LAKE HAVASU CITY

LAKE HAVASU CITY
LAKE HAVASU CITY, ARIZONA

ISLAND WWTP FLOW EQUALIZATION BASIN

PROJECT NO. SS2720

ADDENDUM NO. 1
TO THE
CONTRACT DOCUMENTS

JUNE 16, 2021

carollo®

376 EAST WARM SPRINGS ROAD, SUITE 250 • LAS VEGAS, NEVADA 89119 • P. 702.792.3711 • F. 702.792.4533

CITY OF LAKE HAVASU CITY

ISLAND WWTP FLOW EQUALIZATION BASIN
PROJECT NO. SS2720

ADDENDUM NO. 1

A. SCOPE

This Addendum No. 1 consists of pages AD1-1 through AD1-2 and the attached support documents:

1. Bid Period Question Log.
2. Pre-Bid Sign In Sheet.
3. Pre-Bid Agenda.
4. Lake Havasu Geotechnical Report.
5. DeZURIK Quotation.

B. BID OPENING DATE AND LOCATION

The Bid Opening date and time remains unchanged. The Bid Opening is on June 23, 2021, at 3:00 PM.

C. DRAWINGS

The following Drawings are modified as indicated below:

DRAWING S-3

1. **Add** TYP detail S592 to the two roof hatches in drawing S-3, Section B (Top Plan) on coordinates E-4 & E-5.

D. SPECIFICATIONS

The following Specification Sections are modified as indicated below:

SPECIFICATION SECTION 00040 - INTENT TO BID NOTIFICATION

1. **Delete** Section 00040.

   Note: No Intent to Bid Notification Is Required.

SPECIFICATION SECTION 00800 -SPECIAL PROVISIONS

1. **Paragraph** 8.0 Contract Time:

   Delete existing Paragraph 8.0 and **Replace** with the following:

   "**8.0 CONTRACT TIME**

   The contract time is 365 calendar days from the Notice to Proceed, no intermediate completion dates are required."

SPECIFICATION 01600 - PRODUCT REQUIREMENTS

1. **Delete** existing Article 2.01 Paragraph A.1 and **Replace** with the following:

   "1. Materials: Provide corrosion resistance suitable for project conditions."

SPECIFICATION 09960 - HIGH-PERFORMANCE COATINGS

1. **Revise** Carboline products in Appendix B from "Carboguard 891" to "Carboguard 891 VOC" for Primer, Intermediate Coat and Finish Coatings.

2. **Revise** Primer Carboline product in Appendix B from "Carbocrylic 120" to "Santile 120" for Primer Coating.

SPECIFICATION SECTION 11395A - PACKAGED ODOR SCRUBBING SYSTEM

1. **Modify** Paragraph 2.01.A as follows:

   Add A.3. as follows:

   "3. Perry Fiberglass Products, Inc."

E. OTHER PROVISIONS

All other contract provisions will remain the same.

F. ACKNOWLEDGMENT BY BIDDER

Bidders on the above-named project are hereby notified that the Bidding Documents are modified as indicated herein. Bidders are required to acknowledge receipt of this Addendum in the space provided on the Document 00300 Bid Proposal.

This Addendum shall become part of the Contract and provisions of the Contract apply.

* * * * * * * * * * * ** * * * * * * * *

(The rest of this page left intentionally blank.)

Bid Period Question Log

Project: **Lake Havasu City**
Island WWTP FEB Construction Support Services

Job Number: 200207
Bid Opening: June 23, 2021 at 3:00 PM

From	Company	To	Drawing/Spec Reference	Question	Response
Dylan Morin	Perry Fiberglass Products, Inc.	LHC	General	I am assuming that they need to get the ductwork inspected annually. About how long does the UV coating need to be re-applied? Any other work that I could be missing? What would be the rough/ budgetary cost for the UV coating?	UV coating life expectancy is beyond the scope of this project. Carollo does not provide budgetary costs for bids.
Ryan Christie	Instrumentation and Controls, LLC	LHC	General	Are the drawings to be used for construction? Will there be any further design/ collaboration on design with the owner or contractor once a contractor is selected?	Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on Demand Star at www.demandstar.com. For documents obtained outside of Demand Star please contact Lynette Singleton, purchasing@lhcaz.gov, to be added to the plan holders' list. No further collaboration on the drawings is anticipated. Winning contractor is welcome to submit cost saving construction design changes via RFI during construction.
Dylan Morin	Perry Fiberglass Products, Inc.	LHC	Spec 11395A	Can Perry Fiberglass Products, Inc. be added as a named supplier?	Perry Fiberglass Products Inc. will be included as one of the manufacturer's under Spec 11395A 2.01.A
Christy Bolognani	Kinney Construction Services, Inc.	LHC	Schedule	Is there an anticipated Notice to Proceed date (even ballpark) in your team's mind that you are able to share?	NTP will be approximately 30-60 days after bid opening, upon City Council approval.
Madalaine Elliot	Techno Coatings	LHC	General	I'm hoping you could help me get a list of Generals that are plan holders.	Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on Demand Star at www.demandstar.com. For documents obtained outside of Demand Star please contact Lynette Singleton, purchasing@lhcaz.gov, to be added to the plan holders' list.
Madalaine Elliot	Techno Coatings	LHC	Meeting	I see there is a Mandatory job walk on Wednesday, is this mandatory for subs as well? Please advise.	Job walk is part of the pre-bid meeting. Only General Contractors submitting bids are required to attend, sub contractors are welcome.
Sam McFadden	Phoenix Pumps Inc.	LHC	Bidding	I am trying to find out which contractors are bidding this project. I would like to submit an RFA for our ABS Submersible Mixer as soon as possible. Also, for the prebid meeting, will the sign up sheet be made available after the meeting?	Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on DemandStar at www.demandstar.com. For documents obtained outside of DemandStar please contact Lynette Singleton, purchasing@lhcaz.gov, to be added to the plan holders' list. The Pre-Bid Meeting Sign up sheet will be part of Addendum 1. RFI's can be submitted by the winning contractor for equipment changes.
Drew Scott	Dayton Superior Corporation	LHC	S-03, S-02	Can you ask the architect for S-03? If you look at S-2, Section A; there is a circle around the columns saying S-03 Detail 1. I will need to quote.	The secction is on Drawing S-3 is included in the drawing set on sheet 19 of 47.
Tod Hammon	Hennesy Equipment Sales Co.	LHC	C-2	I am attempting to quote the 20" control plug valve located on C-2. Clow is listed as an approved plug valve manufacturer but there is no motor operator spec just a reference to a Dezurik quote number on the plan page. Can you send me a copy of the Limitorque operator information they quoted so I can provide an equal.	The control valve is a 20" motor operated plug valve. Operator should be designed for 50' of head. It is anticipated that the valve will require a 3 hp motor with appropriate reduction gear. The valve is a modulating valve. Motor and connections shall be submersible. A copy of the quote is attached to Addendum 1.

Bid Period Question Log

Project: **Lake Havasu City**
Island WWTP FEB Construction Support Services

Job Number: 200207
Bid Opening: June 23, 2021 at 3:00 PM

LAKE HAVASU CITY

carollo
Engineers...Working Wonders With Water®

From	Company	To	Drawing/Spec Reference	Question	Response
Richard J. Eismin	The Coombs-Hopkins Company	LHC	11395A	Pre-engineered Single Stage Biotrickling Filter Odor Control System, would it be acceptable to provide an FRP ladder, platform, and handrail in lieu of the specified aluminum? Thank you for your consideration of this question.	Reference 11395A 2.04.H. Maintenance platform shall be designed and furnished by the odor control system Manufacturer for accessing the irrigation manway. The maintenance platforms will be connected and accessed by a single set of stairs supplied by the Contractor. Keep in mind the railings for the maintenance platforms shall be aluminum. Changes to the materials, if needed should be submitted by the winning contractor.
Kara Meyer	Carboline Company	LHC	Coatings	Please let me know if there is other documentation that needs to be completed to have the current Carboline products added to the specification.	Specification has been updated in Addenum 1
Pre Bid	General	LHC	Programing	Will the contractor be responsible for PLC programing	No, programing will be contracted by the City under a separate contract.
Pre Bid	General	LHC	Excavation	Will the reuse pond to the south be drained?	It is not anticipated that the reuse pond will be drained. The contractor should use caution when excavating. There is approximately 30 feet between the pond and the new basin. if new excavation is laided back 1:1, 6 ft. will remain between the exaction and the existing pond. No special shoring required would be required in this case. Contractor shall submit excavation plans prior to excavation.
Pre Bid	General	LHC	Bid Alternate	Is the electrical component work associated with Bid Alternate 1 to be completed if Bid Alternate 1 is not constructed?	Yes, all electrical conduits shall be install and stubbed if Bid Alt 1 is not constructed (odor control).
Farah Jessop	B4 Enterprises	LHC	General	Can you explain the definition of the having the Equalization Basin complete and operable at 275 days after NTP?	See Addendum 1.
Matt Smith	KEAR Civil Corporation	LHC	General	Can owner provide sign in sheet from site visit?	Sign in Sheet from the Pre-Bid Meeting is provided in Addendum 1
Matt Smith	KEAR Civil Corporation	LHC		Are there any as built drawings that can be provided?	No. Winning contractor may request specific drawings for clarification during construction via RFI.
Matt Smith	KEAR Civil Corporation	LHC	Geotechinical	Is there any temporary or permanent slope stabilization required for the slope adjacent to the tertiary filters, or the active basin?	It is not anticipated that the reuse pond will be drained or the tertiary filter will be affected. The contractor should use caution when excavating. There is approximately 30 feet between the pond and the new basin. if new excavation is laided back 1:1, 6 ft. will remain between the exaction and the existing pond. No special shoring required would be required in this case. Contractor shall submit excavation plans prior to excavation. the most recent Geotechnical Report is provided in Addendem 1.
Matt Smith	KEAR Civil Corporation	LHC	Geotechinical	If there is a concern about the excavation affecting these items could the location of the new basin be shifted?	As found conditions that deviate from the Contract documents can be addressed by the winning contractor via RFI.
Matt Smith	KEAR Civil Corporation	LHC	Geotechinical	Can geotechnical report be provided?	Yes, the Geotechnical Report will be provided in Addendum 1.
Matt Smith	KEAR Civil Corporation	LHC	Geotechinical	Sheet C-1 appears to show the grade surrounding the new EQ at approx. 475. Are we to backfill to this elevation? Please provide elevation structure needs to be backfilled to.	See drawing S-2 for back fill requirements.
Matt Smith	KEAR Civil Corporation	LHC	Civil	Can borrow be obtained on site?	No.
Matt Smith	KEAR Civil Corporation	LHC	Geotechinical	Can material excavated for basin construction be utilized for structure backfill?	Only if the material meets the requirements of Specification 02050 Paragraph 2.02.
Matt Smith	KEAR Civil Corporation	LHC	Structural	Will a ladder be required to access the top of new basin?	All appurtenances required for the project are shown on the Contract Documents.
Matt Smith	KEAR Civil Corporation	LHC	Structural	Is handrail required for top of new basin perimeter?	All appurtenances required for the project are shown on the Contract Documents.

Bid Period Question Log

Project: **Lake Havasu City**
Island WWTP FEB Construction Support Services

Job Number: 200207
Bid Opening: June 23, 2021 at 3:00 PM

LAKE HAVASU CITY

carollo
Engineers...Working Wonders With Water®

From	Company	To	Drawing/Spec Reference	Question	Response
Matt Smith	KEAR Civil Corporation	LHC	Specification	We have researched the spray nozzles called for in the specifications and cannot find a compliant product-what was the basis of design?	Spray Nozzles are available from several sources including Spray Systems Company
Matt Smith	KEAR Civil Corporation	LHC	Civil	We could not locate the elevation for the new blower slab and misc. associated pads-please advise	Blower slab elevation is 12" above existing grade.
Matt Smith	KEAR Civil Corporation	LHC	Electrical	Is programming/integration by City?	Programing will be contracted by the City and not part of this contract.
Matt Smith	KEAR Civil Corporation	LHC	Civil	What is elevation at tie in for 20" FEB EFF line?	See Drawing C-2
Matt Smith	KEAR Civil Corporation	LHC	Civil	Are the elevations of the existing lines the 20" FEB EFF cross known?	See Drawing C-3
Matt Smith	KEAR Civil Corporation	LHC	Civil	Please confirm owner will provide water for structure testing?	The owner will provide water for testing.
Matt Smith	KEAR Civil Corporation	LHC	Civil	Where is source of water and available flow rate?	There are several sources of water available on site. Specific flow rates are not known.
Matt Smith	KEAR Civil Corporation	LHC	Civil	Can water used in testing be discharged to system-if not how should it be disposed of ?	Water from testing can be disposed on site with coordination with plant operations.
Matt Smith	KEAR Civil Corporation	LHC	Schedule	What is the expected submittal review time?	See Specification section 01330 paragraph 1.06.
Matt Smith	KEAR Civil Corporation	LHC	Schedule	Can the bid date be extended 1 week?	No.
Matt Smith	KEAR Civil Corporation	LHC	Civil	Is the full 28 day cure time on concrete required prior to coating?	Yes.
Matt Smith	KEAR Civil Corporation	LHC	Schedule	Our preliminary schedule indicates that contract time will need to be extended 60days-can this be considered?	No.
Matt Smith	KEAR Civil Corporation	LHC	Coatings	Is the interior basin concrete to be coated-which system?	The coatings systems are provided in the Specifications.
Matt Smith	KEAR Civil Corporation	LHC	Coatings	Exterior basin concrete below grade-what coating system is required?	The coatings systems are provided in the Specifications.
Luke Weinstein	KE&G Construction Inc.	LHC	15052	Section 15052 3.03 does not include DIP sizes 20" and 30" to designate required lining of these sizes for the specified systems. Please provide direction for coating and lining of these sizes.	Ductile Iron piping shall be coated and lined per Specification 09997.
Luke Weinstein	KE&G Construction Inc.	LHC	Pipe Lining	There are conflicting direction on DIP lining systems in varying spec sections. - 09997 2.07 calls for cement lined pipe - 09997 3.02 calls for ceramic epoxy and glass lining - 15211 3.01.2 references glass lined with tapping. Please provide direction on DIP lining required.	Ductile Iron piping shall be coated and lined per Specification 09997.
Luke Weinstein	KE&G Construction Inc.	LHC	Coatings	Request confirmation on coatings specification for submerged concrete exposed to sewage. Construction Note 1 on Construction Drawings refers to MAG specifications, but Lake Havasu City standard 09900 2.3A specifically refers to concrete coatings in that environment. Please confirm specification to be used.	Where conflict exists between specification, follow the city standard specification unless otherwise noted.
Luke Weinstein	KE&G Construction Inc.	LHC	RFI	Request for approval of Grundfos Submersible Mixer. Data sheets and specification clarifications sent with this RFI.	RFI may be submitted by winning contractor during construction. Substitute equipment will not be reviewed during the bid period.
Luke Weinstein	KE&G Construction Inc.	LHC	AC300/S592	Details AC300, S592 - Please clarify location of ladders and hatches. Which installation detail is to be followed. Both details show attachment to concrete, Sheet S3 detail B does not depict any hatches adjacent to concrete structure.	See Addendum 1.
Ron Crites	Technology Construction Inc.	LHC	Excavation	Excavation on the Basin will impact the stability of the existing Tertiary Filter Building, Washout Pit and Effluent Holding Pond. Will there be an addendum to clarify the procedure to stabilize the Existing Structures?	It is not anticipated that the reuse pond will be drained or the tertiary filters will be affected. The contractor should use caution when excavating. There is approximately 30 feet between the pond and the new basin. if new excavation is laided back 1:1, 6 ft. will remain between the exaction and the existing pond. No special shoring required would be required in this case. Contractor shall submit excavation plans prior to excavation.

carollo

LAKE HAVASU CITY

Sign-In Sheet
Pre Bid Meeting

Island WWTP Flow Equalization Basin
SS2720
Island WWTP, 1150 MCCULLOCH BLVD., LAKE HAVASU CITY, AZ, 86403
June 9, 2021, 10:00 AM

Name	Organization	Email	Phone
Jim Wesley	Carollo	JWESLEY@CAROLLO.COM	
Mike Froelich	Hayden Companies	MFROELICH@HAYDENBC.COM	702-400-7787
Ernest Maestas	Hayden Companies	e.maestas@haydenbc.com	480-578-8952
Rob Butts	Kay Constructors	robb@kayconstructors.com	602-587-9085
Ron Crites	Technology Const Inc.	estimators@live.com	928-777-0099
Koi Johnson	EIFFEL CONSTRUCTION	RJOHNSON@EIFFELINDUSTRIES.COM	520-664-6072
David Cook	TCI	dcookharley@hotmail	928-577-2060
Jason Hart	Lake Havasu City	hartj@lhcaz.gov	928-412-6758
Brian Randall	LHC	randallb@LHCAZ.GOV	928-302-4873
Dulak Fernando	LHC	fernandot@lhcaz.gov	928-855-3999
Keith Lueken	LHC	LuekenK@Lhcaz.gov	928 855 3999

Name	Organization	Email	Phone
Kyle Jessop	B4 Enterprises	Kyle@b4concrete.com	435-619-0076
Ron Stuhlberg	LHC WW	Stuhlbergr@LHCAZ.GOV	928-208-8213
Dan Roberts	KE&G Construction	droberts@kegtus.com	520-965-4433
Luke Weinstein	KE&G Construction	LWeinstein@KegTus.com	520-307-5065
DAN BRAUCH	JCH	DPB@JCHINC.COM	480-665-6098
LORENZO ESQUIVEL	KEAR CIVIL CORP	lorenzo.esquivel@Kearcorp.com	480.259.9850
Gary Furrow	Premier Backhoe Inc.	premierbackhoe@yahoo.com	928 542-0644

Island WWTP FEB Project, SS2720
Pre-Bid Meeting Agenda
Wednesday, June 9th, 2021 @ 10:00 am

1.) Round table introduction and Sign-In Sheet.

2.) Project Plans and Specifications are available on City website and www.DemandStar.com.

3.) The scope of work includes, in general terms, the following:

   a. Removing existing earthen flow equalization basin.
   b. Constructing concrete flow equalization basin.

4.) Preparation and Submission of Bids:

   a. Found in section 00300.

5.) Contract Time:

   a. There are **365 Calendar days** allotted for the completion of the project.
   b. Bid Opening Date: June 23rd, 2021
   c. Anticipated Award Date: July 13th, 2021
   d. Anticipated Contract Signing Date: July 30th, 2021
   e. Anticipated Issuing Notice To Proceed: July 30th, 2021
   f. Anticipated Construction begin date: August 9th, 2021.
   g. Anticipated Completion date: August 8th, 2022.

6.) Site Visit to occur at the conclusion of this meeting.

7.) General questions?

WESTERN TECHNOLOGIES INC.

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

Lake Havasu City
1795 Civic Center Boulevard
Lake Havasu City, Arizona 86403

August 14, 1985

Attn: Mr. L. Dougherty

Re: Island Treatment Plant And Lift Station
McCulloch Boulevard
Lake Havasu City, Arizona

Job No. 2125J191

Our geotechnical report for the above project is attached. The work was performed according to our proposal of July 1, 1985.

Soils at the site consisted of sand and gravel mixed soils with good load bearing capabilities. We recommend that the facility be founded on spread footings. Slabs-on-grade may be utilized.

The report completes Western Technologies Inc.'s current services. We are prepared to review your plans and specifications for consistency with the recommendations and to provide the construction observation and testing recommended.

Sincerely,
WESTERN TECHNOLOGIES INC.
Geotechnical Services

Kenneth L. Ricker, P.E.

bh

Copies to: Addressee (2)
Moore Knickerbocker and Associates (3)

TABLE OF CONTENTS

Lake Havasu City
Job No. 2125J191

Geotechnical Investigation
Island Treatment Plant And Lift Station
McCulloch Boulevard
Lake Havasu City, Arizona
August 14, 1985

INTRODUCTION

This report contains the results of our geotechnical investigation for the proposed additions to the Island Treatment Plant and new force main and lift station to be located west of McCulloch Boulevard on Pittsburgh Points in Lake Havasu City, Arizona. The purpose of these services is to provide information and recommendations relative to foundation design, lateral earth pressures, site preparation, and pavement sections.

PROPOSED CONSTRUCTION

We assume the proposed additions will include a 160 foot diameter, 20 foot deep concrete basin; a 20 foot by 40 foot slab-on-grade blower building; a 25 foot square, 20 foot deep lift station, a force main and paved roadways. Mat and spread footings are planned to support anticipated design loads from 1000 to 2000 psf. We anticipate that ground floor level in at grade buildings will be at or slightly above existing site grade. Final site grading plans were not available prior to preparation of this report.

SITE CONDITIONS

Previous site development in the treatment plant area consisted of gravel and paved roads and existing treatment facilities. Under-

ground facilities such as septic tanks, cesspools, basements, utilities, and dry wells were not observed. The ground surface was depressed in the building areas and relatively level in adjacent areas. Vegetation consisted of sparse growth of grass. Site drainage was to the south, although shallow depressions existed.

The lift station and force main site were undeveloped. The ground surface was relatively level and contained a sparse growth of brush and weeds.

SCOPE OF SERVICES

Six borings were drilled to depths of 20 to 35 1/2 feet at the locations shown on the site plan. During exploration, subsoils were examined visually and sampled at selected intervals.

Existing groundwater conditions were evaluated.

The following tests were performed on selected soil samples:

- Water content
- Dry density
- Compression
- Expansion
- Shear strength
- Gradation
- Plasticity
- R-Value

Test results were used in the development of foundation and earthwork recommendations.

INTERPRETATION OF SUBSURFACE CONDITIONS

Exploration: As presented on Logs of Borings, surface and subsoils to the full depth of exploration were found to be sandy gravels and gravelly sands with various amounts of silt. These soils are medium dense to very dense. In the treatment plant area the upper 1 to 4 feet may be fill.

Testing: Laboratory test results indicate that native subsoils at foundation level are slightly compressible at existing water contents. Some additional compression occurs when the water content is increased. When water is added to compacted near-surface soils, low expansion occurs.

Groundwater: During this investigation, groundwater was encountered in Borings 1 and 2 at a depths of 21 and 30 feet, respectively. No groundwater was encountered in the other borings. The groundwater levels presented represent only current conditions. Groundwater levels during and after construction may fluctuate due to seasonal variations, adjacent construction or development, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

General: The recommendations presented in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the borings. If variations are encountered during construction, or if changes are made in site plan, structural loading, foundation type or floor level, we should be notified for supplemental recommendations.

Shallow And Mat Foundations: We recommend shallow spread and mat foundations bearing upon undisturbed subsoils, recompacted native soils, and/or engineered fill for the anticipated loading conditions.

Alternative foundation depths and design bearing capacities are presented in the following tabulation:

Foundation Depth Below Finished Grade (ft)	Design Bearing Capacity (psf)*
1.0	1500
1.5	2000
2.0	3000

*Design bearing capacities assume fulfillment of "Earthwork" recommendations.

Total or differential settlements resulting from the assumed loads are estimated to be less than 1/2 inch provided that:

- Foundations are constructed as we recommend, and
- Essentially no changes occur in water contents of foundation soils.

Additional foundation movements of up to 1/2 inch could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction.

Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings. The design bearing capacities apply to dead loads plus design live load conditions. The

design bearing capacity may be increased by one-third when considering total loads that include wind or seismic. Recommended minimum widths of column and wall footings are 24 inches and 16 inches, respectively.

For foundations adjacent to slopes, a minimum horizontal setback of five (5) feet should be maintained between the foundation base and slope face. In addition, the setback should be such that an imaginary line extending downward at 45 degrees from the nearest foundation edge does not intersect the slope.

Thickened slab sections can be used to support interior partitions, provided that:

- loads do not exceed 900 plf,
- thickened sections have a minimum width of 12 inches, and
- thickness and reinforcement are consistent with structural requirements.

All footings, stem walls, and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations into undisturbed soils should be inspected by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Lateral Earth Pressures: For soils above any free water surface, recommended equivalent fluid pressures and coefficients of base friction for unrestrained elements are:

- Active:
  Undisturbed subsoil ---------- 30 psf/ft
  Compacted granular backfill ---------- 30 psf/ft
  Compacted site soils ---------- 30 psf/ft

- Passive:
  Shallow wall footings ---------- 250 psf/ft
  Shallow column footings ---------- 400 psf/ft

- Coefficient of base friction ---------- 0.40*

*The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:

- At-rest:
  Undisturbed subsoil ---------- 60 psf/ft
  Compacted granular backfill ---------- 55 psf/ft

The lateral earth pressures herein are not applicable for submerged soils. We should be consulted for additional recommendations if such conditions are to be included in the design.

Fill against footings, stem walls, subsurface walls and retaining walls should be compacted to densities specified in "Earthwork." Medium to high plasticity clay soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause excessive lateral earth pressures which could result in wall movements.

Earthwork:

- General:

  1. The conclusions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section.

  2. Although fills or underground facilities such as septic tanks, cesspools, basements, utilities, and dry wells were not observed, such features might be encountered during construction.

- Site Clearing:

  1. Strip and remove existing vegetation, debris, structural remnants, and other deleterious materials from the building and pavement areas. All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

  2. Sloping areas steeper than 5:1 (horizontal:vertical) should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be level and wide enough to accommodate compaction and earth moving equipment.

- Excavation:

  1. We anticipate that excavations for the proposed construction can be accomplished with conventional equipment.

- Foundation Preparation: In footing areas, the upper 8 inches of existing surface soils are to be recompacted. Recompaction should extend a minimum of 2 feet beyond the footing edges.

- Interior Slab Preparation:

  1. Scarify, moisten, or dry as required, and compact all subgrade soils to a minimum depth of 10 inches. The subgrade preparation is to be accomplished in a manner which will result in uniform water contents and densities after compaction.

  2. In areas subjected to normal loading, four inches of aggregate base course should be placed beneath interior slabs. For unusual loads, reevaluation of slab and/or base course thickness may be required.

  3. If moisture sensitive floor coverings are used on interior slabs, consideration should be given to the use of vapor barriers.

- Pavement Preparation: The subgrade should be scarified, moistened as required, and recompacted for a minimum depth of 10 inches prior to placement of fill and pavement materials.

- Materials:

  1. Clean on-site or imported materials may be used as fill material for the following:

- foundation areas
- interior slab areas
- pavement areas
- backfill

2. Imported soils should conform to the following:

- Gradation (ASTM C136):
  percent finer by weight

6"	100
4"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	60 (max)

- Maximum expansive potential (%)* 1.5

- Maximum soluble sulfates (%) 0.10

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

3. Aggregate base should conform to local government specifications.

- Placement and Compaction:

1. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

2. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D698)
On-site soils, reworked and fill:	
Below footings	95
Below slabs-on-grade	90
Below pavement	95
Subsurface wall backfill	95
Imported fill:	
Below footings	95
Below slabs-on-grade	90
Below pavement	95
Subsurface wall backfill	95
Aggregate base	95
Miscellaneous backfill	90

3. On-site and imported soils should be compacted within a moisture range of 3 percent below to 3 percent above optimum.

- Compliance:

1. Recommendations for slabs-on-grade, foundations, and pavement elements supported on compacted fills or prepared subgrade depend upon compliance with "Earthwork" recommendations. To assess compliance, observation and testing should be performed under the direction of a geotechnical engineer.

Surface Drainage:

1. Positive drainage should be provided during construction and maintained throughout the life of the proposed development. Infiltration of water into utility or foundation excavations

must be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the building should be eliminated.

2. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with an outfall of approximately 3 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of mois- ture infiltration.

Pavement: Based on existing subgrade conditions, the following pavement sections are recommended:

	Asphaltic Concrete Pavement (inches)	Base Course (inches)
Passenger car parking and drives (low traffic frequency)	2.0	4.0
Major access drives (medium traffic frequency)	2.5	5.0

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphaltic concrete. Base course and asphaltic concrete should conform with MAG or City of Lake Havasu City specifications.

Material and compaction requirements should conform to recommendations presented under "Earthwork." The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections.

CLOSURE

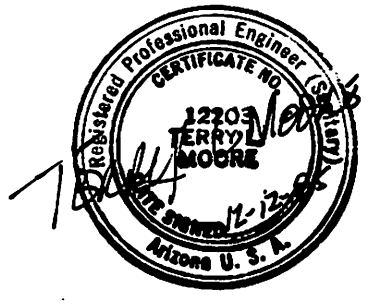
Our conclusions and recommendations are based on observation and testing of the earthwork and foundation preparations directed by a geotechnical engineer. Because of our familiarity with the site, Western Technologies Inc. could provide these services efficiently and effectively.

If plans, specifications, or field applications deviate from our recommendations, we shall be relieved of responsibility unless our written concurrence has been obtained.

LAKE HAVASU CITY ISLAND
WASTEWATER TREATMENT
PLANT IMPROVEMENT
L.H.C. PROJECT # SS - 124 - 86

ENVIRONMENTAL IMPACT ASSESSMENT

EFFLUENT REUSE AND RECHARGE



Moore Knickerbocker and Associates, Inc.
ENGINEERS · SURVEYORS
4433 N. 16th Avenue
Phoenix, Arizona
(602) 265-3776

DECEMBER 5, 1985

M.K.A. PROJECT NO. 8513.4

INTRODUCTION

1.0 Background

Moore Knickerbocker & Assoc., Inc. (MKA) has been retained by Lake Havasu City (LHC) for design services relative to the expansion (from 1.0 MGD existing capacity to 2.5 MGD) of the Pittsburgh Island Wastewater Treatment Plant (Fig. 1-1).

During the design phase, MKA investigated the compatibility of the existing effluent reuse scheme (0.5 MGD for Plant Site landscaping plus 0.5 MGD for golf course irrigation) with the future needs of LHC and the interaction between reuse alternatives and the degree of wastewater treatment at the Pittsburgh Island Plant. MKA's investigations resulted in recommendations that were adopted by LHC and conceptually approved by the Permits Unit at the Arizona Department of Health Services (ADHS). The key recommendation which transpired from MKA's investigations was the construction of a 2.5 MGD biological nitrification-denitrification plant. The basic thinking behind the nitrogen removal concept was two-fold:

- In view of the limited availability of reuse-compatible areas, reduction of the reuse acreage is to the best interest of LHC.

- Reuse area reduction results in deep percolation and hence dictates Bio-N removal, at the plant, to eliminate groundwater pollution by nitrates.

Upon implementation of the 2.5 MGD Bio-N plant design, LHC developed an effluent disposal master plan (Fig. 1-2). A total of 118.8 acres will be ultimately available for reuse (107 acres) and groundwater recharge (11.8 acres). Currently, MKA's design identifies 45 reuse acres (existing golf course) and 11.8 recharge acres (effluent holding pond and plant site landscape irrigation). However, an additional 50 acre golf course is in the final phases of construction at the main land and a 12 acre landscape area is planned at the Pittsburgh Island Marina. LHC, therefore, is expected to meet the master plan 118.8 acres target in the very near future.

2.0 Objectives

Based on the preceeding discussion, we will provide the reader, in the following chapters, with sufficient analysis and documentation to prove the following:

- The LHC effluent disposal master plan provides sufficient area for reuse and groundwater recharge of 2.5 MGD generated at the WWTP.

- Disposal areas identified by MKA's design provide a 1.46

MGD effluent disposal capacity and therefore allow for plant expansion for the interim.

. Reuse/recharge practices will not cause any deterioration in groundwater and surface water quality.

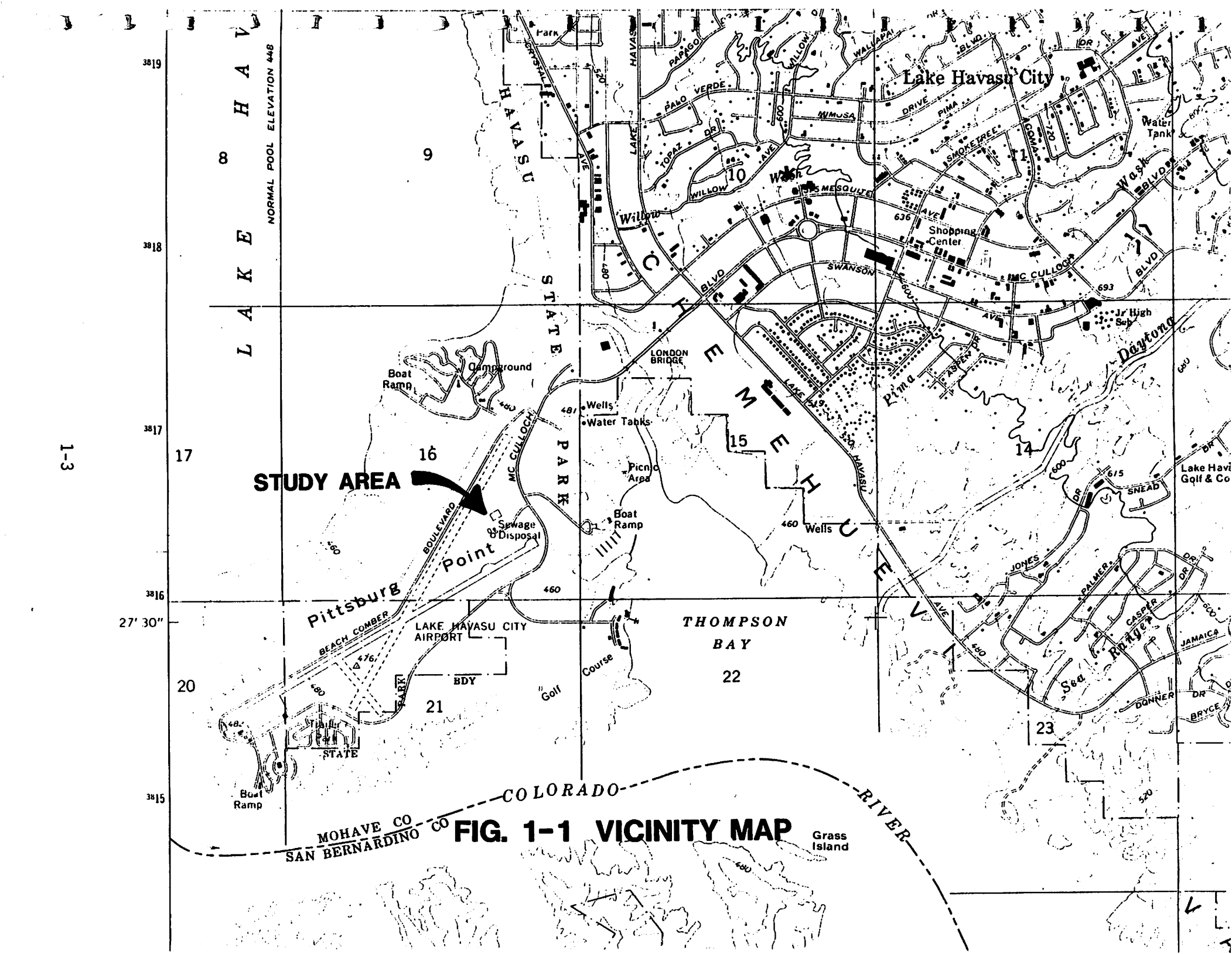
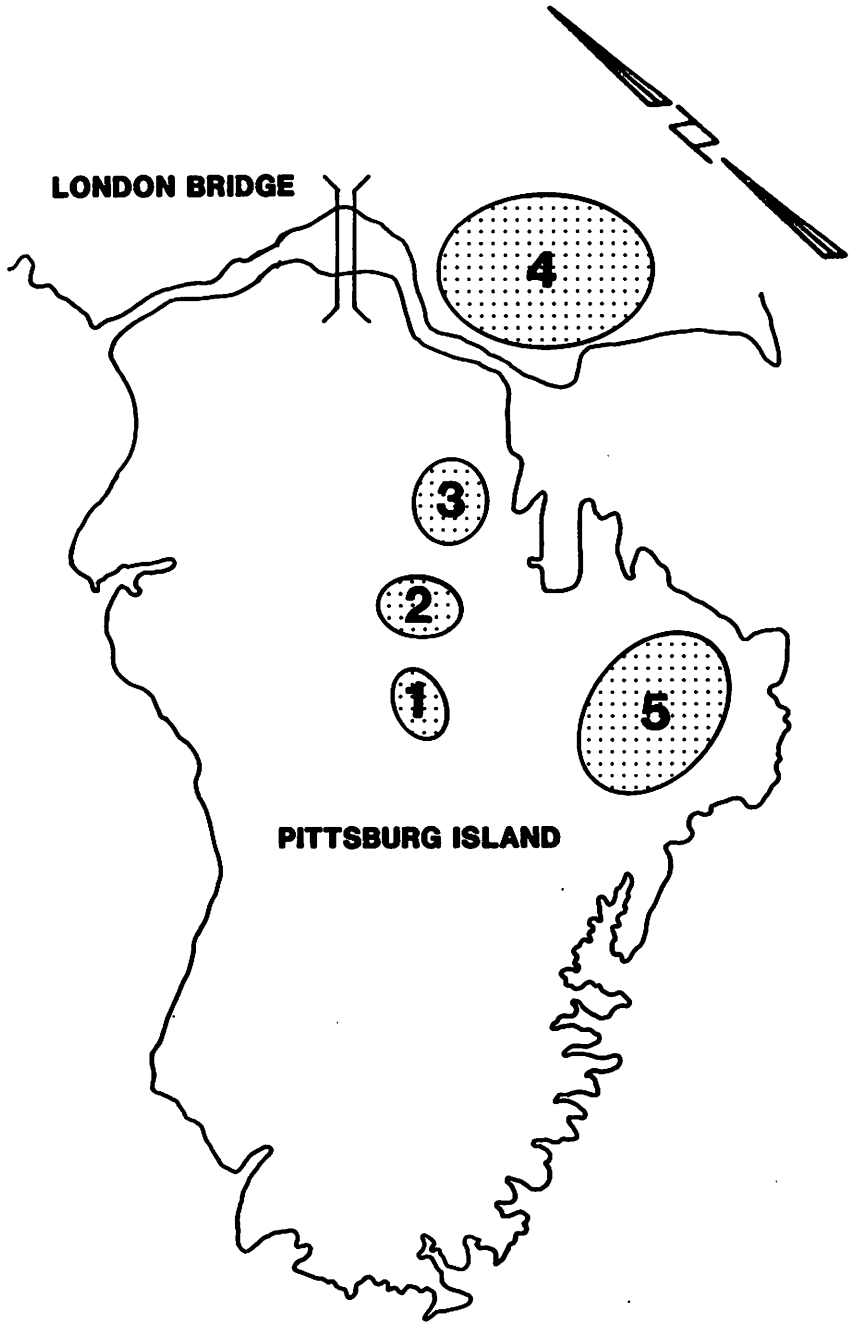


FIG. 1-1 VICINITY MAP



LEGEND

1. EFFLUENT HOLDING/RECHARGE POND.
   PROPOSED DESIGN (4.8 ACRES)
2. LANDSCAPE AREA/PLANT SITE.
   PROPOSED DESIGN (7.0 ACRES)
3. LANDSCAPE AREA/MARINA.
   PLANNED (12 ACRES)
4. GOLF COURSE.
   PLANNED (50 ACRES)
5. GOLF COURSE.
   PROPOSED DESIGN. (45 ACRES)

FIG. 1-2 EFFLUENT REUSE AREAS

LAKE HAVASU CITY ISLAND WASTEWATER TREATMENT PLANT IMPROVEMENT L.H.C. PROJECT # SS - 124 - 86

DESIGN REPORT

Moore Knickerbocker and Associates, Inc.
ENGINEERS • SURVEYORS
4433 N. 19th Avenue
Phoenix, Arizona
(602) 265-3776

DECEMBER, 1985

ENGINEERS DESIGN REPORT

SUBMITTED WITH

PLANS & SPECIFICATIONS

FOR

PITTSBURGH ISLAND WASTEWATER TREATMENT PLANT IMPROVEMENTS
LHC PROJECT #SS-124-86

INTRODUCTION

Lake Havasu City is a growing community located on Lake Havasu, created by the Parker Dam. The city is relatively new having been created in the late 60's as a recreational and retirement community. The primary developer of the area purchased and reconstructed the London Bridge in the city and dredged a channel to create Pittsburgh Island which is the location of one of the city's existing wastewater treatment plants.

Due to the past rapid growth and continued growth projections for the future, facility planning for wastewater treatment has been undertaken.(1) The conclusions drawn in that facility plan included in part the expansion of the Island Treatment plant to an ultimate capacity of 2.75 mgd. (See exhibit 1)

Due to the growth that has occurred in the central drainage area, and the projected development which is currently in some stage of planning, the city decided to proceed with the construction of the Island plant capacity and quality improvements. A plant capacity of 2.5 mgd was decided upon rather than 2.75 mgd, because of space and cost limitations.

This proposal is timely in that the existing plant is operating at or in excess of capacity and does not currently meet all aspects of wastewater effluent reuse regulations.

(1) Lake Havasu Sanitary District Wastewater Management System Facility Plan, September 1979.

DESIGN SUMMARY

Waste Flow & Strength	Present	Design	Design Standard
Flow - MGD AVG	1.0	2.5	--
Peak	2.0	5.0	--
Strength - mg/L			
BOD_5	300	300	
S.S.	300	300	
TKN	25	25	
Organic load - lbs			
BOD_5	2500	6255	
Effluent Requirements (For non restricted access, reuse)			
Turbidity, NTU	5	5	5(2)
Fecal Coliform GMN/100 ml	25	25	25(2)
Virus GMN/40 l	125	125	125(2)
Round Worm Eggs	None Detected		None(2)
Nitrate, mg/l as N	5	5	5(3)

Unit Processes

1. Raw Sewage Pumping
   - A. Plant Lift Station — Gorman Rupp-Duplex lift station ea pump 1500 gpm, 36 TDH, 25 HP
     (This existing station will serve only flow generated on the Island, estimated at 500 gpm avg. flow.)
     Wet well detention at avg flow, min. — 15
   - B. London Bridge Road Lift Station (New) — Flygt Submersible Triplex Station ea pump 2100 gpm, 85 TDH, 77 HP
     Wet well detention at avg flow, min. — 7 — 2.8

2.	Static Screens (3 Exist.,) (2 New)	5 - 72" wide Screens .06"slots, 1.5 mgd ea	C.E.Bauer	
	Reliable Capacity, MGD	6.0	6.0	
	Screenings Handling (Existing)	Conveyor and overhead Hopper, Disposal at Sanitary Landfill		
3.	Flow Equalization Basin (Existing)	Earthen Basin 100' x 150'		
	Volume - gallons	500,000	500,000	
4.	Aeration (New)			
	Schreiber-Counter Current Process (Extended aeration)			
	Fine bubble diffused air			
	Circular Tank, traveling bridge, with anoxic zone for denitrification.			
	Detention Time (Avg flow) hrs	65	26	24
	Anoxic Zone		4.2	
	Aeration Zone		21.8	
	Reliable Aeration Capacity - ICFM			
	Existing 1 @ 2600 - 125 HP			
	1 @ 1500 - Engine	3500		
	2 @ 1000 - 50 HP			
	Future 4 @ 1270 - 75 HP		3810	
	BOD_5 lbs/lb mlss	0.4	.075	.05-.15
	MLSS (mg/L)	3000	4000	
	Mixed Liquor Recycle Pumps- 2-40" Dia Screw			
	Capacity, gpm	7000	7000	
	Return Sludge Pumps-2-32" Dia Screw			
	Capacity, gpm	1750	1750	1300-2600
	Mean Cell Residence Time, days		28	>10

5. Secondary Sedimentation Basins
Rebuild two existing structures
as sedimentation basins
circular sludge scrapers
Scum pump
1 - 93' dia. 12' SWD
1 - 58' dia. 12' SWD

Upflow rate (gpd/sf) @ avg flow	110	265	650
Weir overflow rate (gpd/ft) @ avg flow	2250	5400	7000
Detention Time (hrs) @ avg flow	20.3	8.1	3.6

6. Secondary Effluent Pumping
3-short coupled vertical turbine pumps
2 @ 1000 gpm
1 @ 1750

Reliable Capacity MGD	2.85		
As needed - replace 2 smaller w/1750 gpm		5.0	
Wet well detention time, min. @ avg flow	18.75	7.5	

7. Tertiary Filters

4 Cell Pulsed-bed sand filter (Hydro-clear)

Filter Area, sq ft	720	720	
Filtration Rate, GPM/sq ft			
@ Avg. flow	.97	2.43	1.2-5
w/one cell out of service	1.3	3.25	
Backwash			
Rate, gpm/sq ft	12	12	12-18
Duration min.	3.5	3.5	
Total Volume per backwash	7560	7560	
Estimated Backwash as % of avg flow	2	2	<15
Type of backwash	Periodic pulses with water-jet scouring.		
Air Scour - Rate cfm/sf	2.2	2.2	3-5
Backwash supply storage, gal.	25,000	25,000	
Backwash waste to Equalization Basin			

8. Effluent Holding Ponds

2-Earthen basins (1 existing, 1 new)			
Capacity, MG	12.5	12.5	12.5

9. Irrigation Pumps

Existing			
1 - 300 gpm @ 246'			
1 - 500 gpm @ 246'			
New			
1 - 700 gpm @ 246'			
1 - 900 gpm @ 20'			
Future			
2 - 900 gpm @ 20'			
Reliable capacity, GPM	1500	3300	
MGD	2.1	4.7	

Pnuematic Storage
Existing - 3,000 gal - used for pressure control for high head irrigation pumps.

10. Disinfection

Ultraviolet Light.			
2 New - 3.125 MGD			
Reliable Capacity, MGD	3.125	3.125	(4)

11. Waste Sludge Pumping

2 - Submersible pumps			
200 gpm 28 TDH			
Reliable Capacity, (GPM)	200	200	
Wet Well Capacity, gal.	25,000	25,000	
Daily Volume @ 1.5% Solids, gal	10,000	25,000	

12. Sludge Drying Beds

Existing - Sand filter type			
4 - 40' x 149'			
New Area, sq ft	23,840	23,840	
2-20' x 50' Vacuum Assisted Drying Beds	2,000	2,000	
Future			
1-20' x 50' Vacuum Assisted Drying Beds	1,000	1,000	
Sludge Load lbs/day	1,240	3,100	

Loading on vacuum assisted Beds, lb/sq ft/day	.62	1.55	1.5 (5)
w/3rd bed		1.03	

Sludge Disposal - Sanitary Landfill

(1) All Design Standards are from ADHS, Engineering Bulletin No. 11, "Minimum Requirements for Design, Submission of Plans and Specifications of Sewage Works", unless otherwise noted.

(2) ADHS Wastewater Reuse Regulations, A.G. Rule No. 84-157.

(3) Correspondence from Moore Knickerbocker & Assoc. Inc. to Mr. Wesley Shonerd, ADHS, September 19, 1985. (Exhibit 2)

(4) Correspondence from Moore Knickerbocker & Assoc., to Mr. Dennis Pontius, ADHS, August 22, 1985. (Exhibit 3)

(5) Infilco Degremont design recommendation.

UNIT PROCESS EFFICIENCIES

	Influent (mg/l)				Effluent (mg/l)				% Removal	
	BOD_5	SS	TKN	NH_3	BOD_5	SS	TKN	NO_3	BOD_5	SS
Static Screens	300	300	25	20	295	290	25	--	2	3
Secondary Treatment	295	290	25	20	20	20		10	93	93
Tertiary Treat	20	20	--	--	10	10		10	50	50
Total	300	300	--	--	10	10			96	96

EFFLUENT DISPOSAL

Reference is made to a separate submittal to ADHS entitled "Environmental Impact Assessment, Effluent Reuse and Recharge" indicating the proposed plan for effluent disposal. In general, the plan consists of a combination of golf course irrigation and rapid rate infiltration on the Island and on golf courses in close proximity to the Island.

SCHEDULE

The project schedule is as follows:

1. Submit plans & specs to ADHS.	Dec 13, 1985
2. Issue P.O. to Schreiber for equipment.	Dec 16, 1985
3. Receive ADHS approval to construct	Feb 15, 1986
4. Receive bids.	Mar 20, 1986
5. Award construction contract	Apr 1, 1986
6. Complete draft of O&M manual	Jan 1, 1987
7. Complete construction	Apr 1, 1987
8. Complete O&M manual	Oct 1, 1987

TABLE 5-4. LAKE HAVASU SANITARY DISTRICT
PROJECTED WASTEWATER FLOW, MGD

ZONE	YEAR	1980	1990	2000	2010	2020	2030
1	Q_A	.8	1.62	2.35	2.60	2.75	2.75
	Q_P	1.8	3.45	4.82	5.2	5.5	5.5
2	Q_A	.2	.62	.94	1.09	1.18	1.18
	Q_P	.6	1.59	2.10	2.4	2.54	2.54
3	Q_A	.2	.80	1.52	1.92	2.12	2.2
	Q_P	.6	1.8	3.24	3.96	4.35	4.51
4	Q_A	.02	.10	.29	.55	.78	.89
	Q_P	.08	.36	.84	1.43	1.75	2.0
1 & 3	Q_A	1.0	2.42	3.87	4.52	4.87	4.95
	Q_P	2.2	4.94	6.97	8.14	8.77	8.66
2 & 4	Q_A	.22	.72	1.23	1.64	1.96	2.07
	Q_P	.66	1.58	2.65	3.50	4.05	4.25

Q_A = ADWF
Q_P = PWWF

TABLE 10-1. PRELIMINARY DESIGN DATA, WASTEWATER MANAGEMENT PLAN

Item	Pittsburgh Island	Mulberry Avenue	Port Road
Waste Loading			
Flow, mgd			
Average dry weather (ADWF)	2.1	1.2	1.1
Peak wet weather (PWWF)	4.5	2.6	2.0
Strength, mg/l			
Biochemical Oxygen Demand (BOD_5)	300	200	300
Suspended solids	200	175	200
Loading of ADWF, lbs/day			
BOD_5	5254	2002	2752
Suspended solids	3503	1751	1835
Preliminary Treatment			
Mechanically cleaned bar screens			
Number	1	1	1
Capacity, mgd	5.5	4.5	5
Manually cleaned bar screen			
Number	1	1	1
Capacity, mgd	5.5	4.5	5
Flow meter			
Number	1	1	1
Size, inches	18	12	12
Flow Equalization basin			
Number	1	1	1
Size, mg.	.3	.25	.25
Pumps			
Number	2	2	2
Variable speed			
GPM, Max,	2180	1250	1150
GPM, Min.	730	420	385
Primary Treatment			
Fine screens			
Number	4	2	2
Capacity, each, mgd	1.3	1.3	1.3
Secondary Treatment			
Rotating biological contactors			
Number of stages	1	1	1
Number of shafts	12	6	6
Hydraulic loading, gpdpft^2	1.35	1.35	1.35
Clarifiers			
Number	1	1	1
Hydraulic loading, gpdpsf	800	800	800
Diameter	58	44	44
SWD, ft.	9	9	9

MOORE KNICKERBOCKER AND ASSOC., INC.
ENGINEERS • SURVEYORS

TERRY L. MOORE, P.E.
PRESIDENT
KEN L. KNICKERBOCKER, P.E.
VICE-PRESIDENT

September 19, 1985

Arizona Department of Health Services
OWWQM
Permits Unit
2005 N. Central
Phoenix, AZ 85004

Job No. 8513.3
File No. [redacted]

ATTN: Mr. Wesley Shonerd, Mgr.

Subject: Lake Havasu City Pittsburgh Island Plant
Effluent Reuse Permit

Gentlemen:

The intention of this letter is to document the preliminary response transmitted by the Arizona Department of Health Services (ADHS) relative to effluent disposal at the subject plant and to present, in writing, our reuse design concept.

As you may know, Moore Knickerbocker & Assoc., Inc. has been retained by Lake Havasu City for design services relative to the Pittsburgh Island Plant expansion (2.5 MGD ultimate capacity). Currently, the plant effluent (1 MGD) reuse scheme consists of golf course and landscape irrigation (40 acres and 6 acres at the plant site, respectively). Approximately 225 acres will be required to handle, through conventional reuse schemes, the plant effluent at 2.5 MGD design flow. The limited availability of reuse areas and the potential of indirect discharge to surface water upon effluent reuse, however, resulted in our recommendation of an extended aeration process with main stream biological nitrogen removal (5 mg/l effluent nitrogen concentration) and subsequent sedimentation, sand filtration, and UV disinfection. The proposed system is compatible with the needs of Lake Havasu City and does not impact groundwater and surface water quality.

From the reuse standpoint, the application rates will be limited by the hydraulic capacity of the infiltrative surface rather than the nitrogen mass loading and hence reduce the land area required for effluent reuse. Our proposal consists of utilizing golf course irrigation, rapid infiltration, and percolation.

4433 N. 19TH AVENUE • SUITE 101
PHOENIX, ARIZONA 85015 • (602) 265-3776

Exhibit 2

Irrigation of two golf courses (80 acres, approximately) will be used for disposal of 1.0 MGD when irrigated at 1.2cm per day. The infiltrative surface capacity, for tertiary effluent quality approaches 17.9 cm per day and offers a safety factor of 15 against ultimate failure.

During golf course irrigation, however, effluent will be applied for a 3 to 4 hours duration, per day, to allow for surface drying during the remaining 20 hours. The instantaneous loading rate, therefore, will correspond to 8.4 cm per day during irrigation intervals. This is substantially less than the 17.9 cm per day surface capacity and still offers a two fold safety factor against instantaneous effluent ponding and runoff.

Rapid infiltration (10 acres) will be utilized for disposal of the additional 1.5 MGD at a hydraulic loading rate of 14 cm per day without necessitating scarification of the infiltrative surface. It is our intention, however, to provide flexibility and design the rapid infiltration area to consist of two parallel modules for ease of maintenance, if required. Furthermore, we are proposing an un-lined effluent storage pond (5 acres) that will provide an additional infiltrative capacity equivalent to that of one rapid infiltration module.

As you recall, we have discussed the recommended option during its preliminary development phase. Subsequently, we further developed our concept to yield the preceeding proposal. During the final phase of our conceptual design, we had the opportunity to exchange some ideas with Lyndon Hammon who indicated that:

1. The effluent disposal system is conceptually approvable by ADHS.

2. The Permits Unit will handle the disposal system review through a reuse Permit Application with consideration given to mass loading and infiltrative surface loading rates from the standpoint of hydraulic capacity and groundwater impact, respectively.

3. Phosphorus discharge, in the effluent, will not be subjected to the NPDES requirements.

Based on the preceeding documentation, we will be submitting the Application for Approval to Construct and Reuse Application in the very near future. Meanwhile, please inform the undersigned if you need additional information or disagree with any of the contents of this letter.

Sincerely,

MOORE KNICKERBOCKER & ASSOC., INC.

Sami Nasr, Ph.D.
Project Manager

SN/dc

cc: Lyndon Hammon
Peter Manderfield
[redacted]
Dennis Pontius

MOORE KNICKERBOCKER AND ASSOC., INC.
ENGINEERS • SURVEYORS

TERRY L. MOORE, P.E.
PRESIDENT
KEN L. KNICKERBOCKER, P.E.
VICE-PRESIDENT

August 22, 1985

Arizona Department of Health Services
2005 N. Central
Phoenix, Arizona 85004

Job No. 8513.2

Attention: Dennis Pontius
Technical Review Unit

Subject: Lake Havasu City - Island Treatment Plant
Ultraviolet Disinfection
SS-124--86

Dear Dennis:

This letter is confirmation of the phone conversation between you and the undersigned on August 20, 1985.

We had previously submitted a request for approval to use an adequately designed Ultraviolet Light Disinfection System for the subject project without any standby chlorination facilities.

Per our phone conversation, you agreed with the concept subject to a written narrative discussing the reliability aspects of the proposed system. A recap of the design criteria and reliability discussion follow:

Design Flow - 2.5 MGD average
With Equalization Basin, normal
peak flow 1.25 x Avg = 3.125 MGD

Effluent Quality prior to Disinfection
10 mg/l BOD
10 mg/l SS
5 NTU Turbidity

Reliability:

The U.V. process will be designed in accordance with normal practice by providing for adequate capacity with the largest unit out of service. Each of the two units is capable of disinfecting the normal peak flow of 3.125 MGD.

4433 N. 19TH AVENUE • SUITE 101
PHOENIX, ARIZONA 85015 • (602) 265-3776

Exhibit 3

The U.V. unit being specified is of the Teflon Tube design. Problems which can occur are:

1. Leaking Tubes.
2. Lamps burning out.
3. Ballasts burning out.

Spare parts will be provided to allow prompt repair of these problems.

Teflon is a non-wetling material and thus highly resistant to fouling.

In summary, U.V. light for use as a wastewater disinfection process is, when properly designed, a reliable, effective method of achieving the low fecal Coliform counts required by the regulations.

If we can provide further information, please advise.

Sincerely,

MOORE KNICKERBOCKER & ASSOC., INC.

Larry D. Good

Larry D. Good, P.E.
Project Manager

LDG/ds

CC: Pete Manderfield

Island Treatment Plant
And Lift Station
McCulloch Boulevard
Lake Havasu City, Arizona
for
Lake Havasu City
Job No. 2125J191

SS-124-86/125-86

WESTERN TECHNOLOGIES INC.

Phoenix
3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

Flagstaff
2400 East Huntington Drive
Flagstaff, Arizona 86001
(602) 774-8708

Pinetop
H C 62 Box 19981
Pinetop, Arizona 85935
(602) 367-3011

Tucson
423 South Olsen Avenue
Tucson, Arizona 85719
(602) 624-8894

Sierra Vista
1827 South Paseo San Luis
Sierra Vista, Arizona 85635
(602) 458-0364

Albuquerque
3808 Academy Parkway North, N.E.
Albuquerque, New Mexico 87109
(505) 345-6586

Farmington
400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966

Las Vegas
300 West Boston Avenue
Las Vegas, Nevada 89102
(702) 382-7483

Laughlin
460 Main Street
Bullhead City, Arizona 86430
(602) 754-2271

CHAPTER 2 - ANALYSIS

ANALYSIS

1.0 General

Data collection and analysis were undertaken to develop the basis for this study and estimate the potential environmental impact of reuse and recharge on groundwater quality and surface water quality.

2.0 Data

Field investigations and data collection are categorized hereinafter to reflect soil permeability, soil profile characteristics, depth to groundwater, and ground waterflow.

Relatively shallow subsurface investigations (less than 50 ft. below natural grade) were carried out by Western Technologies on 7-18-85 and by Thomas-Hartig and Associates on 11-6-85 (refer to Appendix "A" and Fig. 2-1). Generally, the soil profile appears to be sandy with intermittent sandy gravely lenses. The phreatic groundwater surface was encountered at several depths and approximated an elevation of 447 ft. (3 ft. below the 100 year flood elevation).

Soil Borings. (boring No. 1, Western Technologies) also revealed the absence of any impervious strata at an elevation of 425 ft. Furthermore, field observations (boring No. 1, Thomas-Hartig and Associates) indicated that groundwater mounding has receeded to the original groundwater position (447 ft) within 4 hours of effluent irrigation (0.5 MGD) at the plant site.

3.0 Analysis and Discussions

Due to the multidisciplinary nature of this study, it is proposed to classify the discussion into two main categories, namely: Hydraulic Considerations and Water Quality Considerations.

3.1 Hydraulic Considerations

The hydraulic capacity of the reuse and recharge sites may be either limited by the infiltrative surface long term acceptance rate (LTAR) or the subsurface seepage capacity (SSC). The analysis presented hereinafter will therefore quantify SSC and LTAR and identify the limiting condition for the LHC plant.

3.1.1 Long Term Acceptance Rate

The magnitude of flow through the infiltrative surface decays with time and approaches LTAR within 6 months to 2 years of effluent application. The long term acceptance rate varies with the permeability of the infiltrative surface and effluent quality (Nasr, 1983). For the LHC project, it is estimated that LTAR for sandy soils receiving tertiary, disinfected, and denitrified effluent approaches

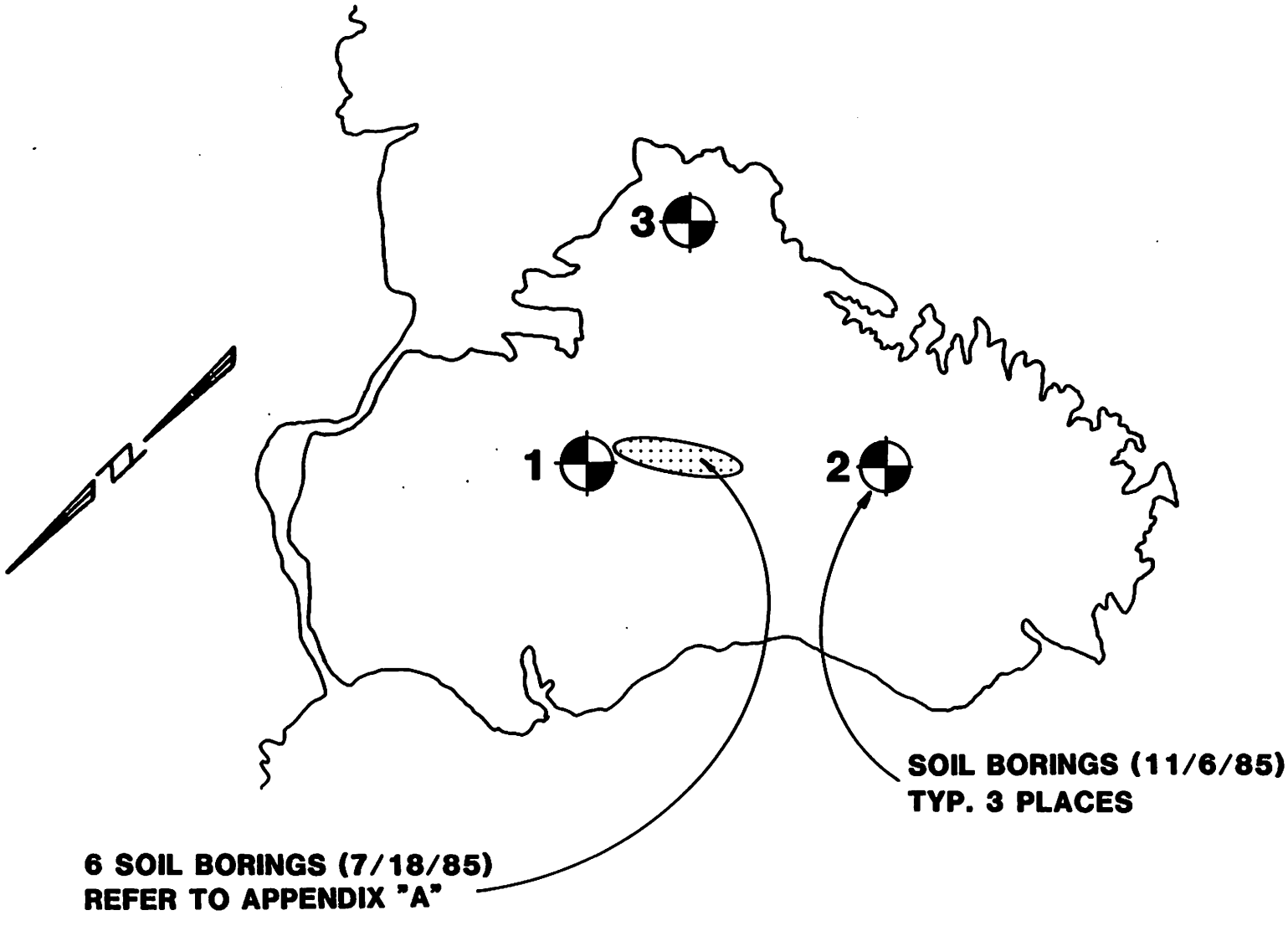


FIG. 2-1 SOIL BORINGS

12 cm/d (Nasr, 1985). Based on the preceeding discussion, it is proposed to quantify the infiltrative surface capacity for the reuse and recharge areas (56.8 acres; 45 acres golf course, 11.8 acres plant site) that will be readily available for receiving treated effluent upon completion of construction. The basis for this quantification relies upon effluent application frequencies approaching 16.7% (4 hrs. per day). This frequency will allow for sufficient surface drying time. At the plant site, the infiltrative surface capacity, for the effluent holding pond and the landscape areas will be quantified at LTAR, i.e. continuous effluent infiltration.

According to the preceeding criteria, it is estimated that the infiltrative surface will be capable of handling 0.36 MGD at the golf course and 1.5 MGD at the plant site (0.89 MGD for landscape irrigation and 0.61 MGD for the effluent holding pond). The total infiltrative capacity will therefore approach 2.46 MGD while offering a significant factor of safety that is inherent to irrigation scheduling (at the golf course) and infiltrative surface rehabilitation (at the effluent holding pond). Increasing the frequency of irrigation will increase the infiltrative potential by 0.24 MGD for every additional hour of irrigation (per day) at the golf course. Occasional scarification of the effluent holding pond will rejuvinate the infiltrative surface and increase its acceptance rate.

Although LTAR indicates sufficient reuse and recharge area for the ultimate 2.5 MGD plant, it is necessary to quantify the seepage capacity and hence determine the limiting condition for this project.

3.1.2 Seepage Capacity

The subsurface hydraulic conductivity (Q/K) may be determined by the existing flow boundaries, and the position of the phreatic surface. For the LHC project, the following limitations were imposed to satisfy WWTP design considerations:

- Groundwater mounding must not rise above elevation 462 ft. due to treatment plant structural considerations.

- The groundwater aquifer is unconfined with an impervious strata (IS) below elevation 425 ft. (Boring No. 1, Western Technologies). From a practical standpoint, the elevation of IS was assumed at 425 ft. and hence a safety factor is provided against subsurface mounding failure (mound higher than 462 ft.).

- Field observation (Boring No. 1, Thomas-Hartig) indicate that the groundwater mounding receeded to its original position within 4 hours of applying 0.5 MGD of treated effluent at the plant site landscape area. Maximum mound elevation, under current practice, was assumed at natural grade (478.3 ft.) and hence 478.3 ft was utilized to conservatively estimate the saturated soil permeability

(K). The assumption provides additional safety since the superimposed gradient of flow underestimates K and the subsequent seepage capacity.

. The 100 year flood elevation (450 ft.) was used for river water surface. Currently, the river water surface is at 447 ft.

Based on the preceeding criteria, the Theim Radial Flow Model (Fig. 2-2 and Fig. 2-3) was implemented to estimate the soil permeability (from existing field observations) and predict the subsurface seepage capacity for both the reuse (golf course) and recharge (plantsite) areas. The total subsurface capacity approached 1.51 MGD and consisted of 0.5 MGD and 1.01 MGD at the reuse and recharge sites, respectively.

3.1.3 Limiting Condition

The infiltrative and seepage analysis results are summarized in Table 2-1. The seepage capacity limits effluent disposal at the recharge site (plant site) and LTAR Limits the infiltrative surface capacity at the reuse site (Golf Course). This is generally unusual for sandy soil deposits. However, in this case, the infiltrative surface LTAR is relatively high due to the reduced rate of surface permeability reduction associated with tertiary effluent quality.

TABLE 2-1 HYDRAULIC CAPACITY

	CAPACITY (MGD)	
	RECHARGE	REUSE
LTAR	1.50	0.96 (1)
SUBSURFACE SEEPAGE	0.50 (2)	1.01
TOTAL - LIMITING CONDITION, MGD (1) + (2)	1.46	

3.1.4 Runoff Control

The magnitude of runoff associated with the reuse approximates 2 inches for a 10 year, 24 hr. duration rainstorm and corresponds to 2.44 MGD and 0.38 MGD for the golf course and the landscaped area at the plant site, respectively. During a 10 year storm, however, WWTP effluent will be stored at the plant's effluent holding pond (5 day storage capacity).

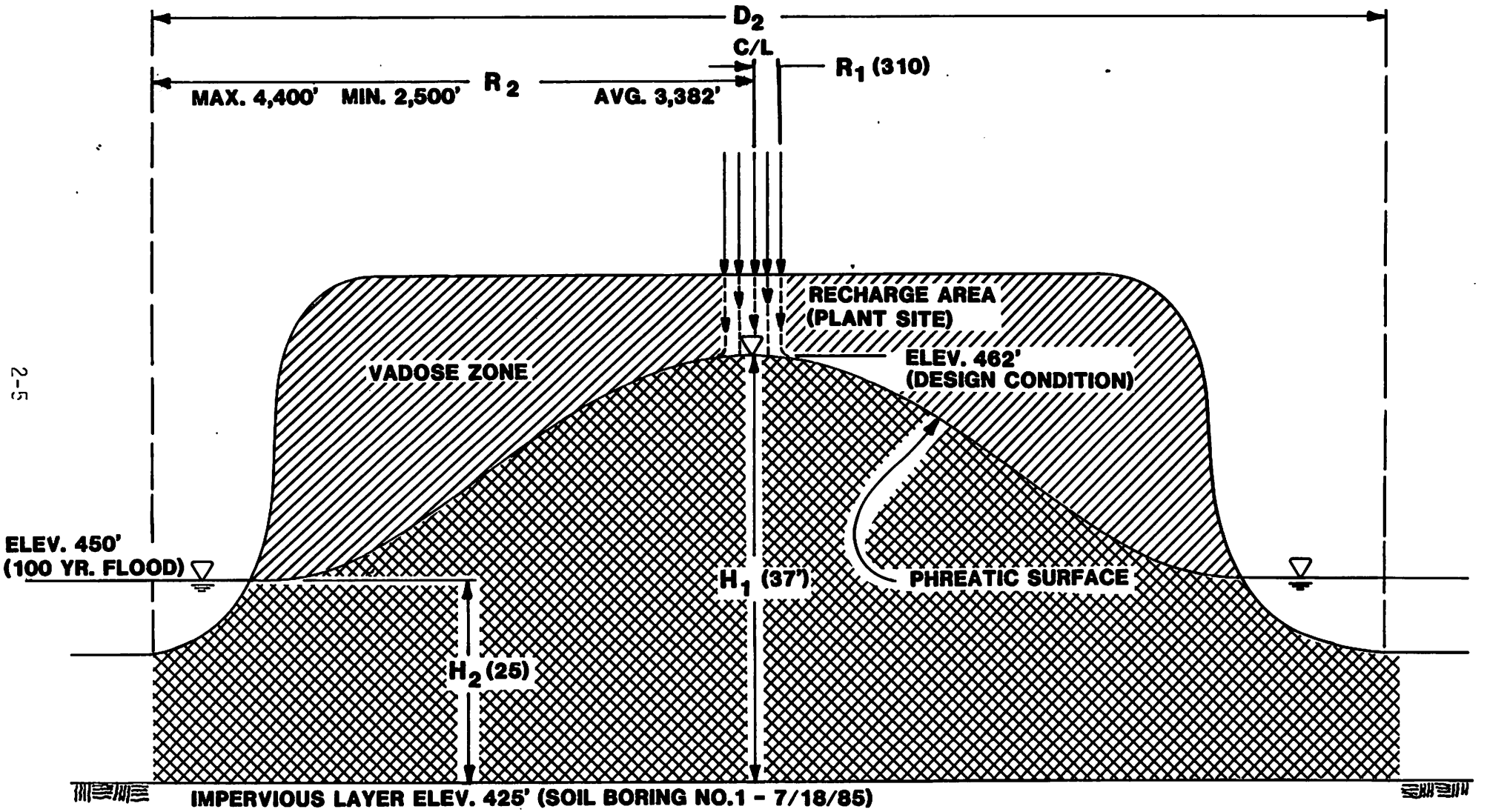


FIG. 2-2 RADIAL FLOW - SECTION

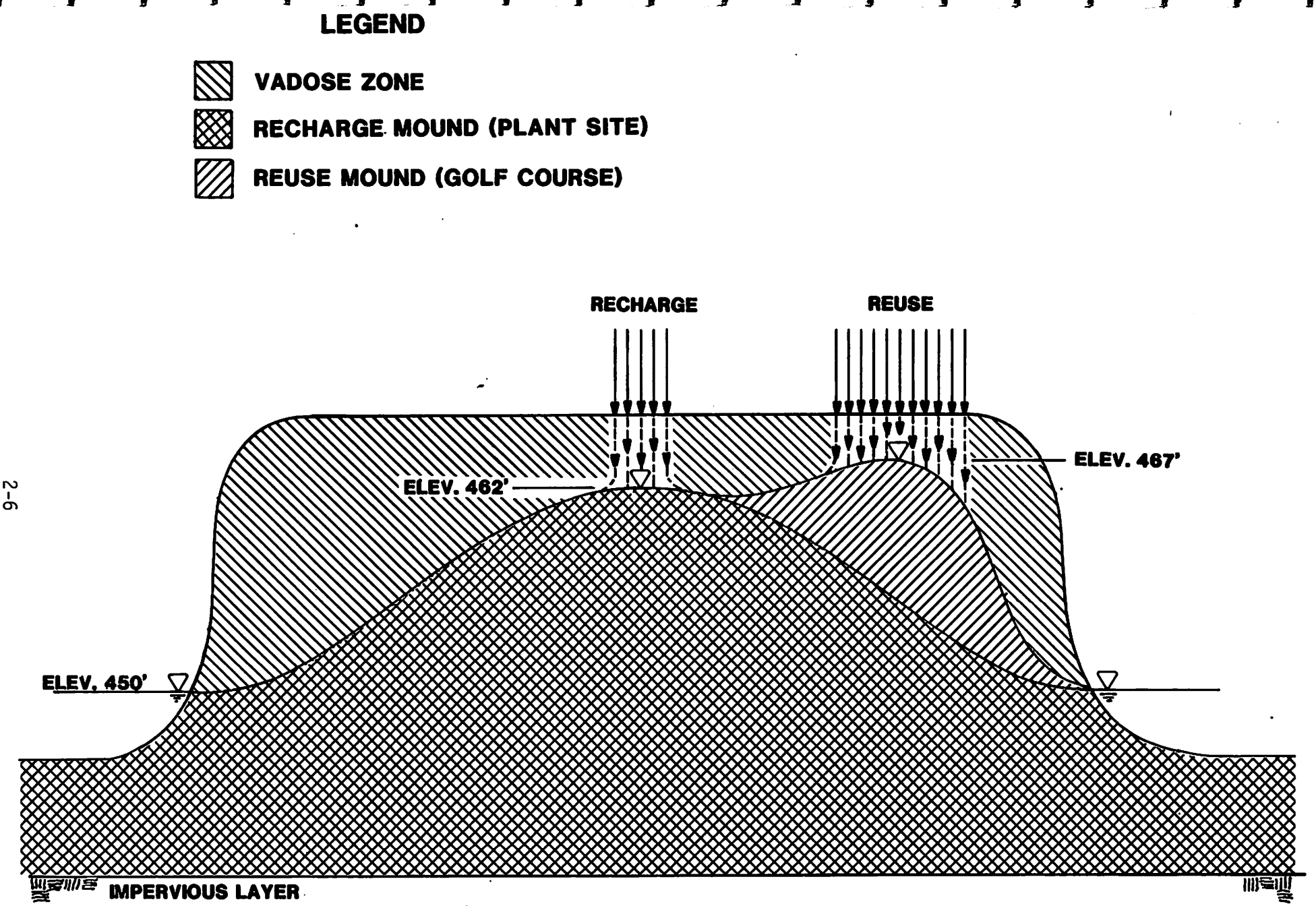


FIG. 2-3 PHREATIC PROFILE (RECHARGE / REUSE)

3.2 Water Quality

The LHC ISLAND WWTP design consists of an extended aeration process with main stream biological nitrification-denitrification (5 mg/l effluent nitrogen concentration) and subsequent sedimentation, sand filtration, and UV disinfection. The proposed system is compatible with the future needs of LHC and does not impact groundwater and surface water quality. The following sections are tailored to further support the preceeding statement and present the reader with sufficient information relative to pollution abatement. Since denitrification and disinfection are undertaken to meet subsurface discharge requirements, discussion will be restricted to phosphorus removal, from the liquid phase, prior to subsurface discharge into the Colorado River.

Phosphorus is often a limiting nutrient which controls algae growth in surface waters. Total phosphorus concentrations exceeding 0.025 mg/l may allow excessive algae growth (EPA, 1975). For the Colorado River, NPDES limits P-concentrations to 0.06 mg/l. Total phosphorus concentrations in domestic sewage generally range from 5 to 12 mg/l (EPA, 1978). Most of the phosphorus is inorganic (approximately 85%) and is predominantly in the orthophosphate form. Polyphosphates and organic phosphorus are eventually converted to orthophosphates within few centimeters of the soil surface (Otis et al., 1975). Phosphates are retained by soils when they precipitate out of solution. The soil composition and the pH of the soil solution govern the type and extent of phosphorus precipitation. Phosphate reactions occur predominantly on calcium minerals, and iron and aluminum oxides and hydroxides (Sikora and Corey, 1976; Sawhney and Hill, 1975; Tyler, 1978). Walker et al., (1973) reported 100 to 300 micrograms of phosphorus per gram of soil beneath the bed of a sandy soil. Sikora and Corey (1975) observed that phosphorus traveled at a rate of 50 cm/yr and 10 cm/yr for sandy and fine textured soils, respectively.

Based on the above and on the soil profile classification presented in Appendix "A", it is postulated that P-adsorption will approach 200 micrograms per gram of sandy soil. The extent of adsorption will therefore correspond to 2,670 tons and 5,490 tons for the recharge and reuse areas, respectively.

At the LHC Island Plant, it is estimated that influent P-concentrations will not exceed a yearly average of 10 mg/l. The estimated P-removal rate by activated sludge mixed liquor synthesis and subsequent wasting is expected to approach 30% of the influent-P concentration. The P-mass load diverted for reuse and recharge, via effluent pumping is therefore estimated at 86 lbs per day at 1.46 MGD and 146 lbs per day at 2.5 MGD (58.3 lbs/MGD).

In the interim of acquiring the new golf course at the main land, the plant is expected to operate at less than 1.46 MGD and to reuse 0.50 MGD at the golf course with the balance recharged to groundwater. The attenuation period relative to reuse and recharge sites will hence approach durations exceeding the useful life of the WWTP by several

folds. It is from that standpoint, therefore, that P-pollution is considered insignificant for this project.

CHAPTER 3 - CONCLUSIONS

CONCLUSIONS

The environmental impact assessment relative to effluent reuse and recharge at the LHC Island Plant dictates the following conclusions:

- Effluent disposal is limited by LTAR and subsurface seepage capacity and may not exceed 0.96 MGD and 0.50 MGD at the reuse and recharge areas, respectively.

- LHC is advised that additional reuse areas (50 acre golf course and 12 acre marina-landscape area) are required to accept effluent hydraulic loading rates in excess of 1.46 MGD.

- Pollution mass transfer does not limit the reuse activity at LHC due to Bio-N removal at the WWTP. P-adsorption within the vadose zone provides adequate safety against surface water pollution.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Inter-Office Memorandum

DATE: March 25, 1988

TO: Louis Parsons
Water Permits Unit

THRU: Debra Daniel, Manager DLD
State Permits Hydrology Unit

FROM: Michael Leach, Hydrologist MDL
State Permits Hydrology Unit

RE: Lake Havasu Main WTP

According to ARS 45-651.4, recharge projects are defined as facilities which are designed and constructed for the purpose of adding water to an aquifer. The above referenced facility does not appear to meet this criteria since:

1) Pond operation efficiency is not taken into consideration through a scheme such as wet/dry cycles to maximize infiltration rates.

2) Water recharged will eventually be lost to the river system from the aquifer due to their hydrologic connection.

Therefore, this facility has been categorized as a discharging facility and not a recharging facility.

A review of the Notice of Disposal (NOD) for the above referenced facility has been completed. The ADEQ file on this facility contains information concerning the installation of three piezometers, but there is no information which indicates their exact locations. DWR well records show that the wells were installed in November, 1985 by Thomas-Hartig and Associates of Chandler, Arizona. However, the well records only give the section number of the piezometer locations. Therefore, it is requested that the Applicant obtain a map with the exact piezometer locations included. This map should be submitted to ADEQ as soon as possible. Copies of the logs from these piezometer installations have been included.

Upon submittal to ADEQ the piezometer locations will be reviewed with respect to their ability to monitor subsurface effluent migrating towards the lake. If one or more of these piezometers appear to be improperly placed, ADEQ will suggest locations at which monitor wells will need to be installed.

If the piezometers appear to be correctly positioned and constructed they will be used as monitor wells. DWR well records indicate that the piezometers have a diameter of only two inches and therefore a bailer may have to be used in order to properly purge and sample them.

After the monitor well/piezometer situation has been taken care of it is also requested that the Lake Havasu Irrigation District well located less than ½ mile northeast of the disposal area (B(13-20)15bcb) be sampled along with the piezometers. Sampling of this well is requested due to the presence of several heavy metal constituents in the discharged effluent (NOD), and since DWR well

records indicate that this well is presently used for municipal purposes (drinking water).

Samples should be obtained from all four wells on a quarterly basis and analyzed for primary and secondary drinking water standards, total phosphorous, total nitrogen, and any Colorado River surface water standards (attached) which are more stringent or are not included in the other required analyses. Proper QA/QC sampling procedures should be used and all sample analysis should be undertaken by a state certified lab.

Effluent samples should also be analyzed for the above constituents and obtained on a monthly basis.

ML:dl

SOIL BORING LOG

Located by Larry Good of Moore, Knickerbocker Engineers near the entrance to the Wastewater Treatment Plant at approximate coordinates of 430X, 1995Y

NO 1 ELEV - SIZE OF HOLE 7" FIELD ENGR MF DATE 11/6/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION
1					Damp	Sandy Gravel, grey-brown	GM
2						small amount of silt and	GP
3						clay	
4							
5		12	R	104.6	5.7	Sand, grey-brown stratified	SP
6						with lenses of sandy	
7						gravel (GP)	
8							
9							
10		20	R	107.4	6.5		
1							
2							
3							
4							
5		27	R	99.2	8.0		
6							
7							
8							
9							
20		17	R	99.7	6.4		
1							
2							
3							
4						NOTE: Installed Permeabil-	
5		30	R	*	*	ity Test Well between	
6						31'0" and 34'11"	
7							
8							
9							
30		35	R	*	*		
1					▽		
2					=		
3					SAT		
4							
5		39	R	104.9	19.6		
6							
7							
8							
9							
40							

GRADATION: WELL, MED, POOR
GRAIN SHAPE: ANGULAR, SUBANGULAR, ROUNDED, SUBROUNDED
RELATIVE DENSITY: LOW, MED, HIGH
PLASTICITY: NONE, LOW, MEDIUM, HIGH
CONSIST: SOFT, FIRM, STIFF, VERY STIFF, HARD
CEMENTATION: NONE, WEAK, MODERATE, STRONG

*No Sample Recovery

Stopped test drilling at 39 ft.

Ground water encountered 31'3"

Project No. 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

NOTE The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated This data may not represent conditions at other locations and/or times This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques Bidders are fully responsible for interpretations or conclusions they draw from the boring log

SOIL BORING LOG

Located by Larry Good of Moore, Knickerbocker near the Golf Course.

NO 2 ELEV - SIZE OF HOLE 7" FIELD ENGR MF DATE 11/6/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R & N	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION: WELL	GRADATION: MED	GRADATION: POOR	GRAIN SHAPE: ANGULAR	GRAIN SHAPE: SUBANGULAR	GRAIN SHAPE: SUBROUNDED	GRAIN SHAPE: ROUNDED	RELATIVE DENSITY: LOW	RELATIVE DENSITY: MED	RELATIVE DENSITY: HIGH	PLASTICITY: NONE	PLASTICITY: LOW	PLASTICITY: MEDIUM	PLASTICITY: HIGH	CLINGING TENDENCY: SOFT	CLINGING TENDENCY: FIRM	CLINGING TENDENCY: STIFF	CLINGING TENDENCY: VERY STIFF	CLINGING TENDENCY: HARD	CEMENTATION: NONE	CEMENTATION: WEAK	CEMENTATION: MEDIUM	CEMENTATION: STRONG
1					Low	Silty Sand, Gravel &	GM	X					X	X		X		X									X			
2						Cobble Mixture; grey-brown	GP																								
3																														
4																														
5		30	R	*	*																									
6																														
7																														
8					Low	Fine Gravelly Sand; grey-	SP	X	X				X	X		X		X									X			
9			•			brown																								
10		14	R	*	*																									
1																														
2																														
3																														
4						Sand; grey-brown, occasion-	SP		X				X	X		X		X									X			
5		20	S		9.8	al sandy gravel lenses.																								
6																														
7																														
8																														
9																														
20		36	S		1.4																									
1																														
2																														
3																														
4					▽	NOTE: Installed Piezo-																								
5		13	S		23.3	meter to 34'2"																								
6					SAT																									
7																														
8																														
9																														
30		16	S		24.6																									
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
40																														

*No Sample Recovery

Stopped test drilling at 34 ft.

Ground water encountered 24'3"

Project No. 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

NOTE The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log

SOIL BORING LOG

Located by Larry Good of Moore, Knickerbocker Engineers near the Airport.

NO 3 ELEV - SIZE OF HOLE 7" FIELD ENGR MF DATE 11/6/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	N	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION
1					Low	Silty Sand; light brown,	SM
2						occasional clean sand	
3						lenses	
4							
5		47	S		2.1		
6							
7							
8							SP
9						Sand; grey-brown, some	
10		19	S		0.7	sandy gravel lenses and	
1						occasional fine gravel	
2						lenses	
3							
4							
5		69	S		0.7		
6							
7							
8							
9						Thin Clay-Silt lenses	
20		30	S		11.1	(2-3" thick) in the sample	
1						from 19 to 20 feet.	
2							
3							
4					3.2		
5		34	S			More fine gravel below	
6						25 ft.	
7							
8							
9					▽		
30		7	S		20.2		
1					SAT	NOTE: Installed Piezo-	
2						meter to 33'2".	
3							
4							
5		73	S		7.5		
6							
7							
8							
9							
40							

SOIL CLASSIFICATION	GRADATION Well	[illegible]	Poor	GRAIN SHAPE Angular	Subangular	Rounded	Subrounded	RELATIVE DENSITY Low	Med	High	PLASTICITY None	Low	Medium	High	CONSISTENCY Soft	Firm	Stiff	Very Stiff	Hard	CEMENTATION None	Weak	Medium	Strong
SM			X		X		X		X		X									X			
SP			X			X	X		X		X									X			

Stopped test drilling at 35 ft.

Ground water encountered 28'9"

NOTE The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated This data may not represent conditions at other locations and/or times This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques Bidders are fully responsible for interpretations or conclusions they draw from the boring log

Project No. 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

DEFINITION OF TERMINOLOGY

ALLOWABLE SOIL BEARING CAPACITY ALLOWABLE FOUNDATION PRESSURE	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
BACKFILL	A specified material placed and compacted in a confined area.
BASE COURSE	A layer of specified material placed on a subgrade or subbase.
BASE COURSE GRADE	Top of base course.
BENCH	A horizontal surface in a sloped deposit.
CAISSON	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
CONCRETE SLABS-ON-GRADE	A concrete surface layer cast directly upon a base, subbase or subgrade.
CRUSHED ROCK BASE COURSE	A base course composed of crushed rock of a specified gradation.
DIFFERENTIAL SETTLEMENT	Unequal settlement between or within foundation elements of a structure.
ENGINEERED FILL	Specified material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
EXISTING FILL	Materials deposited through the action of man prior to exploration of the site.
EXISTING GRADE	The ground surface at the time of field exploration.
EXPANSIVE POTENTIAL	The potential of a soil to expand (increase in volume) due to the absorption of moisture.
FILL	Materials deposited by the action of man.
FINISHED GRADE	The final grade created as a part of the project.
GRAVEL BASE COURSE	A base course composed of naturally occurring gravel with a specified gradation.
HEAVE	Upward movement.
NATIVE GRADE	The naturally occurring ground surface.
NATIVE SOIL	Naturally occurring on-site soil.
ROCK	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
SAND AND GRAVEL BASE	A base course of sand and gravel of a specified gradation.
SAND BASE COURSE	A base course composed primarily of sand of a specified gradation.
SCARIFY	To mechanically loosen soil or break down existing soil structure.
SETTLEMENT	Downward movement.
SOIL	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
STRIP	To remove from present location.
SUBBASE	A layer of specified material placed to form a layer between the subgrade and base course.
SUBBASE GRADE	Top of subbase.
SUBGRADE	Prepared native soil surface.

METHOD OF SOIL CLASSIFICATION
(ASTM D 2487)

COARSE-GRAINED SOILS

LESS THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	
SM	SILTY SANDS, SAND – SILT MIXTURES, MORE THAN 12% FINES	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	

NOTE:
Coarse grained soils receive dual symbols if they contain 5 to 12% fines (e.g. SW-SM, GP-GC, etc.)

FINE-GRAINED SOILS

MORE THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS Liquid limit less than 50
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
OL	ORGANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY	
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS Liquid Limit more than 50
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
PT	PEAT, MUCK, AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

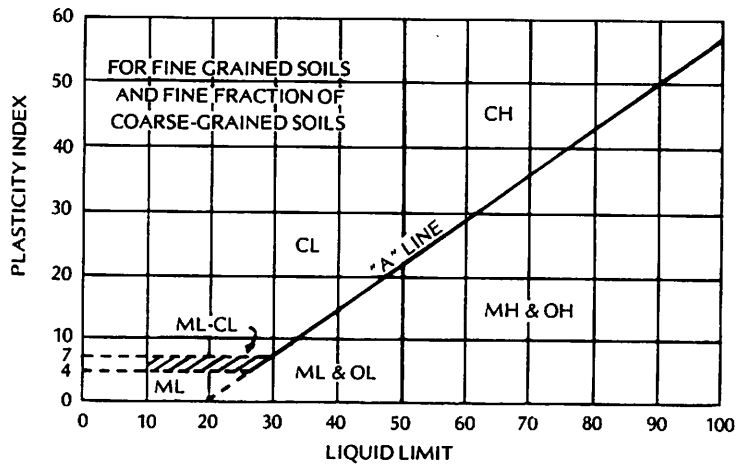
NOTE:
Fine grained soils receive dual symbols if their limits plot in the hatched zone on the Plasticity Chart (ML-CL)

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 in.
COBBLES	3 in. to 12 in.
GRAVEL	No. 4 to 3 in.
Coarse	¾ in. to 3 in.
Fine	No. 4 to ¾ in.
SAND	No. 200 to No. 4
Coarse	No. 10 to No. 4
Medium	No. 40 to No. 10
Fine	No. 200 to No. 40
*FINES (Silt or Clay)	BELOW No. 200

NOTE:
Only sizes smaller than three inches are used to classify soils.

PLASTICITY CHART



SOIL PROPERTIES

Job No. 2125J191

Boring No.	Depth, ft.	Soil Class.	Expansion/Compression					Water Soluble Matter, %		Shear Strength					Consolidation		
			Initial Dry Density pcf	Initial Moisture Content, %	Surcharge KSF	+ Expan. - Comp. %	Max. Swell Pressure KSF	Salts	Sulfates	Test Method	Initial Moisture Content, %	Dry Density pcf	C KSF	ϕ Deg.	Initial Void Ratio	Surcharge KSF	Consol. %
1	10 - 11	SP								DS	6.6	95	0.22	30.4			
2	0 - 3	GP/GM	121(2)	7.3	0.1(5)	+0.2											
2	20 - 21	SP	90	3.7	1.5	-0.7											
2	20 - 21	SP	90	3.7	1.5(5)	-5.2											
3	7 - 8	GP/GM	127	5.0	2.0	-0.6											
3	7 - 8	GP/GM	127	5.0	2.0(5)	-1.1											
5	2 - 3	SP								DS	2.4	117	0.31	32.3			
6	10 - 11	SP								DS	5.4	114	0.16	42.3			
6	20 - 21	SP	101	7.8	1.5	-0.6											
6	20 - 21	SP	101	7.8	1.5(5)	-2.1											

Boring No.	Depth, ft.	Remarks

A-3

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press
- CU Consolidated Undrained
- CD Consolidated Drained
- CR Cyclic Consolidated Undrained w/pore press

REMARKS

1. In-situ density.
2. Compacted density (Approx. 95% of ASTM:D698 max. density at moisture content slightly below optimum).
3. Compacted density (Approx. 95% of ASTM:D1557 max. density at moisture content slightly below optimum).
4. In-situ moisture.
5. Submerged to approximate saturation.
6. Consolidation % upon saturation.
7.

PHYSICAL PROPERTIES

Job No. 2125J191

Boring No.	Depth, ft.	Soil Class.	Particle Size Distribution, % Passing by wt.					Atterberg Limits		Moisture - Density Rel.			Specific Gravity	Permeability		'R' Value	Remarks
			3"	#4	#10	#40	#200	LL	PI	Dry Density pcf	Optimum Moisture %	Meth.		Dry Density pcf	K Cm/Sec	Corrected 'R'	
3	0 - 3	SP	100	62	56	43	7	-	NP								
4	6 - 9	SP	100	36	28	17	4	-	NP								

Boring No.	Depth, ft.	Comments

REMARKS

Classification/Particle Size
1. Visual
2. Laboratory Tested
3. Minus #200 Only

Moisture Density Relationship
4. Tested ASTM D-689/AASHTO T-99
5. Tested ASTM D-1557/AASHTO T-180
6. Other_____

Specific Gravity
7. Minus #4
8. Plus #4

Permeability
9. Constant Head
10. Falling Head

'R' Value
11. Expansion Pressure_____psf
12. Exudation Pressure_____psi

Note: NP = nonplastic

BORING LOG NOTES

The number shown in "LOG OF BORING NO." refers to the approximate location of the same number indicated on the "Site Plan" as positioned in the field by pacing from property lines and/or existing features.

"TYPE/SIZE BORING" refers to the exploratory equipment used in the boring wherein HSA = hollow-stem auger.

"C" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance an AW rod tipped with a two-inch-outside-diameter disk a distance of 1 foot. Refusal to penetration is considered more than 100 blows per foot.

"R" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a 2.42-inch-inside-diameter ring sampler a distance of 1 foot. Refusal to penetration is considered more than 50 blows per foot.

"Sample Type" refers to the form of sample recovery, in which R = Ring sample and G = Grab sample.

"Dry Density, pcf" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol "NR" indicates that no sample was recovered. The symbol "*" indicates that determination of dry density was not possible.

"Moisture Content, %" refers to the laboratory-determined moisture content in percent (ASTM D2216).

"Unified Class" refers to the soil type as defined by "Method of Soil Classification". The soils were classified visually in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

In general, terms and symbols on the boring logs conform with "Standard Definitions of Terms and Symbols Relating to Soil and Rock Mechanics" (ASTM D653).

LOG OF BORING NO. 1

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 466' — Datum Topo Map

Type/Size Boring 7" HSA — Rig Type CME 75

Groundwater Conditions Encountered @ 21' — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
		50/2"	R	NR		GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
5		27	R	101	3.6	SP	SAND; some silt, brown, dense, damp
10		40	R	95	6.6		
15		50/9"	R	102	4.9		Very moist
20		40	R	NR	▽		Wet
25		28	R	NR			
30							

LOG OF BORING NO. 1 CONTINUED

Project Island Treatment Plant And Lift Station Job No. 2125J191

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
31		50/11"	R	NR		SP	SAND; (cont'd)
35		50/5"	R	NR			Stopped @ 35 1/2 feet Boring backfilled with concrete
40							
45							
50							
55							
60							

LOG OF BORING NO. 2

Project Island Treatment Plant And Lift Station Job No. 2125J191

Elevation 476' Datum Topo Map

Type/Size Boring 7" HSA Rig Type CME 75

Groundwater Conditions Encountered @ 30' Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
			G			GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
5		50/3"	R	NR			
			G				
10		41	R				
15		40	R	84	3.8		
						SP	SAND; some silt, brown, dense, damp
20		30	R	90	3.7		Moist
			G				
25		41	R	95	3.2		Very moist
30							

LOG OF BORING NO. 2 CONTINUED

Project Island Treatment Plant And Lift Station Job No. 2125J191

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
31		50/11"	R	100	23.1	SP	SAND; (cont'd)
35							Stopped @ 35 feet Boring backfilled with concrete
40							
45							
50							
55							
60							

LOG OF BORING NO. 3

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 480' — Datum

Type/Size Boring 7" HSA — Rig Type CME 75

Groundwater Conditions None Encountered — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
			G			GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
							(Upper 2 to 4 feet possible fill)
5		50/3"	R	NR			
		50/9"	R	127	5.0		
			G			SP	SAND; some silt, brown, dense, damp
10		40	R	95	2.5		
15		28	R	95	4.0		
20		38	R	98	4.6		
25		50/11"	R	80	5.1		
							Stopped @ 26 feet
30							

LOG OF BORING NO. 4

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 478' — Datum

Type/Size Boring 7" HSA — Rig Type CME 75

Groundwater Conditions None Encountered — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
						GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
		24	R	108	4.0		
			G				
5		36	R	NR			
			G				
10		27	R	NR			
			G				
15							
20							
							Stopped @ 20 feet
25							
30							

LOG OF BORING NO. 5

Project Island Treatment Plant And Lift Station Job No. 2125J191

Elevation 476' Datum

Type/Size Boring 7" HSA Rig Type CME 75

Groundwater Conditions None Encountered Date 7/18/ 85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
5		28	G R	117	2.4	SP	GRAVELLY SAND; some silt, light brown, medium dense to dense, slightly damp
10		27 24	R G R	NR NR		GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
15						SP	SAND; some silt, brown, dense, damp
20							
25							Stopped @ 20 feet
30							

LOG OF BORING NO. 6

Project Island Treatment Plant And Lift Station Job No. 2125J191

Elevation 469' Datum

Type/Size Boring 7" HSA Rig Type CME 75

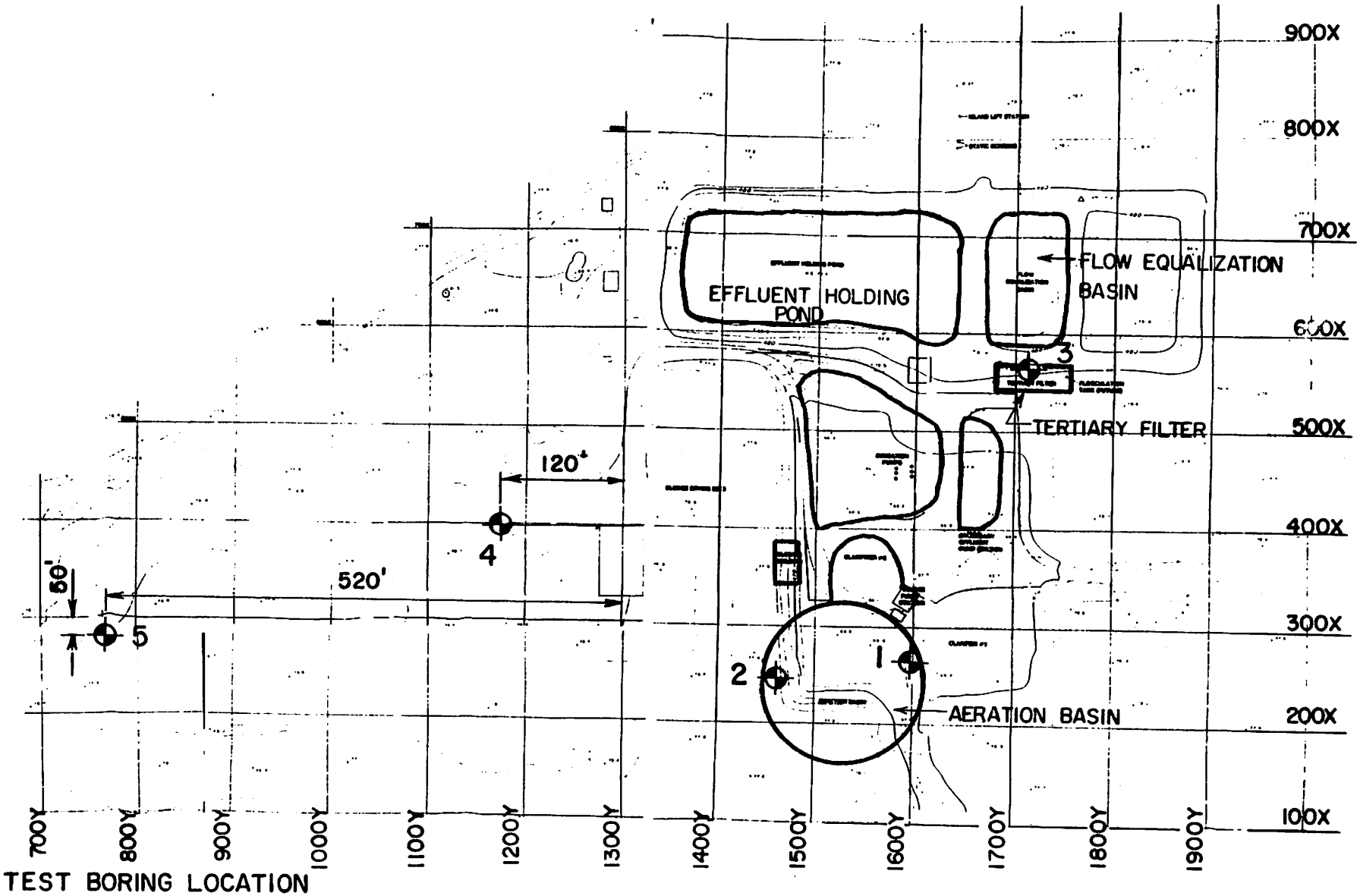
Groundwater Conditions None Encountered Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
						GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
5		38	R G	NR		SP	SAND; with gravel, some silt, brown, dense, damp
10		14	R G	114	5.4		
15		22	R G	113	4.2		
20		41	R	101	7.8		Moist - very moist
							Stopped @ 21 feet
25							
30							

Prepared By S.F. Date 8/15/05 Checked By _____ Date _____

JOB NO. 2125J191
REF. MOORE KNICKERBOCKER & ASSOC.
NO. DATE

LAKE HAVASU CITY
WASTEWATER TREATMENT PLANT IMPROVEMENTS



Prepared By S.F. Date 8/15/85 Checked By _____ Date _____

JOB NO. 2125J191

REF. MOORE KNICKERBOCKER & ASSOC.

⊕ TEST BORING LOCATION

APPENDIX A - SOIL TESTING

WESTERN TECHNOLOGIES INC.

3737 East Broadway Road
P.O. Box 21387
Phoenix, Arizona 85036
(602) 437-3737

Lake Havasu City
1795 Civic Center Boulevard
Lake Havasu City, Arizona 86403

August 14, 1985

Attn: Mr. L. Dougherty

Re: Island Treatment Plant And Lift Station
McCulloch Boulevard
Lake Havasu City, Arizona

Job No. 2125J191

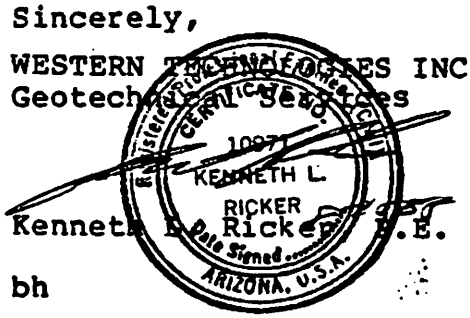
Our geotechnical report for the above project is attached. The work was performed according to our proposal of July 1, 1985.

Soils at the site consisted of sand and gravel mixed soils with good load bearing capabilities. We recommend that the facility be founded on spread footings. Slabs-on-grade may be utilized.

The report completes Western Technologies Inc.'s current services. We are prepared to review your plans and specifications for consistency with the recommendations and to provide the construction observation and testing recommended.

Sincerely,

WESTERN TECHNOLOGIES INC.
Geotechnical Services



Kenneth L. Ricker, P.E.

bh

Copies to: Addressee (2)
Moore Knickerbocker and Associates (3)

Lake Havasu City
Job No. 2125J191

TABLE OF CONTENTS

Lake Havasu City
Job No. 2125J191

Geotechnical Investigation
Island Treatment Plant And Lift Station
McCulloch Boulevard
Lake Havasu City, Arizona
August 14, 1985

INTRODUCTION

This report contains the results of our geotechnical investigation for the proposed additions to the Island Treatment Plant and new force main and lift station to be located west of McCulloch Boulevard on Pittsburgh Points in Lake Havasu City, Arizona. The purpose of these services is to provide information and recommendations relative to foundation design, lateral earth pressures, site preparation, and pavement sections.

PROPOSED CONSTRUCTION

We assume the proposed additions will include a 160 foot diameter, 20 foot deep concrete basin; a 20 foot by 40 foot slab-on-grade blower building; a 25 foot square, 20 foot deep lift station, a force main and paved roadways. Mat and spread footings are planned to support anticipated design loads from 1000 to 2000 psf. We anticipate that ground floor level in at grade buildings will be at or slightly above existing site grade. Final site grading plans were not available prior to preparation of this report.

SITE CONDITIONS

Previous site development in the treatment plant area consisted of gravel and paved roads and existing treatment facilities. Under-

ground facilities such as septic tanks, cesspools, basements, utilities, and dry wells were not observed. The ground surface was depressed in the building areas and relatively level in adjacent areas. Vegetation consisted of sparse growth of grass. Site drainage was to the south, although shallow depressions existed.

The lift station and force main site were undeveloped. The ground surface was relatively level and contained a sparse growth of brush and weeds.

SCOPE OF SERVICES

Six borings were drilled to depths of 20 to 35 1/2 feet at the locations shown on the site plan. During exploration, subsoils were examined visually and sampled at selected intervals.

Existing groundwater conditions were evaluated.

The following tests were performed on selected soil samples:

- Water content
- Dry density
- Compression
- Expansion
- Shear strength
- Gradation
- Plasticity
- R-Value

Test results were used in the development of foundation and earthwork recommendations.

INTERPRETATION OF SUBSURFACE CONDITIONS

Exploration: As presented on Logs of Borings, surface and subsoils to the full depth of exploration were found to be sandy gravels and gravelly sands with various amounts of silt. These soils are medium dense to very dense. In the treatment plant area the upper 1 to 4 feet may be fill.

Testing: Laboratory test results indicate that native subsoils at foundation level are slightly compressible at existing water contents. Some additional compression occurs when the water content is increased. When water is added to compacted near-surface soils, low expansion occurs.

Groundwater: During this investigation, groundwater was encountered in Borings 1 and 2 at a depths of 21 and 30 feet, respectively. No groundwater was encountered in the other borings. The groundwater levels presented represent only current conditions. Groundwater levels during and after construction may fluctuate due to seasonal variations, adjacent construction or development, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

General: The recommendations presented in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the borings. If variations are encountered during construction, or if changes are made in site plan, structural loading, foundation type or floor level, we should be notified for supplemental recommendations.

Shallow And Mat Foundations: We recommend shallow spread and mat foundations bearing upon undisturbed subsoils, recompacted native soils, and/or engineered fill for the anticipated loading conditions.

Alternative foundation depths and design bearing capacities are presented in the following tabulation:

Foundation Depth Below Finished Grade (ft)	Design Bearing Capacity (psf)*
1.0	1500
1.5	2000
2.0	3000

*Design bearing capacities assume fulfillment of "Earthwork" recommendations.

Total or differential settlements resulting from the assumed loads are estimated to be less than 1/2 inch provided that:

- Foundations are constructed as we recommend, and
- Essentially no changes occur in water contents of foundation soils.

Additional foundation movements of up to 1/2 inch could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction.

Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings. The design bearing capacities apply to dead loads plus design live load conditions. The

design bearing capacity may be increased by one-third when considering total loads that include wind or seismic. Recommended minimum widths of column and wall footings are 24 inches and 16 inches, respectively.

For foundations adjacent to slopes, a minimum horizontal setback of five (5) feet should be maintained between the foundation base and slope face. In addition, the setback should be such that an imaginary line extending downward at 45 degrees from the nearest foundation edge does not intersect the slope.

Thickened slab sections can be used to support interior partitions, provided that:

- loads do not exceed 900 plf,
- thickened sections have a minimum width of 12 inches, and
- thickness and reinforcement are consistent with structural requirements.

All footings, stem walls, and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations into undisturbed soils should be inspected by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Lateral Earth Pressures: For soils above any free water surface, recommended equivalent fluid pressures and coefficients of base friction for unrestrained elements are:

- Active:
  Undisturbed subsoil ---------- 30 psf/ft
  Compacted granular backfill ---------- 30 psf/ft
  Compacted site soils ---------- 30 psf/ft

- Passive:
  Shallow wall footings ---------- 250 psf/ft
  Shallow column footings ---------- 400 psf/ft

- Coefficient of base friction ---------- 0.40*

*The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:

- At-rest:
  Undisturbed subsoil ---------- 60 psf/ft
  Compacted granular backfill ---------- 55 psf/ft

The lateral earth pressures herein are not applicable for submerged soils. We should be consulted for additional recommendations if such conditions are to be included in the design.

Fill against footings, stem walls, subsurface walls and retaining walls should be compacted to densities specified in "Earthwork." Medium to high plasticity clay soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause excessive lateral earth pressures which could result in wall movements.

- Foundation Preparation: In footing areas, the upper 8 inches of existing surface soils are to be recompacted. Recompaction should extend a minimum of 2 feet beyond the footing edges.

- Interior Slab Preparation:

  1. Scarify, moisten, or dry as required, and compact all subgrade soils to a minimum depth of 10 inches. The subgrade preparation is to be accomplished in a manner which will result in uniform water contents and densities after compaction.

  2. In areas subjected to normal loading, four inches of aggregate base course should be placed beneath interior slabs. For unusual loads, reevaluation of slab and/or base course thickness may be required.

  3. If moisture sensitive floor coverings are used on interior slabs, consideration should be given to the use of vapor barriers.

- Pavement Preparation: The subgrade should be scarified, moistened as required, and recompacted for a minimum depth of 10 inches prior to placement of fill and pavement materials.

- Materials:

  1. Clean on-site or imported materials may be used as fill material for the following:

- foundation areas
- interior slab areas
- pavement areas
- backfill

2. Imported soils should conform to the following:

- Gradation (ASTM C136):
  percent finer by weight

6"	100
4"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	60 (max)

- Maximum expansive potential(%)* 1.5

- Maximum soluble sulfates(%) 0.10

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

3. Aggregate base should conform to local government specifications.

- Placement and Compaction:

1. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

2. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D698)
On-site soils, reworked and fill:	
Below footings	95
Below slabs-on-grade	90
Below pavement	95
Subsurface wall backfill	95
Imported fill:	
Below footings	95
Below slabs-on-grade	90
Below pavement	95
Subsurface wall backfill	95
Aggregate base	95
Miscellaneous backfill	90

3. On-site and imported soils should be compacted within a moisture range of 3 percent below to 3 percent above optimum.

- Compliance:

1. Recommendations for slabs-on-grade, foundations, and pavement elements supported on compacted fills or prepared subgrade depend upon compliance with "Earthwork" recommendations. To assess compliance, observation and testing should be performed under the direction of a geotechnical engineer.

Surface Drainage:

1. Positive drainage should be provided during construction and maintained throughout the life of the proposed development. Infiltration of water into utility or foundation excavations

must be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the building should be eliminated.

2. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with an outfall of approximately 3 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of mois- ture infiltration.

Pavement: Based on existing subgrade conditions, the following pavement sections are recommended:

	Asphaltic Concrete Pavement (inches)	Base Course (inches)
Passenger car parking and drives (low traffic frequency)	2.0	4.0
Major access drives (medium traffic frequency)	2.5	5.0

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphaltic concrete. Base course and asphaltic concrete should conform with MAG or City of Lake Havasu City specifications.

Material and compaction requirements should conform to recommendations presented under "Earthwork." The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections.

CLOSURE

Our conclusions and recommendations are based on observation and testing of the earthwork and foundation preparations directed by a geotechnical engineer. Because of our familiarity with the site, Western Technologies Inc. could provide these services efficiently and effectively.

If plans, specifications, or field applications deviate from our recommendations, we shall be relieved of responsibility unless our written concurrence has been obtained.

DEFINITION OF TERMINOLOGY

ALLOWABLE SOIL BEARING CAPACITY ALLOWABLE FOUNDATION PRESSURE	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
BACKFILL	A specified material placed and compacted in a confined area.
BASE COURSE	A layer of specified material placed on a subgrade or subbase.
BASE COURSE GRADE	Top of base course.
BENCH	A horizontal surface in a sloped deposit.
CAISSON	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
CONCRETE SLABS-ON-GRADE	A concrete surface layer cast directly upon a base, subbase or subgrade.
CRUSHED ROCK BASE COURSE	A base course composed of crushed rock of a specified gradation.
DIFFERENTIAL SETTLEMENT	Unequal settlement between or within foundation elements of a structure.
ENGINEERED FILL	Specified material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
EXISTING FILL	Materials deposited through the action of man prior to exploration of the site.
EXISTING GRADE	The ground surface at the time of field exploration.
EXPANSIVE POTENTIAL	The potential of a soil to expand (increase in volume) due to the absorption of moisture.
FILL	Materials deposited by the action of man.
FINISHED GRADE	The final grade created as a part of the project.
GRAVEL BASE COURSE	A base course composed of naturally occurring gravel with a specified gradation.
HEAVE	Upward movement.
NATIVE GRADE	The naturally occurring ground surface.
NATIVE SOIL	Naturally occurring on-site soil.
ROCK	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
SAND AND GRAVEL BASE	A base course of sand and gravel of a specified gradation.
SAND BASE COURSE	A base course composed primarily of sand of a specified gradation.
SCARIFY	To mechanically loosen soil or break down existing soil structure.
SETTLEMENT	Downward movement.
SOIL	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
STRIP	To remove from present location.
SUBBASE	A layer of specified material placed to form a layer between the subgrade and base course.
SUBBASE GRADE	Top of subbase.
SUBGRADE	Prepared native soil surface.

METHOD OF SOIL CLASSIFICATION
(ASTM D 2487)

COARSE-GRAINED SOILS

LESS THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	
SM	SILTY SANDS, SAND - SILT MIXTURES, MORE THAN 12% FINES	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	

NOTE:
Coarse grained soils receive dual symbols if they contain 5 to 12% fines (e.g. SW-SM, GP-GC, etc.)

FINE-GRAINED SOILS

MORE THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS Liquid limit less than 50
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
OL	ORGANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY	
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS Liquid Limit more than 50
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
PT	PEAT, MUCK, AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

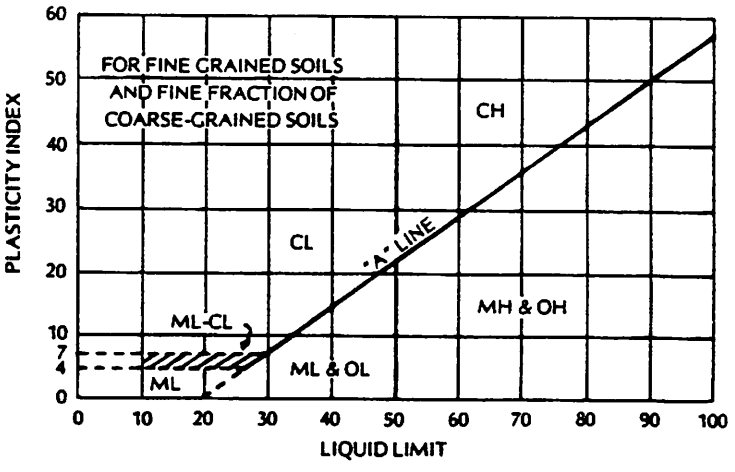
NOTE:
Fine grained soils receive dual symbols if their limits plot in the hatched zone on the Plasticity Chart (ML-CL)

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 in.
COBBLES	3 in. to 12 in.
GRAVEL	No. 4 to 3 in.
Coarse	¾ in to 3 in.
Fine	No. 4 to ¾ in.
SAND	No. 200 to No. 4
Coarse	No. 10 to No. 4
Medium	No. 40 to No. 10
Fine	No. 200 to No. 40
*FINES (Silt or Clay)	BELOW No. 200

NOTE:
Only sizes smaller than three inches are used to classify soils.

PLASTICITY CHART



SOIL PROPERTIES

Job No. 2125J191

Boring No.	Depth, ft.	Soil Class.	Expansion/Compression					Water Soluble Matter, %		Shear Strength					Consolidation		
			Initial Dry Density pcf	Initial Moisture Content, %	Surcharge KSF	+ Expan. - Comp %	Max. Swell Pressure KSF	Salts	Sulfates	Test Method	Initial Moisture Content, %	Dry Density pcf	C KSF	ø Deg.	Initial Void Ratio	Surcharge KSF	Consol. %
1	10 - 11	SP								DS	6.6	95	0.22	30.4			
2	0 - 3	GP/GM	121 (2)	7.3	0.1 (5)	+0.2											
2	20 - 21	SP	90	3.7	1.5	-0.7											
2	20 - 21	SP	90	3.7	1.5 (5)	-5.2											
3	7 - 8	GP/GM	127	5.0	2.0	-0.6											
3	7 - 8	GP/GM	127	5.0	2.0 (5)	-1.1											
5	2 - 3	SP								DS	2.4	117	0.31	32.3			
6	10 - 11	SP								DS	5.4	114	0.16	42.3			
6	20 - 21	SP	101	7.8	1.5	-0.6											
6	20 - 21	SP	101	7.8	1.5 (5)	-2.1											

Boring No.	Depth, ft.	Remarks

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press
- CU Consolidated Undrained
- CD Consolidated Drained
- CR Cyclic Consolidated Undrained w/pore press

REMARKS

1. In-situ density
2. Compacted density (Approx. 95% of ASTM D698 max. density at moisture content slightly below optimum).
3. Compacted density (Approx. 95% of ASTM D1557 max. density at moisture content slightly below optimum)
4. In-situ moisture
5. Submerged to approximate saturation.
6. Consolidation % upon saturation.
7.

PHYSICAL PROPERTIES

Job No. 2125J191

Boring No.	Depth, ft.	Soil Class.	Particle Size Distribution, % Passing by wt.					Atterberg Limits		Moisture - Density Rel.			Specific Gravity	Permeability		'R' Value	Remarks
			3"	#4	#10	#40	#200	LL	PI	Dry Density pcf	Optimum Moisture %	Meth.		Dry Density pcf	K Cm/Sec	Corrected 'R'	
3	0 - 3	SP	100	62	56	43	7	-	NP								
4	6 - 9	SP	100	36	28	17	4	-	NP								

Boring No.	Depth, ft.	Comments

REMARKS

Classification/Particle Size
1. Visual
2. Laboratory Tested
3. Minus #200 Only

Moisture Density Relationship
4. Tested ASTM D-689/AASHTO T-99
5. Tested ASTM D-1557/AASHTO T-180
6. Other_____

Specific Gravity
7. Minus #4
8. Plus #4

Permeability
9. Constant Head
10. Falling Head

'R' Value
11. Expansion Pressure_____psf
12. Exudation Pressure_____psi

Note NP = nonplastic

BORING LOG NOTES

The number shown in "LOG OF BORING NO." refers to the approximate location of the same number indicated on the "Site Plan" as positioned in the field by pacing from property lines and/or existing features.

"TYPE/SIZE BORING" refers to the exploratory equipment used in the boring wherein HSA = hollow-stem auger.

"C" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance an AW rod tipped with a two-inch-outside-diameter disk a distance of 1 foot. Refusal to penetration is considered more than 100 blows per foot.

"R" in "Blows/Foot" refers to the number of blows of a 140-pound weight, dropped 30 inches, required to advance a 2.42-inch-inside-diameter ring sampler a distance of 1 foot. Refusal to penetration is considered more than 50 blows per foot.

"Sample Type" refers to the form of sample recovery, in which R = Ring sample and G = Grab sample.

"Dry Density, pcf" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol "NR" indicates that no sample was recovered. The symbol "*" indicates that determination of dry density was not possible.

"Moisture Content, %" refers to the laboratory-determined moisture content in percent (ASTM D2216).

"Unified Class" refers to the soil type as defined by "Method of Soil Classification". The soils were classified visually in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

In general, terms and symbols on the boring logs conform with "Standard Definitions of Terms and Symbols Relating to Soil and Rock Mechanics" (ASTM D653).

LOG OF BORING NO. 1

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 466' — Datum Topo Map

Type/Size Boring 7" HSA — Rig Type CME 75

Groundwater Conditions Encountered @ 21' — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
		50/2"	R	NR		GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
5		27	R	101	3.6	SP	SAND; some silt, brown, dense, damp
10		40	R	95	6.6		
15		50/9"	R	102	4.9		Very moist
20		40	R	NR			Wet
25		28	R	NR			
30							

LOG OF BORING NO. 1 CONTINUED

Project Island Treatment Plant And Lift Station Job No 2125J191

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
31		50/11"	R	NR		SP	SAND; (cont'd)
35		50/5"	R	NR			Stopped @ 35 1/2 feet Boring backfilled with concrete GL 466
40							
45							
50							
55							
60							

LOG OF BORING NO. 2

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 476' — Datum Topo Map

Type/Size Boring 7" HSA — Rig Type CME 75

Groundwater Conditions Encountered @ 30' — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
			G			GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
5		50/3"	R	NR			
			G				
10		41	R				
15		40	R	84	3.8		
						SP	SAND; some silt, brown, dense, damp
20		30	R	90	3.7		Moist
			G				
25		41	R	95	3.2		Very moist
30							GL 472

LOG OF BORING NO. 2 CONTINUED

Project Island Treatment Plant And Lift Station Job No. 2125J191

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Moisture Content, %	Unified Classification	Description
31		50/11"	R	100	23.1	SP	SAND; (cont'd)
35							Stopped @ 35 feet Boring backfilled with concrete
40							
45							
50							
55							
60							

LOG OF BORING NO. 3

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 480' — Datum

Type/Size Boring 7" HSA — Rig Type CME 75

Groundwater Conditions None Encountered — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
			G			GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
							(Upper 2 to 4 feet possible fill)
5		50/3"	R	NR			
		50/9"	R	127	5.0		
			G			SP	SAND; some silt, brown, dense, damp
10		40	R	95	2.5		
15		28	R	95	4.0		
20		38	R	98	4.6		
25		50/11"	R	80	5.1		
							Stopped @ 26 feet
30							

LOG OF BORING NO. 4

Project: Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation: 478' — Datum:

Type/Size Boring: 7" HSA — Rig Type: CME 75

Groundwater Conditions: None Encountered — Date: 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
0						GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
		24	R	108	4.0		
			G				
5		36	R	NR			
			G				
10		27	R	NR			
			G				
15							
20							
							Stopped @ 20 feet
25							
30							

LOG OF BORING NO. 5

Project Island Treatment Plant And Lift Station Job No. 2125J191

Elevation 476' Datum

Type/Size Boring 7" HSA Rig Type CME 75

Groundwater Conditions None Encountered Date 7/18/ 85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
5		28	G R	117	2.4	SP	GRAVELLY SAND; some silt, light brown, medium dense to dense, slightly damp
10		27 24	R G R	NR NR		GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
15 20						SP	SAND; some silt, brown, dense, damp
25 30							Stopped @ 20 feet

LOG OF BORING NO. 6

Project Island Treatment Plant And Lift Station — Job No. 2125J191

Elevation 469' — Datum

Type/Size Boring 7" HSA — Rig Type CME 75

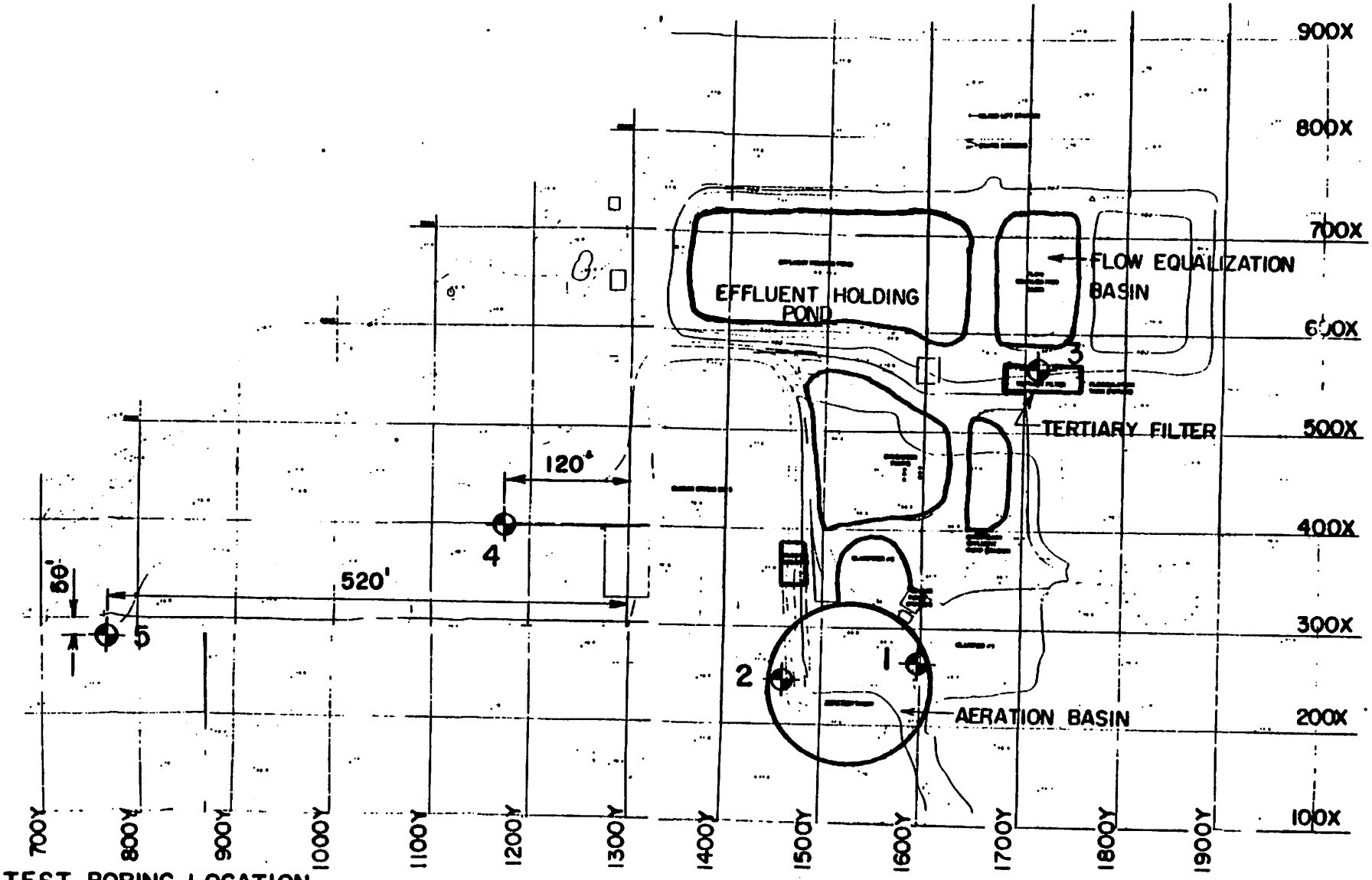
Groundwater Conditions None Encountered — Date 7/18/85

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description
						GP/GM	SANDY GRAVEL; trace to some silt, light brown, dense to very dense, slightly damp
5		38	R G	NR		SP	SAND; with gravel, some silt, brown, dense, damp
10		14	R G	114	5.4		
15		22	R G	113	4.2		
20		41	R	101	7.8		Moist - very moist
							Stopped @ 21 feet
25							
30							

Prepared By S.F. Date 8/15/05 Checked By Date

JOB NO. 2125J191
REF. MOORE KNICKERBOCKER & ASSOC.
NO. DATE

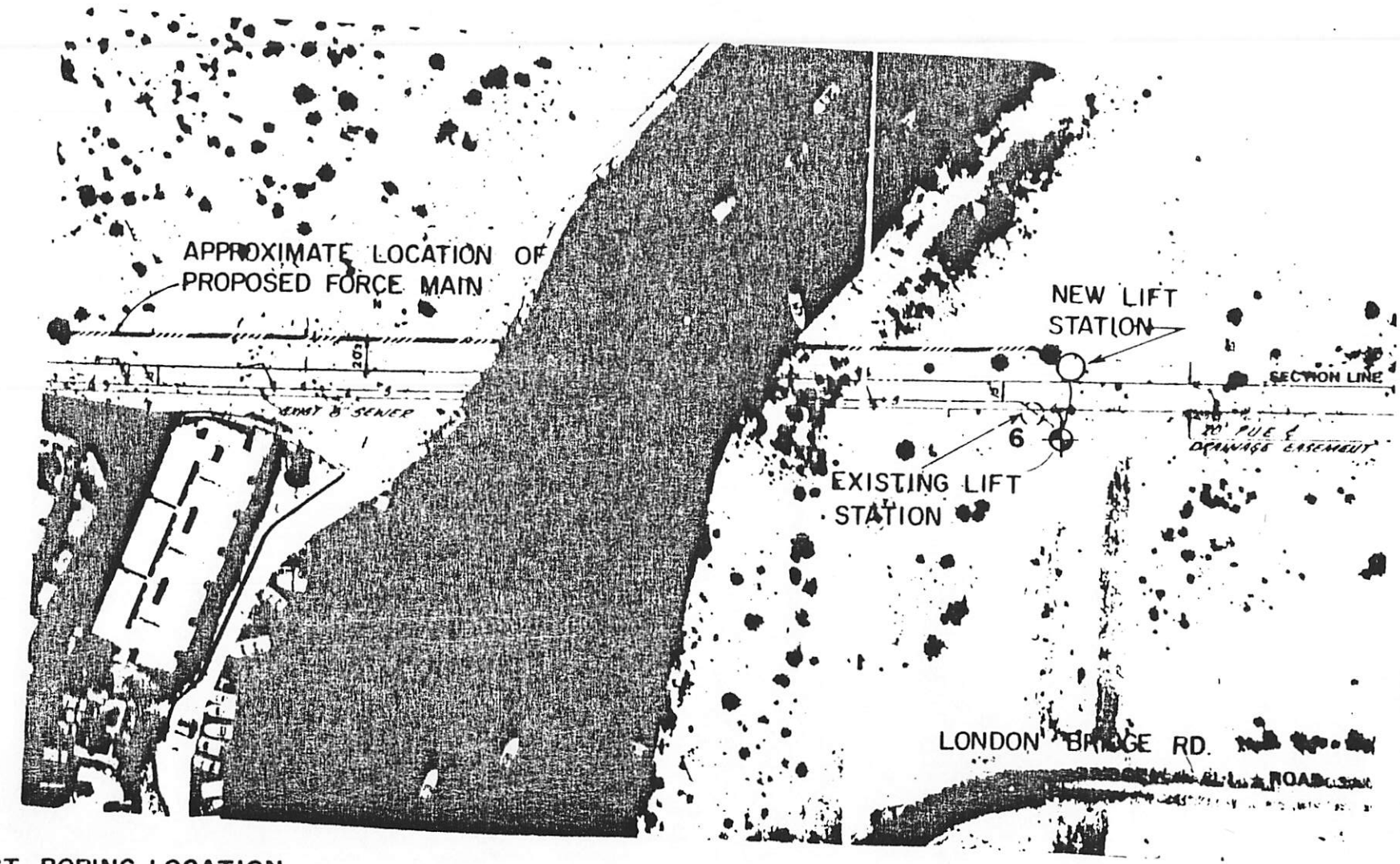
LAKE HAVASU CITY
WASTEWATER TREATMENT PLANT IMPROVEMENTS



Prepared By S.F Date 8/15/85 Checked By _____ Date _____

JOB NO. 2125J191

REF. MOORE KNICKERBOCKER & ASSOC.



⊕ TEST BORING LOCATION

SOIL BORING LOG

Located by Larry Good of Moore, Knickerbocker Engineers near the entrance to the Wastewater Treatment Plant at approximate coordinates of 430X, 1995Y

NO 1 ELEV - SIZE OF HOLE 7" FIELD ENGR MF DATE 11/6/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
1					Damp	Sandy Gravel, grey-brown	GM		X				X	X		X		X	X								X			
2						small amount of silt and	GP																								
3						clay																									
4																															
5		12	R	104.6	5.7	Sand, grey-brown stratified	SP		X				X	X		X		X									X			
6						with lenses of sandy																									
7						gravel (GP)																									
8																															
9																															
10		20	R	107.4	6.5																										
1																															
2																															
3																															
4																															
5		27	R	99.2	8.0																										
6																															
7																															
8																															
9																															
20		17	R	99.7	6.4																										
1																															
2																															
3																															
4						NOTE: Installed Permeabil-																										
5		30	R	*	*	ity Test Well between																									
6						31'0" and 34'11"																									
7																															
8																															
9																															
30		35	R	*	*																										
1					▽																										
2					=																										
3					SAT																										
4																															
5		39	R	104.9	19.6																										
6																															
7																															
8																															
9																															
40																															

*No Sample Recovery

Stopped test drilling at 39 ft.

Ground water encountered 31'3"

Project No. 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log

SOIL BORING LOG

Located by Larry Good of Moore, Knickerbocker near the Golf Course.

NO 2 ELEV - SIZE OF HOLE 7" FIELD ENGR MF DATE 11/6/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R & N	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
1					Low	Silty Sand, Gravel &	GM		X				X	X		X		X					X		
2						Cobble Mixture; grey-brown	GP																			
3																									
4																									
5		30	R	*	*																				
6																									
7																									
8					Low	Fine Gravelly Sand; grey-	SP		X	X			X	X		X		X					X		
9						brown																			
10		14	R	*	*																				
1																									
2																									
3																									
4						Sand; grey-brown, occasion-	SP		X			X	X		X		X					X		
5		20	S		9.8	al sandy gravel lenses.																			
6																									
7																									
8																									
9																									
20		36	S		1.4																				
1																									
2																									
3																									
4					▽	NOTE: Installed Piezo-																			
5		13	S		23.3	meter to 34'2"																			
6					SAT.																				
7																									
8																									
9																									
30		16	S		24.6																				
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
40																									

*No Sample Recovery

Stopped test drilling at 34 ft.

Ground water encountered 24'3"

Project No. 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log

SOIL BORING LOG

Located by Larry Good of Moore, Knickerbocker Engineers near the Airport.

NO 3 ELEV. - SIZE OF HOLE 7" FIELD ENGR MF DATE 11/6/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT N	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
1					Low	Silty Sand; light brown, occasional clean sand lenses	SM		X		X	X		X		X		X									X			
2																														
3																														
4																														
5		47	S		2.1																									
6																														
7																														
8																														
9						Sand; grey-brown, some sandy gravel lenses and occasional fine gravel lenses	SP		X			X	X		X		X											X			
10		19	S		0.7																									
1																														
2																														
3																														
4																														
5		69	S		0.7																									
6																														
7																														
8																														
9																														
20		30	S		11.1	Thin Clay-Silt lenses (2-3" thick) in the sample from 19 to 20 feet.																										
1																														
2																														
3																														
4					3.2																									
5		34	S																											
6						More fine gravel below 25 ft.																									
7																														
8																														
9					▽																									
30		7	S		20.2																									
1					SAT																									
2						NOTE: Installed Piezometer to 33'2".																									
3																														
4																														
5		73	S		7.5																									
6																														
7																														
8																														
9																														
40																														

Stopped test drilling at 35 ft.

Ground water encountered. 28'9"

Project No. 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

NOTE The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes and should not be construed as part of the plans governing construction or defining construction techniques Bidders are fully responsible for interpretations or conclusions they draw from the boring log

REPORT ON LABORATORY TESTS

SAMPLE: Date 11/12/85

Source Test Borings

Type Auger Cuttings and Drive Samples

Material Subsoil

Sampled By Frede/Thomas-Hartig & Associates

TESTED: Gradation and Atterberg Limits

RESULTS:

Sample	LL	PI	Sieve Size - Accum. % Passing 200	100	50	30	16	8	4	3/4"	1"	2"	3"	* Class
1; 0 - 4'	24	4	14	18	25	40	43	46	50	72	91	100		GM
1; 4 - 30'	-	NP	3	10	47	79	81	82	83	84	85	100		SP
1; 34 - 35'	-	NP	10	25	79	98	99		100					SP/SM
2; 24 - 25.5 2; 29 - 30.5	-	NP	1	13	98	99			100					SP
3; 0 - 8'	-	NP	26	50	69	90	95	97	99	100				SM
3; 29 - 30.5 3; 34 - 35.5	-	NP	5	12	34	44	48	53	61	90	100			SP

NP = Non-plastic

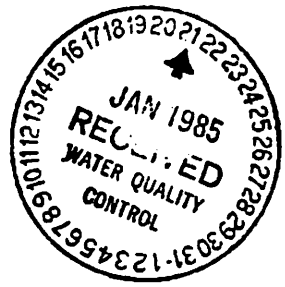
* Unified Soil Classification

Project No 85-1308

THOMAS-HARTIG & ASSOCIATES, INC

APPENDIX B - NOTICE OF DISCHARGE

NOTICE OF DISPOSAL FORM



1.) a. Facility name Lake Havasu City Island Plant

b. Facility Owner Lake Havasu Sanitary District
Golf Course Discharge Area -Nautical Inn Corp.

c. Name, title, address, and telephone number of contact person for facility.

Name: James J. Schulte

Title: Director of Public Works

Mailing address: 705 N. Lake Havasu Ave

Lake Havasu City

Arizona Zip Code 86403

Telephone number: (602)-855-2618
(Area Code)

d. Address and telephone number of facility:

Mailing address: 705 N. Lake Havasu Ave

Lake Havasu City

Arizona Zip Code 86403

Telephone number: (602)-855-3999
(Area Code)

e. Facility location information:

1150 McCulloch Blvd

Lake Havasu City

Arizona Zip Code 86403

Mohave County, Arizona

Township -13N

Range -20W

Section -16

NE ¼ SW ¼ SE

f. Describe access to facility State Highway 95 to Swanson Ave, east 1 block to Lake Havasu Ave, north 1 block to McCulloch Blvd, west to entrance gate on west side of McCulloch Blvd

g. Landowner of facility site Lake Havasu Sanitary District & Arizona State Parks

h. Type of Permit you are applying for:

area permit X individual facility permit _____

i. Type of facility requesting permit:

new _____ existing X

2.) a. Attach a topographic map (preferably a 7.5 minute quadrangle base), showing the geographic location of the facility(s) and all disposal locations. In addition, show the location of any existing groundwater withdrawal wells within the approximate vicinity (½ mile radius) of the disposal area and identify the use of each well (i.e. industrial wells, drinking water supply wells, etc.). (If applying for an area permit as described in R9-20-211, indicate on the map the location of each facility and disposal location in the proposed permitted area).

b. List Latitude/Longitude of all disposal locations indicated on the attached map Plant Lat. N 34° 27' 45", Long. W 114° 21' 23"

Golf Course Area Lat. N34° 27' 19", Long. W 114° 21' 04"

3.) a. Type of Facility(s) 2.5 MGD Sewage Treatment Plant

b. Nature of Activity conducted at facility(s) Extended aeration process with main stream biological nitrification-denitrification. UV effluent disinfection. Effluent reuse and groundwater recharge. Sludge drying and land filling.

c. List applicable U.S. Department of Commerce Standard Industrial Classification (SIC) Codes for above activities

Group 495 Industry 4952

4.) Date Facility began/will begin operating 1966

5.) Expected Facility(s) Operational Lifetime 50+ years

6.) List any other environmental permits issued to the facility(s) (i.e. air quality permit, NPDES permit, hazardous waste permit)

Wastewater reuse

7.) a. Describe disposal acitivites at the facility(s) Effluent from plants is stored in aerated pond until applied to golf course or plant site landscaping through stray irrigation. Residue from static screens is buried on site. Dried sludge from digester is hauled to city operated landfill and buried.

b. Describe any control measures and treatment processes designed and operated to protect groundwater quality from effects of the disposal

Biological nitrogen removal and effluent ultraviolet disinfection.

c. Describe existing groundwater use(s) of the receiving aquifer(s) Drinking water wells

d. Note of depth to groundwater Varies, see Environmental Impact Assessment, Appendix A.
Source of data Soil investigations. Environmental Impact Assessment.
Date of measurement 1985

e. Enter in Appendix A - Part I the ambient groundwater concentrations of the receiving aquifer(s) for those constituents listed that are contained in the disposal. Indicate source of data and date of sampling for all values listed.

8.) a. Identify the type(s) of waste(s) generated by each process within the facility. Be as descriptive as possible without listing specific constituents.

Disinfected effluent from Bio-N removal process. Residue from static screens. Sludge from aerobic digester. Dried sludge from drying beds.

b. Check of list in Appendix A - Part II of the specific pollutants disposed by the facility. Include those disposed materials that are listed in Tables I and II of this document, in Title 40 Code of Federal Regulations Part 261, or any other constituent contained in the disposed waste stream.

c. Enter in Appendix A - Part II the maximum disposal concentration of those constituents you checked or listed, as required by 8b. Indicate the date of sampling in parenthesis next to the sample value and the source of the data at the bottom of page three in Appendix A.

d. Estimate the disposal schedule including the annual average in hours per day, days per year, and the disposal periods if the disposal is seasonal.

Hours/day 16 hrs per day at the plant landscape area. 4 hrs per day at the Golf Course. 24 hrs per day at effluent holding pond.
Days/year 365 days/year

Seasonal Distribution of Disposal Minimal.

e. Estimate the flow rate(s) of the disposal (i.e. minimum, average, and maximum daily flow; mean annual flow; or mean, minimum, and maximum flow by season if disposal is periodic; or by whatever other units appropriate to the type of disposal.

	Present	Design*
Min:	600,000 gals/day	2,500,000 gals/day
Avg:	724,000 gals/day	2,500,000 gals/day
Max:	1,200,000 gals/day	2,500,000 gals/day

* Plant has flow equalization basin.

9.) Describe any existing groundwater quality monitoring program(s) (attach supporting technical reports if available)

None

10.) Include any other data or information which, in the judgement of the owner/operator, demonstrates that the facility qualifies for a groundwater quality protection permit based on compliance with the criteria listed in R9-20-208.A. Use attachments if applicable (i.e. depth to groundwater, geology at the site).

Environmental Impact Assessment-Effluent Reuse and Recharge. Existing reuse permit.

Attachment of analysis completed by ADHS

Lake Havasu Irrigation & Drainage Rules and Regulations

11.) Certification:

"I certify that under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

Jon L. Devner
Printed Name of Applicant

City Manager
Title

January 18, 1985
Date Application Signed

for Jon Devner by Gary D. Judd
Signature of Applicant

Appendix A| - NOTICE OF DISPOSAL FORM

Ambient Groundwater and Maximum Disposal Waste Stream Constituent Concentrations

	PART I Ambient Groundwater		Units	PART II Disposal Waste Stream		
Microbiological						
Fecal Coliform Bacteria	0	(1/85)	#/100 ml	<1.	(1/85)	
Inorganic Chemicals						
Arsenic	<.02	(1982)	mg/l	19.0	(6/84)	ug/l
Barium	<.5	(1982)	mg/l	NA	(6/84)	ug/l
Cadmium	<.005	(1982)	mg/l	4.0	(6/84)	ug/l
Chromium (Total)	<.02	(1982)	mg/l	18.0	(6/84)	ug/l
Lead	<.01	(1982)	mg/l	40.0	6/84)	ug/l
Mercury	<.001	(1982)	mg/l	< 0.2	(6/84)	ug/l
Nitrate (as N)	1.1	(1982)	mg/l	NA		
Selenium	<.01	(1982)	mg/l	6.0	(6/84)	ug/l
Silver	<.02	(1982)	mg/l	< 2.0	(6/84)	ug/l
Fluoride	.7	(1982)	mg/l	NA	(6/84)	ug/l
Organic Chemicals						
Chlorinated Hydrocarbons						
Endrin	NA		mg/l	< 0.006	(6/84)	ug/l
Lindane	NA		mg/l	< 0.02	(6/84)	ug/l
Methoxychlor	NA		mg/l	< 0.02	(6/84)	ug/l
Toxaphene	NA		mg/l	< 0.5	(6/84)	ug/l
Chlorophenoxys						
2, 4-D	NA		mg/l	< 0.05	(6/84)	ug/l
2, 4, 5TP Silvex	NA		mg/l	< 0.05	(6/84)	ug/l
Total Trihalomethanes	NA		mg/l	NA		

	PART I Ambient Groundwater		Units	PART II Disposal Waste Stream	
Radiochemicals					
Combined radium-226 and radium-228	.5 ± .2	(1982)	pCi/l	NA	
Gross alpha particle activity (including radium-226 but excluding radon and Uranium)	25 ± 4	(1982)	pCi/l	NA	
Beta particle and photon emitters from man-made radionuclides	NA		pCi/l	NA	
Secondary Contaminants					
Alkalinity	225	(1982)	mg/l	NA	
Calcium	118	(1982)	mg/l	NA	
Chloride	187.8	(1982)	mg/l	NA	
Copper	.08	(1982)	mg/l	NA	
Hardness	371	(1982)	mg/l	NA	
Iron	< .1	(1982)	mg/l	NA-	
Magnesium	1.	(1982)	mg/l	NA	
Manganese	< .02	(1982)	mg/l	NA	
pH	7.7	(1982)	mg/l	7.4	(1/85)
Sodium	204	(1982)	mg/l	NA	
Sulfate	20	(1982)	mg/l	NA	
Total Dissolved Solids (TDS)	1039	(1982)	mg/l	NA	
Zinc	< .02	(1982)	mg/l	NA	

	PART I Ambient Groundwater	Units	PART II Disposal Waste Stream
Priority Pollutants			
See Attachment			

Others: (list all other constituents contained in the disposal waste stream)

Source of data: Part I - Lake Havasu Irrigation & Drainage District well records.

Part II - Analysis furnished by Arizona Department of Health Services

Appendix A - NOTICE OF DISPOSAL FORM

Ambient Groundwater and Maximum Disposal Waste Stream Constituent Concentrations

	PART I Ambient Groundwater	Units	PART II Disposal Waste Stream
Microbiological			
Fecal Coliform Bacteria	0 (1/85)	#/100 ml	<1. (1/85)
Inorganic Chemicals			
Arsenic	<.02 (1982)	mg/l	19.0 (6/84) ug/l
Barium	<.5 (1982)	mg/l	NA (6/84) ug/l
Cadmium	<.005 (1982)	mg/l	4.0 (6/84) ug/l
Chromium (Total)	<.02 (1982)	mg/l	18.0 (6/84) ug/l
Lead	<.01 (1982)	mg/l	40.0 6/84) ug/l
Mercury	<.001 (1982)	mg/l	< 0.2 (6/84) ug/l
Nitrate (as N)	1.1 (1982)	mg/l	NA
Selenium	<.01 (1982)	mg/l	6.0 (6/84) ug/l
Silver	<.02 (1982)	mg/l	< 2.0 (6/84) ug/l
Fluoride	.7 (1982)	mg/l	NA (6/84) ug/l
Organic Chemicals			
Chlorinated Hydrocarbons			
Endrin	NA	mg/l	< 0.006 (6/84) ug/l
Lindane	NA	mg/l	< 0.02 (6/84) ug/l
Methoxychlor	NA	mg/l	< 0.02 (6/84) ug/l
Toxaphene	NA	mg/l	< 0.5 (6/84) ug/l
Chlorophenoxys			
2, 4-D	NA	mg/l	< 0.05 (6/84) ug/l
2, 4, 5TP Silvex	NA	mg/l	< 0.05 (6/84) ug/l
Total Trihalomethanes	NA	mg/l	NA

	PART I Ambient Groundwater		Units	PART II Disposal Waste Stream	
Radiochemicals					
Combined radium-226 and radium-228	.5 ± .2	(1982)	pCi/l	NA	
Gross alpha particle activity (including radium-226 but excluding radon and Uranium)	25 ± 4	(1982)	pCi/l	NA	
Beta particle and photon emitters from man-made radionuclides	NA		pCi/l	NA	
Secondary Contaminants					
Alkalinity	225	(1982)	mg/l	NA	
Calcium	118	(1982)	mg/l	NA	
Chloride	187.8	(1982)	mg/l	NA	
Copper	.08	(1982)	mg/l	NA	
Hardness	371	(1982)	mg/l	NA	
Iron	< .1	(1982)	mg/l	NA-	
Magnesium	1.	(1982)	mg/l	NA	
Manganese	< .02	(1982)	mg/l	NA	
pH	7.7	(1982)	mg/l	7.4	(1/85)
Sodium	204	(1982)	mg/l	NA	
Sulfate	20	(1982)	mg/l	NA	
Total Dissolved Solids (TDS)	1039	(1982)	mg/l	NA	
Zinc	< .02	(1982)	mg/l	NA	

	PART I Ambient Groundwater	Units	PART II Disposal Waste Stream
Priority Pollutants			
See Attachment			

Others: (list all other constituents contained in the disposal waste stream)

Source of data: Part I - Lake Havasu Irrigation & Drainage District well records.

Part II - Analysis furnished by Arizona Department of Health Services

APPENDIX C - REUSE APPLICATION

STATE OF ARIZONA
APPLICATION FOR
RECLAIMED WASTEWATER REUSE PERMIT

1. a. **Name of Wastewater Treatment Plant where reclaimed wastewater emanates** Lake Havasu City Island Plant

b. **Name of Wastewater Treatment Plant Owner** Lake Havasu Sanitary District; Golf Course Discharge Area (Nautical Inn Corp.)

c. **ADHS system number of Wastewater Treatment Plant** 38003

d. **Mailing address and telephone number of wastewater treatment plant:**

Mailing address: 705 N. Lake Havasu Avenue
Lake Havasu City
Arizona **Zip Code** 86403

Telephone Number: (602) 855-3999
Area Code

e. **Location of Wastewater Treatment Plant:**

1150 McCulloch Blvd
Lake Havasu City
Arizona **Zip Code** 86403
Mohave **County, Arizona**

Township 13 N **Range** 20 W

Section 16 NE ¼ SW ¼ SE ¼

f. Name, address, and telephone number of contact person for the wastewater treatment plant:

Name: James J. Schulte; Public Works Director

Mailing Address: 705 N. Lake Havasu Avenue

Lake Havasu City

Arizona Zip Code 86403

Telephone Number: (602) 855-3999
Area Code

2. a. Name, address, and telephone number of reclaimed wastewater owner (if different than wastewater treatment plant owner):

Name: James J. Schulte, Public Works Director

Mailing address: 705 N. Lake Havasu Avenue

Lake Havasu City

Arizona Zip Code 86403

Telephone Number: (602) 855-3999
Area Code

b. Location of reclaimed wastewater reuse site:

1. Pittsburgh Island Plant
2. Nautical Inn Golf Course
Main Land Golf Course (under construction)
3. Lake Havasu City Zip Code 86403

Mohave County, Arizona

Township 13 N Range 20 W

Section 1. 16 SW SE ¼ ____ ¼ ____ ¼
2. 21 NE
3. 15 NW

3. a. Type of treatment process reclaimed wastewater receives:

Partially treated _____ Primary _____

Secondary _____ Other XX

Tertiary with UV disinfection and biological nitrogen removal.

b. Maximum quantity of reclaimed wastewater to be released for reuse by the wastewater treatment plant 2.5 MGD.

c. Quality of reclaimed wastewater being released by wastewater treatment plant (average monthly values; attach copies of monitoring report forms from which averages were calculated):

Suspended Solids 10 mg/l

Biochemical Oxygen Demand (BOD) 10 mg/l

Settleable Solids 1 mg/l

Dissolved Oxygen (DO) 2 mg/l

Fecal Coliform Bacteria 25 CFU/100 ml

Total Residual Chlorine 0 mg/l

pH 6-7.5 pH units

Turbidity J NTU

Enteric Virus 3.1 (PFU or MPN/l)

Entamoeba histolytica N/A

Giardia lamblia N/A

Ascaris lumbricoides Non-Detectable

Common Large Tapeworm N/A

Temperature 15-20 °C

Others: Trace Substances, Toxic Substances, Organic Chemicals, Radiochemicals (as available) N/A

d. Is blending or additional treatment of secondary effluent going to be utilized to meet a specific reuse category?

Yes _X_ No _____

If yes, attach a plan of operation (i.e. operation and maintenance manual) and describe: _____

1. the additional treatment process The effluent quality will be tertiary, denitrified and UV disinfected.

2. blending volumes N/A

3. estimate the final quality at the point of reuse (by parameters listed above) Refer to the quality listed under 3 c

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

_____ Orchards

_____ Fiber, Seed, Forage

_____ Pastures

_____ Livestock Watering

_____ Processed Food

_____ Landscaped Restricted Access

_____ Industrial

_X_ Areas Open Access (excluding treatment plant recharge sites).

_____ Food To Be Consumed Raw

_____ Incidental Human Contact

_____ Full Body Contact

_____ On-Site Wastewater Treatment or Graywater Surface Irrigation

_____ Wetlands Marsh

5. a. Attach an irrigation site plan which documents applicable design criteria including: the local topography and drainage patterns; the design to control the 10-year, 24-hour precipitation event; the design for a minimum of five days storage if no means of reuse, discharge, or disposal are available other than surface irrigation; the design for any discharges of excess reclaimed wastewater including emergency overflows; distribution of sprinkler heads, public drinking fountains; etc. (Refer to the Environmental Impact Assessment)

   b. Are any discharges of excess reclaimed wastewater planned/expected? Yes _____ No X

   If yes, describe expected discharge period(s) and quantities

   N/A

   c. Method of disposal for such discharge N/A

   d. Name of receiving lake, stream, dry wash, etc. of such discharge N/A

   Does the wastewater treatment plant have an NPDES permit?

   Yes _____ No X

   If yes, list NPDES permit number _____

6. a. Area of reclaimed wastewater application 118.8 acres.

b. Describe cropping, pasturing, and harvesting operations as applicable to the specific reuse category applying for

N/A; Golf course and open areas landscaped areas.

c. Describe reclaimed wastewater: application rates; daily and seasonal schedule of application; irrigation practices/methods; plan of operations. Attach documents as necessary.

Refer to Environmental Impact Assessment.

7. I certify that I am familiar with the information contained in this application and that to the best of my knowledge and belief, such information is true, complete and accurate.

Jon L. Denver
Printed Name of Applicant

City Manager
Title

December 10, 1985
Date application signed

For Jon Denver by Larry D. Ford
Signature of Applicant

LITERATURE CITED

LITERATURE CITED

Allison, L.E. "Effect of Microorganisms on Permeability of Soil under Prolonged Submergence." Soil Sci. 63:439-450 (1947).

Anvimelech, Y. and Z. Nevo. "Biological Clogging of Sands." Soil Sci. 98:222-226 (1964).

DeVries, T. "Soil Infiltration of Wastewater Effluent and the Mechanism of Pore Clogging." J. Wat. Poll. Control Fed. April 1972, 44(4): 565-574 (1972).

EPA. Process Design Manual for Nitrogen Control. U.S. EPA Technology Transfer (1975).

Martin, J.P., and D.D. Focht. "Biological Properties of Soils." Soils for Management of Organic Wastes and Wastewaters. Soil Sci. Soc., American Soc., Agronomy, and Crop Sci. Soc. America, Madison, Wisconsin (1977).

Menzies, J.D. "Pathogen Considerations for Land Application of Human and Domestic Animal Wastes." Soils for Management of Organic Wastes and Wastewaters. Soil Sci. Soc., American, American Soc. Agronomy, and Crop Sci. So., American, Madison, Wisconsin (1977).

Nasr, S.M. "A Passive Denitrification System." Fourth Northwest Onsite Wastewater Disposal Conference. University of Washington, Seattle, Washington (1983).

Nasr, S.M. "Nitrification Sand Filter Design." New Directions and Research in Wastewater Treatment and Residual Management. International Conference Proceedings, University British Columbia, Vancouver, Canada (1985).

Nasr, S.M.; Knickerbocker, K.L. and Moore, T.L., "Biological Nutrient Removal-Payson, Arizona".1 58th WPCF Conference, Kansas City, 1985.

Nilsson, K., and P. Englov. "Rapid Infiltration of Wastewater." 3.79, Vatten, Malmo, Sweden (1979).

Walker, W.G. et al. "Nitrogen Transformations During Subsurface Disposal of Septic Tank Effluent in Sands - L. Soil Transformation." J. Environ. Qual. 2:475-480 (1973).

LITERATURE CITED

LITERATURE CITED

Allison, L.E. "Effect of Microorganisms on Permeability of Soil under Prolonged Submergence." Soil Sci. 63:439-450 (1947).

Anvimelech, Y. and Z. Nevo. "Biological Clogging of Sands." Soil Sci. 98:222-226 (1964).

DeVries, T. "Soil Infiltration of Wastewater Effluent and the Mechanism of Pore Clogging." J. Wat. Poll. Control Fed. April 1972, 44(4): 565-574 (1972).

EPA. Process Design Manual for Nitrogen Control. U.S. EPA Technology Transfer (1975).

Martin, J.P., and D.D. Focht. "Biological Properties of Soils." Soils for Management of Organic Wastes and Wastewaters. Soil Sci. Soc., American Soc., Agronomy, and Crop Sci. Soc. America, Madison, Wisconsin (1977).

Menzies, J.D. "Pathogen Considerations for Land Application of Human and Domestic Animal Wastes." Soils for Management of Organic Wastes and Wastewaters. Soil Sci. Soc., American, American Soc. Agronomy, and Crop Sci. So., American, Madison, Wisconsin (1977).

Nasr, S.M. "A Passive Denitrification System." Fourth Northwest Onsite Wastewater Disposal Conference. University of Washington, Seattle, Washington (1983).

Nasr, S.M. "Nitrification Sand Filter Design." New Directions and Research in Wastewater Treatment and Residual Management. International Conference Proceedings, University British Columbia, Vancouver, Canada (1985).

Nasr, S.M.; Knickerbocker, K.L. and Moore, T.L., "Biological Nutrient Removal-Payson, Arizona".1 58th WPCF Conference, Kansas City, 1985.

Nilsson, K., and P. Englov. "Rapid Infiltration of Wastewater." 3.79, Vatten, Malmo, Sweden (1979).

Walker, W.G. et al. "Nitrogen Transformations During Subsurface Disposal of Septic Tank Effluent in Sands - L. Soil Transformation." J. Environ. Qual. 2:475-480 (1973).

www.dezurik.com

DeZURIK Quotation

To: CAROLLO ENGINEERS
CRAIG GALUSKA
376 E WARM SPRINGS RD STE 250
LAS VEGAS, NV
USA
Phone 702-696-6216
Email cgaluska@carollo.com

Reference: **BUDGETARY**
Invoice Terms: Net 30 Days
Days Valid: 30
Shipping Point: FOB: ORIGIN / SARTELL, MN
Delivery Notes: *LEAD TIME = TBD
*LEAD TIME QUOTES ARE BASED ON AVAILABLE INVENTORY AT TIME OF QUOTE
*SHIPPING TERMS= FREIGHT ALLOWED

Date of Quote: 10-27-2020
Quote Number: 204643
Project Name: LAKE HAVASU CITY FLOW CONTROL VALVE
I.D. (Rep. Use): 201420
Line of Business: 4941 - Municipal Water Treatment
Make Order To: DeZURIK, Inc.
C/O INDUSTRIAL AUTOMATION SERVICES
LUIS TRUJILLO SALES
550 S ELLIS ST SUITE 1
CHANDLER, AZ 85224
USA
Phone 480-413-0899
Fax 480-413-0960
Email sales@iasaz.com

Currency and Values expressed in USD ($)

ANY PURCHASE ORDER ISSUED AS A RESULT OF THIS QUOTATION IS SUBJECT TO ALL OF THE MANUFACTURER'S CONDITIONS SET FORTH IN THIS DOCUMENT HEREOF, REASONABLE CONTRACT LANGUAGE NEGOTIATIONS AND FINAL ACCEPTANCE BY DEZURIK AT SARTELL, MN USA.

Line #	Cust. Line # Tag #	Qty	Order Code	Unit Price	Total Price
1		1	PEF,20,F1,CI,NBR,CR,DTR-S30SC0*X,SB16 Modified **PEF:** Style - DeZURIK 100% Area Rectangular Port Eccentric Plug Valve (AWWA C517) **20:** Size - 20 Inch (500mm), Type 316 Stainless Steel Bearings - ASTM A743 Grade CF8M, Welded-In Nickel Seat **F1:** End Connection - Flanged, Drilled to ASME B16.1 Class 125/150 **CI:** Body Material - Cast Iron, ASTM A126, Class B **NBR:** Packing - Acrylonitrile-Butadiene Reinforced, Multiple V-Ring with External Adjustment, -20 to 180 Degree F. (-29 to 83 Degree C.) **CR:** Plug Facing - Ductile Iron - ASTM A536 with Chloroprene Face; -20 to 180°F (-29 to 83°C) **Coating or Paint:** S30SC0 - 8 mils minimum (non-stainless steel parts) of Blue DeZURIK Epoxy (NSF Std. 61) on Interior and Standard (SP10) surface prep AND 8 mils minimum (non-stainless steel parts) of Blue DeZURIK Epoxy (NSF Std. 61) on Exterior and Standard (SP10) surface prep **DTR:** Option - DeZURIK Standard Certified Production Hydrostatic Shell and Seat Test Report **X:** Actuator Type - LIMITORQUE ACTUATOR, MXb-10/WG-05-1SD-B, 3/60/460VAC, NEMA 4X,6, MODULATING SERVICE, INCLUDES SEPARATE PUSH BUTTON STATION **SB16:** Accessories - 316 Stainless Steel Bolting	$29,000.00	$29,000.00
Total					$29,000.00

DeZURIK
Quotation

Line #	Cust. Line # Tag #	Qty	Order Code	Unit Price	Total Price

Comments

SUBMITTAL LEAD TIME (IF REQUIRED) = 2-4 WEEKS FOR MANUAL VALVES / 4-6 WEEKS FOR AUTOMATED VALVES

START UP SERVICES (IF REQUIRED) = $1,500.00 + EXPENSES PER 8 HOUR DAY AS NEEDED TO COMPLETE JOB

1) PRICING VALID FOR 30 DAYS
2) WE RESERVE THE RIGHT TO ADJUST INDIVIDUAL ITEM PRICING IN THE EVENT OF A PARTIAL AWARD.
3) UNLESS SPECIFIED IN PART NUMBER AND/OR DESCRIPTION;
TESTS/CERTIFICATIONS,SUPPORTS, ANCHORS, VALVE BOXES, COVERS, GUIDES, EXTENSIONS OR OTHER ACCESSORIES ARE NOT INCLUDED IN QUOTED PRICING.
4) THE USER, THROUGH ITS OWN ANALYSIS AND TESTING, IS SOLELY RESPONSIBLE FOR MAKING THE FINAL SELECTION OF PRODUCTS AND SYSTEMS AND ASSURING THAT ALL PERFORMANCE, SAFETY AND WARNING REQUIREMENTS OF THE APPLICATION ARE MET.
5) "CHECK TO SPECS" ARE NOT INCLUDED AS PART OF SUBMITTAL PACKAGE AND WILL NOT BE PROVIDED BY DEZURIK OR INDUSTRIAL AUTOMATION SERVICES.

MANUFACTURER'S CONDITIONS

These conditions apply to all quotations, orders and contracts for DeZURIK, Inc. ("we," "us" or "our")

1. CONSTRUCTION AND LEGAL EFFECT: Our sale to you, as the purchaser of goods from us, is limited to and expressly made conditional on your assent to these typed and printed terms and conditions of sale, the face and reverse side hereof ('These Terms"), all of which form a part of the agreement to sell and which supersede and reject all prior writings (including your order), representations, negotiations with respect hereto and any conflicting terms and conditions of yours, any statement therein to the contrary notwithstanding. The sending of the purchase order for the goods referred to herein, whether or not signed by you, or your acceptance of the goods or payment operates as acceptance by you of These Terms. In case of conflict between These Terms and the terms of your purchase order or acceptance, These Terms govern; any different or conflicting terms submitted by you in any purchase order or acceptance shall be deemed objected to by us and shall be of no effect unless specifically agreed to by us in writing. We will furnish only the quantities and goods specifically listed on the face hereof or the pages attached hereto. We assume no responsibility for other terms or conditions or for furnishing other equipment or material shown in any plans and/or specifications for a project to which the goods quoted or ordered herein pertain or refer. Our published or quoted terms and conditions are subject to change without notice prior to acceptance of order.

2. PRICES: Unless otherwise noted on the face hereof, quotations are valid for 30 days, prices are net, FCA carrier, our factory. Stenographic, clerical, and mathematical errors are subject to correction. Until acceptance of order on These Terms, quoted prices and delivery are subject to change. Thereafter, unless otherwise noted, prices are firm for shipment of goods within 12 months from the relevant quotation date. Our prices are based on current prices for material. We will endeavor to obtain the lowest pricing on materials from our suppliers, but if a significant material price increase occurs between order acceptance and shipment date, goods scheduled to ship beyond 12 months of the quotation date are subject to a price adjustment by the amount necessary to cover such increase.

3. DELIVERY: Dates for the furnishing of services and/or delivery or shipment of goods are approximate only and are subject to change. Quoted lead times are figured from the later of date of acceptance of order on These Terms or from the date of receipt of complete technical data and approved drawings as such may be necessary. We shall not be liable, directly or indirectly, for any delay in or failure to perform caused by carriers or suppliers or delays from labor difficulties, shortages, strikes or stoppages of any sort, failure or delay in obtaining materials, customer requested order changes, fires, floods, storms, accidents, causes designated acts of God or force majeure by any statute or court of law or other causes beyond our reasonable control.

4. SHORTAGE, DAMAGE, ERRORS IN SHIPMENT: Our responsibility ceases upon delivery to carrier. Risk of loss, injury or destruction of property, shall be borne by you from and after our delivery to carrier, and such loss, injury or destruction shall not release you from the obligation to pay the purchase price. You shall note receipt for goods that are not in accordance with bill of lading or express receipt and you shall make claim against such carrier for any shortage, damage or discrepancy in the shipment per the ICC Code for Freight Claims promptly. You shall inspect and examine all items and goods covered by the order when unpacking crated or boxed goods, and if damage is discovered, leave as is until the carrier's agent makes examination and notation on freight or express bill of concealed damage. We will render reasonable assistance to help trace and recover lost goods and collect just claims as a business courtesy, but without obligation. We do not guarantee safe delivery.

5. TAXES: Our prices do not include sales, use, excise, occupation, processing, transportation or other similar taxes which we may be required to pay or collect with respect to any of the materials covered hereby under existing or future law. Consequently, in addition to the price specified herein, such taxes shall be paid by you, or you shall provide us with a tax exemption certificate acceptable to the appropriate taxing authorities. You shall also assume and pay any import or export duties and taxes, with respect to the materials covered by the order, and shall hold harmless and reimburse us therefrom.

6. CREDIT AND PAYMENT: Unless otherwise noted on the face hereof, payment of goods shall be (30) days net in US dollars. Prorated payments shall become due with partial shipments. We reserve the right at any time to suspend credit or to change credit terms provided herein, when, in our sole opinion, your willingness or ability to pay your obligations to us is in doubt. Failure to pay invoices at maturity date, at our election, makes all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled and we shall not, in such event, be liable for non-performance of contract in whole or in part. You agree to pay, without formal notice, 1.5% per month of the amount not paid when due, provided that, if such rate is in excess of applicable governing law, you agree to pay the maximum permitted rate.

7. CANCELLATIONS AND CHANGES: Orders which have been accepted by us are not subject to your cancellation or changes in specifications, except upon our written consent, and we may require, as a condition of such consent, appropriate adjustments in price, delivery schedule and other relevant terms, and in the case of cancellation, cancellation charges. In the event we accept your cancellation, you shall be liable for a cancellation charge equal to the higher of (i) 25% of the purchase price of the item(s), or (ii) any loss or cost incurred by us, including cost of materials, labor, engineering, reconditioning and our profit margin.

8. DEFERRED SHIPMENT: If shipment is deferred at your request, payment of the contract price shall become due when you are notified that the equipment is ready for shipment. If you fail to make payment and/or furnish shipping instructions we may either extend time for so doing or cancel contract. In case of deferred shipment at your request, storage and other reasonable expenses attributable to such delay shall be payable by you.

9. LIMITED WARRANTY: Products, auxiliaries and parts thereof that we manufacture are warranted to the original purchaser for a period of twenty-four (24) months from date of shipment from factory, against defective workmanship and material, but only if properly stored, installed, operated, and serviced in accordance with our recommendations. Repair or replacement, at our option, for items we manufacture will be made free of charge, (FOB) our facility with removal, transportation and installation at your cost, if proved to be defective within such time, and this is your sole remedy with respect to such products. Equipment or parts manufactured by others but furnished by us will be repaired or replaced, but only to the extent provided in and honored by the original manufacturers' warranty, in each case subject to the limitations contained therein. No claim for transportation, labor or special or consequential damages or any other loss, cost or damage shall be allowed. You shall be solely responsible for determining suitability for use and in no event shall we be liable in this respect. We do not guarantee resistance to corrosion, erosion, abrasion or other sources of failure, nor do we guarantee a minimum length of service. Your failure to give written notice to us of any alleged defect under this warranty within twenty (20) days of its discovery, or attempts by someone other than us or our authorized representatives to remedy the alleged defects therein, or failure to return product or parts for repair or replacement as herein provided, or failure to install and operate said products and parts according to instructions we furnished, or misuse, modification, abuse or alteration of such product, accident, fire, flood or other Act of God, or failure to pay entire contract price when due shall be a waiver by you of all rights under this warranty. The foregoing guarantee shall be null and void if, after shipment from our factory, the item is modified in any way or a component of another manufacturer, such as but not limited to; an actuator is attached to the item by anyone other than our Factory Service personnel. All orders accepted shall be deemed accepted subject to this limited warranty, which shall be exclusive of any other or previous Warranty, and this shall be the only effective guarantee or warranty binding on us, despite anything to the contrary contained in the purchase order or represented by any of our agents or employees, in writing or otherwise, notwithstanding, including but not limited to implied warranties.

THE FOREGOING REPAIR AND REPLACEMENT OBLIGATIONS ARE IN LIEU OF ALL OTHER WARRANTIES, OBLIGATIONS AND LIABILITIES, INCLUDING ALL WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BY LAW, AND STATE OUR ENTIRE AND EXCLUSIVE LIABILITY AND YOUR EXCLUSIVE REMEDY FOR ANY CLAIM IN CONNECTION WITH THE SALE AND FURNISHING OF SERVICES, GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATIONS.

10. INTELLECTUAL PROPERTY. We shall indemnify and hold you harmless from any amount that you are required to pay to a third-party pursuant to final, non-appealable court order as a result of such third-party's claim that a product sold hereunder infringes any United States patent or copyright of such third party; provided that our obligation of indemnification is contingent upon (a) your notifying us of any such claim within 20 days of receipt thereof, (b) your providing us with exclusive control of the defense and/or settlement thereof, and (c) your cooperating with us in such defense and/or settlement. In the event of such a successful infringement claim by the third party, at our option, we shall either (i) modify the product sold hereunder so that it performs comparable functions without infringement, (ii) obtain a royalty-free license for you to continue using the infringing product or (iii) refund to you the then-depreciated fair market value of the infringing component. We shall have no obligation under this Section to the extent a claim is based upon (a) the combination, operation or use of the product with equipment, products, hardware, software, systems or data that was not provided by us, if such infringement would have been avoided in the absence of such combination, operation or use, or (b) your use of the product in any manner inconsistent with our written materials regarding the use of such product. This Section states our entire liability and your exclusive remedy with respect to any alleged infringement arising from the use of the products sold hereunder or any part thereof and is subject to the other limitations contained in These Terms.

11. LIMITATION OF LIABILITY: IN NO EVENT SHALL WE BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES WHATSOEVER, AND OUR LIABILITY, UNDER NO CIRCUMSTANCES, WILL EXCEED THE CONTRACT PRICE FOR THE GOODS AND/OR SERVICES FOR WHICH LIABILITY IS CLAIMED, ANY ACTION FOR BREACH OF CONTRACT BY YOU, OTHER THAN RIGHTS RESPECTING OUR LIMITED WARRANTY DESCRIBED IN SECTION 9 ABOVE, MUST BE COMMENCED WITHIN THE EARLIER OF 12 MONTHS AFTER THE DATE OF SALE.

12. EXPORT CONTROL COMPLIANCE: You agree and acknowledge that the products are sold in accordance with U.S. export control and sanctions laws, regulations and orders, as they may be amended from time to time. You agree to ascertain and comply with all applicable export and re-export obligations and restrictions, including without limitation, U.S. export and re-export controls under the Export Administration Regulations ("EAR"), International Traffic in Arms Regulations ("ITAR"), and all regulations and orders administered by the U.S. Department of Treasury, Office of Foreign Assets Control (collectively, "U.S. Export Control Laws"). If you are conducting the export from the United States or the re-export from a country outside the United States, you shall comply with such U.S. Export Control Laws and obtain any license or other authorization required to export or re-export the products and related technology. We shall reasonably cooperate and exercise reasonable efforts, at your expense, to support you in obtaining any necessary licenses or authorizations. You shall not export or re-export the products and/or related technology to any country or entity to which such export or re-export is prohibited, including any country or entity under sanction or embargoes administered by the United States. Any diversion contrary to the law of the United States is prohibited. You will not take, and will not solicit us to take, any action that would violate any anti-boycott or any export or import statutes or regulations of the United States or other governmental authorities, and shall defend and indemnify us for any loss or damage arising out of or related to such actions.

13. GENERAL COMPLIANCE WITH LAWS. In addition to your obligations under Section 12 above, you represent and warrant that, in performing your duties under this Agreement, you will comply with, at your sole expense, all applicable laws and regulations of any governmental authority, including your duties involving any required registrations, requirements as to product contents, packaging and labeling, restraint of trade, consumer laws, data privacy and environmental laws. You have had an opportunity to obtain legal advice regarding, and currently comply with, all applicable legal requirements that prohibit unfair, fraudulent or corrupt business practices, including the U.S. Foreign Corrupt Practices Act (FCPA) as well as U.S. and other legal requirements that are designed to combat terrorism and terrorist activities. In addition, neither you nor any of your equity interest owners, officers or directors are named as a "specially designated national' or "blocked person" as designated by the United States Department of the Treasury's Office of Foreign Assets Control under the U.S. PATRIOT Act.

14. INDEMNIFICATION BY YOU. You will indemnify, defend and hold us and our corporate parents and other affiliates and their respective officers, directors, stockholders, members, insurers, attorneys, employees, agents, successors, predecessors, assigns, heirs and personal representatives harmless against any and all liability, claims, suits, actions, losses, liabilities, damages, costs and legal fees arising out of or related to: (i) any conduct of you or any related party as described in Sections 12 or 13 above; or (ii) your breach of any other provision herein.

15. PROPRIETARY INFORMATION: We retain title to all engineering and production prints, drawings, technical data, and other intellectual property, information and documents that relate to the goods and services sold to you. Unless advised by us in writing to the contrary, all such information and documents disclosed or delivered by us to you are to be deemed proprietary to us and shall be used by you solely for the purpose of inspection, installation, and maintenance and not used by you for any other purpose.

16. ARBITRATION: Any controversy or claim arising out of or relating to this Agreement or the breach thereof shall be settled by arbitration administered by the American Arbitration Association in accordance with its Commercial Arbitration Rules, and judgment on the award rendered by the arbitrator(s) may be entered in any court having jurisdiction thereof. The venue for such proceedings shall be St. Cloud, MN.

17. TEXAS WAIVER OF CONSUMER RIGHTS: If you are entitled to its protection, you hereby agree to waive your rights under the Deceptive Trade Practices-Consumer Protection Act, Section 17.41 et seq., Business & Commerce Code, a law that gives consumers special rights and protections. You warrant that, after consultation with an attorney of your own selection, you voluntarily consent to this waiver.

18. APPLICABLE LAW: The rights and duties of the parties shall be governed by the laws of the State of Minnesota.

19. NO OTHER CONTRACT PROVISIONS; OTHER: This is the entire agreement with respect to the products. Terms and conditions of your order shall be without force and effect, except to the extent identical herewith. No dealer, broker, branch manager, agent, employee or representative of ours has any power of authority except to take orders for our products and to submit the same to us, at our factory, for our approval and acceptance on the terms herein or rejection. There are no representations, agreements, obligations, or conditions, expressed or implied, statutory or otherwise, relating to the subject matter hereof, other than herein contained. DeZURIK, Inc. and related terms (we, us and our) shall refer to DeZURIK, Inc. and its affiliates. If any provision hereof is invalid or not enforceable under applicable law, the remaining provisions shall remain in full force and effect. Any assignment of your rights hereunder without our consent (which shall not be unreasonably withheld) shall be void. These Terms shall be binding on your successors and assigns. Our failure to require your performance of any of These Terms shall not serve as a waiver of or diminish our rights to require strict performance of such provision or These Terms.