Lake{3}	A&Ww, PBC, FC
Canyon Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Canyon Lake	A&Wc, FBC, FC, AgI, AgL
Carrizo Creek	A&Wc, FBC, FC, AgI, AgL
Cedar Creek	A&Ww, FBC, AgI, AgL
Centerfire Creek	A&Wc, FBC, FC, AgI, AgL
Chambers Draw Creek	A&Wc, FBC, FC
Chaparral Park Lake{3}	A&Ww, PBC, FC, AgI
Cherry Creek	A&Wc, FBC, FC, AgI, AgL
Chino Tank	A&Ww, FBC, FC, AgI, AgL
Christmas Tree Lake	A&Wc, FBC, FC, AgI, AgL
Christopher Creek	A&Wc, FBC, FC, AgI, AgL
Cibecue Creek	A&Wc, FBC, FC, AgI, AgL
Clover Tank	A&Ww, FBC, FC, AgL
Cold Springs Canyon Creek	A&Ww, FBC, FC
Conklin Creek	A&Wc, FBC, FC, AgI, AgL
Cooley Lake	A&Wc, FBC, FC, AgI, AgL
Coon Creek	A&Ww, FBC
Corduroy Creek	A&Wc, FBC, FC, AgI, AgL
Corn Tank	A&Ww, FBC, FC, AgI, AgL
Cortez Park Lake{3}	A&Ww, PBC, FC, AgI
Coyote Creek	A&Wc, FBC, FC, AgI, AgL
Crescent Lake	A&Wc, FBC, FC, AgI, AgL
Crooked Creek	A&Wc, FBC, FC, AgI, AgL

Cyclone Lake	A&Wc, FBC, FC, AgI, AgL
Deep Creek	A&Wc, FBC, FC, AgI, AgL
Deer Creek	A&Wc, FBC, FC
Deer Tank	A&Ww, FBC, FC, AgL
Desert Breeze Lake{3}	A&Ww, PBC, FC
Devil's Chasm Creek	A&Wc, FBC, FC
Diamond Creek	A&Wc, FBC, FC, AgI, AgL
Dobson Lake{3}	A&Ww, PBC, FC
Double Cienega Creek	A&Wc, FBC, FC
Drift Fence Lake	A&Wc, FBC, FC, AgI, AgL
Earl Creek	A&Wc, FBC, FC, AgI, AgL
Earl Park Lake	A&Wc, FBC, FC, AgI, AgL
East Bonito Praire Tank	A&Ww, FBC, FC, AgL
East Deer Tank	A&Ww, FBC, FC, AgL
Eldorado Park Lake{3}	A&Ww, PBC, FC
Elwood Tank	A&Ww, FBC, FC, AgL
Encanto Park Lake{3}	A&Ww, PBC, FC, AgI
Fish Creek	A&Wc, FBC, FC, AgI, AgL
Flash Creek	A&Wc, FBC, FC, AgI, AgL
George's Basin Lake	A&Ww, FBC, FC, AgI, AgL
Glade Tank	A&Ww, FBC, FC, AgL
Gold Creek	A&Ww, FBC
Gomez Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Gooseberry Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Gordon Canyon Creek	A&Ww, FBC, FC
Granada Park Lake{3}	A&Ww, PBC, FC
Haigler Creek	A&Wc, FBC, FC, AgI, AgL
Halfway Tank	A&Ww, FBC, FC, AgL
Hannagan Creek	A&Wc, FBC, FC, AgL
Hawley Lake	A&Wc, FBC, FC, AgI, AgL
Hay Creek	A&Wc, FBC, FC
Herrington Tank	A&Ww, FBC, FC, AgL
Highway Tank	A&Ww, FBC, FC, AgL
Home Creek	A&Wc, FBC, FC
Horse Creek	A&Wc, FBC, FC
Horseshoe Cienega Lake	A&Wc, FBC, FC, AgI, AgL
Horseshoe Creek	A&Wc, FBC, FC
Horton Creek	A&Wc, FBC, FC, AgI, AgL
Houston Creek	A&Ww, FBC, FC, AgL
Hunter Creek	A&Wc, FBC, FC, AgL
Hurricane Creek	A&Wc, FBC, FC
Hurricane Lake	A&Wc, FBC, FC, AgI, AgL
Indian Bend Wash	A&Ww, PBC, FC
Indian Bend Wash Lakes{3}	A&Ww, PBC, FC
Indian School Park Lake{3}	A&Ww, PBC, FC
Kiwanis Park Lake{3}	A&Ww, PBC, FC, AgI
Lake Sierra Blanca	A&Wc, FBC, FC, AgI, AgL
Little Bonito Creek	A&Wc, FBC, FC, AgI, AgL
Little Diamond Creek	A&Wc, FBC, FC, AgI, AgL
Lofer Cienega Creek	A&Wc, FBC, FC, AgI, AgL
Lost Basin Tank	A&Ww, FBC, FC, AgL
Lost Mule Tank	A&Ww, FBC, FC, AgL
Martin Luther Tank	A&Ww, FBC, FC, AgL
McDonald Tank	A&Ww, FBC, FC, AgL
McKellips Park Lake{3}	A&Ww, PBC, FC, AgI
McNary Mill Pond	A&Wc, FBC, DWS, FC, AgI, AgL
Miami Wash	A&We, PBC
Moon Creek	A&Wc, FBC, FC, AgI, AgL

Morman Tank	A&Ww, FBC, FC, AgL
Mule Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Nash Creek Reservoir	A&Wc, FBC, FC, AgI, AgL
Navajo Pit Tank	A&Ww, FBC, FC, AgI, AgL
North Bonito Praire Tank	A&Ww, FBC, FC, AgL
Open Draw Creek	A&Wc, FBC, FC
Ord Creek	A&Wc, FBC, FC, AgI, AgL
Pacheta Creek	A&Wc, FBC, FC, AgI, AgL
Pacheta Lake	A&Wc, FBC, FC, AgI, AgL
Paddy Creek	A&Wc, FBC, FC, AgL
Papago Park Ponds{3}	A&Ww, PBC, FC
Paradise Creek	A&Wc, FBC, FC, AgI, AgL
Perry Creek	A&Wc, FBC, FC, AgL
Phillips Park Tank	A&Ww, FBC, FC, AgL
Phoenix Area Canals (Granite Reef Dam to municipal WTP)	DWS, AgI, AgL
Phoenix Area Canals (Below WTP intakes and all other locations)	AgI, AgL
Pickett Corral Tank	A&Ww, FBC, FC, AgL
Pinal Creek (Headwaters to Globe WWTP)	A&We, PBC, AgI, AgL
Pinal Creek{1} (Globe WWTP to Radium)	A&Wedw, PBC
Pinal Creek (Radium to Setka Ranch)	A&We, PBC, AgI, AgL
Pinal Creek (Setka Ranch to the Salt River)	A&Ww, FBC, FC, AgI, AgL
Pinto Creek	A&Ww, FBC, FC, AgI, AgL
Pole Corral Tank	A&Ww, FBC, FC, AgL
Powerline Tank	A&Ww, FBC, AgL
Pueblo Canyon Creek	A&Wc, FBC, FC, AgL
Reservation Creek	A&Wc, FBC, FC, AgI, AgL
Reservation Lake	A&Wc, FBC, FC, AgI, AgL
Reynolds Creek	A&Wc, FBC, FC, AgL
Riverview Lake{3}	A&Ww, PBC, FC
Roadrunner Park Lake{3}	A&Ww, PBC, FC
Roosevelt Lake	A&Ww, FBC, DWS, FC, AgI, AgL
Rye Creek	A&Ww, FBC, FC, AgL
Saguaro Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Salome Creek	A&Wc, FBC, FC, AgI, AgL
Salt River (Above Roosevelt Lake)	A&Ww, FBC, FC, AgI, AgL
Salt River (Stewart Mountain Dam to the Verde River)	A&Wc, FBC, DWS, FC, AgI, AgL
Salt River (Verde River to 2 km below Granite Reef Dam)	A&Ww, FBC, DWS, FC, AgI, AgL
Salt River (2 km below Granite Reef Dam to the I-10 bridge)	A&We, PBC
Salt River (I-10 bridge to the 23rd Avenue WWTP)	A&Ww, PBC
Salt River{1} (23rd Avenue WWTP to the Gila River confluence)	A&Wedw, PBC, FC, AgI, AgL
Sand Creek	A&Wc, FBC, FC, AgI, AgL
Sawmill Creek	A&Ww, FBC, AgI, AgL
Sawmill Tank	A&Ww, FBC, FC, AgL
Seneca Lake	A&Ww, FBC, FC
Shush Be Tou Lake	A&Wc, FBC, FC, AgI, AgL
Shush Bezahze Lake	A&Wc, FBC, FC, AgI, AgL
Slate Creek	A&Ww, PBC, FC, AgL
Snake Creek	A&Wc, FBC, FC, AgI, AgL

Soldier Creek	A&Wc, FBC, FC
Spring Creek	A&Wc, FBC, FC, AgL
Spur Tank	A&Ww, FBC, FC, AgL
Squaw Creek	A&Wc, FBC, FC, AgI, AgL
Steele Tank	A&Ww, FBC, FC, AgL
Stinky Creek	A&Wc, FBC, FC
Stove Tank	A&Ww, FBC, FC, AgL
Sun Creek	A&Wc, FBC, FC, AgI, AgL
Sunrise Lake	A&Wc, FBC, FC, AgI, AgL
Sycamore Tank	A&Ww, FBC, FC, AgL
Tanks Canyon Tank	A&Ww, FBC, FC, AgL
Thomas Creek	A&Wc, FBC, FC, AgL
Thompson Creek	A&Wc, FBC, FC
Tonto Creek	A&Wc, FBC, FC, AgI, AgL
Tonto Lake	A&Wc, FBC, FC, AgI, AgL
Trout Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Turkey Creek	A&Ww, FBC, FC
Tuttle Tank	A&Ww, FBC, FC, AgL
Upper Corn Creek Tank	A&Ww, FBC, FC, AgL
Upper Highway Tank	A&Ww, FBC, FC, AgL
Vista Del Camino Park North{3}	A&Ww, PBC, FC
Vista Del Camino Park South{3}	A&Ww, PBC, FC
Weaning Pen Tank	A&Ww, FBC, FC, AgI, AgL
White River	A&Wc, FBC, FC, AgI, AgL
White River, East Fork	A&Wc, FBC, FC, AgI, AgL
White River, North Fork	A&Wc, FBC, DWS, FC, AgI, AgL
Wild Steer Tank	A&Ww, FBC, FC, AgL
Wildcat Creek	A&Wc, FBC, FC
Williams Creek	A&Wc, FBC, FC, AgI, AgL
Willow Creek	A&Wc, FBC, FC
Workman Creek	A&Wc, FBC, DWS, FC, AgI, AgL

SAN JUAN RIVER BASIN

Chinle Wash	A&Ww, FBC, AgL
Laguna Creek	A&Ww, FBC, FC, AgI, AgL
Many Farms Reservoir	A&Ww, FBC, FC, AgI
Round Rock Lake	A&Ww, FBC, FC, AgI
Tsaile Creek	A&Ww, FBC, FC, AgL
Tsaile Lake	A&Wc, FBC, FC, AgI
Walker Creek	A&Ww, FBC, AgI, AgL
Wheatfields Creek	A&Ww, FBC, FC, AgL
Wheatfields Lake	A&Wc, FBC, FC, AgI
Whiskey Creek	A&Ww, FBC, FC, AgL

SAN PEDRO RIVER BASIN

Aravaipa Creek	A&Ww, FBC, DWS, FC, AgL
Babocomari Creek	A&Ww, FBC, FC, AgL
Bass Canyon Tank	A&Ww, FBC, FC, AgL
Blacktail Pond	A&Ww, FBC, FC
Buehman Canyon Creek	A&Ww, FBC, AgL
Bull Tank	A&Ww, FBC, FC, AgL
Carr Canyon Creek	A&Wc, FBC, FC, AgL
Copper Creek	A&Ww, PBC, AgI, AgL
East Gravel Pit Pond	A&Ww, FBC, FC
Fly Pond	A&Ww, FBC, FC
Garden Canyon Creek	A&Ww, FBC, DWS, AgI

Golf Course Pond	A&Ww, FBC, FC
Gravel Pit Pond	A&Ww, FBC, FC
Hidden Pond	A&Ww, FBC, FC
Hotsprings Canyon Creek	A&Ww, FBC, FC, AgL
Lower Garden Canyon Pond	A&Ww, FBC, FC
Miller Canyon Creek	A&Wc, FBC, FC, AgL
Officers Club Pond	A&Ww, FBC, FC
Ramsey Canyon Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Redfield Canyon Creek	A&Ww, FBC, FC, AgL
San Pedro River (Mexico border to Redington)	A&Ww, FBC, FC, AgI, AgL
San Pedro River (Redington to the Gila River)	A&Ww, FBC, AgL
Sycamore Pond I	A&Ww, FBC, FC
Sycamore Pond II	A&Ww, FBC, FC
Turkey Creek	A&Ww, FBC, AgI, AgL
Unnamed Wash{1} (Oracle WWTP to Big Wash)	A&Wedw, PBC
Walnut Gulch{1} (Tombstone WWTP to the San Pedro River)	A&Wedw, PBC
Woodcutters Pond	A&Ww, FBC, FC

SANTA CRUZ RIVER BASIN

Agua Caliente Wash	A&Ww, FBC, AgL
Aguirre Wash	A&We, PBC
Alambre Wash	A&We, PBC
Alamo Wash	A&We, PBC
Altar Wash	A&We, PBC
Alum Gulch	A&We, PBC
Arivaca Creek	A&Ww, FBC, AgL
Arivaca Lake	A&Ww, FBC, FC, AgI, AgL
Atterbury Wash	A&We, PBC
Bear Grass Tank	A&Ww, FBC, FC, AgL
Big Wash	A&We, PBC
Bog Hole Tank	A&Ww, FBC, AgL
Brawley Wash	A&We, PBC
Cañada del Oro (Headwaters to Highway 89)	A&Ww, FBC, DWS, FC, AgI, AgL
Cañada del Oro (Below Highway 89)	A&We, PBC, AgI, AgL
Cienega Creek (Headwaters to I-10)	A&Ww, FBC, AgL
Cienega Creek()2 (I-10 to Del Lago dam)	A&Ww, FBC, AgL
Cienega Creek (Below Del Lago dam)	A&Ww, FBC, AgL
Davidson Canyon (Headwaters to I-10)	A&We, PBC
Davidson Canyon (I-10 to Cienega Creek)	A&Ww, FBC, AgL
Empire Gulch (Headwaters to Empire Ranch Spring)	A&We, PBC
Empire Gulch (Below Empire Ranch Spring)	A&Ww, FBC, AgL
Fagen Tank	A&Ww, FBC, FC, AgL
Flux Canyon	A&We, PBC
Gardner Canyon Creek	A&Ww, FBC
Greene Wash	A&We, PBC
Harshaw Wash	A&Ww, PBC, AgL
Huachuca Tank	A&Ww, FBC, AgL

Julian Wash	A&We, PBC
Lemmon Canyon Creek	A&Wc, FBC, FC
Los Robles Wash	A&We, PBC
Madera Canyon Creek	A&Ww, FBC, FC
Nogales Wash	A&Ww, PBC, AgI, AgL
Oak Tree Canyon	A&We, PBC
Palisade Canyon Creek	A&Wc, FBC, FC
Pantano Wash	A&We, PBC
Parker Canyon Creek	A&Ww, PBC, FC
Parker Canyon Lake	A&Wc, FBC, FC, AgI, AgL
Patagonia Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Pena Blanca Lake	A&Wc, FBC, FC, AgI, AgL
Puertocito Wash	A&We, PBC
Redrock Canyon Creek	A&Ww, FBC, FC
Rillito Creek	A&We, PBC, AgL
Romero Canyon Creek	A&Wc, FBC, FC
Rose Canyon Creek	A&Ww, FBC, FC
Rose Canyon Lake	A&Wc, FBC, FC, AgI, AgL
Sabino Canyon Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Salero Ranch Tank	A&Ww, FBC, FC, AgL
Santa Cruz River (Headwaters to the International Boundary)	A&Ww, FBC, FC, AgI, AgL
Santa Cruz River (International Boundary to Nogales WWTP)	A&Ww, DWS, FBC, AgI, AgL
Santa Cruz River{1} (Nogales WWTP to Tubac)	A&Wedw, PBC
Santa Cruz River (Tubac to the Roger Rd WWTP)	A&We, PBC, AgL
Santa Cruz River{1} (Roger Rd WWTP to Baumgartner Rd)	A&Wedw, PBC
Santa Cruz River (Wash) (Baumgartner Rd to the Gila River Reservation)	A&We, PBC, AgL
Santa Cruz River (Wash) (Gila River Reservation to the Gila River)	A&Ww, FBC, AgI, AgL
Santa Cruz River, West Branch	A&We, PBC
Santa Cruz Wash, N Branch{1} (Casa Grande WWTP to the Santa Cruz River)	A&Wedw, PBC
Santa Rosa Wash	A&We, PBC
Soldier Lake	A&Wc, FBC, AgI, AgL
Sonoita Creek (Above the town of Patagonia)	A&Ww, PBC, AgI, AgL
Sonoita Creek (Below the town of Patagonia)	A&Ww, FBC, FC, AgI, AgL
Split Tank	A&Ww, FBC, FC, AgL
Stock Tank	A&Ww, FBC, AgL
Sutherland Wash	A&We, PBC
Sycamore Spring Reservoir	A&Wc, FBC, FC
Tanque Verde Creek	A&Ww, FBC, AgL
The Lake Tank	A&Ww, FBC, FC, AgL
Tinaja Wash	A&Ww, PBC, AgL
Vekol Wash	A&We, PBC
Williams Ranch Tanks	A&Ww, FBC, AgL

UPPER GILA RIVER BASIN

Apache Creek	A&Ww, FBC, AgL
Armstrong Tank	A&Ww, FBC, FC, AgL
Arrowhead Tank	A&Ww, FBC, FC, AgL
Arsenic Tub	A&Ww, FBC, FC
Ash Creek	A&Ww, FBC, FC, AgL
Barlow Pass Tank	A&Ww, FBC, FC, AgL
Bennet Wash{1} (Arizona Department of Correction-Safford WWTP to the Gila River)	A&Wedw, PBC
Big Bonita Tank	A&Ww, FBC, FC, AgL
Big Brushy Tank	A&Ww, FBC, FC, AgL
Bitter Creek	A&Ww, PBC
Bloody Basin Tank	A&Ww, FBC, FC, AgL
Blue River	A&Wc, FBC, FC, AgI, AgL
Boni Tank	A&Ww, FBC, FC, AgL
Bonita Creek{2}	A&Ww, FBC, DWS, FC, AgL
Brushy Basin Tank	A&Ww, FBC, FC, AgL
Buckalou Creek	A&Wc, FBC, FC
Burdette Tank	A&Ww, FBC, FC, AgL
Cammerman Wash{1} (Arizona Department of Correction-Globe WWTP to 3 km downstream)	A&Wedw, PBC
Campbell Blue Creek	A&Wc, FBC, FC
Castle Creek	A&Wc, FBC, FC
Cave Creek and Ponds	A&Wc, FBC, FC, AgI, AgL
Chapman Tank	A&Ww, FBC, FC, AgL
Chase Creek	A&Ww, PBC, AgL
Chitty Canyon Creek	A&Wc, FBC, FC
Cluff Ranch Pond #1	A&Ww, FBC, FC, AgI, AgL
Cluff Ranch Pond #2	A&Ww, FBC, FC, AgI, AgL
Cluff Ranch Pond #3	A&Ww, FBC, FC, AgI, AgL
Coleman Creek	A&Wc, FBC, FC
Cox Corral Tank	A&Ww, FBC, FC, AgL
Dankworth Lake	A&Wc, FBC, FC
Deadman Canyon Creek	A&Wc, FBC, DWS, FC, AgL
Deadman Tank	A&Ww, FBC, FC, AgL
Dry Lake	A&Ww, FBC, FC, AgL
Dry Prong Tank	A&Ww, FBC, FC, AgL
Eagle Creek	A&Wc, FBC, DWS, FC, AgI, AgL
East Eagle Creek	A&Wc, FBC, FC, AgL
East Salt Shed Tank	A&Ww, FBC, FC, AgL
East Shortline Tank	A&Ww, FBC, FC, AgL
Evans Pond	A&Ww, FBC
Foote Creek	A&Ww, FBC, FC
Four Mile Tank	A&Ww, FBC, FC, AgL
Frye Creek	A&Wc, FBC, FC, AgL
Frye Mesa Reservoir	A&Wc, FBC, DWS, FC
Geronimo Tank (Concrete)	A&Ww, FBC, FC, AgL
Geronimo Tank (Earth Dam)	A&Ww, FBC, FC, AgL
Gibson Creek	A&Wc, FBC, FC, AgI, AgL
Gila River (New Mexico border to San Carlos Lake)	A&Ww, FBC, FC, AgI, AgL
Gila River (San Carlos Lake to San Pedro River)	A&Ww, FBC, FC, AgL
Gila River (San Pedro River to Mineral Creek)	A&Ww, FBC, FC, AgI, AgL
Gila River (Mineral Creek to	A&Ww, FBC, FC, AgI, AgL

Ashurst-Hayden Dam)	
Gimme Tank	A&Ww, FBC, FC, AgL
Grant Creek	A&Wc, FBC, FC
Green Mountain Tank	A&Ww, FBC, FC, AgL
Headquarters Tank	A&Ww, FBC, FC, AgL
Homer J. Tank	A&Ww, FBC, FC, AgL
IDT Tank	A&Ww, FBC, FC, AgL
Juniper Tank	A&Ww, FBC, FC, AgL
K P Creek	A&Wc, FBC, DWS, FC, AgL
Kidde Tank	A&Ww, FBC, FC, AgL
Lasley Tank	A&Ww, FBC, FC, AgL
Little Creek	A&Wc, FBC, FC
Loafer Tank	A&Ww, FBC, FC, AgL
Lower Georges Reservoir	A&Wc, FBC, FC, AgL
Luna Lake	A&Wc, FBC, FC, AgL
Maggie Jones Tank	A&Ww, FBC, FC, AgL
Marijilda Creek	A&Wc, FBC, FC, AgI, AgL
Markham Creek	A&Ww, FBC, AgL
Mineral Creek	A&Ww, FBC, FC, AgL
Nine Mile Tank	A&Ww, FBC, FC, AgL
Pigeon Creek	A&Ww, FBC, AgL
Pima Gap Tank	A&Ww, FBC, FC, AgL
Pine Flat Tank	A&Ww, FBC, FC, AgL
Point of Pines Lake	A&Ww, FBC, FC
Point-O-Pines Charco Tank	A&Ww, FBC, FC, AgL
Prairie Tank	A&Ww, FBC, FC, AgL
Raspberry Creek	A&Ww, FBC, FC
Riggs Reservoir	A&Ww, FBC, FC
Rodeo Tank	A&Ww, FBC, FC, AgL
Roper Lake	A&Ww, FBC, FC
Salt Creek Tank	A&Ww, FBC, FC, AgL
Salt Shed Tank	A&Ww, FBC, FC, AgL
San Carlos Lake	A&Ww, FBC, FC, AgI, AgL
San Carlos River	A&Ww, FBC, FC
San Francisco River (Headwaters to New Mexico border)	A&Wc, FBC, FC, AgI, AgL
San Francisco River (New Mexico border to the Gila River)	A&Ww, FBC, FC, AgI, AgL
San Simon River	A&Ww, FBC, AgI, AgL
Seven Mile Tank	A&Ww, FBC, FC, AgL
Sheep Tank	A&Ww, FBC, FC, AgL
Shortline Tank	A&Ww, FBC, FC, AgL
Slaughter Camp Tank	A&Ww, FBC, FC, AgL
Smith Pond	A&Ww, FBC, FC
Soldier Hole Tank	A&Ww, FBC, FC, AgL
South Headquarters Tank	A&Ww, FBC, FC, AgL
South Summit Tank	A&Ww, FBC, FC, AgL
Stone Creek	A&Wc, FBC, FC, AgI, AgL
Strayhorse Creek	A&Wc, FBC, FC
Summit Tank	A&Ww, FBC, FC, AgL
Sweetmeat Tank	A&Ww, FBC, FC, AgL
Talkali Lake	A&Ww, FBC, FC, AgI
Tarantula Tank	A&Ww, FBC, FC, AgL
Tinny Pond	A&Ww, FBC, FC, AgL
Turkey Creek	A&Wc, FBC, FC, AgI, AgL
Turkey Roost Tank	A&Ww, FBC, FC, AgL
Turtle Tank	A&Ww, FBC, FC, AgL
University Charco Tank	A&Ww, FBC, FC, AgL

Upper Cienega Tank	A&Ww, FBC, FC, AgL
Walnut Canyon Creek	A&Ww, FBC, FC
White Canyon Creek	A&Ww, FBC, FC

VERDE RIVER BASIN

American Gulch (Headwaters to the Payson WWTP)	A&Ww, FBC, FC, AgI, AgL
American Gulch{1} (Payson WWTP to the East Verde River)	A&Wedw, PBC
Aspen Creek	A&Ww, PBC
Bar Cross Tank	A&Ww, FBC, FC, AgL
Barrata Tank	A&Ww, FBC, AgL
Bartlett Lake	A&Ww, FBC, DWS, FC, AgI, AgL
Beaver Creek	A&Wc, FBC, FC, AgL
Bitter Creek (Headwaters to the Jerome WWTP)	A&Ww, PBC, AgL
Bitter Creek{1} (Jerome WWTP to 2.5 km downstream)	A&Wedw, PBC
Bitter Creek (Below 2.5 km downstream of the Jerome WWTP)	A&Ww, FBC, AgI, AgL
Bonita Creek	A&Wc, FBC, DWS, FC
Bray Creek	A&Ww, FBC, FC, AgL
Carter Tank	A&Ww, FBC, FC, AgL
Cement Dam Lake	A&Wc, FBC, FC, AgI, AgL
Chase Creek	A&Wc, FBC, DWS, FC
Dead Horse Lake	A&Wc, FBC, FC
Deadman Creek	A&Ww, FBC, FC, AgL
Del Rio Dam Lake	A&Ww, FBC, FC, AgL
Dry Beaver Creek	A&Ww, FBC, FC, AgI, AgL
Dude Creek	A&Wc, FBC, FC, AgI, AgL
East Verde River	A&Wc, FBC, DWS, FC, AgI, AgL
El Paso Tank	A&Ww, FBC, FC, AgL
Ellison Creek	A&Wc, FBC, FC, AgL
Fossil Creek	A&Ww, FBC, FC, AgI, AgL
Fossil Springs	A&Ww, FBC, DWS
Foxboro Lake	A&Ww, FBC, AgL
Fry Lake	A&Ww, FBC, FC, AgL
Gap Creek	A&Wc, FBC, FC, AgL
Garrett Tank	A&Ww, FBC, FC, AgL
Goldwater Lake	A&Wc, FBC, DWS, FC
Granite Basin Lake	A&Ww, FBC, FC, AgI, AgL
Granite Creek	A&Ww, FBC, AgI, AgL
Heifer Tank	A&Ww, FBC, FC, AgL
Hell Canyon Tank	A&Ww, PBC, FC, AgL
Homestead Tank	A&Ww, FBC, FC, AgL
Horse Park Tank	A&Ww, FBC, AgL
Horseshoe Lake	A&Ww, FBC, FC, AgI, AgL
Jacks Canyon Wash{1} (Big Park WWTP to Dry Beaver Creek)	A&Wedw, PBC
J.D. Dam Lake	A&Wc, FBC, FC, AgI, AgL
McLellan Reservoir	A&Ww, FBC, FC, AgI, AgL
Meath Dam Tank	A&Ww, FBC, AgL
Mullican Tank	A&Ww, FBC, FC, AgL
Oak Creek{2}	A&Wc, FBC, DWS, FC, AgI, AgL
Oak Creek, West Fork{2}	A&Wc, FBC, FC, AgL
Peck's Lake	A&Wc, FBC, FC, AgI, AgL
Perkins Lake	A&Wc, FBC, FC, AgL

Pine Creek	A&Wc, FBC, DWS, FC, AgI, AgL
Red Lake	A&Ww, FBC, FC, AgL
Reservoir #1	A&Ww, FBC, FC
Reservoir #2	A&Ww, FBC, FC
Scholze Lake	A&Ww, FBC, FC, AgL
Spring Creek	A&Ww, FBC, FC, AgI, AgL
Steel Dam Lake	A&Ww, FBC, FC, AgL
Stehr Lake	A&Ww, FBC, FC, AgL
Stoneman Lake	A&Wc, FBC, FC, AgI, AgL
Sullivan Lake	A&Ww, FBC, FC, AgI, AgL
Sycamore Creek (Coconino Forest)	A&Wc, FBC, FC, AgI, AgL
Sycamore Creek (Tonto Forest)	A&Ww, FBC, FC, AgI, AgL
Tangle Creek	A&Ww, FBC, FC, AgI, AgL
Trinity Tank	A&Ww, FBC, FC, AgL
Verde River (Above Bartlett Dam)	A&Ww, FBC, FC, AgI, AgL
Verde River (Below Bartlett Dam)	A&Ww, FBC, DWS, FC, AgI, AgL
Watson Lake	A&Ww, FBC, FC, AgI, AgL
Webber Creek	A&Wc, FBC, FC, AgL
West Clear Creek	A&Wc, FBC, FC, AgL
Wet Beaver Creek	A&Wc, FBC, FC, AgI, AgL
Whitehorse Lake	A&Wc, FBC, DWS, FC, AgI, AgL
Williscraft Lake	A&Ww, FBC, FC, AgL
Willow Creek	A&Wc, FBC, FC, AgL
Willow Lake	A&Ww, FBC, FC, AgI, AgL
Willow Valley Lake	A&Ww, FBC, AgL

WILLCOX PLAYA

Ash Creek	A&Wc, FBC, FC, AgI, AgL
Big Canyon Creek	A&Ww, FBC, FC, AgL
Grant Creek	A&Wc, FBC, DWS, FC, AgL
High Creek	A&Ww, FBC
Moonshine Creek	A&Wc, FBC, FC, AgL
Pinery Creek	A&Ww, FBC, DWS, FC
Post Creek	A&Wc, FBC, FC, AgI, AgL
Riggs Flat Lake	A&Wc, FBC, FC, AgI, AgL
Rock Creek	A&Ww, FBC, FC, AgL
Snow Flat Lake	A&Wc, FBC, FC, AgI, AgL
Soldier Creek	A&Wc, FBC, FC, AgL
Willcox Playa	A&Ww, FBC, AgL

ABBREVIATIONS:

A&Wc = Aquatic and Wildlife (cold water fishery).
A&We = Aquatic and Wildlife (ephemeral).
A&Wedw = Aquatic and Wildlife (effluent dominated water).
A&Ww = Aquatic and Wildlife (warm water fishery).
AgL = Agricultural Livestock Watering.
AgI = Agricultural Irrigation.
DWS = Domestic Water Source.
FBC = Full Body Contact.
PBC = Partial Body Contact.
FC = Fish Consumption.
WTP = Water Treatment Plant.
WWTP = Wastewater Treatment Plant.

NOTES:

{1} An effluent dominated water.
{2} A unique water: Limits developed on a site-specific basis for each stream segment or lake. See R18-11-112 for applicable criteria.
{3} Municipal Park Lake.

Appendix C -- Practical Quantitation Limits (PQLs)

PARAMETER	PQLs (µg/L)
Acenaphthylene	10
Acrylonitrile	5
Aldrin	0.05
Anthracene	10
Antimony	5
Arsenic	10
Benzidine	20
Benzo (a) anthracene	10
Benzo (a) pyrene	6
Benzo (ghi) perylene	10
Benzo (k) fluoranthene	10
3,4-Benzofluoranthene	10
Beryllium	0.5
BHC-alpha	0.05
BHC-beta	0.05
BHC-gamma (lindane)	0.05
Bis(2-chloroethyl) ether	10
Bis-(2-ethylhexyl) phthalate	10
Chlordane	0.1
Chlorodibromomethane	1
3-methyl-4-chlorophenol	5
Chrysene	10
Cyanide	20
DDD	0.1
DDE	0.1
DDT	0.1
Dibenzo (ah) anthracene	10
3,3-Dichlorobenzidine	20
Dichlorobromomethane	0.5
1,3-Dichloropropene	0.5
Dieldrin	0.1
2,4-Dinitrophenol	50
2-methyl-4,6-Dinitrophenol	50
2,4-Dinitrotoluene	10
2,3,7,8-TCDD (Dioxin)	0.005
Endosulfan sulfate	0.2
Endosulfan-alpha	0.1
Endosulfan-beta	0.05
Endrin	0.1
Endrin aldehyde	0.2
Fluorene	10
Heptachlor	0.05
Heptachlor epoxide	0.1
Hexachlorobenzene	0.5
Hexachlorobutadiene	5

Hexachlorocyclopentadiene	5
Indeno (1,2,3-cd) pyrene	10
Mercury	0.5
N-nitrosodimethylamine	10
N-nitrosodi-n-propylamine	10
PCBs	0.5
Phenanthrene	10
Pyrene	10
Selenium	5
Silver	1
Sulfides	10000
1,1,2,2-Tetrachloroethane	5
Toxaphene	2
2,4,6-Trichlorophenol	5

µg/L -- micrograms per liter

APP APLICATION
GUIDANCE MAN.

AQUIFER PROTECTION PERMITS
APPLICATION GUIDANCE MANUAL

PREPARED BY:
ARIZONA DEPARTMENT OF
ENVIRONMENTAL QUALITY
Modified September 11, 1991

APPLICATION GUIDANCE MANUAL

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Date: September 11, 1991

I. INTRODUCTION

A. PURPOSE AND USE OF THE MANUAL

The purpose of this manual is to provide the regulated community with information to help complete a permit application and guide them through the Aquifer Protection Permit (APP) process. It describes the permitting process, outlines specific information requirements for the individual permit application and provides technical information to guide the applicant in designing acceptable monitoring, contingency, and closure plans.

By the fact that you are using this guidance manual, it must be assumed that you are required to obtain an Individual Aquifer Protection Permit (APP). If you are uncertain, the DEQ has a simple form ("Determination of Applicability") which may be submitted to determine if the APP rules apply to your operation, or if you qualify for a general permit. A general permit is written into the regulations, and does not require the submission of an application, but there are criteria listed in the regulations to which a facility must adhere to maintain compliance with a particular general permit.

Each discharge facility or practice will present a unique situation and the specific requirements will depend on that situation. Content presented here is not intended to be all inclusive. Furthermore, not every applicant will have to address everything in this document. This manual is to be used as a general guide by the permit applicant to facilitate the permitting process. It can not substitute for direct communications with the Arizona Department of Environmental Quality, Office of Water Quality, Water Permits Unit (257-2270).

B. APPLICABLE STATUTES AND RULES

The Environmental Quality Act of 1986 (Arizona Revised Statutes, or A.R.S. Title 49) established the requirement to develop the Aquifer Protection Permit program. Throughout this manual, statutory references will be in the form: A.R.S. 49-xxx, where xxx stands for the specific section of the statute; and regulatory references will be in the form: A.A.C. R18-9-xxx, which stands for Arizona Administrative Code, Title 18, Chapter 9, and xxx represents the specific section or rule.

The legal basis for this program are the following statutes and regulations:

- A.R.S. Title 49, specific sections including:
  - 201 (Definitions)

- 203 (Powers and Duties of Director)
- 221 & 223 (Water Quality Standards)
- 224 (Aquifer Identification, Classification)
- 241-251 (Aquifer Protection Permits)

- Arizona Administrative Code:
  - Title 18, Chapter 9, Article 1 (Aquifer Protection Permits)
  - Title 18, Chapter 11, Article 4 (Aquifer Water Quality Standards)
  - Title 18, Chapter 11, Article 5 (Aquifer Boundaries and Protected Use Classification)

For more specific information concerning this program, not contained in this manual, you are directed to consult any of the above. These documents may be obtained from the Secretary of State, State Capital, 7th Floor, West Wing, 1700 W. Washington, Phoenix, AZ 85007 or (602) 542-4086.

C. MAJOR REQUIREMENTS FOR AN AQUIFER PROTECTION PERMIT

In order to obtain an Aquifer Protection Permit for a discharging facility, the applicant must make two demonstrations:

1. The first demonstration is that "the facility will be so designed, constructed and operated as to ensure the

greatest degree of discharge reduction achievable through the application of the best available demonstrated control technology, processes, operating methods or other alternatives. This requirement, commonly referred to as "BADCT", is described in A.R.S. 49-243.B.1.

2. The second demonstration is that the discharge will not cause or contribute to a violation of an aquifer water quality standard (see Appendix A) at the applicable point of compliance, (A.R.S. 49-243.B.2.), or if an aquifer water quality standard is already exceeded at the point of compliance, that the discharge will not cause further degradation of the aquifer with respect to the parameter which exceeds the standard (A.R.S. 49-243.B.3.).

One exception to these requirements is applicants for recharge or underground storage and recovery projects. Applicants for permits for these projects are not required to demonstrate compliance with BADCT. The requirements for permitting recharge or underground storage and recovery projects are given in A.R.S. 49-243.C. Applicants for these projects must show that it will be so designed, constructed and operated as to ensure that the project will not cause or contribute to the violation of an aquifer water quality standard.

More detailed information concerning these demonstrations can be found in Chapter III.

II. AQUIFER PROTECTION PERMIT PROCESS

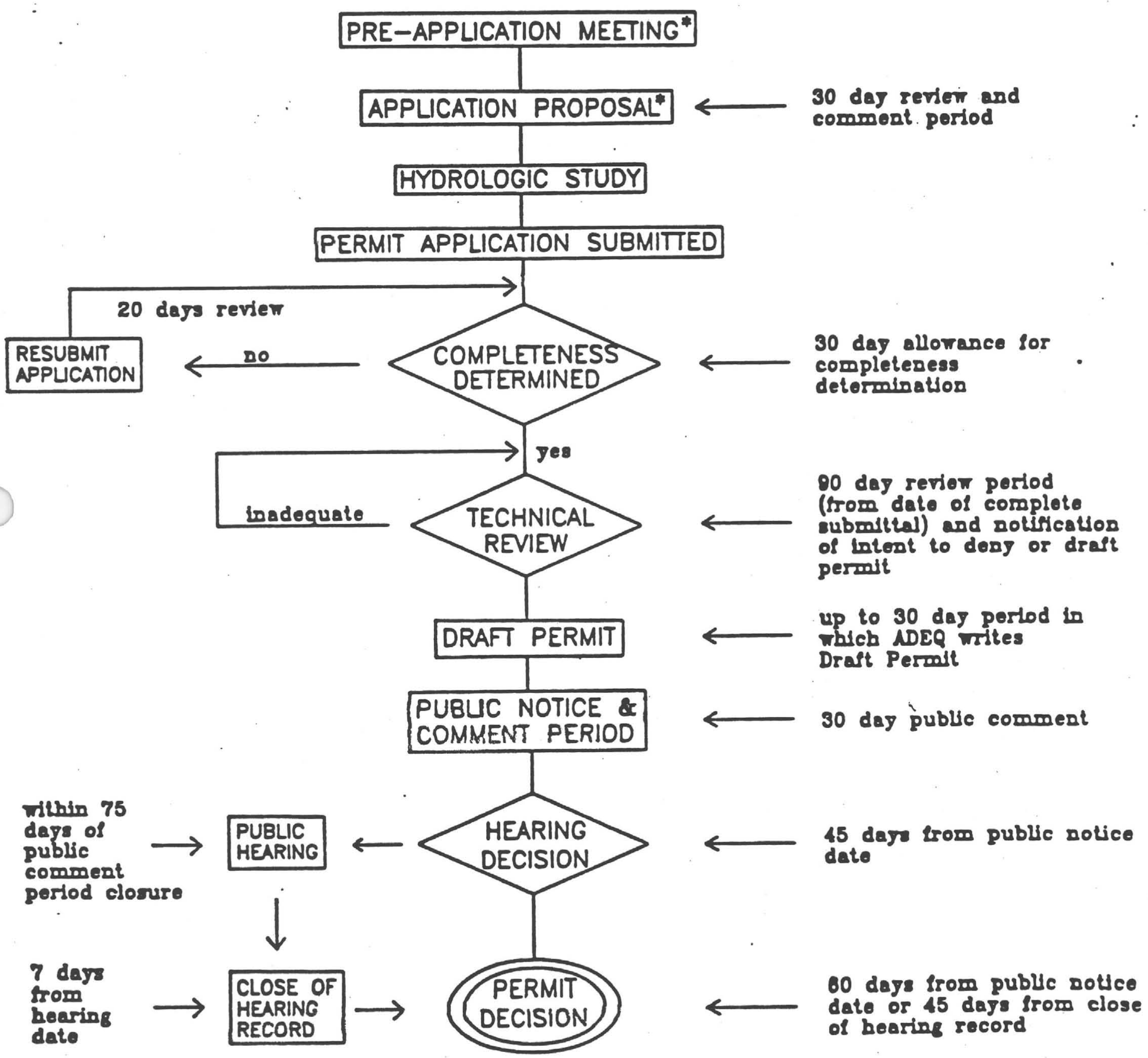
A. STEPS IN THE PERMIT PROCESS

Figure 1 is a flow chart indicating the major steps for obtaining an individual Aquifer Protection Permit. The associated time frames are the maximum times allowed for ADEQ review or processing. Many permits will not require this much time.

1. In order to clarify ADEQ's information needs and requirements for a permit application a facility owner/operator can request a pre-application meeting be held. This meeting will also help the Department understand the facility design and operation.

   In order to make the pre-application meeting be more effective, the applicant should be prepared to discuss specific facility designs and locations. Bring a location map and site plan to the meeting, if possible. Available information on waste characterization will also be helpful. Reviewing this manual prior to the pre-application meeting may give an applicant some more ideas of information to present to the Department.

ADEQ AQUIFER PROTECTION PERMIT PROCESS



*optional

figure 1

It should be noted that ADEQ will be glad to meet with a prospective applicant in more preliminary stages of project development, but these meetings should not be considered as a formal pre-application conference.

The degree of guidance the Department will be able to provide is dependent upon the extent the applicant has finalized his/her plans and the amount of information that can be supplied at the meeting. Please be aware the Department can not commit to absolute decisions at a pre-application meeting, but will provide guidance in terms of the BADCT proposal, level of detail for any necessary hydrologic studies, and the scope of any water quality sampling.

2. Following the pre-application meeting, an applicant has the option of submitting a proposal for a permit application. The proposal should outline how the applicant will meet the informational requirements for a permit based on issues identified in the pre-application meeting. For example, a proposal might explain that an applicant will generate a water table elevation map in the area of the facility by measuring water levels in five known existing wells, and propose to drill three other wells at specific locations on site. These last

three will also be used to collect water quality data, and the proposal would include well construction designs for this purpose. The Department will respond by approving the usefulness of the existing well locations and the proposed locations along with the designs, or make comments or suggestions to modify the proposed task. Other aspects of developing the permit application may be addressed in the proposal.

3. After approval of the proposal or other direction given to the applicant by the Department, the applicant will conduct a hydrologic study if it is required. Determining the scope of the study is a good reason for having a pre-application meeting. The format for collecting and reporting data for the hydrologic study is discussed later in this manual. (See Chapter IV).

4. Once all the information for the permit application has been gathered, it must be compiled in a format easily reviewed by ADEQ so that the processing of the permit is as efficient as possible. The Department has prepared a form which accompanies this manual to assist an applicant in presenting the information in a uniform manner. Chapters III & IV discuss how to organize application information as well. At this time, the application should be submitted to the Water Permits Unit of ADEQ

along with the appropriate fee. The fees list can be found in Table 1.

5. When the Department receives an application, it is assigned to a project officer in the Department's Water Permits Unit. This person will be your contact for all questions concerning your project. The first thing a project officer does is check the application for completeness. In other words, are all the required parts included? If not, the applicant is notified of the deficiencies and requested to correct them. There is no specific response time for new facilities, but an existing facility will be requested to submit this information according to a schedule agreed on by the applicant and DEQ.

TABLE 1

FEE SCHEDULE

Each application for an individual Aquifer Protection Permit must be accompanied by a non-refundable fee. Make checks payable to the State of Arizona.

Categories	Fee (In U.S. Dollars)
On-Site Sewage Disposal Systems (less than 20,000 gpd)	$1,200
Wastewater Treatment Plants Where Influent is Predominantly Sewage	
Surface Impoundment	$1,400
Discharge to Water of the U.S.	$1,600
Subsurface Discharge	$1,400
Recharge and Underground Storage and Recovery Without Effluent	$2,200

Recharge and Underground Storage and Recovery Using Effluent	$2,800
Solid Waste Disposal Facility (Landfills)	$2,200
Construction Debris Landfills	$1,200
Mines	
Surface Impoundments	$1,800
Tailings Piles or Ponds	$2,200
Base Metal Leaching Operations Including Collection and Process Ponds	$2,300
Cyanide Leaching Including Collection and Process Ponds	$1,500
In-Situ Leaching	$3,400
Discharge to Water of U.S	$1,900
Dry Wells	$ 900
Industrial Wastewater Discharges	
Surface Impoundment	$2,200
Discharge to Water of U.S	$1,700
Subsurface Discharge	$1,900

Other Discharging Facilities........................	$1,800
Permit Transfer....................................	$ 200
Permit Modification that constitutes a major modification as described in A.R.S. 49-201.18..........................	Same as for original permit in application according to type of facility
Permit Modification that is described as a minor modification under R18-9-121.D.............................	0
Permit modification that is neither a major modification nor a minor modification......................	$ 200

6. Once it has been determined that the application is complete, the Department begins its technical review of the submittal. The project officer may refer various portions of the application to appropriate units within the department for this technical review. Staff evaluates the technical merits of the data to see if they support the conclusions. Staff reviews the adequacy of the demonstrations of BADCT and compliance with Aquifer Water Quality Standards at the applicable point(s) of compliance (see Chapter III.E.6.). If there are problems with the presentation or substance of the information, the applicant will be informed and have an opportunity to rectify the situation. Whenever additional information is requested the 90-day ADEQ review timeframe is halted and resumes upon receipt of the information. If the requirements of the statutes and regulations have been met, the applicant will be notified of our preliminary decision to issue a permit.

7. At this stage the project officer will begin drafting the permit, setting the appropriate conditions such as discharge limitations, groundwater monitoring limits, alert levels, reporting requirements or compliance schedules. The public notice and other supporting documents are also prepared at this time.

8. The public notice of ADEQ's intent to issue (or deny) a permit is published in a newspaper with distribution in the area where the facility is located. The Department accepts written comment from the public concerning the draft permit for a period of 30 days following publication. During this period any person may request a public hearing be held.

9. The Department will conduct a public hearing in a city near the location of the facility to solicit further public comment on the draft permit if the Director determines that significant public interest exists, or that significant issues or information have been brought to our attention which were not previously considered in the permitting process.

10. Weighing information contained in the permit application and obtained from either the general public comment period or the public hearing, the Director will make his final decision to issue or deny an Aquifer Protection Permit. An applicant will have had previous opportunity (in steps 5 & 6) to correct any situation which would lead to denial of the application. However, the Director has authority for denial of permit applications for good cause.

11. Any person may appeal a permit action if that person is or may be adversely affected by the action. Appeals are made to the Water Quality Appeals Board in accordance with A.R.S. 49-323.

B. PERMIT ACTIONS

The flow chart of Figure 1, just discussed, describes the basic process of permit issuance. As was mentioned, the process may culminate in permit denial. The regulations provide for denial in the cases where the applicant has failed or refused to correct deficiencies in the application, provided false or misleading information or has failed to demonstrate that the operation of the facility will comply with the requirements of the statutes and regulations. In the last case, the applicant will have an opportunity to correct an application before the decision to deny is necessary. The statute also provides that the Director may deny a permit if he determines the applicant incapable of fully carrying out the terms and conditions of the permit based on the applicant's past performance or technical and financial competence to comply with the terms and conditions.

Other permit actions the Director may take include modifying, transferring, suspending and revoking. There are two types of modifications that can be performed on permits, major and minor. A major modification constitutes substantial changes in an issued permit for reasons outlined in the regulations. (A.A.C. R18-9-121.C.) and requires submission of a fee (A.A.C. R18-9-123.D.). Minor modifications are changes which do not affect the scope or intent of the permit, and do not require the publishing of a public notice (A.A.C. R18-9-121.D.). All other permit actions must go through the public participation process described in steps 8 through 11 of the permit process (Sec. II.A.).

When a facility is sold to a new owner, a permit is transferrable if the Director determines the new owner is able to comply with the statutes and regulations (A.A.C. R18-9-121.E.).

C. OTHER PERMITS AND REGULATIONS

Other approvals and permits may be required by Federal, State or Local governments. A list of possible permits that may be required for various facility types is included in Table 2. This is not an exhaustive list; additional permits may be necessary. It is the permittee's responsibility to obtain and comply with all applicable laws and regulations.

TABLE 2

Other Permits and Approvals Which May Be Required in Addition to The Aquifer Protection Permit

Permit or Regulation	Agency
Solid Waste Disposal	DEQ (Solid Waste Unit)
Zoning Approval	Local City or County
WQARF (closed facilities before January 1, 1986)	DEQ (Remedial Action Unit)
Permit for Reuse of Reclaimed Wastewater	ADEQ
NPDES (Discharge to navigable waters)	Application is made at ADEQ EPA is issuing authority
Sludge Handling and Disposal	ADEQ and/or EPA

Air Pollution Control (e.g. incinerators, air strippers or dust control)	ADEQ/County Health Department
Flood Control	Local Flood Control District
Construction Permits	ADEQ/County Health Dept. and local building authority
Well Construction	Department of Water Resources
404 Permit	U.S. Army Corps of Engineers
Reclamation Plan	BLM
Operation & Reclamation Plan	Forest Service
Hazardous Waste Permit	EPA-RCRA
Air Quality Permit	EPA-Air

Dredge & Fill 404 Permit	Corps of Engineers
UIC Regulations (In-situ leach)	EPA
UMTRA & Other Programs	EPA
UMTRA & Other Programs	N.R.C.
Air Emmission Permit	DEQ - Air Quality
Solid Waste Disposal/ Operational Plan Approval	DEQ-Solid Waste
Well Construction Program Permit	Department of Water Resources
Poor Water Quality Withdrawal Permit	Department of Water Resourses
If on or near State lands	State Lands
Approval to Proceed	State Historic Preservation Office
Registration/Safety	State Mine Inspector

Land use - zoning approval	**County/City**
Engineering/Construction Approval	**County**
Dam Safety & Stability	**Department of Water Resources**

III. INFORMATION REQUIREMENTS FOR A PERMIT APPLICATION

This chapter is intended to aid the applicant in providing the mandatory information required in a permit application (A.A.C. R18-108.A & B). By following these instructions, the information should be presented in a format most useful to the Department. This should facilitate a more speedy review of your application. The instructions are numbered and organized to refer to the specific item on the application form.

A. FACILITY DATA

1. Name of Facility

This should be the name of the business, project or operation. It should be a unique name; that is, if the company owns or operates multiple facilities in other locations, you may want to incorporate a reference to location in the name. It should be the name by which the operation is commonly known. If the facility was known by any previous names, please include also.

2. Duration of Facility Operation

a) Date facility began (or is expected to begin) operations.

Beginning operations for the Department's purposes means when do you expect to begin discharging from the facility?

b) Expected life of the facility.

Describe in specific terms if possible, you may use more general terms if the facility has a finite lifetime, an ore deposit, as opposed to a municipality's wastewater treatment plant which is hoped to serve the community in perpetuity.

3. Mailing Address of Facility

To what address would the Department write if sending correspondence about the facility? Give the street or Post Office Box, City, State and Zip Code on lines provided.

4. Facility Address

If different from the mailing address, include a street address, route number or other specific identifier, and the City, State and Zip Code for the actual location of the facility.

5. <u>County</u>

In which county or counties is the facility located?

6. <u>Facility Location</u>

a) Township, range, section, and quarters.

Locate the facility by the township and range coordinate system. If possible, break the section location down to three (3) quarter section divisions (1/4, 1/4, 1/4). This will be a 10 acre parcel. This location can be determined from U.S.G.S. topographic maps. Refer to Figure 2 for an explanation of this system. This information may also be obtained from County Recorder or Assessor's Offices.

b) Latitude and Longitude. Give the latitude and longitude of the approximate center of the property on which the facility is located. (See Appendix B for description of how to determine latitude and longitude.)