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UNITED PARK CITY MINES COMPANY
309 KEARNS BUILDING
SALT LAKE CITY, UTAH 84101

JAN 1988
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8HWM SR

043051

January 15, 1988

Ms. Paula M. Schmittdiel
U. S. Environmental Protection Agency (8HWM-SR)
Hazardous Waste Management Division
999 18th Street, Suite 500
Denver, Colorado 80202-2405

Dear Ms. Schmittdiel:

Pursuant to your Assistant Regional Counsel's letter of December 9, 1987, we herewith submit our Response to Questions 10 through 19 of your November 23, 1987 Request for Information.

This Response consists of 7 Volumes. You will find an index in Volume 1 which is attached to this letter.

You will note that 42 U.S.C. Section 9605 (g) (Oct. 17, 1986), concerning Special Study Wastes, appears to be particularly applicable to the Richardson Flat Site, and we direct your attention to this statute.

Yours truly,

E. L. Osika, Jr.
Vice President

enclosures

cc: Mr. Robert L. Duprey w/o encls.
Mr. Barry Stein w/o encls.

RESPONSE

OF

UNITED PARK CITY MINES COMPANY

TO

QUESTIONS 10 THROUGH 19

OF

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY'S

NOVEMBER 23, 1987,

REQUEST FOR INFORMATION

Volume 1

Submitted: January 15, 1988

United Park City Mines Company reserves the right to supplement this response as additional information and documents become available.

United Park City Mines Company

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United Park City Mines Company

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET—SUITE 500
DENVER, COLORADO 80202-2405

DEC 9 1987

REF 8RC

Mr. E. L. Osika, Jr.
Vice President
United Park City Mines
307 Kearns Building
Salt Lake City, Utah 84101

Re: Extension of Time for Response
to Request for Information

Dear Mr. Osika:

This letter will confirm our discussion regarding an extension of time for you to respond to EPA's November 23, 1987 Request for Information letter. Pursuant to our agreement, you have until December 31, 1987, to respond to questions 1-9, and until Jan 15, 1988 to respond to the rest of the questions.

Please let me know if this letter does not accurately reflect your understanding of our conversation. If you have any further questions, do not hesitate to give me a call.

Sincerely,

Barry Stein

Barry Stein
Assistant Regional Counsel

cc: Paula Schmittdiel

UNITED PARK CITY MINES COMPANY
308 KEARNS BUILDING
SALT LAKE CITY, UTAH 84101

COPY FOR YOUR FILE

December 4, 1987

FEDERAL EXPRESS

Mr. Robert L. Duprey, Director
Hazardous Waste Management Division
U. S. Environmental Protection Agency (8HWM-SR)
999 18th Street, Suite 500
Denver, Colorado 80202-2405

Dear Mr. Duprey:

Re: Your November 23, 1987 Request for Information - Richardson Flat Tailings Site in Summit County, Utah

I wish to acknowledge receipt of the above captioned Request for Information which we shall honor.

Many of your questions have a far-reaching scope as mining in the Park City District has been conducted for over a hundred years. In preparing to answer your Information Request, it has become apparent to us that, in order for us to fully and accurately respond to your questions, fourteen (14) calendar days are not sufficient time for us to locate, review and reproduce all of the documents which might address your inquiry.

In consideration of the scope of your Information Request and the fact that our legal counsel for environmental matters will undergo major surgery next week, we herewith request an extension of time to February 1, 1987 in which to fully answer your Request for Information. Due to the volume of material which we must locate and review, we feel that February 1, 1987 would be a more "reasonable notice" date pursuant to 42 U.S.C. Sec. 9604. We would appreciate your written response to our request for this extension.

Additionally, we would appreciate your informing us of the names of any third parties (individuals or entities other than EPA employees, EPA's contractors or our employees) who

have reviewed or copied EPA's records in this matter.

As the deadline which you set in your November 23, 1987 letter is rapidly approaching, time is of the essence and we would appreciate your immediate attention to these matters.

Yours truly,

E. L. Osika, Jr.
Vice President

cc: D. W. Bernolfo
R. J. Beless
K. C. Gee
P. M. Schmittdiel

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET—SUITE 500
DENVER, COLORADO 80202-2405

NOV 23 1987

Ref: 8RC

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. E. L. Osika, Jr.
Vice President
United Park City Mines
307 Kearns Building
Salt Lake City, Utah 84101

Re: Request for Information Pursuant to Section 104(e) of CERCLA and Section 7003 of RCRA for the Richardson Flat Tailings Site in Summit County, Utah

Dear Mr. Osika:

The United States Environmental Protection Agency, Region VIII ("EPA") is currently investigating the source, extent, and nature of the release or threatened release of hazardous substances, pollutants, or contaminants or hazardous wastes at or near the Richardson Flat Tailings Site in Summit County, Utah (the "Site"). This investigation requires inquiry into the identification, nature, and quantity of materials that have been or are generated, treated, stored, or disposed of at or transported to the site and the nature or extent of a release or threatened release of a hazardous substance or pollutant or contaminant at or from the Site. EPA is also seeking information relating to the ability of persons connected with the site to pay for or to perform a cleanup of the Site.

Pursuant to the authority of section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. § 9604, as amended by the Superfund Amendments and Reauthorization Act of 1986 ("SARA"), P.L. 99-499, and section 3007 of the Resource Conservation and Recovery Act ("RCRA") 42 U.S.C. § 6927, you are hereby requested to respond to the Information Request set forth in Enclosure A.

Compliance with the Information Request set forth in Enclosure A is mandatory. Failure to respond fully and truthfully to the Information Request within fourteen (14) calendar days of receipt of this letter, or to adequately justify such failure to respond, can result in enforcement action by EPA pursuant to section 104(e)(5) of CERCLA, as amended, and/or section 3008 of RCRA. Each of these statutes permits EPA to seek the imposition of penalties of up to twenty-five thousand dollars ($25,000) for each day of continued noncompliance. Please be further advised that provision of false, fictitious, or fraudulent statements or representations may subject you to criminal penalties under 18 U.S.C. section 1001.

This Information Request is not subject to the approval requirements of the Paperwork Reduction Act of 1980, 44 U.S.C. § 3501, et seq.

Your response to this Information Request should be mailed to:

U.S. Environmental Protection Agency (8HWM-SR)
Ms. Paula M. Schmittdiel
Hazardous Waste Management Division
999 18th Street, Suite 500
Denver, Colorado 80202-2405

If you have any legal questions, please direct such questions to Barry Stein of the Office of Regional Counsel at (303) 293-1458. If you have any technical questions, please direct such questions to Paula M. Schmittdiel, at the above address, or at (303) 293-1518.

Due to the seriousness of our concerns at the site and the legal ramifications of your failure to respond properly, EPA strongly encourages you to give this matter your immediate attention and to respond to this Information Request within the time specified above.

Thank you for your cooperation in this matter.

Sincerely yours,

Robert L. Duprey, Director
Hazardous Waste Management Division

Enclosures

cc: Barry Stein, Office of Regional Counsel
Paula M. Schmittdiel, Hazardous Waste Management Division
Brent Bradford, Director, Bureau of Solid and Hazardous Waste

ENCLOSURE A

RICHARDSON FLAT TAILINGS SITE

FIRST SET OF INFORMATION REQUESTS

INSTRUCTIONS

1. A separate response must be made to each of the Questions set forth in this Information Request.

2. For purposes of clarity, please restate each question prior to stating your response.

3. If information not known or not available to you as of the date of submission of a response to this Information Request should later become known or available to you, you must supplement your response to EPA. Moreover, should you find at any time after the submission of this response that any portion of the submitted information is false or misrepresents the truth, you must notify EPA thereof as soon as possible.

4. Any documents referred to in or relevant to any answer or relied on or used by you to answer any question in this Request for Information (the "Request") must be copied and submitted to EPA with your responses. All documents submitted by you must contain a notation indicating the question to which they are responsive.

5. The information requested herein must be provided notwithstanding its possible characterization as confidential information or trade secrets. You may, if you desire, assert a confidentiality claim covering part or all of the information requested, pursuant to sections 104(e)(7)(E) and (F) of CERCLA, as amended by SARA, 42 U.S.C. §§ 9604(e)(7)(E) and (F), and 40 CF.R. § 2.203(b), by attaching to such information, at the time it is submitted, a cover sheet, stamped or typed legend, or other suitable form of notice employing language such as "trade secret," or "proprietary" or "company confidential." Information covered by such a claim will be disclosed by EPA only to the extent, and only by means of the procedures set forth in 40 C.F.R. Part 2, Subpart B. If no such claim accompanies the information when it is received by EPA, it may be made available to the public by EPA without further notice to you. You should read the above cited regulations carefully before asserting a business confidentiality claim, since certain categories of information are not properly the subject of such a claim.

6. Where specific information has not been memorialized in any document, but is nonetheless responsive to a Question, you must respond to the Question with a written response.

7. This Request applies to documents and information within your possession or control, including without limitation, all documents and information within the possession or control of any agent, attorney, consultant, employee, investigator, or third person.

DEFINITIONS

The following definitions shall apply to the following words as they appear in this Enclosure A:

1. The terms "you," "your," or "Respondent" shall mean the addressee of this Request, the addressee's officers, managers, employees, contractors, trustees, successors, assigns, and agents.

2. The term "person" as used herein includes, in the plural as well as the singular, any natural person, firm, unincorporated association, partnership, corporation, trust, or other entity.

3. The terms "the Site" or "the facility" shall mean and include the property on or about the United Park City Mines' property in the northwest quarter of Section 1 and the northeast quarter of Section 2, Township 2 South, Range 4 East, Summit County, Utah.

4. The term "hazardous substance" is defined in section 101(14) of CERCLA, 42 U.S.C. § 9601(14), and includes the substances designated at 40 C.F.R. section 302.4 (1986).

5. The term "pollutant or contaminant" is defined in section 101(33) of CERCLA, 42 U.S.C. § 9601(33).

6. The term " hazardous waste" is defined in section 1004(5) of RCRA, 42 U.S.C. § 6903(5), and includes the substances identified in 40 C.F.R. sections 261.1 to 261.33 (1986).

7. The term "materials" shall mean all substances that have been generated, treated, stored, or disposed of or otherwise handled at or transported to the Site, including but not limited to all hazardous substances, pollutants, and contaminants, hazardous wastes and solid wastes, as defined above, and mine tailings.

8. The term "identify" means, with respect to a natural person, to set forth the person's name, present or last known business address and business telephone number, present or last known address and home telephone number, and present or last known job title, position, or business.

9. The term "identify" means, with respect to a corporation, partnership, business trust, or other association or business entity, including a sole proprietorship) to set forth its full name, address, legal form (e.g., corporation, partnership, etc.), organization, if any, and a brief description of its business.

10. The term "identify" means, with respect to a document, to provide its customary business description, its date, its number if any (invoice or purchase order number), the identity of the author, addressor, addressee and/or recipient, and the substance or the subject matter.

11. The term "release" has the same definition as that contained in section 101(22) of CERCLA, 42 U.S.C. § 9601(22).

herein or who may be able to provide additional responsive documents, please identify such persons and the additional information or documents that they may have.

6. Please list the present and any former names under which you operated or conducted business, including the names of any predecessors or successors in interest. Describe the form of business organization of each name listed (e.g., corporation, partnership, joint venture, sole proprietorship, etc.) and identify the state in which each was/is organized, the date of organization or initiation of business, the date of discontinuation or dissolution, and the reason or purpose therefore.

7. Please identify all persons, including Respondent's employees, who have knowledge or information about the mining and milling operations or related to the Richardson Flat site.

8. Please identify current owner and any previous owners of the Richardson Flat site and the dates of ownership.

9. Please identify any current or previous operators or lessors of the Richardson Flat site. For each such operator or lessor, further identify:

a. the dates of their operation at or lease of the site.

b. the nature of their operations at the site.

10. Describe the physical characteristics of the site including but not limited to the following:

a. Previous surface structures (e.g., buildings, tanks, pipelines etc.).

b. Groundwater wells, including drilling logs except for existing EPA monitoring wells.

c. Tailings pond(s) dams, dikes, diversions, excavations, etc., that exist or were removed or changed. Please provide dates for removal, modifications, etc. of such structures and state the type of materials used to construct pond, dam, dikes, diversions, etc.

11. Please provide information regarding your mining and milling operations that are (were) the source of the mine tailings disposed of at Richardson Flat. Include in your description the type of milling process, the dates the mill was in operation, the amount of ore mined and milled on an annual basis, and the amount of tailings/waste material generated on an annual basis, any chemicals used in the milling process (acids, etc.), amount of water used in the mining/milling process and the source of the water.

12. Please state whether the tailings have been re-worked, the source of the ores (i.e., what mines), location of mine(s), mill, distance from mine to mill to Richardson Flat, how the tailings were conveyed from the mill to Richardson Flat (e.g., trucked, pipeline, etc.)

13. Please give specific locations other than the Richardson Flat site where United Park City Mines disposed of mine tailings.

14. Please identify any person who may have removed mine tailings from the Richardson Flat site. Please include address and phone number of such persons, if known, and the dates when removal occurred.

15. Please provide any existing technical or analytical information United Park City Mines may have about the site, including but not limited to data and documents (except for EPA Analytical Results Report) related to soil, water (ground and surface), geology, geohydrology, or air quality on and about the site.

16. Please provide any information on whether United Park City Mines or its consultants are planning to perform any investigations of the soil, water (ground or surface), geology, hydrogeology or air quality on or about the site. Please include the following:

a. What the nature and scope of these investigations will be.

b. The contractors or other persons that will undertake these investigations.

c. The purpose of the investigations.

d. The dates when such investigations will take place and be completed.

e. Where on the site such investigation will take place.

17. List each insurance company or other person that provided casuality or pollution liability insurance coverage, including but not limited to any Comprehensive General Liability coverage, Environmental Impairment coverage, Insurance Services Office coverage, Umbrella coverage, or any other indemnification or defense agreement, that provides to you or any other person or entity identified in response to question 5 a right of indemnification or defense in any action involving hazardous substances. This question applies to policies or agreements that are or were in effect at any time to the present. Submit copies of all insurance policies or agreements identified.

18. Provide copies of all income tax returns sent to the Federal Internal Revenue Service in the last five years.

19. Provide all financial statements for the past five fiscal years, including but not limited to those filed with the federal and state Internal Revenue Service and Securities and Exchange Commission.

Response of United Park City Mines Company, 01/15/88

QUESTION 10

Describe the physical characteristics of the site including but not limited to the following:

a. Previous surface structures (e.g., buildings, tanks, pipelines etc.)
b. Groundwater wells, including drilling logs except for existing EPA monitoring wells.
c. Tailings pond(s) dams, dikes, diversions, excavations, etc. that exist or were removed or changed. Please provide dates for removal, modifications, etc. of such structures and state the type of such structures and state the type of materials used to construct pond, dam, dikes, diversions, etc.

RESPONSE

GEOGRAPHY AND GENERAL CHARACTERISTICS:

The Richardson Flat Tailings Pond (Site) is located about 1 mile easterly of the City Limits of Park City, Utah, in portions of sections 1 and 2 of Township 2 South, Range 4 East, SLB&M, and occupies the southeastern portion of the northwest trending Silver Creek Valley. The area covered by tailings is in the northern edge of Richardson Flat and consists of approximately 160 acres. Southwest of the tailings pond, in the south half of the northeast quarter of Section 2, T2S, R4E lies a gravel pit owned by United Park and leased to different operators in the past. Adjacent to the gravel pit lies the northern portions of the Park City Municipal Landfill leased to Park City from 1973 to about 1985. The northern end of a graded airstrip lies directly south of the western corner of the tailings pond. This airstrip is not used often and serves as a road into the area.

Hills rise rather abruptly to the north of the tailings pond with the right-of-way for U. S. 40 existing within 100 feet of the northermost portion of the tailings impoundment dam. An impoundment dike abuts the hillside on the extreme eastern end of the pond. The dike, about 6 to 8 feet high in most places, lies on the pond's eastern, southern and western edges with the main embankment located on the western edge of the structure. A diversion ditch, existing about fifty feet outside of the dike system, parallels the

Continued On Next Page

dike on the east, south and southwest portions of the dike. This ditch diverts runoff around the pond. Another ditch, located high on the hillside to the north, diverts a portion of the runoff from the northern hills around the pond. The Union Pacific Railroad tracks pass to the south of the Pond with the Silver Creek Floodplain to the west. East of the pond are grasslands that are marshy during the spring of the year. The elevation of the pond is approximately 6,620 feet above sea level. Access to the pond is from three points. The oldest road enters the pond along its southern edge. A road onto the dike exists in the far northeastern corner of the pond. This road is only usable after late summer, when drier conditions exist. The third road is along the southwest corner of the pond. It has recently been constructed to facilitate more efficient haulage of topsoil onto the impounded tailings in an effort to control dust.

A pipeline to transport the tailings enters the pond from the south in the southwest section of the pond.

The Site has been used as a tailings pond since the early days of mining in the Park City area. The existing impoundment dam, located along the western edge, was the site of the original dam. While no factual data is known to exist, it is believed that the original dam was constructed of material indigenous to the immediate area.

A major reconstruction effort was undertaken by Park City Ventures in about 1973-1974. As part of the effort, the existing impoundment dike around the pond, the diversion ditches and the main impoundment dam were constructed. In 1973, three ground water monitoring wells were installed at the toe of the dam as a condition imposed by the Utah State Department of Health for granting a construction permit (see Exhibit 10-E). Later, in perhaps 1976 or 1977 (the date is uncertain at this time) three additional wells were installed by Park City Ventures. This was again done at the request of the Utah State Department of Health. There are no known drill logs of these three new wells.

It appears that the existing dam was built to the west of and on top of the preexisting structure. Engineering plans indicate that the preexisting structure was to undergo some modification prior to the construction of the existing dam.

Continued on next page

Exhibit 10-A and 10-C are reports by an engineering firm under contract to Park City Ventures to study the area and advise Park City Ventures on a tailings pond design. United Park City Mines Company was not involved in the construction or design of the tailings pond. The only information available to United Park City Mines Company is that contained within the reports of various consultants to Park City Ventures and Noranda Mining Inc. Exhibit 10-D is a report by a consulting firm under contract by Noranda Mining Inc. to study the tailings pond and report on its condition and the possibility of enlarging it for Noranda Mining Inc. This report describes some physical characteristics of the pond. **It should be kept in mind that these reports may not be entirely accurate. The compilers were consultants that may not have spent a great deal of time studying the area or may not have had the opportunity to review available data. The consultants did not contact United Park City Mines Company for background information and, therefore, their representations are not always accurate. United Park City Mines Company reserves the right to make comment upon these reports in the future.**

Approval from the Utah State Health Department for operation of the Park City Landfill was apparently granted in May of 1973 (See Exhibit 10-F). The Landfill consisted of several trenches or cells excavated to an unknown depth that were eventually covered with material presumably excavated from the trench. The Landfill is on property which United Park City Mines Company leased to Park City Municipal Corporation and consists of four five-acre tracts of land. At this time, the Landfill has been abandoned by Park City and is partially surrounded by a fence. The material on top of the exisiting Landfill consists of alluvium from sedimentary and igneous origin. Trenching completed prior to the Landfill's operation, indicates that the water table is deeper that 20 feet deep (see Exhibit 10-G). Additional information indicates that the water table is about 30 feet below the surface (see Exhibit 10-H). Geological reconnaissance reports indicate that drillholes or monitoring wells may exist for the Landfill (see Exhibit 10-I) but, United Park does not know of any holes drilled specifically for the Landfill.

The Utah Department Of Transportation (UDOT), in its project

Continued on next page

to realign U. S. Interstate 40, has drilled holes along the proposed alignment of the relocated highway. United Park City Mines Company has not received any information from UDOT concerning the drilling.

Additionally, the Utah Department of Transporation (UDOT) is proposing to drill the Park City Landfill in conjunction with the proposed realignment of U.S. Highway 40. Refer to Exhibit 17-A attached.

GEOLOGICAL SETTING:

The Park City area lies along the northern flank of the east-west trending Uinta Mountain Range as it intersects the north-south trending fault blocks of the Wasatch Mountains. The immediate area within Park City consists of Paleozoic sediments folded slightly into a northeast-southwest trending anticline that plunges gently to the north. The area to the east and northeast of Park City is occupied by Tertiary aged volcanics that have filled a large structural "sag" that exists between the uplifted mountains around Park City and the Unita Mountains to the east.

The Richardson Flat area lies near the contact between the Paleozoic sediments and the overlying volcanics. The hills and mountains adjacent to the area, along the south, east, north and northwest borders, are composed of the Tertiary aged volcanics. The hills to the southwest are composed of Paleozoic sediments. Based on mapping completed in 1971 by the U. S. Geological Survey along with recent field observations and drillhole information, it appears that the bedrock underlying the Site consists of grey, greenish grey and rust brown, highly weathered volcanic breccia (Exhibit 10-B is a copy of the U.S.G.S. map). However, the depth to the volcanics as well as their thickness is uncertain. The volcanic breccia, when highly weathered, has a low permeability due to the high clay content.

The composition of the alluvial gravels in the area varies a great deal. The gravels that originate from the erosion of the hills that form the southwestern borders of the area are of sedimentary origin. Gravels that lie along the eastern, northern and central sections of Richardson Flat are of volcanic origin. From test pits, water wells, trenches and

Continued on next page

other excavations in the area it appears that there is a layer of gravels that are of volcanic origin that "cap" or overlay the gravels of sedimentary origin. The thickness of the overlaying gravels would vary greatly and would be dependent upon the proximity to the hillsides composed of volcanic material.

United Park City Mines Company reserves the right to supplement this response as additional information and documents become available.

EXHIBIT 10-A

REPORT OF GROUND WATER MONITORING AND SEEPAGE STUDY
TAILINGS POND DEVELOPMENT
NEAR PARK CITY, UTAH
FOR PARK CITY VENTURES CORPORATION

Dames & Moore Job No. 8998-001-06

SUITE 200, 250 EAST BROADWAY • SALT LAKE CITY, UTAH 84[illegible] • [illegible]
CABLE: DAMEMORE TWX: [illegible]

December 6, 1973

Park City Ventures Corporation
Star Route 1, Box 40
Heber City, Utah 84032

Attention: Mr. Niles Andrus

Gentlemen:

Six copies of our report entitled "Report of Ground Water Monitoring and Seepage Study, Tailings Pond Development, Near Park City, Utah, For Park City Ventures Corporation," are herewith submitted.

The purpose and scope of this study were planned in discussions between Mr. Niles Andrus of Park City Ventures Corporation and Mr. George C. Toland of Dames & Moore, and were presented in our proposal dated October 16, 1973.

Our investigation indicates that excessive seepage will likely occur from the tailings area in its present condition. Data obtained in our study, discussions, and our conclusions regarding subsurface conditions, water quality, potential seepage losses, and net evaporation rates are presented herein.

oOo

We appreciate the opportunity to perform this service for you. If you have any questions or require additional information, please contact us.

Yours very truly,
DAMES & MOORE

George C. Toland

George C. Toland
Consulting Partner
Professional Engineer No. 2311
State of Utah

GCT/GWC:ab

Enclosures

REPORT OF GROUND WATER MONITORING AND SEEPAGE STUDY

TAILINGS POND DEVELOPMENT

NEAR PARK CITY, UTAH

FOR PARK CITY VENTURES CORPORATION

INTRODUCTION

This report presents the results of our ground water monitoring and seepage study for the proposed tailings pond development near Park City, Utah. The tailings pond site is located immediately south of Highway 40, four miles southeast of Silver Creek Junction as shown on Plate 1, Vicinity Map.

PURPOSE AND SCOPE

The purpose and scope of this study were developed in discussions between Mr. Niles J. Andrus of Park City Ventures and Mr. George C. Toland of Dames & Moore. The purpose of our study was to establish and sample three monitor wells located below the toe of the existing tailings pond and was to evaluate the seepage potential through the materials on which the pond will be established. In accomplishing this purpose, the scope as outlined below was followed:

1. A field program consisting of the drilling, sampling and logging of three monitor wells below the existing tailings pond embankment and the excavation, sampling and logging of nine test pits in the existing tailings pond area.
2. A laboratory program consisting of chemical analyses of six water samples obtained from the monitor wells and

percolation tests upon representative samples of natural soils and rock and tailings material.

3. An office program consisting of engineering analyses, and the compilation of this report, which includes:
   a. A vicinity map and plot plan.
   b. Logs of monitor wells and test pits.
   c. A description of surface and subsurface site conditions.
   d. A summary of field explorations and laboratory testing.
   e. Discussions and conclusions concerning the chemical quality of the water obtained from the monitor wells, the seepage potential from the pond and net evaporation rate for the site.

PROPOSED DEVELOPMENT

A tailings disposal area is to be established within an area occupied by an old tailings pond. Present planning indicates that 350 tons per day of fine-grained tailings (70 to 80 percent minus 325 mesh) will be deposited in the area. It is estimated that approximately 63 gallons per minute of water will be used to transport the tailings.

SITE CONDITIONS

SURFACE:

The existing tailings pond occupies the northern portion of Richardson Flat, as shown on Plate 1, Vicinity Map. The site is bounded by Highway 40 and low hills to the north and by Silver Creek to the west. To the south and east is flat-lying open land and hills. A railroad track runs west of the existing tailings storage area and crosses the southern portion of the area.

The old tailings retention embankment is located on the northwest margin of the storage area. The former pond area is occupied by silty sand and silt tailings and scattered vegetation. A drainage ditch has been constructed through the center of the tailings pond to the upstream toe of the embankment. Surface water that collects at the upstream toe of the dam runs through a culvert under the dam and reappears downstream of the toe. Another ditch, which has been cut along and through the northern abutment of the embankment, acts as an emergency spillway. The site is shown in detail on Plate 2, Plot Plan.

SUBSURFACE:

Below the toe of the dam natural soils consist of an upper layer of black, soft, organic silty clay which generally grades non-organic and gray to greenish-gray in color with depth. In Monitor Well 2 at a depth of four feet below the natural ground surface, a 5.5-foot-thick layer of dark gray, medium-dense, fine to coarse gravel with some clay, cobbles and sand was encountered overlying bedrock. In Monitor Well 1, only two, 3-inch-thick gravel layers were encountered above bedrock. Monitor Well 3, which is located low on the slope of the northern abutment below the retention dam, encountered 5.5 feet of dark brown to brown, medium-stiff, gravelly clay with some cobbles and boulders overlying the bedrock.

Bedrock was encountered in Wells 1 and 2 at depths of 10.0 feet below the natural ground surface. Bedrock consists of gray, greenish-gray and rust brown, highly weathered volcanic breccia. The U. S. Geological Survey[1] describes the breccia as rhyodacitic to andesitic in composition.

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1. Bromfield, C. S., and Crittenden, M. D., 1971, Geologic Map of the Park City East Quadrangle, Utah: U. S. Geological Survey Map GQ-852.

The breccia has weathered to form a relatively soft, tight, sandy material with a silty and clayey matrix. With depth, bedrock grades moderately hard, less weathered and slightly to moderately fractured.

The tailing materials in the vicinity of the embankment are composed of gray to grayish-brown, medium-stiff silt with a trace clay which contain occasional layers of loose, silty fine sand. The tailings grade coarser eastward to primarily light gray and grayish-brown fine sand with some silt or silty fine sand.

Ground water was encountered in Monitor Wells 1, 2 and 3 at depths of 2.2, 1.5, and 5.4 feet below the fill pad surface, respectively. The water levels in the test pits varied from 3.5 feet to greater than the depth excavated.

A detailed description of the soil and ground water conditions encountered is presented graphically on Plates A-1A and A-1B, Log of Monitor Wells, and Plates A-1C and A-1D, Log of Test Pits, in the appendix of this report.

DISCUSSIONS AND CONCLUSIONS

MONITOR WELLS:

Three monitor wells were established below the toe of the existing retention embankment at the locations shown on Plate 2, Plot Plan. A description of the wells and their installation is presented in the appendix of this report.

Monitor Well 1 is slotted and gravel packed from a depth of 24.0 to 34.0 feet below the fill pad surface, a zone entirely in bedrock. Unfortunately, due to difficulties in withdrawing the temporary drill casing

from the well during construction, we expect that the seal above the gravel packed zone was disturbed. However, inflow into the well, observed during bailing operations, was quite low, which would be expected in the low permeability bedrock. The static water elevation was 6594.7 feet on November 15, 1973. This is several feet above the natural ground surface, but still below the surface of the constructed drilling pad.

Monitor Well 2 is slotted and gravel packed from a depth of 3.0 to 10.0 feet below the fill pad surface. This is a zone entirely within alluvial soil. At completion, the well was pumped at a rate of approximately 20 gallons per minute (the maximum pump capacity) for 20 minutes. The static water elevation was 6594.9 feet on November 15, 1973.

Monitor Well 3, located below the northern abutment of the dam, is slotted and gravel packed from a depth of 3.0 to 25.0 feet below the ground surface. Inflow into the well was faster than in Well 1 and was sufficient to keep pace with the bailing. The static water level stood at an elevation of 6598.7 feet on November 15, 1973, some four feet higher than the other wells.

WATER QUALITY:

Water samples were obtained from each of the monitor wells shortly after completion and about one week after completion. The results of chemical analyses performed upon these samples are presented on Plates A-4A through A-4C in the appendix of this report.

Silver Creek has been given a "CC" classification by the Utah Water Pollution Committee and the Utah State Board of Health. Chemical standards for effluent discharge into class "CC" streams is presented on Table 1.

TABLE 1

CHEMICAL QUALITY STANDARDS CLASS "CC" STREAMS

Item	Limits Recommended Mg/l	Limits Mandatory Mg/l	Item	Limits Recommended Mg/l	Limits Mandatory Mg/l	Item	Limits Recommended Mg/l	Limits Mandatory Mg/l
TDS	500	-	Cu	1.0	-	NO_3	45	-
As	0.01	0.05	Cn	0.01	0.02	Phenol	0.001	-
Ba	-	1.0	F	1.0	2.0	Se	-	0.01
CCE	0.2	-	Fe	0.3	-	Ag	-	0.05
Cd	-	0.01	Pb	-	0.05	SO_4	250	-
Cl	250	-	Mn	0.05	-	MBAS	0.5	-
Cr	-	0.05				Zn	5.0	-

All samples analyzed were above the recommended limit for total dissolved solids and were above the mandatory limit for lead. All the samples, except for the initial one from Monitor Well 1, exceeded the recommended limit for manganese. The samples from Wells 1 and 2 exceeded the recommended limits for sulfate. The second sample from Well 1 and the first sample from Well 2 exceeded the mandatory limit for cadmium, while the second sample from Well 2 equaled the limit. The first sample from Well 1 was slightly below the limit for cadmium. The iron (filtered) content of two samples, the second from Well 1 and the first from Well 2, exceeded the recommended limit.

The water quality of the samples obtained from Monitor Well 2 was the poorest and the quality from Well 3 was the best. The water quality from Well 1 was intermediate and may reflect some seepage from alluvial soil above the bedrock zone due to disturbance of the seal around the casing.

SEEPAGE POTENTIAL:

It is our opinion that seepage is occurring under or through the lower portion of the dam and along the northern abutment. The small seeps

noted along the northern abutment may be due to water passing along the ditch and the dam-abutment interface in the northern part of the site.

The embankment itself does not appear to be an engineered fill and would be expected to exhibit variable seepage conditions therefore. Also, we doubt that the existing dam was keyed into the alluvium or bedrock.

The seepage potential of the alluvial soils is variable. The gravel encountered in Monitor Well 1 and which is readily observable at the surface south of the railroad, is a moderately to highly permeable horizon. The silty clay and organic clay are of very low permeability if confined. Percolation rates obtained for two samples of organic clay were .001 and 5 feet per year. However, water under an artesian head will percolate up through a surface layer of soft clay if unconfined, as may be the case below the toe of the existing dam.

The volcanic breccia, when highly weathered, is of very low permeability. Percolation rates obtained for three samples of weathered breccia were 0.6, 1 and 2 feet per year. The zone of weathering observed in the borings was quite deep. Permeability of the rock would be higher in the fractured unweathered portions which might occur at greater depth. We would expect that the weathered surface of the breccia would nearly eliminate seepage to greater depths.

The permeability of the tailings materials is also variable. The silts which compose most of the tailings in the vicinity of the dam are of low permeability. Percolation rates for the silt tailings ranged from 10 to 30 feet per year in the horizontal direction and a rate of 3 feet per year was obtained in the vertical direction. The silty fine sand composing

high of 34.8 inches to a low of 17.9 inches with an average of 25.6 inches.[3] The May-October evaporation value is an average of 80 percent of the annual value; thus, the average annual evaporation would be 32.0 inches. Unfortunately, the time of the lowest evaporation is also the time of highest precipitation; the normal October-April precipitation is 12 to 16 inches for the site.[4]

Subtracting the average precipitation from the average evaporation leaves a net average evaporation rate of 12 to 16 inches annually for the site. This value is equal to 0.6 to 0.8 gallons per minute per acre. Assuming no seepage loss, a pond with an area of 80 to 105 acres would be required to evaporate a net of 63 gallons per minute of water annually.

Fluctuation of the pond level is unavoidable since the time of year of high precipitation coincides with the time of low evaporation. Also, as total seepage control is impossible, we estimate the ponded water area with an engineered cutoff system would average about 60 acres.

oOo

The following plates and appendix are attached and complete this report:

Plate 1 - Vicinity Map

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3. Richardson, E. A., Evaporation Data for Utah: National Weather Service.
4. 1960, Normal October-April Precipitation, 1931-1960: Utah State Engineer Map.

Plate 2 - Plot Plan

Appendix - Field Program and Laboratory Testing.

Respectfully submitted,

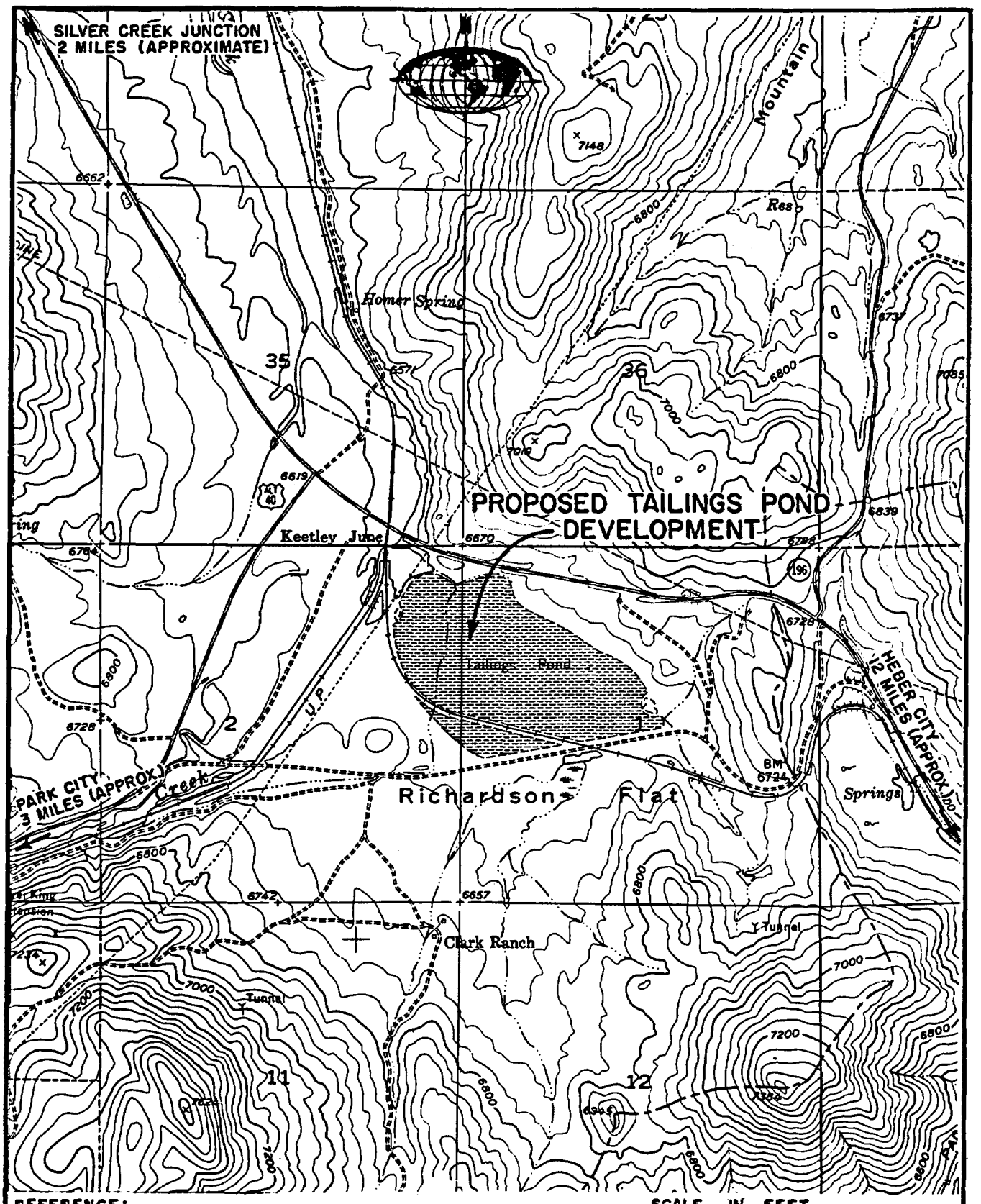
DAMES & MOORE

George C. Toland

George C. Toland
Consulting Partner
Professional Engineer No. 2311
State of Utah

GCT/GWC:ab

Attachments



REFERENCE:
U.S.G.S. MAP TITLED, "PARK CITY EAST QUADRANGLE, UTAH," AND DATED 1955.

SCALE IN FEET
1,000 0 1,000 2,000 3,000 4,000 5,000

VICINITY MAP

DAMES & MOORE

PLATE I

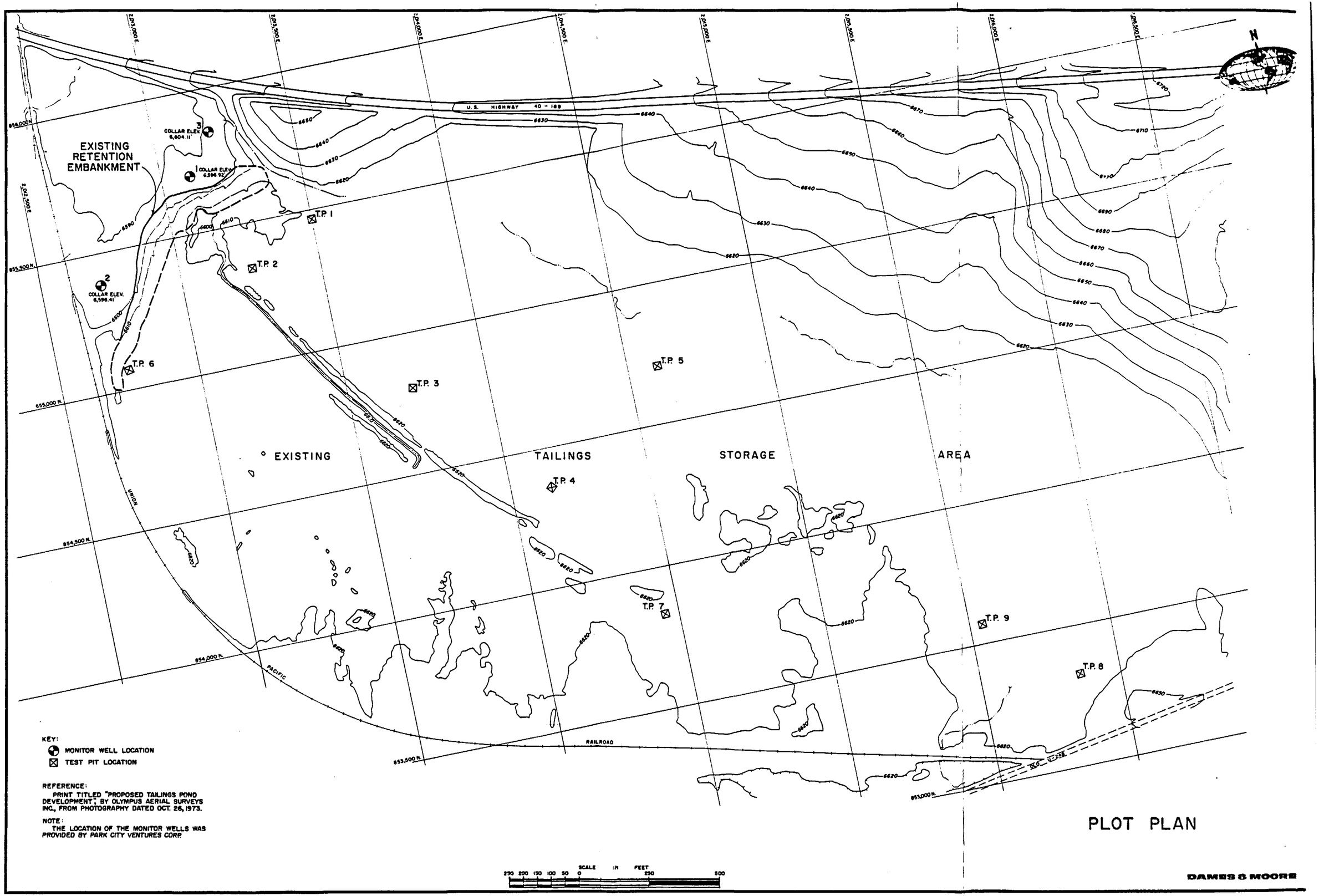
REVISIONS BY ____ DATE ____

FILE 8998-001 PARK CITY VENTURES-PARK CITY

BY A.B.D. DATE 11-30-73

CHECKED BY [signature]

740./(REV. 6-61)



REVISIONS
BY ____ DATE ____
BY ____ DATE ____
BY ____ DATE ____
PLATE ____ OF ____

FILE 8998-001
PARK CITY VENTURES: PARK CITY UTAH
BY ABD DATE 12-3-73
CHECKED BY ____ DATE ____

46 11 040

PLATE 2

APPENDIX

FIELD PROGRAM AND LABORATORY TESTING

FIELD EXPLORATIONS:

Subsurface soil and ground water conditions at the site were explored by drilling three borings with a truck mounted rotary drill rig, and excavating nine test pits with a tractor mounted backhoe. The borings were outfitted to serve as permanent monitor wells. The locations of the monitor wells and test pits are shown with respect to the existing facilities and topography on Plate 2, Plot Plan, in the text of this report.

The field exploration program was conducted and supervised by an experienced engineer from our staff. Undisturbed samples of the soils penetrated in the wells were obtained by utilizing a Dames & Moore sampler as described on Plate A-3, Soil Sampler Type U. Undisturbed soil samples in the test pits were obtained by hand driving 2.5-inch diameter thin wall tubes. The soils penetrated were classified by visual and textural examination in the field. These classifications were later supplemented by inspection and testing in our laboratory. A complete log was maintained in the field of each boring and test pit. Graphical representation of the soils encountered is presented on Plates A-1A through A-1D. The nomenclature used to describe the soil types appears on Plate A-2, Unified Soil Classification System.

MONITOR WELL INSTALLATION:

Three borings drilled for this study were outfitted as monitor wells. Three-inch diameter PVC pipe, slotted at a selected interval, was installed in each boring. The selected interval was gravel packed and

sealed from the other zones in the well. The slotted and gravel packed interval for each boring is shown on Plates A-1A and A-1B, Log of Monitor Wells. The wells were flushed with clear water and were then bailed or pumped. A series of two water samples were obtained from each completed well.

LABORATORY TESTING:

Chemical Analysis of Water Samples. Chemical analyses were performed upon the water samples obtained from the monitor wells. These tests were performed by Ford Chemical Laboratories, Inc., of Salt Lake City, Utah. The results of the analyses are presented on Plates A-4A through A-4C, Certificate of Analysis.

Moisture and Density Determinations. To aid in classifying the soils and to help in correlating the percolation test data, moisture and density determinations were performed on selected samples. The results of the moisture and density tests are presented to the left of the logs on Plates A-1A through A-1D.

Percolation Tests. To determine the permeability characteristics of soil, rock, and tailings materials, a series of percolation tests were performed. Samples of tailings material were obtained in both horizontal and vertical attitudes to determine the vertical and horizontal permeability of these materials. All tests were performed in accordance with the method described on Plate A-5, Method of Performing Percolation Tests.

The results of the percolation tests are tabulated on the following page.

Well or Test Pit No.	Depth In Feet	Material	Attitude of Sample	Percolation Rate In Feet Per Year
W-1	15.5	Rock	Vertical	1
W-1	25.5	Rock	Vertical	0.6
W-2	3.5	CL-OL (soil)	Vertical	.001
W-3	9.5	Rock	Vertical	2
TP-1	1.5	ML (tailing)	Vertical	3
TP-1	1.5	ML (tailing)	Horizontal	30
TP-2	3.5	ML (tailing)	Vertical	3
TP-2	3.5	ML (tailing)	Horizontal	10
TP-3	3.0	SM (tailing)	Horizontal	4000
TP-4	4.8	SP-SM (tailing)	Vertical	4000
TP-8	5.5	OL (soil)	Vertical	5

The following plates are attached and complete this appendix:

Plates A-1A and A-1B - Log of Monitor Wells

Plates A-1C and A-1D - Log of Test Pits

Plate A-2 - Unified Soil Classification System

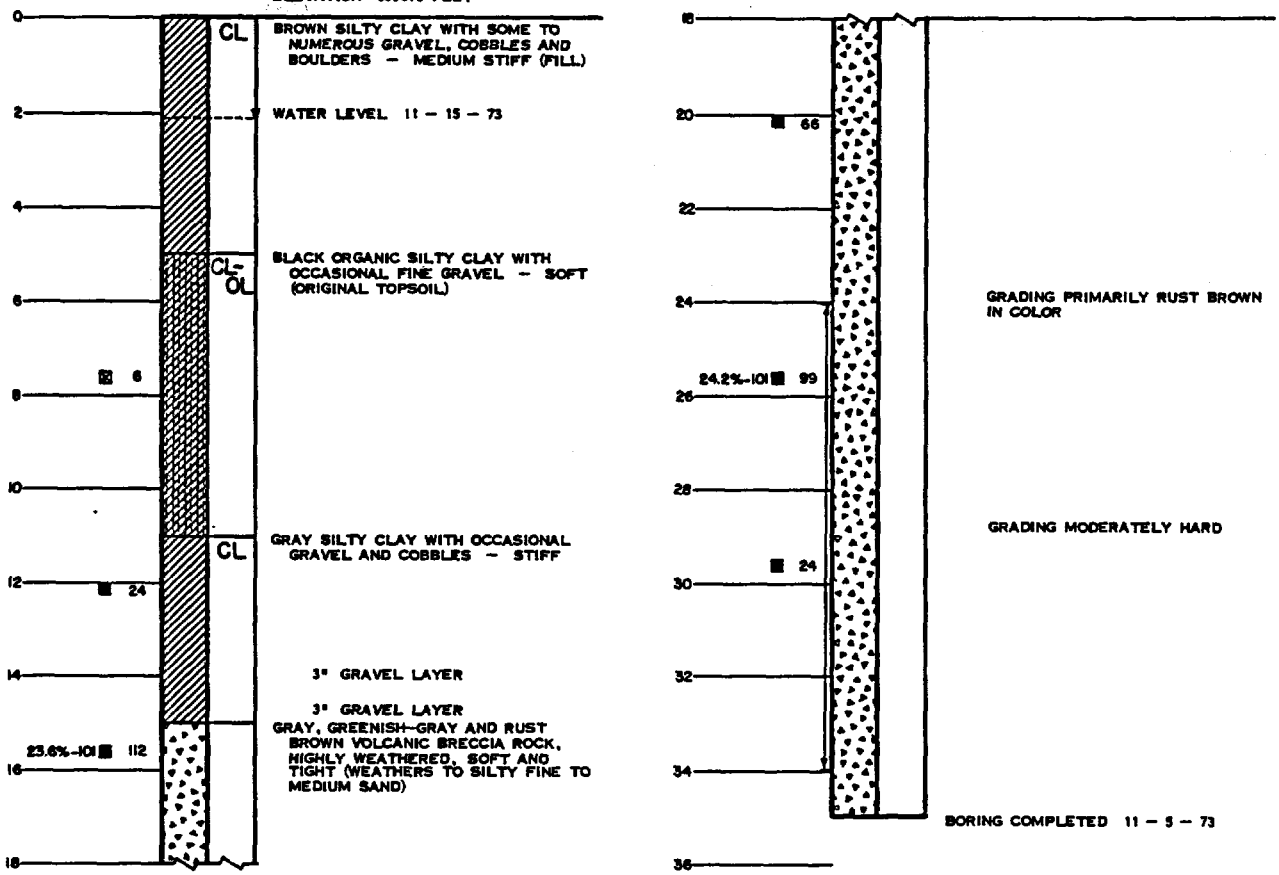
Plate A-3 - Soil Sampler Type U

Plates A-4A through A-4C - Certificate of Analysis

Plate A-5 - Method of Performing Percolation Tests.

MONITOR WELL I

ELEVATION 6596.9 FEET



KEY

A – B ■ C

A FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL

B DRY DENSITY EXPRESSED IN LBS. PER CUBIC FOOT

C BLOWS PER FOOT OF PENETRATION USING A 140 LB. HAMMER DROPPING 30 INCHES

■ DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED

⊠ DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED

I SCREENED AND GRAVEL PACKED

NOTES

THE DISCUSSION IN THE TEXT UNDER THE SECTION TITLED, "SITE CONDITIONS, SUBSURFACE", IS NECESSARY TO A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIALS.

ZONE OF WELL WHICH IS GRAVEL PACKED AND SLOTTED IS INDICATED BY ARROW (↕) TO LEFT OF LOG OF MONITOR WELLS. OTHER ZONES OF WELL SEALED OFF FROM SLOTTED ZONE. SEE TEXT FOR DETAILS.

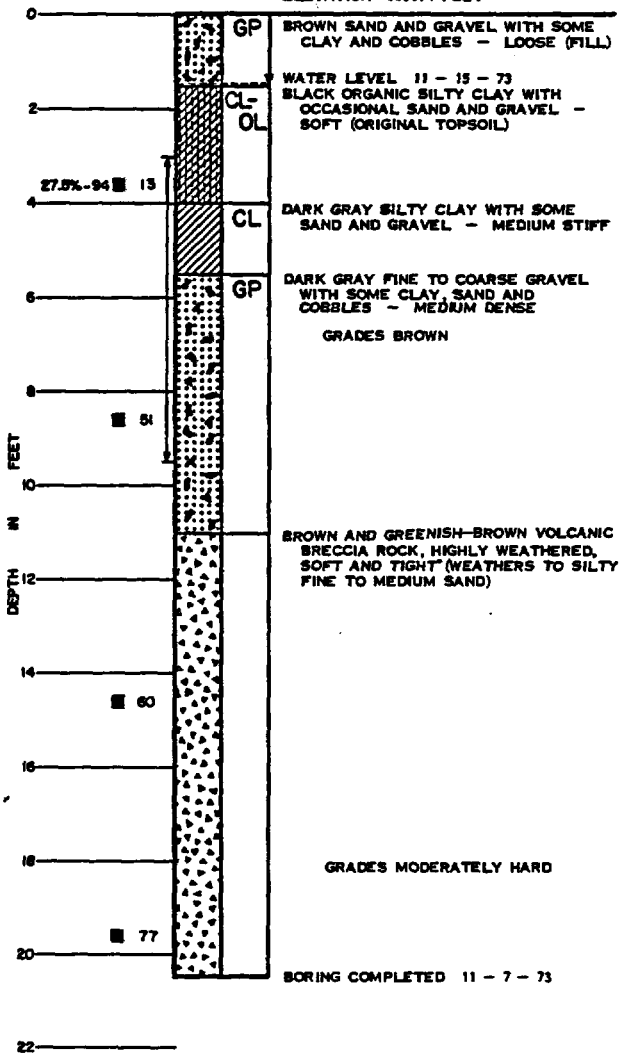
LOG OF MONITOR WELL

DAMES & MOORE

PLATE A-1A

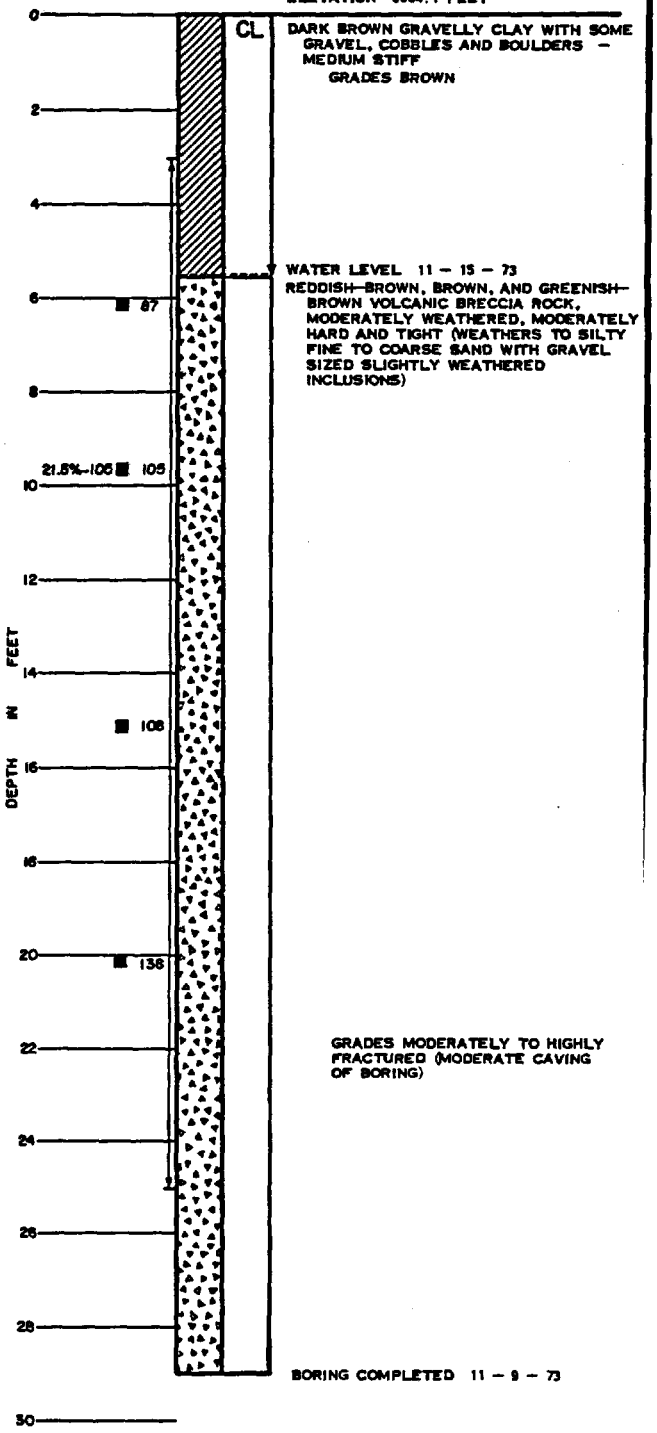
MONITOR WELL 2

ELEVATION 6596.4 FEET



MONITOR WELL 3

ELEVATION 6604.1 FEET



LOG OF MONITOR WELLS

DAMES & MOORE

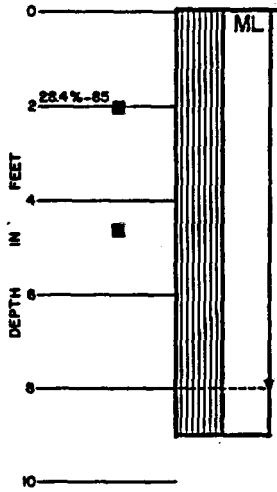
PLATE A-1B

REVISIONS BY DATE
BY DATE
PLATE OF

FILE 6278-001
Park City Villages - Park City Utah
BY A.R.D.-H.R.Y. DATE 11-26-73
CHECKED BY Stoc DATE 12-3-73

TEST PIT 1

ELEVATION 6613.0 FEET



GRAYISH-BROWN SILT WITH TRACE CLAY AND SEAMS OF SILT AND FINE SAND AND ROOTS TO 1.5' – MEDIUM STIFF (TAILINGS)

GRADING LAYERS OF GRAY, GRAYISH-BROWN, BROWN AND DARK GRAY IN COLOR AND SOFT

GRADING ALL DARK GRAY IN COLOR AND VERY SOFT

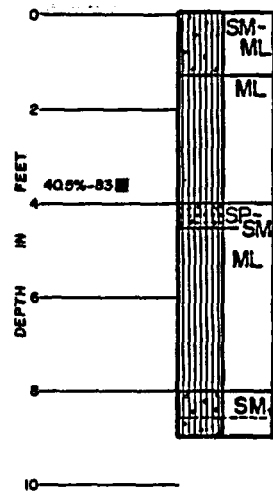
WATER SEEPS THROUGH SAND AND SILT LAYERS

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 2

ELEVATION 6614.0 FEET



LIGHT GRAYISH-BROWN SILTY VERY FINE SAND WITH ROOTS TO 12" AND SEAMS OF CLAYEY SILT – LOOSE (TAILINGS)

GRAYISH-BROWN SILT WITH TRACE CLAY AND SEAMS OF SILT AND FINE SAND – MEDIUM STIFF (TAILINGS)

GRADING GRAYISH-BROWN, BROWN AND DARK GRAY LAYERS

GRADING ALL DARK GRAY IN COLOR AND VERY SOFT

BROWN FINE SAND WITH SOME SILT AND TRACE ROOTS – LOOSE (TAILINGS)

GRAYISH-BROWN SILT WITH TRACE CLAY AND SEAMS OF SILT AND FINE SAND – MEDIUM STIFF (TAILINGS)

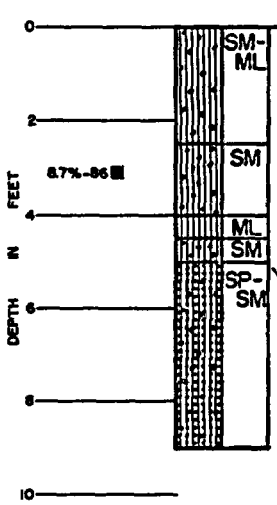
DARK GRAY SILTY FINE SAND WITH LAYERS OF CLAYEY SILT – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 3

ELEVATION 6616.0 FEET



GRAYISH-BROWN SILTY VERY FINE SAND WITH SEAMS OF SILT AND CLAYEY SILT AND ROOTS TO 18" – MEDIUM DENSE (TAILINGS)

2" LAYER OF DARK GRAY CLAYEY SILT

LIGHT GRAYISH-BROWN SILT FINE SAND – MEDIUM DENSE (TAILINGS)

DARK GRAY SILT WITH TRACE AND SEAMS OF SILT AND FINE SAND – SOFT (TAILINGS)

LIGHT GRAY SILTY FINE SAND WITH 1/4" TO 1/2" LAYERS OF DARK GRAY CLAYEY SILT – LOOSE (TAILINGS)

GRAY FINE TO MEDIUM SAND WITH SOME SILT – LOOSE (TAILINGS)

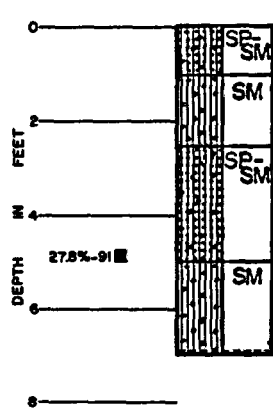
GRADES WITH OCCASIONAL 1/2" TO 1" LAYERS OF SILTY FINE SAND

TEST PIT COMPLETED 10 – 31 – 73

GROUND WATER WAS NOT ENCOUNTERED IN THIS TEST PIT.

TEST PIT 4

ELEVATION 6617.0 FEET



LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT AND ROOTS – LOOSE (TAILINGS)

GRAYISH-BROWN, BROWN, AND DARK GRAY LAYERED SILTY FINE SAND WITH 1/4" TO 1/2" LAYERS OF CLAYEY SILT, ROOTS – MEDIUM DENSE (TAILINGS)

LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT AND OCCASIONAL ROOTS – LOOSE (TAILINGS)

ZONE WITH 1/4" TO 1/2" LAYERS OF DARK GRAY CLAYEY SILT 4.0' TO 4.5'

GRAY SILTY FINE SAND WITH OCCASIONAL ROOTS – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

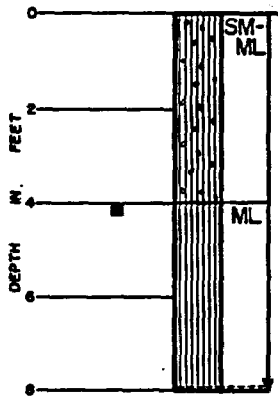
LOG OF TEST PITS

DAMES & MOORE

PLATE A-1C

TEST PIT 5

ELEVATION 6615.0 FEET



GRAYISH-BROWN, BROWN, AND LIGHT GRAYISH-BROWN SILTY VERY FINE SAND WITH ROOTS AND OCCASIONAL SEAMS OF CLAYEY SILT – LOOSE (TAILINGS)

GRADING GRAY IN COLOR

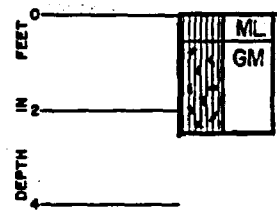
DARK GRAY SILT WITH OCCASIONAL SEAMS AND 1/4" TO 1/2" LAYERS OF SILTY FINE SAND – VERY LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 6

ELEVATION 6612.0 FEET



LIGHT GRAY SILT WITH TRACE VERY FINE SAND – LOOSE (TAILINGS)

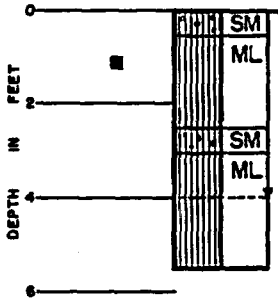
GRAY AND BROWN FINE TO COARSE GRAVEL AND COBBLES IN A MATRIX OF SILTY FINE TO COARSE SAND WITH SOME CLAY – MEDIUM DENSE

GRAVEL AND COBBLE FLOATING IN MATRIX

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 7

ELEVATION 6617.0 FEET



LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT – LOOSE (TAILINGS)

DARK GRAY SILT WITH SEAMS OF SILTY FINE SAND AND CLAYEY SILT – MEDIUM DENSE (TAILINGS)

DARK GRAY SILTY FINE SAND WITH ORGANIC MATERIAL AND SEAMS OF CLAYEY SILT – LOOSE (TAILINGS)

DARK GRAY SILT WITH SEAMS OF SILTY FINE SAND AND CLAYEY SILT AND TRACE CLAY – VERY LOOSE (TAILINGS)

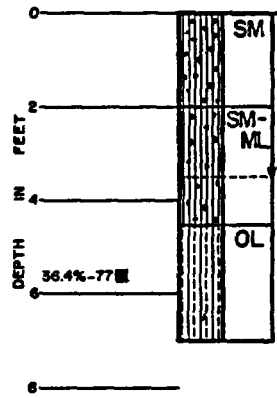
WATER LEVEL 10 – 31 – 73

GRADING LIGHT GRAY IN COLOR AND WITH MORE CLAY

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 8

ELEVATION 6618.0 FEET



LIGHT BROWNISH-GRAY SILTY FINE SAND WITH ROOTS – LOOSE (TAILINGS)

GRADING SILTY VERY FINE SAND

GRAY SILTY VERY FINE SAND WITH SEAMS OF SILT – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

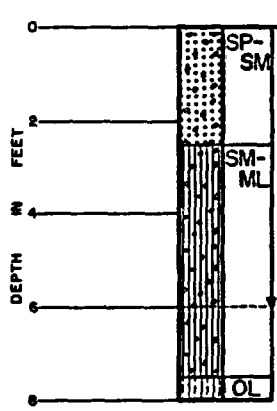
BLACK ORGANIC SILT WITH LAYERS OF SILTY FINE SAND AND PEAT – MEDIUM DENSE

TEST PIT COMPLETED 10 – 31 – 73

NOTE WATER COMING IN ABOVE ORGANIC SILT

TEST PIT 9

ELEVATION 6618.0 FEET



LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT AND ROOTS – LOOSE (TAILINGS)

GRADING SILTY VERY FINE SAND

GRAY SILTY VERY FINE SAND WITH SEAMS OF SILT AND CLAYEY SILT – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

EXCESSIVE CAVING

BLACK ORGANIC SILT WITH ZONES OF SILTY FINE SAND AND PEAT – LOOSE

TEST PIT COMPLETED 10 – 31 – 73

LOG OF TEST PITS

DAMES & MOORE

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

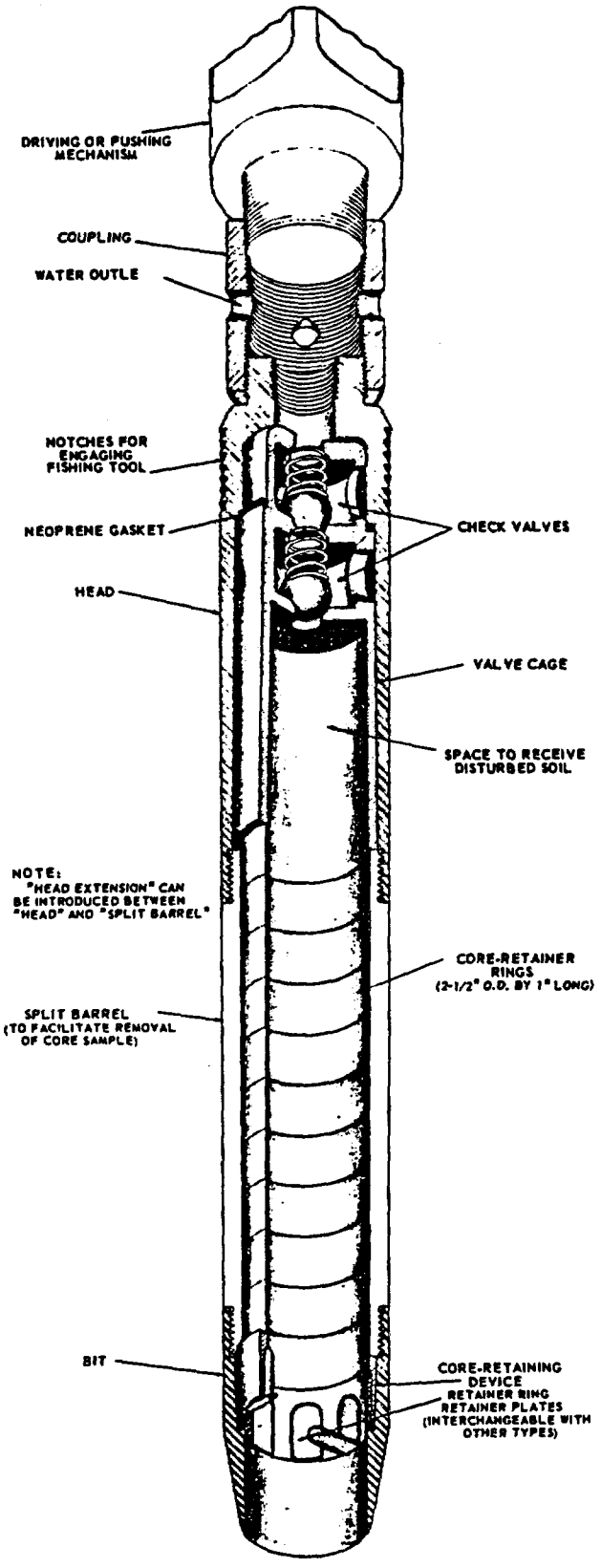
SOIL CLASSIFICATION CHART

UNIFIED SOIL CLASSIFICATION SYSTEM

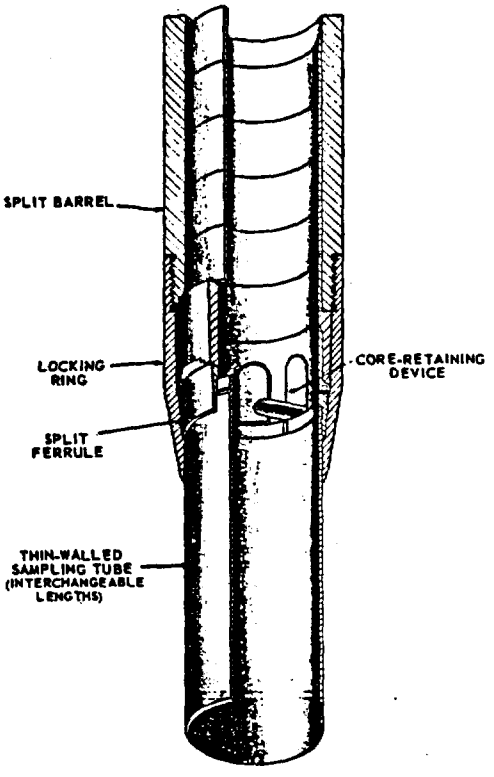
DAMES & MOORE

PLATE A-2

REVISED 11-13-73 SLL



ALTERNATE ATTACHMENTS



SOIL SAMPLER TYPE U

U. S. PATENT NO. 2,318,062

DAMES & MOORE

PLATE A-3

REVISIONS BY ____ DATE ____

FILE ____

CHECKED BY ____ DATE ____

BY: ____

REVISED 11-13-73 SLC

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

Date: November 29, 1973

CERTIFICATE OF ANALYSIS
73-3853

Name: Dames & Moore Eng.
Address: 250 East Broadway
Salt Lake City, Utah

Sample: Water Boring #3 received on November 13, 1973 for complete chemical analysis, Job No. 8998-001 under P.O. No. SL1103

Date Sampled: November 9, 1973

Turbidity	0.28 JTU	Fluoride as F	0.27 mg/1
Conductivity	988.4 u mhos/cm	Total Hardness as $CaCO_3$	396.0 mg/1
pH	7.55	Iron (Total) as Fe	0.26 mg/1
Total Dissolved Solids at 180° C.	682.0 mg/1	Iron (Filtered) as Fe	0.10 mg/1
Alkalinity as $CaCO_3$	188.0 mg/1	Lead as Pb	0.07 mg/1
Aluminum as Al	0.00 mg/1	Magnesium as Mg	26.80 mg/1
Arsenic as As	0.00 mg/1	Manganese as Mn	0.17 mg/1
Bicarbonate as HCO_3	227.8 mg/1	Mercury as Hg	0.000 mg/1
Barium as Ba	0.09 mg/1	Nitrate as NO_3	0.88 mg/1
Boron as B	0.47 mg/1	Phosphate as PO_4	0.10 mg/1
Cadmium as Cd	0.001 mg/1	Potassium as K	5.90 mg/1
Calcium as Ca	113.0 mg/1	Selenium as Se	0.00 mg/1
Carbonate as CO_3	0.00 mg/1	Silica as SiO_2	0.76 mg/1
Chloride as Cl	60.0 mg/1	Silver as Ag	0.000 mg/1
Chromium as Cr (Hex)	0.00 mg/1	Sulfate as SO_4	210.0 mg/1
Cyanide as Cn	0.00 mg/1	Sodium as Na	41.50 mg/1
Copper as Cu	0.05 mg/1	Zinc as Zn	0.03 mg/1

Ford Chemical Laboratory, Inc.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

Date: November 30, 1973

CERTIFICATE OF ANALYSIS
73-3855

Name: Dames & Moore Eng.
Address: 250 East Broadway
Salt Lake City, Utah

Sample: Water Boring #3 received on November 15, 1973 for complete chemistry, Job No. 8998-001, P.O. No. SL1103

Date Sampled: November 15, 1973

Turbidity	0.30 JTU	Fluoride as F	0.31 mg/1
Conductivity	1,036 u mhos/cm	Total Hardness as $CaCO_3$	408.0 mg/1
pH	7.50	Iron (Total) as Fe	0.25 mg/1
Total Dissolved Solids at 180° C.	715.0 mg/1	Iron (Filtered) as Fe	0.14 mg/1
Alkalinity as $CaCO_3$	204.0 mg/1	Lead as Pb	0.115 mg/1
Aluminum as Al	0.00 mg/1	Magnesium as Mg	28.80 mg/1
Arsenic as As	0.00 mg/1	Manganese as Mn	0.41 mg/1
Bicarbonate as HCO_3	247.2 mg/1	Mercury as Hg	0.000 mg/1
Barium as Ba	0.04 mg/1	Nitrate as NO_3	1.30 mg/1
Boron as B	0.50 mg/1	Phosphate as PO_4	0.40 mg/1
Cadmium as Cd	0.000 mg/1	Potassium as K	6.70 mg/1
Calcium as Ca	115.0 mg/1	Selenium as Se	0.00 mg/1
Carbonate as CO_3	0.00 mg/1	Silica as SiO_2	0.75 mg/1
Chloride as Cl	64.0 mg/1	Silver as Ag	0.000 mg/1
Chromium as Cr (Hex)	0.00 mg/1	Sulfate as SO_4	210.00 mg/1
Cyanide as Cn	0.00 mg/1	Sodium as Na	44.80 mg/1
Copper as Cu	0.10 mg/1	Zinc as Zn	0.15 mg/1

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Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

Date: November 29, 1973

CERTIFICATE OF ANALYSIS
73-3854

Name: Dames & Moore Eng.
Address: 250 East Broadway
Salt Lake City, Utah

Sample: Water Boring #2 received on November 13, 1973 for complete culinary chemical analysis, Job No. 8998-001 P.O. No. SL 1103

Date Sampled: November 8, 1973

Turbidity	0.51	JTU	Fluoride as F	0.10	mg/1
Conductivity	2,291	u mhos/cm	Total Hardness as $CaCO_3$	1,060	mg/1
pH	7.36		Iron (Total) as Fe	1.40	mg/1
Total Dissolved Solids at 180° C.	1,581	mg/1	Iron (Filtered) as Fe	0.46	mg/1
Alkalinity as $CaCO_3$	220.0	mg/1	Lead as Pb	0.133	mg/1
Aluminum as Al	0.00	mg/1	Magnesium as Mg	91.20	mg/1
Arsenic as As	0.00	mg/1	Manganese as Mn	3.39	mg/1
Bicarbonate as HCO_3	266.6	mg/1	Mercury as Hg	0.000	mg/1
Barium as Ba	0.00	mg/1	Nitrate as NO_3	0.50	mg/1
Boron as B	0.00	mg/1	Phosphate as PO_4	0.26	mg/1
Cadmium as Cd	0.011	mg/1	Potassium as K	3.12	mg/1
Calcium as Ca	272.0	mg/1	Selenium as Se	0.00	mg/1
Carbonate as CO_3	0.00	mg/1	Silica as SiO_2	0.65	mg/1
Chloride as Cl	18.0	mg/1	Silver as Ag	0.000	mg/1
Chromium as Cr (Hex)	0.00	mg/1	Sulfate as SO_4	880.0	mg/1
Cyanide as Cn	0.00	mg/1	Sodium as Na	51.70	mg/1
Copper as Cu	0.10	mg/1	Zinc as Zn	1.42	mg/1

Ford Chemical Laboratory, Inc.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

Date: November 30, 1973

CERTIFICATE OF ANALYSIS
73-3856

Name: Dames & Moore Eng.
Address: 250 East Broadway
Salt Lake City, Utah

Sample: Water Boring #2 received on November 15, 1973, for complete chemistry, Job No. 8998-001, P.O. No. SL1103

Date Sampled: November 15, 1973

Turbidity	0.50	JTU	Fluoride as F	0.15	mg/1
Conductivity	2,255	u mhos/cm	Total Hardness as $CaCO_3$	1,050	mg/1
pH	7.31		Iron (Total) as Fe	0.39	mg/1
Total Dissolved Solids at 180° C.	1,556	mg/1	Iron (Filtered) as Fe	0.20	mg/1
Alkalinity as $CaCO_3$	200.0	mg/1	Lead as Pb	0.117	mg/1
Aluminum as Al	0.00	mg/1	Magnesium as Mg	86.40	mg/1
Arsenic as As	0.00	mg/1	Manganese as Mn	3.58	mg/1
Bicarbonate as HCO_3	242.4	mg/1	Mercury as Hg	0.000	mg/1
Barium as Ba	0.10	mg/1	Nitrate as NO_3	0.95	mg/1
Boron as B	0.49	mg/1	Phosphate as PO_4	0.44	mg/1
Cadmium as Cd	0.010	mg/1	Potassium as K	4.50	mg/1
Calcium as Ca	276.0	mg/1	Selenium as Se	0.00	mg/1
Carbonate as CO_3	0.00	mg/1	Silica as SiO_2	0.85	mg/1
Chloride as Cl	15.0	mg/1	Silver as Ag	0.000	mg/1
Chromium as Cr (Hex)	0.00	mg/1	Sulfate as SO_4	890.00	mg/1
Cyanide as Cn	0.00	mg/1	Sodium as Na	43.50	mg/1
Copper as Cu	0.06	mg/1	Zinc as Zn	1.25	mg/1

Ford Chemical Laboratory, Inc.

DAMES & MOORE

PLATE A-4B

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

Date: November 29, 1973

CERTIFICATE OF ANALYSIS
73-3848

Name: Dames & Moore Eng.
Address: 250 East Broadway
Salt Lake City, Utah

Sample: Water sample Boring #1 received on November 13, 1973, P.O. No. SL 1103 Job No. 8998-001

Date Sampled: November 7, 1973

Turbidity	0.78 JTU	Fluoride as F	0.17 mg/1
Conductivity	1,878.0 u mhos/cm	Total Hardness as $CaCO_3$	810.0 mg/1
pH	7.38	Iron (Total) as Fe	0.23 mg/1
Total Dissolved Solids at 180° C.	1,296.0 mg/1	Iron (Filtered) as Fe	0.20 mg/1
Alkalinity as $CaCO_3$	390.0 mg/1	Lead as Pb	0.110 mg/1
Aluminum as Al	0.00 mg/1	Magnesium as Mg	69.60 mg/1
Arsenic as As	0.00 mg/1	Manganese as Mn	0.00 mg/1
Bicarbonate as HCO_3	472.6 mg/1	Mercury as Hg	0.000 mg/1
Barium as Ba	0.10 mg/1	Nitrate as NO_3	2.45 mg/1
Boron as B	0.55 mg/1	Phosphate as PO_4	1.10 mg/1
Cadmium as Cd	0.006 mg/1	Potassium as K	7.03 mg/1
Calcium as Ca	208.0 mg/1	Selenium as Se	0.00 mg/1
Carbonate as CO_3	0.00 mg/1	Silica as SiO_2	2.50 mg/1
Chloride as Cl	70.0 mg/1	Silver as Ag	0.000 mg/1
Chromium as Cr (Hex)	0.00 mg/1	Sulfate as SO_4	420.0 mg/1
Cyanide as Cn	0.00 mg/1	Sodium as Na	50.06 mg/1
Copper as Cu	0.01 mg/1	Zinc as Zn	0.16 mg/1

Ford Chemical Laboratory, Inc.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

Date: November 30, 1973

CERTIFICATE OF ANALYSIS
73-3855

Name: Dames & Moore Eng.
Address: 250 East Broadway
Salt Lake City, Utah

Sample: Water Boring #1 received on November 15, 1973 for complete chemical analysis, Job No. 8998-001, P.O. No. SL 1103

Date Sampled: November 15, 1973

Turbidity	0.68 JTU	Fluoride as F	0.20 mg/1
Conductivity	1,905 u mhos/cm	Total Hardness as $CaCO_3$	790.0 mg/1
pH	7.36	Iron (Total) as Fe	0.99 mg/1
Total Dissolved Solids at 180° C.	1,315 mg/1	Iron (Filtered) as Fe	0.33 mg/1
Alkalinity as $CaCO_3$	400.0 mg/1	Lead as Pb	0.24 mg/1
Aluminum as Al	0.00 mg/1	Magnesium as Mg	69.60 mg/1
Arsenic as As	0.00 mg/1	Manganese as Mn	0.15 mg/1
Bicarbonate as HCO_3	484.0 mg/1	Mercury as Hg	0.000 mg/1
Barium as Ba	0.07 mg/1	Nitrate as NO_3	1.65 mg/1
Boron as B	0.87 mg/1	Phosphate as PO_4	0.80 mg/1
Cadmium as Cd	0.024 mg/1	Potassium as K	7.10 mg/1
Calcium as Ca	200.0 mg/1	Selenium as Se	0.00 mg/1
Carbonate as CO_3	0.00 mg/1	Silica as SiO_2	0.75 mg/1
Chloride as Cl	80.0 mg/1	Silver as Ag	0.014 mg/1
Chromium as Cr (Hex)	0.00 mg/1	Sulfate as SO	410.0 mg/1
Cyanide as Cn	0.00 mg/1	Sodium as Na	65.0 mg/1
Copper as Cu	0.08 mg/1	Zinc as Zn	0.49 mg/1

Ford Chemical Laboratory, Inc.

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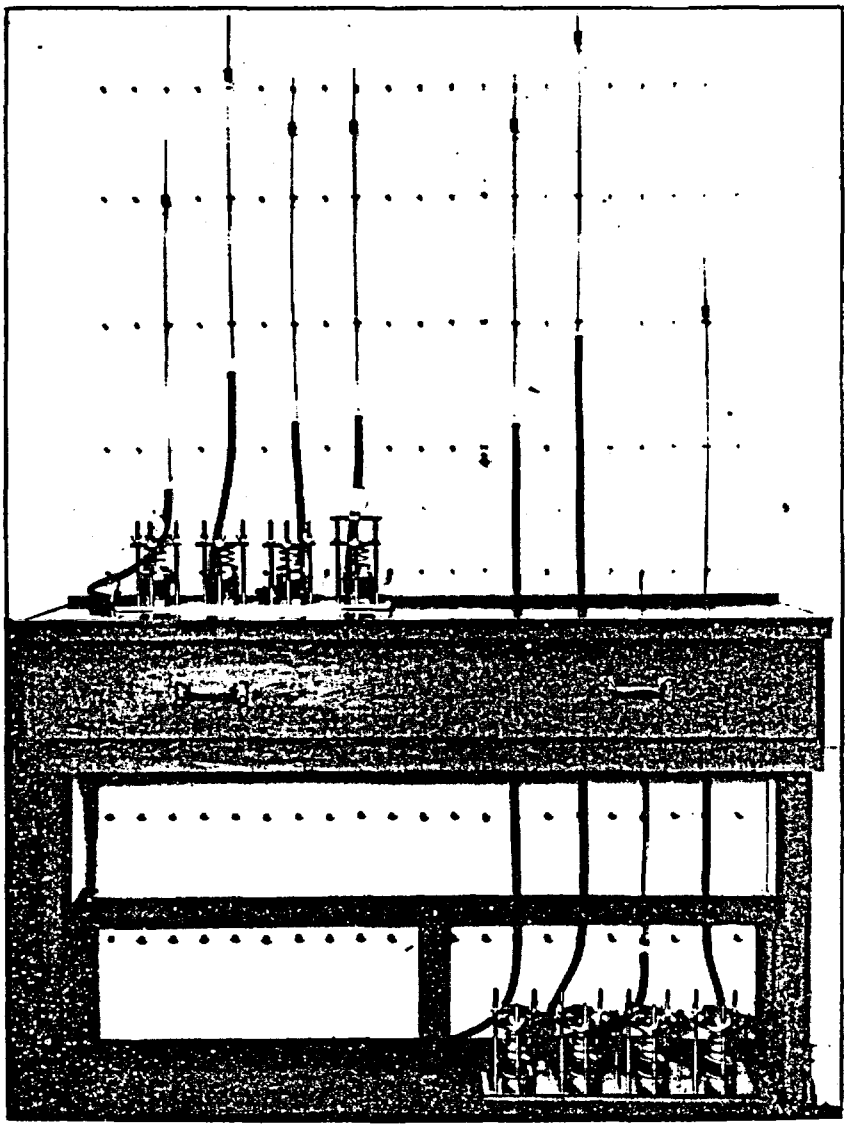
PLATE A-4A

The quantity and the velocity of flow of water which will escape through an earth structure or percolate through soil are dependent upon the permeability of the earth structure or soil. The permeability of soil has often been calculated by empirical formulas but is best determined by laboratory tests, especially in the case of compacted soils.

A one-inch length of the core sample is sealed in the percolation apparatus, placed under a confining load, or surcharge pressure, and subjected to the pressure of a known head of water. The percolation rate is computed from the measurements of the volume of water which flows through the sample in a series of time intervals. These rates are usually expressed as the velocity of flow in feet per year under a hydraulic gradient of one and at a temperature of 20 degrees Centigrade. The rate so expressed may be adjusted for any set of conditions involving the same soil by employing established physical laws. Generally, the percolation rate varies over a wide range at the beginning of the test and gradually approaches equilibrium as the test progresses.



APPARATUS FOR PERFORMING PERCOLATIONS TESTS
Shows tests in progress on eight samples simultaneously.

During the performance of the test, continuous readings of the deflection of the sample are taken by means of micrometer dial gauges. The amount of compression or expansion, expressed as a percentage of the original length of the sample, is a valuable indication of the compression of the soil which will occur under the action of load or the expansion of the soil as saturation takes place.

METHOD OF PERFORMING PERCOLATION TESTS

DAMES & MOORE

REVISIONS BY DATE
FILE
CHECKED BY DATE
BY
REVISED 11-13-73 S.L.C.

REPORT OF EMBANKMENT AND DIKE DESIGN REQUIREMENTS
PROPOSED TAILINGS POND DEVELOPMENT
NEAR PARK CITY, UTAH
FOR PARK CITY VENTURES CORPORATION

Dames & Moore Job No. 8998-003-06

SUITE 200, 250 EAST BROADWAY · SALT LAKE CITY, UTAH 84111 · 801 359-3754
CABLE: DANEMORE TWX: 910-925-5622

March 8, 1974

Park City Ventures Corporation
Star Route 1, Box 40
Heber City, Utah 84032

Attention: Mr. Niles Andrus

Gentlemen:

Six copies of our report entitled "Report of Embankment and Dike Design Requirements, Proposed Tailings Pond Development, Near Park City, Utah, For Park City Ventures Corporation," are herewith submitted.

The purpose and scope of this investigation were outlined in our proposal dated December 26, 1973, and also in our confirming proposal of January 10, 1974.

The results of our analyses indicate that the existing tailings embankment will have to be augmented by a proposed embankment constructed primarily of clays, sands, and gravels found on and near the site. The proposed embankment will have a compacted soil cutoff extending to bedrock. The proposed perimeter dikes can be built using near-site sands and gravels, but their construction will require that all tailings beneath the dike foundation be removed.

It is recommended that the construction of the proposed diversion ditch be commenced immediately, in order to lower ground water levels within the dike foundation areas.

oOo

We appreciate the opportunity of performing this service for you. If you have any questions concerning the enclosed report, please contact us.

Yours very truly,

DAMES & MOORE

George C. Toland

George C. Toland
Consulting Partner
Professional Engineer No. 2311
State Of Utah

GCT/SV:ab

Enclosures

EPA REGION VIII
SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID # ~~7329~~ 483489
PAGE #

IMAGERY COVER SHEET
UNSCANNABLE ITEM

Contact the Superfund Records Center to view this document.

SITE NAME Richardson Flats

OPERABLE UNIT

REPORT OR DOCUMENT TITLE US EPA's Request For Information

DATE OF DOCUMENT ~~Nov. 23, 1987~~ Jan 15 1988

DESCRIPTION OF IMAGERY Geologic Quadrangle Map

Exhibit 1D-B → Oversized Map

NUMBER AND TYPE OF IMAGERY ITEM(S) 1

EXHIBIT 10-C

REPORT OF EMBANKMENT AND DIKE DESIGN REQUIREMENTS
PROPOSED TAILINGS POND DEVELOPMENT
NEAR PARK CITY, UTAH
FOR PARK CITY VENTURES CORPORATION

Dames & Moore Job No. 8998-003-06

CONSULTANTS IN THE ENVIRONMENTAL AND APPLIED EARTH SCIENCES

SUITE 200, 250 EAST BROADWAY · SALT LAKE CITY, UTAH 84111 · (801) 359-8764
CABLE: DAMEMORE TWX: 910-925-5692

March 8, 1974

Park City Ventures Corporation
Star Route 1, Box 40
Heber City, Utah 84032

Attention: Mr. Niles Andrus

Gentlemen:

Six copies of our report entitled "Report of Embankment and Dike Design Requirements, Proposed Tailings Pond Development, Near Park City, Utah, For Park City Ventures Corporation," are herewith submitted.

The purpose and scope of this investigation were outlined in our proposal dated December 26, 1973, and also in our confirming proposal of January 10, 1974.

The results of our analyses indicate that the existing tailings embankment will have to be augmented by a proposed embankment constructed primarily of clays, sands, and gravels found on and near the site. The proposed embankment will have a compacted soil cutoff extending to bedrock. The proposed perimeter dikes can be built using near-site sands and gravels, but their construction will require that all tailings beneath the dike foundation be removed.

It is recommended that the construction of the proposed diversion ditch be commenced immediately, in order to lower ground water levels within the dike foundation areas.

oOo

We appreciate the opportunity of performing this service for you. If you have any questions concerning the enclosed report, please contact us.

Yours very truly,

DAMES & MOORE

George C. Toland

George C. Toland
Consulting Partner
Professional Engineer No. 2311
State Of Utah

GCT/SV:ab

Enclosures

REPORT OF EMBANKMENT AND DIKE DESIGN REQUIREMENTS

PROPOSED TAILINGS POND DEVELOPMENT

NEAR PARK CITY, UTAH

FOR PARK CITY VENTURES CORPORATION

INTRODUCTION

This report presents the results of our investigation of design requirements for the embankments which will enclose the proposed tailings pond development near Park City, Utah. The tailings pond site is located immediately south of U. S. Highway 40, four miles southeast of Silver Creek Junction, as shown on Plate 1, Vicinity Map.

Ground water and seepage studies at the site of the proposed tailings pond were presented in our report of December 6, 1973. Field and laboratory data presented in this report were used in developing the recommendations presented herein.

PURPOSE AND SCOPE

The detailed purpose and scope of this investigation was originally presented in our proposal of December 26, 1973, and later in our confirming proposal dated January 10, 1974. The purpose of the investigation was to provide design requirements for the proposed tailings pond embankments, with special attention being given to minimizing seepage of the contaminated pond effluent. In accomplishing this purpose, the scope as outlined below was followed:

1. A field program consisting of a general field reconnaissance and the drilling of two exploratory borings and the excavation of twelve test pits.

2. A laboratory program to determine strength, permeability, and compressibility characteristics of the on-site soils.
3. An office program consisting of engineering analyses, development of design requirements, definition of suitable construction materials, identification of potential construction problems, and the preparation of this report.

EXISTING FACILITIES

The site of the proposed tailings pond is presently occupied by an old tailings disposal area. This disposal area was first put into use more than 80 years ago and was initially developed by the construction of a small dam across what was then a low, marshy area. Evidence indicates that the original dam was constructed by simply piling up the soft organic silty surface soils found on the valley floor. Tailings were then deposited behind the dam. When the tailings reached a level which required increasing the height of the dam, the dam was raised with any available material, including the organic silts and silty sands and gravels found near the dam, as well as garbage and rubbish. At one time, the dam served as a disposal area for Park City garbage and rubbish; this material is presumably now incorporated into the body of the embankment.

Presently, the crest of the embankment stands at about elevation 6614, with tailings standing behind the dam to nearly its full height in most areas. The length of the embankment is about 900 feet, and the downstream slopes vary from nearly vertical to about 3 horizontal to 1 vertical. A culvert runs through the embankment foundation near the mid-point of the dam.

The location of the existing embankment is shown on Plate 2, Plot Plan. A more detailed discussion of the nature of the materials which comprise the embankment and the existing tailings deposits can be found in the section of this report entitled SITE CONDITIONS.

PROPOSED CONSTRUCTION

The need for the proposed tailings pond arises from the construction of a mill located south of Park City by Park City Ventures Corporation. Tailings resulting from the flotation process carried out at the mill will be cycloned to remove the coarser fraction. The remaining tailings, which will be about 80 percent finer than the number 325 mesh, will be carried by pipeline to the proposed pond. It is estimated that the total tailings discharge will be on the order of 325 tons per day. The tailings slurry, which will consist of about 10 to 20 percent solids, will be discharged into the pond at a rate of about 60 gallons per minute. The maximum anticipated elevation of the pond is 6625 feet, and it is not expected that tailings will be discharged above this elevation at any time in the future.

Containment of the tailings will require that dikes be constructed around the tailings disposal area along the approximate alignment shown on Plate 2, Plot Plan. The dikes will average on the order of 10 feet in height. The total length of the required dikes will be approximately 5300 feet.

The existing embankment on the north side of the tailings pond will have to be substantially upgraded in order to provide stability and reduce seepage of the tailings effluent water.

In order to bypass surface runoff which would otherwise accumulate in the pond, a ditch will be constructed around the pond. The ditch will

intercept runoff from the hills lying to the northeast and direct it around the southeastern and southwestern sides of the pond to the Silver Creek drainage.

SITE CONDITIONS

SURFACE:

The existing tailings disposal area is located on the northern portion of Richardson Flat, as shown on Plate 1, Vicinity Map. Hills rise on the north side of the site. U. S. Highway 40 traverses the north edge of the site, and Silver Creek bounds the site to the west. A Union Pacific railroad track runs west of the existing tailings disposal area and crosses the southern portion of the area. Immediately west of this railroad track, near the extreme western corner of the site, is a gravel pit. A drainage ditch runs from the culvert in the existing embankment to the central area of the pond.

The existing tailings disposal area is occupied by scattered low grass. Sparse brush grows on the hillsides to the north.

A more detailed description of the site is shown on Plate 2, Plot Plan.

SUBSURFACE:

Existing Embankment. As previously noted, the existing embankment which lies on the northwest corner of the existing tailings disposal area consists generally of a heterogeneous mixture of organic silts and silty sands and gravels, with some trash and rubbish. As indicated by the two exploratory borings drilled through the crest of the embankment, and as suggested by the probable method of construction of the dam, it is likely

that those portions of the embankment near the abutments consist largely of silty or clayey sands and gravels which were taken from the low hills to the north and south of the embankment. Where they were encountered in Boring 2, these materials were of moderate density and permeability. It also seems likely that the central portion of the embankment consists mainly of silts and organic silts with zones of silty sands and gravels, as well as zones of trash and rubbish, such as were encountered in Boring 1. The central portion could be expected to be substantially more compressible than the portions near the abutments.

It should be emphasized, however, that extreme variations in soil type, strength permeability, and compressibility can be expected to occur over very short distances in the material which comprises the existing embankment.

The logs of Borings 1 and 2 are shown on Plate A-1C, Log of Borings, in the appendix of this report.

Natural Soils and Rock. The natural soils which were encountered immediately downstream from the existing embankment in Monitor Wells 1 through 3 consist generally of soft organic silts and clays and medium-stiff, gravelly clays, as well as sandy gravels with some clays. Natural soils and rock encountered downstream from the existing embankment are described in detail on Plates A-1A and A-1B, Log of Monitor Wells, in the appendix of this report.

Soils in the northeastern half of the area which lies immediately downstream from the existing embankment consist generally of a surface layer of clayey filt and/or a layer of compressible organic silts and clays. These

surface soils range in depth from zero to eleven feet, with the greater thickness existing near the center of the valley. Beneath these surface soils lies a layer of stiff silty clay and gravelly clay with a thickness of about four to six feet. Below this clay layer lies weathered bedrock.

The soils in the southwestern portion of the area downstream from the existing embankment consist of a thin surface layer of gravels underlain by organic silts and clays and silty clays to a depth of about six feet below the surface. Between these soils and the weathered bedrock lies a layer of gravel with some sand, silt and clay. This layer is approximately six feet thick and is moderately to highly permeable.

The rock which underlies the soil deposits consists of highly weathered, soft, volcanic breccia. The rock is similar in appearance to a deposit of relatively hard cobbles and boulders in a tight matrix of dense silty or clayey sands and gravels. Where it is exposed in a nearby highway cut, the rock exhibits no continuous fractures.

The natural soils which underlie the tailings in the old tailings disposal area consist generally of a layer of soft to stiff black organic silt about two feet thick. This organic silt is underlain by a layer of stiff tan clay. These layers of silt and clay appear to be continuous beneath the entire pond area with the exception of the extreme western corner where the natural soils consist of silty sands and silty gravels.

The low hills to the northwest are covered by a layer of dark brown stiff clay of varying thickness. In its lower extent, the clay grades with some sand and generally lighter in color, and ultimately to the dense clayey sand indicative of the highly weathered volcanic breccia rock which underlies it.

The natural soils which lie on the hills to the northwest and beneath the tailings deposits are described on Plates A-1D through A-1H, Logs of Test Pits, in the appendix of this report.

Tailings. The tailings which comprise the existing tailings deposit range in gradation from clean fine sands to silty fine sands and fine sandy silts. They are primarily loose to very soft in consistency. The water content of the tailings was high, even samples taken above the water table were nearly totally saturated. Layering of tailings into zones of differing gradation was distinct, with the thickness of the various zones ranging from about 1 to 12 inches.

In addition, the entire tailings deposit was segregated into zones of differing overall gradation. It appears that the point of discharge of the tailings into the original pond was in the vicinity of Test Pit 12, as evidenced by the relatively coarse grain size of the tailings and the absence of fines at this point. Since the coarser fraction of the tailings settles rapidly, leaving the fines in suspension for a longer time, the fines generally travel a longer distance from the point of discharge before settling. Consequently, it would be expected that the closer to the vicinity of Test Pit 12, the coarser and cleaner the tailings would be, and conversely, the farther away the higher the percentage silt would be. This conjecture was generally borne out by the results of the field exploration program, with the cleaner and coarser tailings found in the southwest portion of the pond, and with the siltier tailings found in the northeast portion. These areas of differing overall gradation are shown on Plate 2, Plot Plan. A detailed description of the tailings is shown on Plates A-1D through A-1H, Log of Test Pits, in the appendix of this report.

GROUND WATER:

Depths at which ground water was encountered during field operations are shown on Plates A-1A and A-1B, Log of Monitor Wells, and Plates A-1D through A-1H, Log of Test Pits, in the appendix of this report.

In general, the gradient of present ground water flow in the existing pond is to the west and northwest, as indicated by the test pit ground water levels. The ditch running through the central portion of the pond collects water and discharges it through the culvert in the existing embankment. In addition, low ground water levels in Test Pits 10 and 11 indicate that some seepage is presently occurring through the silty gravels which underlie the tailings in the extreme western corner of the existing tailings pond. Some seepage also occurs through the north aboutment of the existing embankment, as noted in our report of December 6, 1973.

SEISMICITY:

~~The immediate vicinity of the proposed tailings pond development has a history of relative seismic inactivity.~~ The only earthquake near the site within the last 120 years occurred near Midway in 1932. It was relatively small, with a magnitude of approximately 3.7 Richter.*

Owing to the historic lack of major seismic activity near the immediate vicinity of the site, the design earthquake affecting the site has been taken as one which would occur along the Wasatch Fault. Such an earthquake would develop bedrock accelerations along the fault of approximately 0.15g, and would be of approximately Magnitude 7.0 Richter.

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*Cook, K. L., and Smith, R. B., Seismicity in Utah, 1850 through June, 1965, Bull. of S.S.A., August, 1967.

Attenuation of the seismic forces developed by the design earthquake epicentered along the Wasatch Fault would result in bedrock accelerations at the site of approximately 0.10g. A duration of shaking of 10 significant stress cycles was chosen as being consistent with the magnitude of the design earthquake.

DISCUSSIONS AND RECOMMENDATIONS

GENERAL:

We feel that a tailings retention system providing a reasonable degree of seepage control can be feasibly constructed at the proposed site. The essential elements of such a system would be:

1. A diversion ditch which would collect runoff from the hillsides to the northeast and direct it around the proposed pond. It is our understanding that this ditch will be designed by others.
2. ~~An earthen embankment which would be constructed immediately downstream of the existing embankment and would incorporate the existing embankment into its upstream toe.~~ Such an embankment would be constructed with a cutoff extending to weathered bedrock using primarily the clayey sands and sandy clays which lie on the hillsides to the northeast, as well as the silty sands and gravels which are found in the southwest portion of the site.
3. A system of dikes averaging approximately 10 feet in height and with a total length of about 5,300 feet to enclose the pond area. Due to the susceptibility of the existing

tailings deposits to liquefaction during earthquakes, the major part of the dike sections must be founded on the natural soils which underlie the tailings. The dikes can be constructed primarily from the silty sands and gravels located near the southwestern portion of the site.

4. ~~A permanent discharge tailings line which would extend around the dikes and the embankment.~~

Since the location of the ground water table will play a major role in the type and magnitude of construction difficulties encountered, it is recommended that construction of the diversion ditch be commenced immediately in an attempt to prevent accumulation of spring runoff within the pond area. In addition, construction of the proposed embankment and dikes should be delayed as long as possible into late summer or early fall in order to take advantage of the lower ground water levels which normally occur during these months.

DIVERSION DITCH:

At the time that the field portion of this study was performed, ground water levels along most of the alignment of the proposed dikes ranged from existing grade to about three feet below existing grade. Since construction of the proposed dikes will require excavation and placement of compacted fill to depths ranging from approximately one to fourteen feet below existing grade, it will be necessary to dewater the area along the alignment of the proposed dikes.

It is recommended that dewatering in this area be undertaken by constructing a diversion ditch extending across the hills to the northeast

of the existing pond and around the southeast and southwest sides of the pond on an alignment roughly parallel to that of the proposed dikes. The diversion ditch should be constructed downstream from the proposed dikes and so that no part is closer than 50 feet to the maximum downstream extent of the dikes.

Since the dikes must be constructed on natural soils, the ditch must extend to a minimum depth of two feet below the surface of the natural soils at all points along its length in order to effectively dewater the dike foundation area. This will require cuts with a minimum depth ranging from about three to six feet below existing grade in most areas. The maximum ditch cuts will be on the order of fifteen feet in the vicinity of Test Pit 11, as shown on Plate 2, Plot Plan.

In order for the diversion ditch to provide the required ground water drawdown, it must be constructed prior to the spring snowmelt. Consequently, it is recommended that construction of the ditch be commenced as soon as possible.

EMBANKMENT:

General. The proposed embankment in the northwest portion of the pond can be feasibly constructed using primarily the clayey sands and sandy clays which lie on the hillsides to the northeast of the pond, and the silty sands and gravels which are found southwest of the pond area. The proposed embankment will be constructed immediately downstream from the existing embankment, and will incorporate portions of the existing embankment into its upstream toe. The proposed embankment will include a cutoff trench extending into the surface of the weathered bedrock. Consequently, dewatering of the foundation area of the proposed embankment will be required.

Configuration. The approximate alignment of the proposed embankment is shown on Plates 2 and 3. Embankment sections are shown on Plates 4 and 5.

Prior to placement of fill, the downstream slopes of the existing embankment should be cut back to an inclination of one horizontal to one vertical. The slopes should extend on this inclination to a depth which is two feet below the surface of the weathered bedrock. A cutoff trench a minimum of fifteen feet wide should then be cut into the weathered rock, as shown on Plates 4 and 5, Embankment Sections.

Although the existing soil profile in the area of the foundation of the proposed embankment is variable, the surface soils consist generally of black or dark brown organic silts and clays which range in consistency from soft to very soft. These soft organic soils will be unsuitable for support of the proposed embankment, and should be fully removed where they are encountered. Suitable foundation soils will be generally dark brown to gray, stiff to medium-stiff silty clay with sand and gravel, or dark gray to brown, medium-dense, fine to coarse gravel with some silt or clay. Suitable soils were encountered at depths below existing grade of approximately eleven feet and five feet in Monitor Wells 1 and 2, respectively, and at the surface in Monitor Well 3. In areas where suitable foundation soils are encountered, a minimum of the top six inches of these soils should be stripped so as to remove vegetation, sod, and roots.

After preparation of the existing embankment slopes and the foundation area of the proposed embankment, the proposed embankment should be constructed as shown on Plates 4 and 5, Embankment Sections. The upstream and

downstream slopes of the embankment can be constructed at an inclination of 2.0 horizontal to 1.0 vertical.

The crest should be constructed to elevation 6628. The crest width will be variable and will depend on the depth to bedrock and the height of the existing embankment. The crest should extend a minimum of 10 feet in the downstream direction from that point which marks the maximum upstream extent of the bottom of the cutoff trench. The minimum total crest width should be 15 feet.

The embankment should be constructed with three zones. Zone 1, the downstream shell, should consist of silty sands and gravels similar to those found in the existing gravel pit which lies immediately southwest of the pond area. A typical gradation of suitable material is shown on Plate 7.

Zone 2, the upstream core, should consist of a mixture of the silty clays, sandy clays, and clayey sands which lie on the hillsides immediately northwest and northeast of the existing pond. Suitable material was encountered in Test Pits 16, 19, 20, and 21, as described on Plates A-1G and A-1H, in the appendix of this report. Suitable material should have a gradation similar to that shown on Plate 7.

Zone 3, the downstream drain, should consist of clean, well-graded sands, or clean, well-graded sands and gravels, with less than five percent passing the No. 200 sieve. If suitable soils cannot be found on or near the site, washed Zone 1 sands and gravels should provide suitable material. Zone 3 material should lie within the gradation range shown on Plate 7 and should have a gradation curve which approximately parallels the boundaries shown.

Construction.

Cut Slopes. It is anticipated that the slopes of the existing embankment will be stable when cut back to an inclination of 1.0 horizontal to 1.0 vertical for a length of time sufficient to place Zone 2 fill. However, the stability of this temporary slope will depend to a large extent on such factors as the location of the phreatic surface and the nature of the soils encountered within the existing embankment. Since these factors are difficult to predict, it is recommended that a program of surveillance be carried out at all times when construction equipment is in operation on or near the slope.

The slope should be inspected on a continual basis for signs of instability, such as sloughing, bulging, or tension cracks. The lowermost parts of the slope, especially where seepage exists, will be the most critical from the standpoint of observation. Stakes should be located on 50-foot centers along the downstream edge of the existing dam crest and the locations of these stakes should be surveyed daily. Movement of the stakes should be taken as a sign of instability.

Should the slope show signs of instability, remedial measures should be undertaken immediately, and all men and equipment should be removed from the area above and below the slope.

Fill Placement. All soils used in the construction of the proposed embankment should be free from sod, vegetative matter,

rubbish, or other deleterious material. Under no circumstances should fill be placed in standing or ponded water. All fill soils should be placed in horizontal lifts not exceeding eight inches in loose thickness. Cobbles over six inches in diameter should be removed from fill before compaction.

Fill used in Zone 1 should be placed at or near the optimum water content to a density of at least 90 percent of the maximum dry density as determined by the A.A.S.H.O.* T180, Method of Compaction. Fill used in Zone 2 should be placed at a water content ranging from 1 percent drier to 3 percent wetter than the optimum water content. Fill should be compacted to 90 percent of the maximum dry density as determined by the A.A.S.H.O. T180, Method of Compaction.

Lifts of soils comprising Zone 1 and Zone 2 should be brought up simultaneously, maintaining a maximum of five feet vertical distance between the surfaces of the two zones at all times. Construction of the highest portions of Zone 2 will require that the upstream slope of the Zone be placed at an inclination steeper than that specified. The overfilled portion should then be cut back to the specified inclination of 2.0 horizontal to 1.0 vertical.

Fill used in Zone 3 should be kept thoroughly wetted during placement and compaction. Compaction should be provided by at

*American Association of State Highway Officials.

least two complete passes of heavy construction equipment over the surface of each lift.

Dewatering. It is anticipated that dewatering of the cutoff trench can be successfully accomplished by pumping from open sumps located in the bottom of the trench. However, relatively high flows may be encountered in the extreme southwestern portion of the trench.

Slope Stability. The stability of the downstream embankment slopes was analyzed under conditions of steady-state seepage for both static and seismic loading cases. Slope stability was analyzed using the Ordinary Method of Slices (Fellenius Method), which assumes a circular failure surface. This method of analysis assumes that the slope fails as a "rigid body," and neglects the effects of internal deformations of the soil mass.

Computer data sheets are available in our files showing the actual calculation and assumptions used.

The maximum phreatic surface was obtained using graphical flow-net procedures, assuming a maximum pond water elevation of 6625. Soil strength parameters were obtained using laboratory tests as described in the appendix of this report.

Under conditions of static loading and steady-state seepage, the factor of safety of the downstream embankment slope is approximately 1.5. Under steady-state seepage conditions, but assuming the maximum anticipated seismic forces of 0.10g, the factor of safety of the downstream embankment slope is approximately 1.2.

Settlement. As described in preceding sections of this report, the compressibility of the existing embankment which underlies the upstream

toe of the proposed embankment is highly variable. This fact raises the possibility that differential settlements could occur in the upstream portion of the proposed embankment. Although the magnitude of these differential settlements is impossible to predict accurately, differential settlements in the upstream portion of the dam up to one and one-half feet could occur. Differential settlements of this magnitude could be expected to cause significant cracking of the upstream Zone 2 core, which would ordinarily have an adverse effect on the performance of the embankment. However, compaction of the Zone 2 material at or above the optimum water content should help to minimize the potential cracking problem. However, as shown on Plates 4 and 5, Embankment Sections, at least 10 feet of crest width will be founded on rock. This would prevent any possible cracking of Zone 2 material from affecting the integrity of the embankment.

DIKES:

General. The results of our analyses indicate that the tailings in the existing pond area would be moderately to highly susceptible to liquefaction in the event of an earthquake with assumed parameters as described in the SEISMICITY section of this report. Liquefaction is a phenomenon in which pore water pressures in saturated soils such as loose fine sands or silty fine sands increase to the extent that the soil loses much of its shear strength and behaves as a fluid. Consequently, the proposed dike sections which cross the southeast and southwest sides of the pond area would not be safe under expected earthquake conditions if founded on the existing tailings deposits. It is therefore recommended that the tailings within these dike foundation areas be completely removed and replaced with compacted dike fill. However, liquefaction-induced failure

of the short dike segment which crosses the northeast corner of the pond would pose no risk to life or property. Hence, this dike segment can be constructed on the surface of the existing tailings deposits.

The proposed dikes can be constructed using the silty sands and gravels which exist near the southwest portion of the pond. It is anticipated that the proposed diversion ditch will dewater the foundation area of the proposed dikes so that little, if any, pumping will be required.

Configuration. The alignment of the proposed dikes is shown on Plate 2, Plot Plan. Minor adjustments in this alignment may be necessary to accommodate the proposed diversion ditch. The dike should be constructed so that its downstream toe is no closer than 50 feet from the ditch.

The dike will, in general, be constructed to an elevation of 6,627 feet, except for a short transition zone as shown on Plate 3, Plan View of Embankment. The two feet of freeboard thus provided will be reduced by approximately one-half to one foot due to foundation settlement. ~~This remaining freeboard will afford adequate protection provided that a tailings beach is built up by a perimeter discharge system, as described in subsequent sections of this report, and provided that ponded water is kept a minimum distance of 100 feet from the dikes slopes.~~

The dike should be constructed to dimensions as shown on Plate 6, Dike Sections, and should consist of material equivalent to that specified for use in Zone 1 of the proposed embankment. A typical gradation of suitable material is shown on Plate 7.

The existing tailings and a minimum of one foot of the underlying black organic silts and clays (or silty sands and gravels) should be excavated from the foundation area of the dikes, except for the northeast

dike section where only six inches of surface stripping will be required. This will require an excavation ranging from about three to six feet deep in most areas. The maximum depth of excavation will be on the order of fifteen feet in the vicinity of Test Pit 11.

Construction.

Excavation. The black organic silts and clays exposed in the bottom of the foundation excavation should generally be of medium-stiff consistency. If very soft or highly organic soils are encountered, the excavation should be extended down to firmer soils. The silty sands and gravels which will be encountered in the southwest sections of the dikes are anticipated to be sufficiently dense so as to require no additional excavation beyond the specified minimum depth of one foot.

Portions of the excavation extending no more than four feet below existing grade can be cut with sideslopes of 0.5 horizontal to 1.0 vertical. Portions of the excavation deeper than four feet should be cut with sideslopes not exceeding 1.0 vertical to 1.0 horizontal. These deeper excavations should be inspected regularly for signs of instability. If distress is noted, remedial measures should be undertaken immediately.

Fill Placement. All dike fill should be free from sod, rubbish, or other deleterious materials. Under no circumstances should fill be placed in standing or ponded water. All fill should be placed in horizontal lifts not exceeding six inches in loose thickness, and cobbles over six inches in diameter should be removed from the fill before compaction. Dike fill

should be placed at or near the optimum water content to a density of at least 90 percent of the maximum dry density as determined by the A.A.S.H.O. T180, Method of Compaction.

Backfill. After dike fill has been placed to an elevation higher than that of adjacent grade, the remaining slopes of the foundation excavation may be backfilled with excavated tailings. Clayey natural soils should not be used as backfill. The backfill need not be compacted.

Slope Stability. The stability of the downstream dike slopes, as shown on Section E-E on Plate 6, was analyzed under conditions of steady-state seepage for both static and seismic loading cases. Slope stability was analyzed using the Ordinary Method of Slices (Fellenius Method) as previously described.

The maximum phreatic surface was obtained using graphical flow-net procedures, assuming a maximum pond water elevation of 6625. Soil strength parameters were obtained from the results of laboratory tests as described in the appendix of this report.

Under conditions of static loading and steady-state seepage, the minimum factor of safety of the downstream dike slopes was calculated to be at least 2.0. Under steady-stage seepage conditions, but assuming the maximum anticipated seismic forces of 0.10g, the factor of safety of the downstream embankment slope was calculated to be at least 1.2. The analysis under seismic loading conditions assumes that the existing tailings lying against the dike slope have zero shear strength, as a result of liquefaction.

Settlement. The magnitude and rate of dike settlement will be related to the properties of the foundation soils upon which the various

dike sections rest. For dike sections overlying the natural silty sands and gravels in the southwest pond areas, total settlements will range from approximately two to four inches and will occur very soon after initial loading. Dike sections constructed on the natural soft to medium-stiff organic silts and clays will undergo settlements on the order of 6 to 12 inches, of which approximately 20 to 40 percent will occur during construction. The northeast dike section, which will be constructed directly on existing tailings, will experience total settlements on the order of 12 inches. However, at least 50 percent of this settlement will occur during construction.

DISCHARGE SYSTEM:

~~It is recommended that a perimeter discharge tailings line be utilized to deposit tailings slurry into the proposed pond area. Such a system should consist of a tailings line which extends around the entire dike and embankment perimeter and discharges at closely-spaced intervals. The discharge points should initially be established at the upstream toe of the dike and embankment, and should be moved up the slope as the tailings elevation rises. In this manner, a tailings beach should be established near the dikes and embankment. The beach should be of sufficient width so that the ponded water is maintained a minimum distance of 100 feet from the dikes and embankment.~~

SEEPAGE LOSSES:

The results of our field exploration program indicate that nearly the entire existing pond area is underlain by a layer of organic silts and clays which, as indicated by the results of laboratory tests, can be assumed to be impermeable for practical purposes. However, the extreme

southwest corner of the pond area is underlain by silty sands and gravels of low to moderate permeability. These soils were encountered in Test Pits 6 and 10.

Pond seepage rates will attain maximum values immediately after startup of pond operations. Theoretical seepage analyses assuming two feet of standing water over the entire pond surface indicate that initial seepage rates will be on the order of 20 gallons per minute.

However, the subsequent buildup of a perimeter beach composed of tailings slimes will result in a progressive decrease in seepage rates. This will come about due to the very low permeability of the slimes and the increased length of the flow path of the seeping water. This progressive sealing action provided by the discharged slimes will be particularly effective in reducing seepage rates in the extreme southwest corner of the pond, where initial seepage rates will be highest.

OPERATIONAL PROCEDURES:

Erosion resulting from the improper regulation of discharge tailings, natural precipitation, and seepage are among the major causes of tailings embankment failures. Because of this fact, it is recommended that an operational program of supervision and operation of the tailings discharge system be instituted. The discharge system should be inspected on at least a daily basis. In addition, the dikes and embankment should be inspected on a regular basis.

As previously stated, standing water in the pond should be maintained at least 100 feet from the upstream face of the dikes and embankment. Any discharge of tailings from the dike or embankment slopes should be done in such a manner that detrimental erosion of the slope does not occur. By

following these procedures, the possibility of erosional damage and slope failure will be greatly reduced.

oOo

The following plates and appendix are attached and complete this report:

Plate 1 - Vicinity Map

Plate 2 - Plot Plan

Plate 3 - Plan View of Embankment

Plate 4 - Embankment Sections, Sections A-A and B-B

Plate 5 - Embankment Sections, Sections C-C and D-D

Plate 6 - Dike Sections

Plate 7 - Typical Gradations of Embankment Materials

Appendix - Field Exploration and Laboratory Testing.

Respectfully submitted,

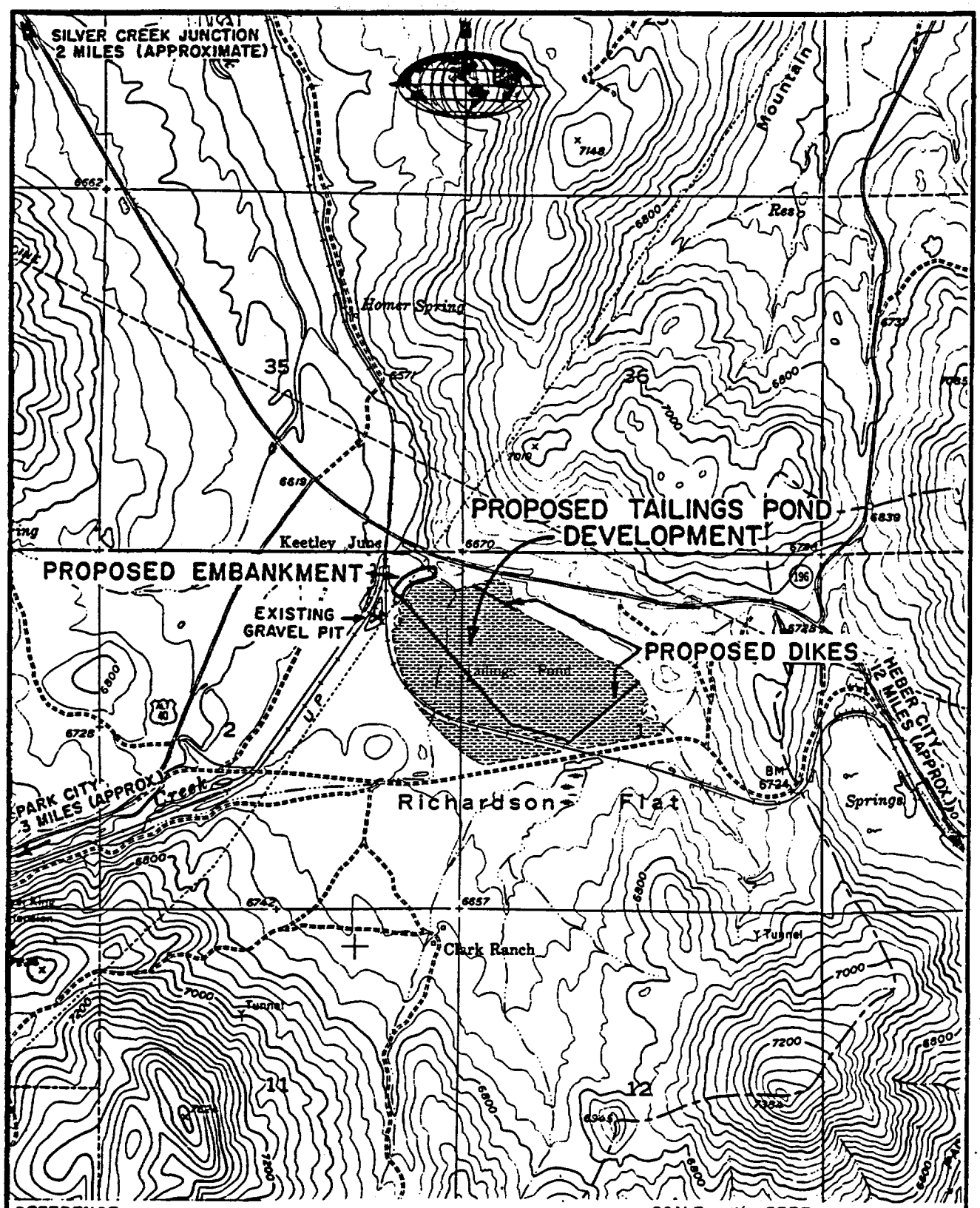
DAMES & MOORE

George C. Toland

George C. Toland
Consulting Partner
Professional Engineer No. 2311
State of Utah

GCT/SV:ab

Attachments



REFERENCE:
U.S.G.S. MAP TITLED, "PARK CITY EAST QUADRANGLE, UTAH," AND DATED 1955.

SCALE IN FEET
1,000 0 1,000 2,000 3,000 4,000 5,000

VICINITY MAP

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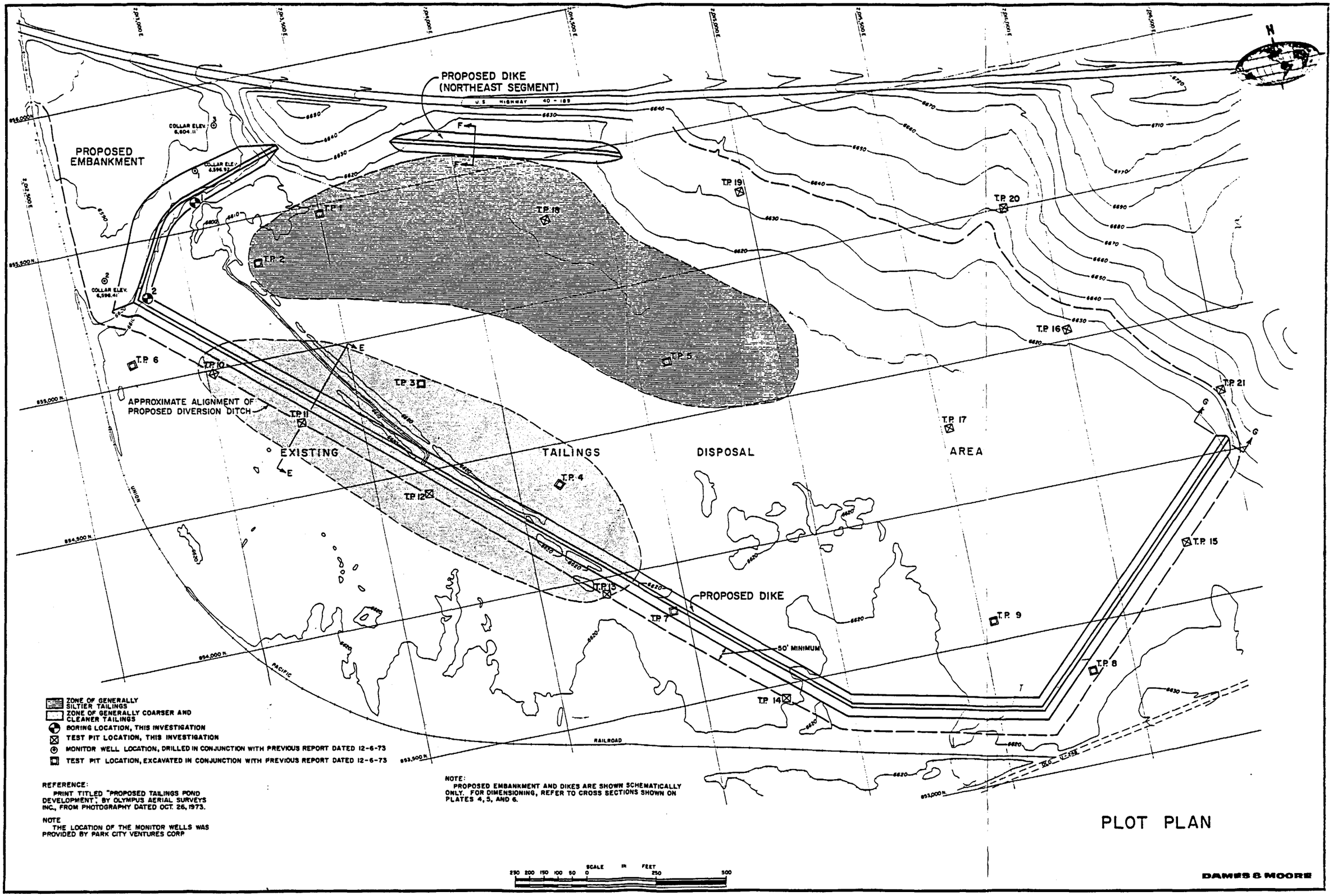
PLATE 1

REVISIONS BY ____ DATE ____

FILE 8998-003 Park City Ventures-Park City

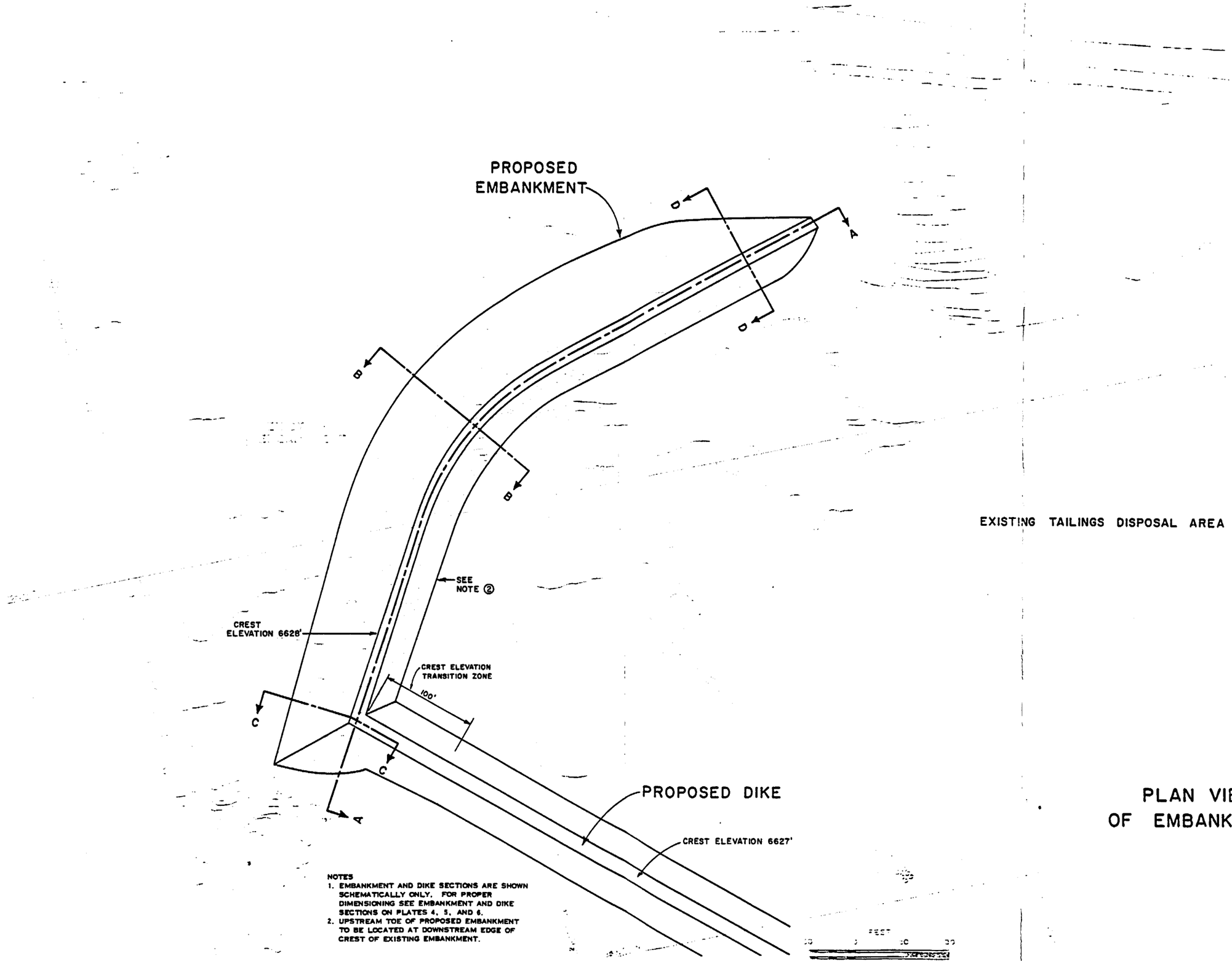
BY A.B.D. DATE 2-22-74
CHECKED BY [illegible] 3-1-74

946.7 (REV. 6-81)



PLOT PLAN

PLATE 2



NOTES
1. EMBANKMENT AND DIKE SECTIONS ARE SHOWN SCHEMATICALLY ONLY. FOR PROPER DIMENSIONING SEE EMBANKMENT AND DIKE SECTIONS ON PLATES 4, 5, AND 6.
2. UPSTREAM TOE OF PROPOSED EMBANKMENT TO BE LOCATED AT DOWNSTREAM EDGE OF CREST OF EXISTING EMBANKMENT.

PLAN VIEW OF EMBANKMENT

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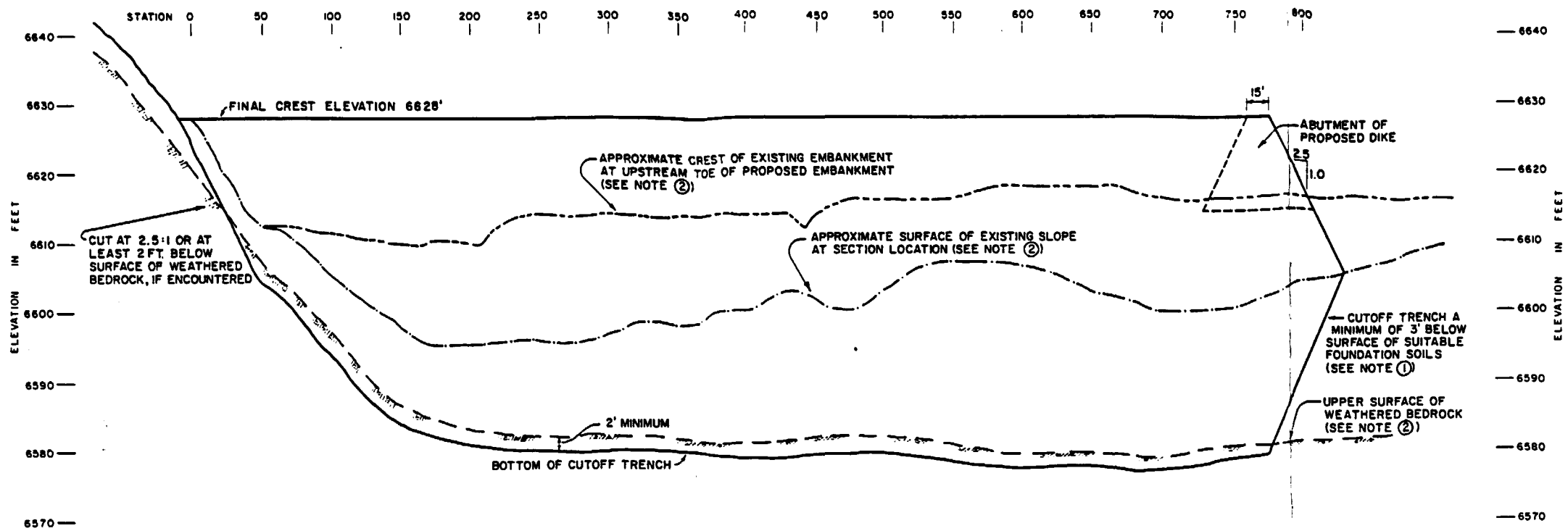
PLATE 3



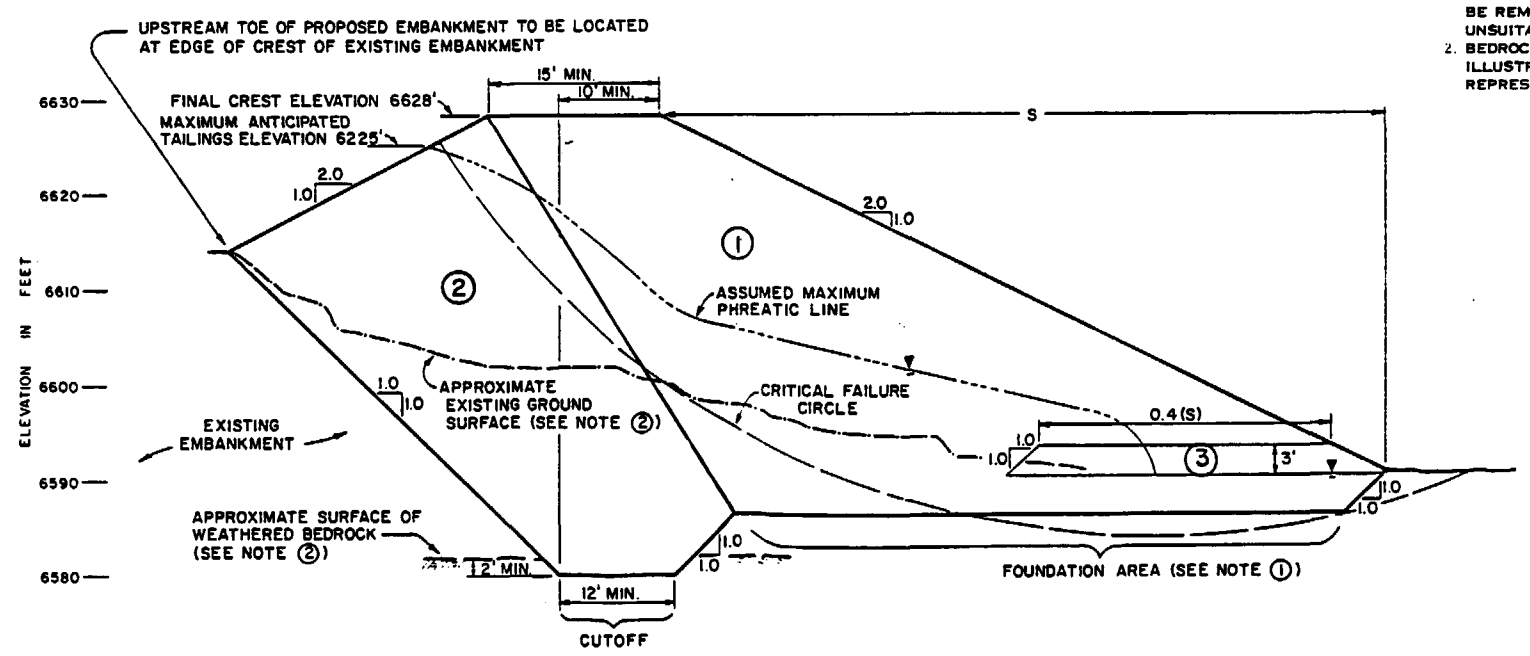
SECTION A-A

HORIZONTAL SCALE IN FEET
50 0 50 100

VERTICAL SCALE IN FEET
5 0 5 10 15 20 25

NOTES

1. ELEVATION OF THE FOUNDATION AREA TO BE DETERMINED BY THE PRESENCE OF SUITABLE FOUNDATION MATERIALS. A MINIMUM STRIPPING DEPTH OF 6" IS REQUIRED IN SUITABLE MATERIALS. ALL UNSUITABLE MATERIALS ARE TO BE REMOVED. SEE TEXT FOR DESCRIPTION OF TYPICAL SUITABLE AND UNSUITABLE MATERIALS.
2. BEDROCK SURFACES AND GROUND SURFACES SHOWN ARE PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY AND ARE NOT INTENDED TO BE REPRESENTATIVE OF ACTUAL CONDITIONS TO BE ENCOUNTERED.



SECTION B-B

SCALE IN FEET
5 0 5 10 15 20 25

KEY

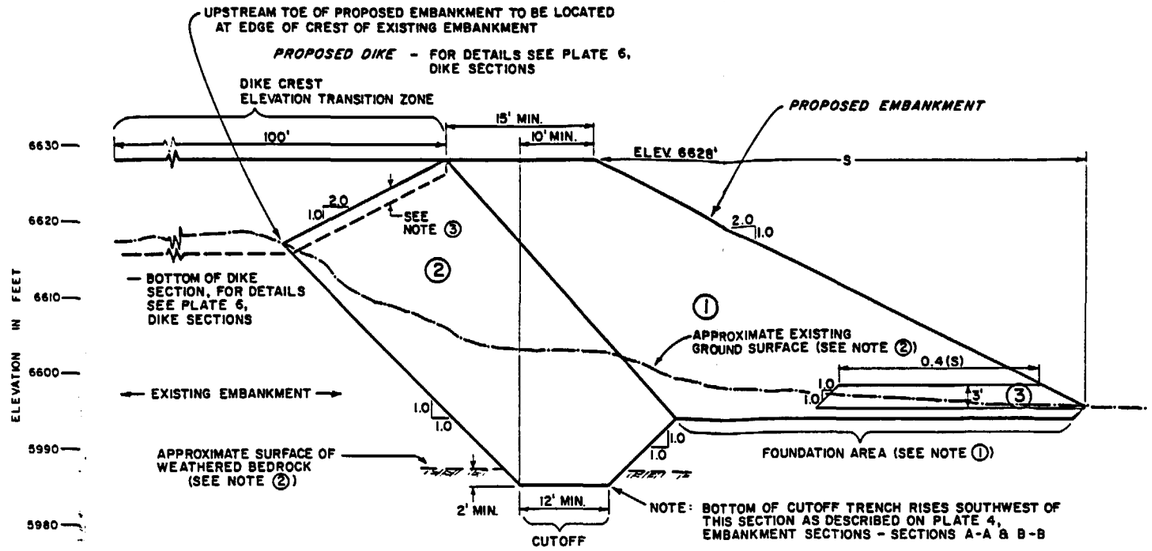
1. SILTY OR CLAYEY WELL-GRADED SANDS AND GRAVELS HAVING A GRADATION AS SHOWN ON PLATE 7 AND FOUND GENERALLY IN THE VICINITY OF THE EXISTING GRAVEL PIT NEAR THE SOUTHWESTERN PORTION OF THE SITE.
2. SILTY CLAYS OR SANDY CLAYS HAVING A GRADATION AS SHOWN ON PLATE 7 AND FOUND GENERALLY ON THE HILLSIDES NEAR THE NORTHEASTERN PORTION OF THE SITE.
3. CLEAN WELL-GRADED GRAVELLY SANDS WITH LESS THAN 5 PERCENT PASSING THE NO. 200 SIEVE AND WITH A GRADATION AS SHOWN ON PLATE 7

FACTORS OF SAFETY

CONDITION	F.S.
1. STATIC LOADING, MAXIMUM PHREATIC SURFACE	1.5
2. SEISMIC LOADING = 0.10g, MAXIMUM PHREATIC SURFACE	1.2

EMBANKMENT SECTIONS SECTIONS A-A & B-B

DAMES & MOORE



SECTION C-C

KEY

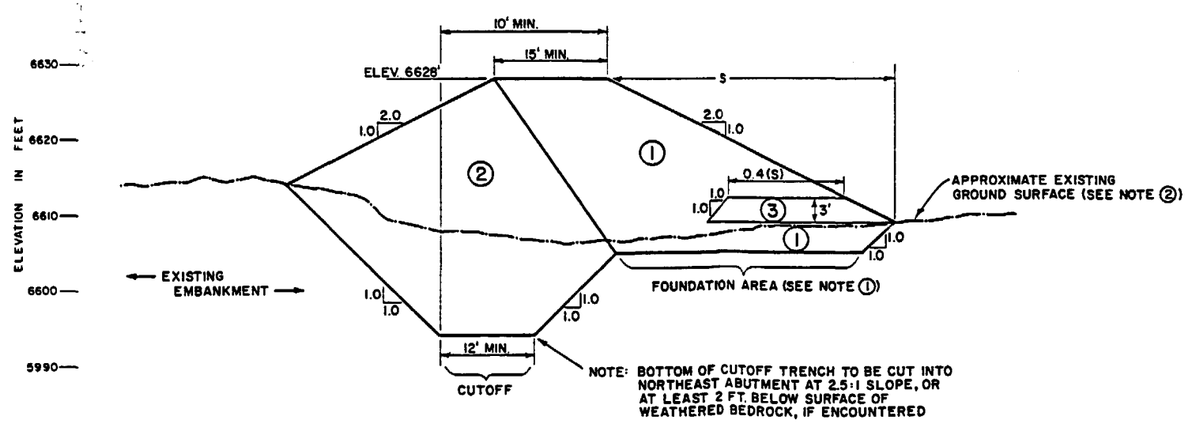
① SILTY OR CLAYEY WELL-GRADED SANDS AND GRAVELS HAVING A GRADATION AS SHOWN ON PLATE 7 AND FOUND GENERALLY IN THE VICINITY OF THE EXISTING GRAVEL PIT NEAR THE SOUTHWESTERN PORTION OF THE SITE.

② SILTY CLAYS OR SANDY CLAYS HAVING A GRADATION AS SHOWN ON PLATE 7 AND FOUND GENERALLY ON THE HILLSIDES NEAR THE NORTHEASTERN PORTION OF THE SITE.

③ CLEAN WELL-GRADED GRAVELLY SANDS WITH LESS THAN 5 PERCENT PASSING THE NO. 200 SIEVE AND WITH A GRADATION AS SHOWN ON PLATE 7.

NOTES

1. ELEVATION OF THE FOUNDATION AREA TO BE DETERMINED BY THE PRESENCE OF SUITABLE FOUNDATION MATERIALS. A MINIMUM STRIPPING DEPTH OF 6" IS REQUIRED IN SUITABLE MATERIALS. ALL UNSUITABLE MATERIALS ARE TO BE REMOVED. SEE TEXT FOR DESCRIPTION OF TYPICAL SUITABLE AND UNSUITABLE MATERIALS.
2. BEDROCK SURFACES AND GROUND SURFACES SHOWN ARE PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY AND ARE NOT INTENDED TO BE REPRESENTATIVE OF ACTUAL CONDITIONS TO BE ENCOUNTERED.
3. CUT KEY INTO THE ZONE 2 EMBANKMENT MATERIAL AT LEAST 2 FEET DEEP OVER THE ENTIRE AREA OF THE DIKE SECTION BEFORE PLACEMENT OF DIKE FILL AT ITS CONTACT WITH THE EMBANKMENT.

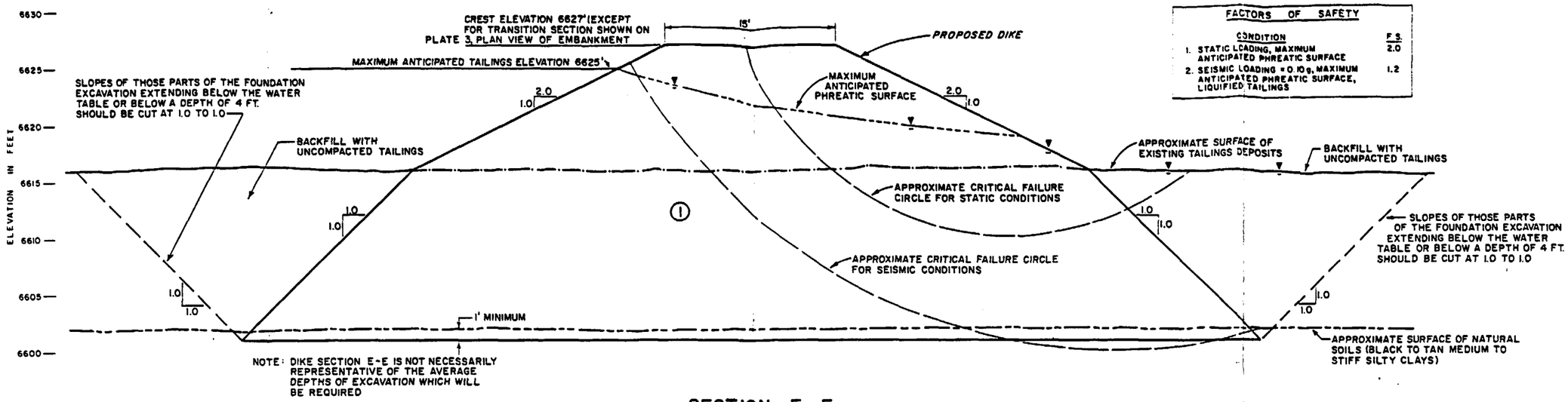


SECTION D-D

EMBANKMENT SECTIONS
SECTIONS C-C & D-D

SCALE IN FEET
5 0 5 10 15 20 25

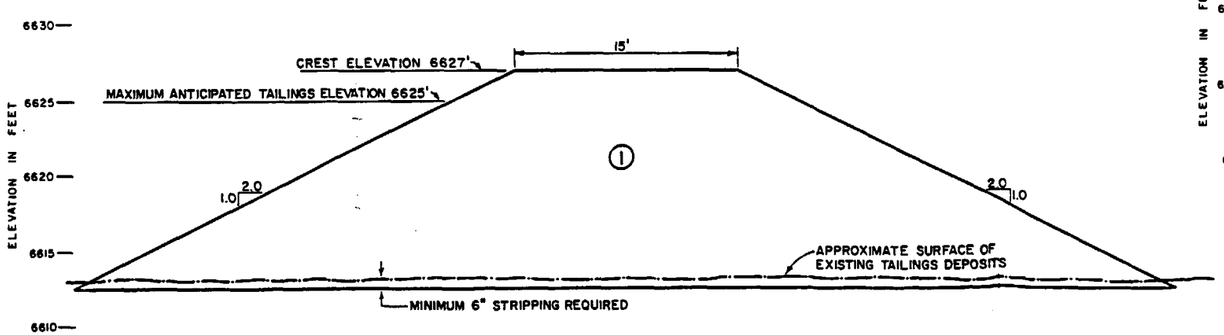
DAMES & MOORE



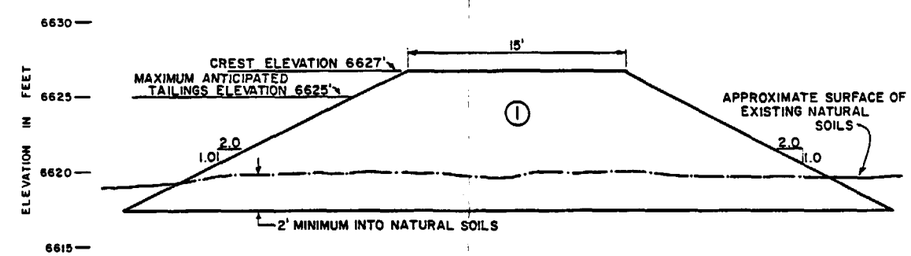
SECTION E-E

FACTORS OF SAFETY

CONDITION	F.S.
1. STATIC LOADING, MAXIMUM ANTICIPATED PHREATIC SURFACE	2.0
2. SEISMIC LOADING = 0.10g, MAXIMUM ANTICIPATED PHREATIC SURFACE, LIQUIFIED TAILINGS	1.2



SECTION F-F



SECTION G-G

SCALE IN FEET

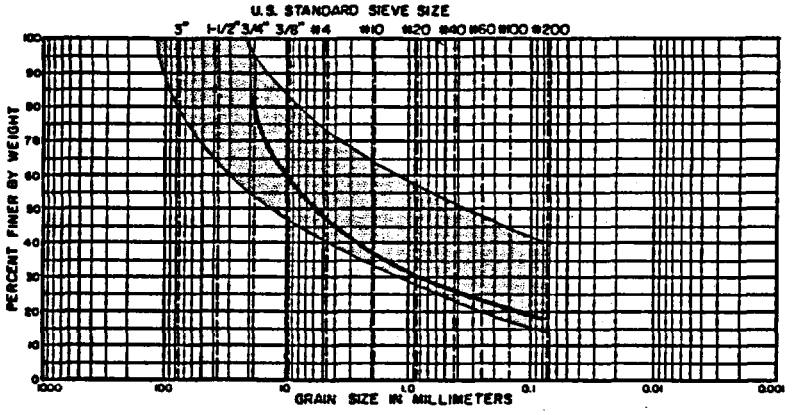
5 0 5 10

KEY

① SILTY OR CLAYEY WELL-GRADED SANDS AND GRAVELS HAVING A GRADATION AS SHOWN ON PLATE 7 AND FOUND GENERALLY IN THE VICINITY OF THE EXISTING GRAVEL PIT NEAR THE SOUTHWESTERN PORTION OF THE SITE.

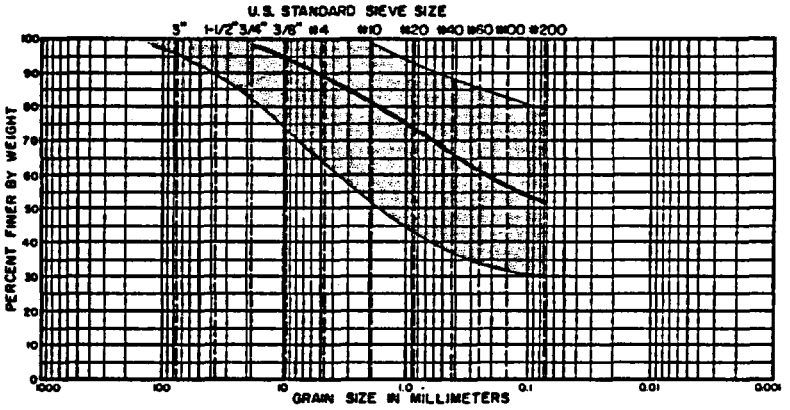
DIKE SECTIONS

DAMES & MOORE



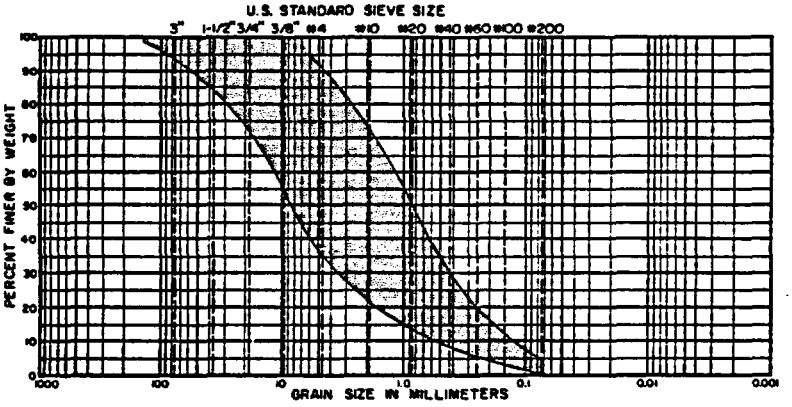
SUITABLE GRADATION OF ZONE 1 MATERIAL

NOTE: INTERMEDIATE CURVE DENOTES RESULTS OF GRADATION ANALYSIS ON GRAVEL PIT SAMPLE.



SUITABLE GRADATION OF ZONE 2 MATERIAL

NOTE: INTERMEDIATE CURVE DENOTES RESULTS OF GRADATION ANALYSIS ON MIXTURE OF SOILS FROM SAMPLES 1 AND 2, TEST PIT 20



SUITABLE GRADATION OF ZONE 3 MATERIAL

TYPICAL GRADATIONS OF EMBANKMENT MATERIALS

DAMES & MOORE

APPENDIX

FIELD EXPLORATION AND LABORATORY TESTING

FIELD EXPLORATION:

Two sources of subsurface information were used in developing the recommendations presented herein. The first source of information pertains to field explorations performed in conjunction with our previous report dated December 6, 1973. These explorations were performed during the period from October 31 to November 9, 1973, and included three monitor wells and nine test pits. The logs of Monitor Wells 1 through 3, and the logs of Test Pits 1 through 9 are shown on Plates A-1A and A-1B, Log of Monitor Wells, and on Plates A-1D and A-1E, Log of Test Pits, which are attached to this appendix. Details of the performance of this phase of the field explorations can be found in the above referenced report.

The second source of subsurface information pertains to field explorations carried out in conjunction with the present study. Two borings were drilled, and a total of twelve test pits were excavated. Logs of the borings drilled are shown on Plate A-1C, Log of Borings. Logs for Test Pits 10 through 21 are shown on Plates A-1F through A-1H, Log of Test Pits.

The borings, which extended to depths of 35.5 and 40.5 feet below grade, were drilled using a truck mounted rotary type drill rig. Both borings were drilled on the crest of the existing embankment. The test pits were excavated using a tractor-mounted backhoe, and extended to depths ranging from 3.0 to 14.5 feet below grade.

The locations of the borings and test pits drilled or excavated in conjunction with this study, as well as those of the monitor wells and test pits drilled or excavated as part of our previous study, are shown on Plate 2, Plot Plan.

The field exploration program was conducted and supervised by an experienced Dames & Moore soil engineer. Both disturbed and undisturbed samples taken from the borings were obtained using a Dames & Moore sampler as illustrated on Plate A-3, Soil Sampler Type U. Disturbed and undisturbed samples were taken from the test pits using hand-sampling techniques. All samples were classified by visual and textural examination in the field. These classifications were confirmed by subsequent inspection and testing in our laboratory. The nomenclature used to describe the soil types appears on Plate A-2, Unified Soil Classification System.

LABORATORY TESTING:

General. Laboratory tests were performed on samples of both the tailings and natural soils found on or near the site in order to determine their engineering properties. The tests performed include moisture and density, Atterberg Limits, gradation, compaction, minimum density, consolidation, direct shear, triaxial compression, and percolation tests. A few of these tests were performed in conjunction with our previous study. These tests have been so designated in the discussions in the following sections.

Moisture and Density Tests. Moisture and density tests were performed in order to aid in classifying the soils and to help correlate other test data. The results of the moisture and density determinations are shown to the left of the boring, test pit, and monitor well logs on Plates A-1A through A-1H.

Atterberg Limits. The Atterberg Limits of two samples of cohesive natural soils were determined in order to aid in classifying these soils, and for use in estimating their engineering properties. The results are shown on the following page.

Test Pit No.	Depth In Feet	Soil Type	Liquid Limit In Percent	Plastic Limit In Percent
20	0.5	CL	37.0	21.1
5	1.5	CL	37.8	22.6

Gradation Tests. Gradation tests were performed on selected samples in order to aid in interpreting other test data and to aid in evaluating the behavior of the soils.

A gradation test was performed on a sample of the silty sands and gravels located in the existing gravel pit near the southwest corner of the site. The results of this test are shown on Plate 7 of the text.

Another test was performed on a mixture of soils from Samples 1 and 2 of Test Pit 20. The results of this test are also shown on Plate 7 of the text.

Additional tests were performed on two other samples. The results are presented below in tabular form:

Test Pit No.	Depth In Feet	Soil Type	Percent Passing Sieve Size							
			3/4"	3/8"	#4	#10	#40	#60	#100	#200
10	2.5	GM	89	82	80	77	69	65	62	56
13	0.5	SM (tailings)	-	-	-	-	-	-	-	47

Compaction Tests. Three compaction tests were performed on selected samples in order to correlate laboratory-determined soil properties with those which will be obtained from field construction operations. All tests were performed on material passing the 3/4" sieve, and were performed in accordance with the A.A.S.H.O. T180, Method of Compaction, as shown on Plate A-4. The results of the tests are shown on Plate A-5, Compaction Test Data.

Minimum Density Determination. A determination was made of the minimum density of a sample of tailings soils taken from Test Pit 13 at a depth of 0.5 feet in order to aid in evaluating the liquefaction potential of the tailings. The test was performed in accordance with A.S.T.M.* Designation D-2049. The minimum density thus determined was 87 pounds per cubic foot.

Consolidation Tests. Three consolidation tests were performed on samples of tailings soils in order to estimate their compressibility. The results of these tests are retained in our files.

Direct Shear Tests. A number of direct shear tests were performed on both undisturbed and recompacted soil samples in order to estimate the shear strength of various on-site soils. The tests were performed as shown on Plate A-6, Method of Performing Direct Shear and Friction Tests. All samples were saturated prior to testing. The results of the tests performed are shown below:

UNDISTURBED SAMPLES

Test Pit No.	Depth In Feet	Soil Type	Normal Pressure In PSF	Peak Shear Strength In PSF
2**	6	ML (Tailings)	1,000	450
2	6	ML (Tailings)	3,000	1,220
6***	1	SM-ML (Tailings)	2,500	2,600
6***	1	SM-ML (Tailings)	1,000	1,550
2	3.5	SP-SM-ML (Tailings)	2,000	1,950
2	3.5	SP-SM-ML (Tailings)	500	820
9	3	ML (Tailings)	2,000	1,500
9	3	ML-SM (Tailings)	500	900
8	1	ML-SM (Tailings)	1,500	1,600
8	1	SM (Tailings)	2,500	2,520

** Sample disturbed during testing.
***Sample contained numerous roots.

*American Society for Testing and Materials.

Direct shear tests were also performed on recompacted soil samples. The samples were compacted to 90 percent of the appropriate maximum dry density as determined by compaction tests as previously described. Soils from Test Pit 20 were passed through a No. 10 sieve before recompaction. The results of these tests are shown below:

RECOMPACTED SAMPLES

Test Pit No.	Sample Number	Normal Pressure In PSF	Peak Shear Strength In PSF
20	1 and 2	2,000	1,960
20	1 and 2	500	1,000
20	1 and 2	1,000	1,300
20	1 and 2	3,000	2,500
20	1 and 2	4,000	3,140
17	1	500	1,200
17	1	1,000	1,750
17	1	2,000	2,500
17	1	3,000	3,400
17	1	4,000	4,000

Triaxial Compression Tests. Three consolidated-drained (CD) triaxial compression tests were performed on recompacted samples of the silty sands and gravels from the existing gravel pit located near the southwest corner of the pond area. The soil was passed through a 3/8" sieve before recompaction. The samples were compacted to 90 percent of the maximum dry density, determined as previously described and corrected for gravel particles larger than 3/8". The method of performing triaxial compression tests is shown on Plate A-7, Method of Performing Unconfined Compression and Triaxial Compression Tests.

The samples were backpressure-saturated and allowed to consolidate under the effective confining stress. The samples were then sheared at a speed sufficiently low so as to prevent the development of excess pore pressures during the test. The results are shown on the following page.

Sample Location	Effective Confining Stress $\bar{\sigma}_3$ (PSF)	Shear Strength $\frac{\sigma_1-\sigma_3}{2}$
Gravel pit	500	1,100*
	1,500	2,100**
	2,500	3,320**

* Peak shear strength
**Shear strength at 10 percent axial strain.

Percolation Tests. A series of percolation tests was performed on both undisturbed and recompacted samples of tailings and natural soils, as well as on undisturbed samples of rock. The tests were performed as shown on Plate A-8, Method of Performing Percolation Tests.

The percolation tests shown below were performed on undisturbed samples of tailings, natural soils, and rock, and were performed on samples of varying orientations. These tests were performed in conjunction with our previous study, as referenced at the beginning of this appendix.

Monitor Well or Test Pit No.	Depth In Feet	Material	Orientation Of Sample	Permeability In Feet Per Year
MW-1	15.5	Rock	Vertical	1
MW-1	25.5	Rock	Vertical	0.6
MW-2	3.5	CL-OL (natural soil)	Vertical	0.001
MW-3	9.5	Rock	Vertical	2
TP-1	1.5	ML (tailings)	Vertical	3
TP-1	1.5	ML (tailings)	Horizontal	30
TP-2	3.5	ML (tailings)	Vertical	3
TP-2	3.5	ML (tailings)	Horizontal	10
TP-3	3.0	SM (tailings)	Horizontal	4,000
TP-4	4.8	SP-SM (tailings)	Vertical	4,000
TP-8	5.5	OL (natural soil)	Vertical	5

The following test was performed on a sample of recompacted silty sand and gravel from Test Pit 10. The sample was recompacted to a wet density of 111 pounds per cubic foot, which approximates the in-situ density of

the soil, and tested under a surcharge of 500 PSF. The results of this test are shown below:

Test Pit No.	Depth In Feet	Soil Type	Permeability In Feet Per Year
1	2.5	GM	42

The tests shown below were performed on samples which were recompacted to 90 percent of the appropriate maximum dry density, as determined by the compaction tests performed on the respective soils. The gravel pit soils were sieved through the 3/8" sieve and the maximum dry density was corrected for the percentage of gravel larger than 3/8". A 500 PSF surcharge was applied to all samples during testing.

RECOMPACTED SAMPLES

Test Pit No.	Sample No.	Soil Type	Permeability In Feet Per Year
20	1 and 2	CL	1
20	1 and 2	CL	1
17	1	SM (Tailings)	23
17	1	SM (Tailings)	33
17	1	SM (Tailings)	45
Gravel Pit	-	GM	82
Gravel Pit	-	GM	75

Two percolation tests were performed on samples of tailings slimes similar to those which will be discharged into the proposed tailings pond. The samples, which were provided by others, are approximately 80 percent finer than the No. 325 sieve. They were artificially sedimented from a thin slurry and tested under a surcharge pressure of 100 PSF. The results of the tests are shown below:

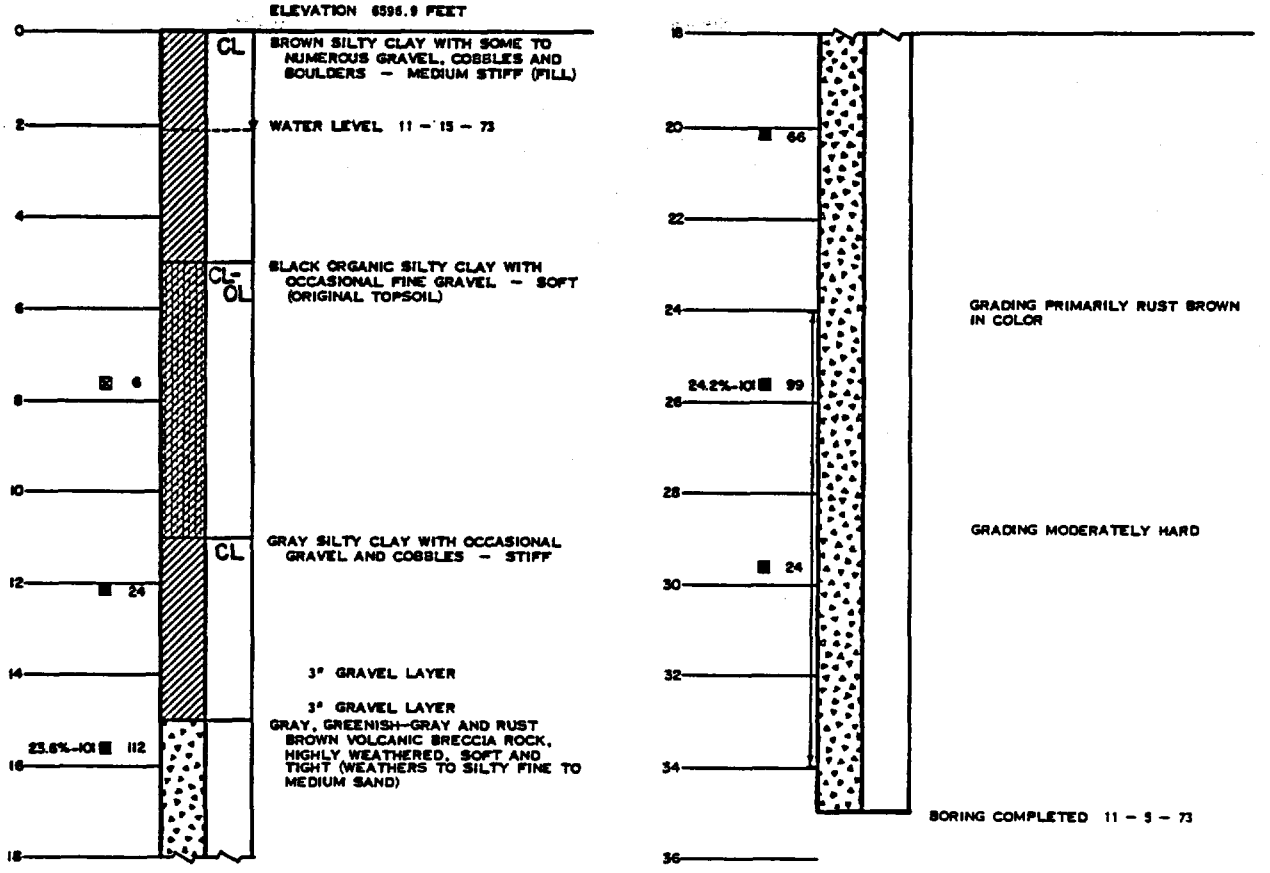
Soil Type	Permeability (Ft/Yr)
Tailings slimes	9
Tailings slimes	8

oOo

The following plates are attached and complete this appendix:

Plates A-1A and A-1B	- Log of Monitor Wells
Plate A-1C	- Log of Borings
Plates A-1D through A-1H	- Log of Test Pits
Plate A-2	- Unified Soil Classification System
Plate A-3	- Soil Sampler Type U
Plate A-4	- Method of Performing Compaction Tests
Plate A-5	- Compaction Test Data
Plate A-6	- Method of Performing Direct Shear and Friction Tests
Plate A-7	- Method of Performing Unconfined Compression and Triaxial Compression Tests
Plate A-8	- Method of Performing Percolation Tests.

MONITOR WELL I



NOTE

MONITOR WELLS WERE DRILLED IN CONJUNCTION WITH DAMES & MOORE REPORT DATED DECEMBER 6, 1973. THE TEXT OF THIS REPORT UNDER THE SUBSECTION ENTITLED, "SITE CONDITIONS, SUBSURFACE", IS NECESSARY TO A PROPER UNDERSTANDING OF THE SUBSURFACE MATERIALS.

KEY

A – B■C

- A FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL
- B DRY DENSITY EXPRESSED IN LBS. PER CUBIC FOOT
- C BLOWS PER FOOT OF PENETRATION USING A 140 LB. HAMMER DROPPING 30 INCHES
- ■ DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED
- ⊠ DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED
- □ SAMPLING ATTEMPT WITH NO RECOVERY

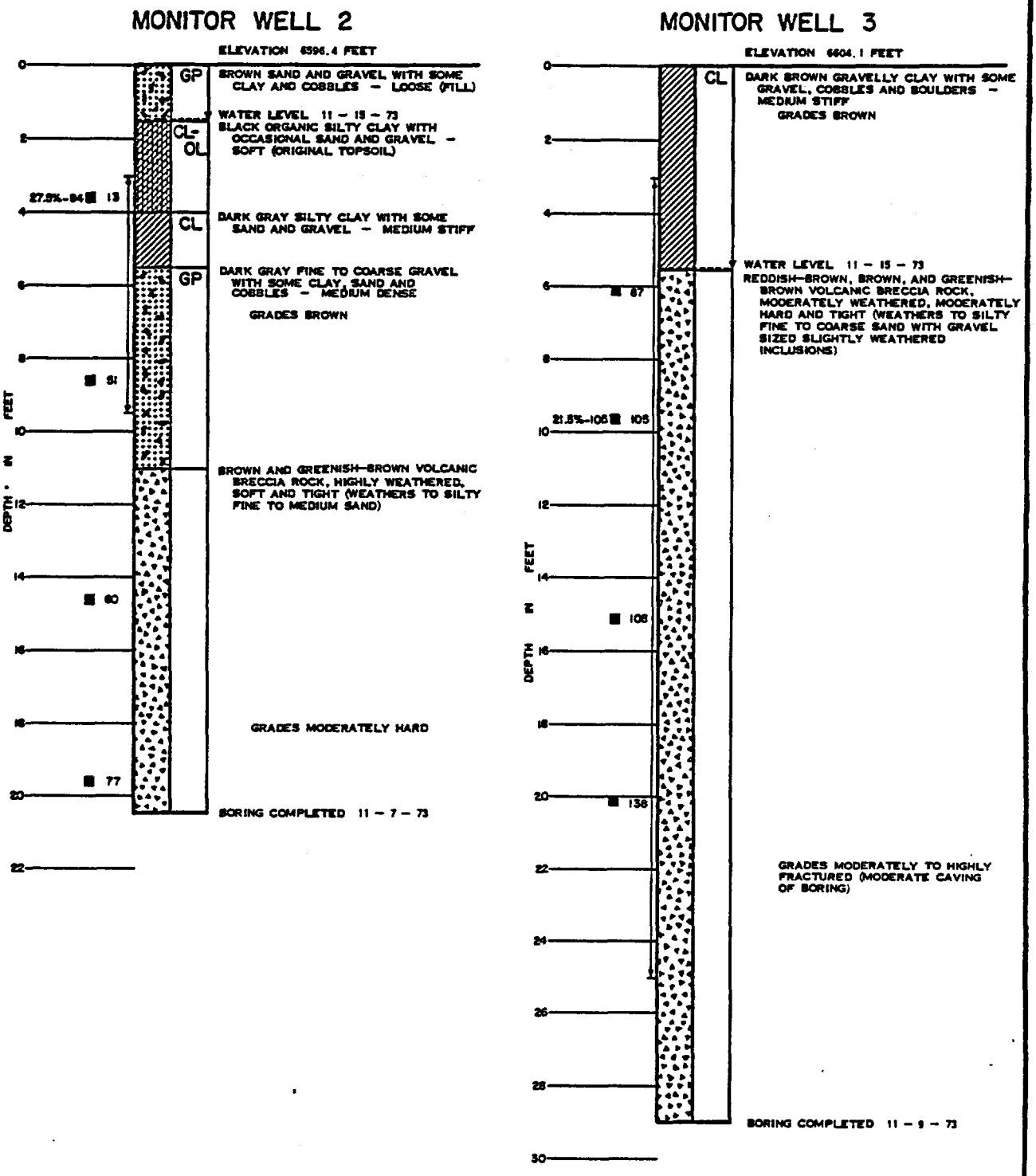
LOG OF MONITOR WELLS

DAMES & MOORE

PLATE A-1A

REVISIONS BY ____ DATE ____ BY ____ DATE ____ PLATE ____ OF ____

FILE 6998-001 Park City Ventures - Park City, Utah
BY ABB - MEE DATE 11-16-78
CHECKED BY ____ DATE ____



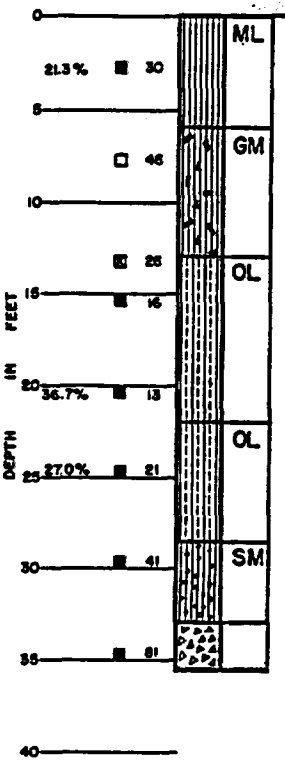
LOG OF MONITOR WELLS

DAMES & MOORE

PLATE A-18

BORING 1

ELEVATION 6614 FEET



DARK BROWN CLAYEY SILT WITH SOME QUARTZITE GRAVEL AND POCKETS OF SANDY DECOMPOSED ROCK — MEDIUM STIFF (FILL)

METAL FRAGMENT AT 4', VOID AT LEAST 3" DEEP EXISTS BENEATH METAL. HOLE WILL NOT HOLD WATER

BROWN SILTY GRAVEL WITH SOME MEDIUM TO COARSE SAND — MEDIUM DENSE (FILL)

HOLE CAVES BELOW CASING
HOLE WILL NOT HOLD WATER
GRADES WITH PIECES OF WOOD
GRAVEL GRADES SLABBY, WEATHERED, AND FRIABLE

BLACK ORGANIC SILT WITH POCKETS AND LAYERS GRAY SILTY CLAY — SOFT (FILL)

GRADES WITH SOME GRAVEL, AND WITHOUT GRAY CLAY POCKETS

GRADES WITH SOME FINE TO COARSE SAND

BLACK ORGANIC SILT WITH SOME CLAY, FINE TO COARSE SAND, AND GRAVEL — MEDIUM STIFF (ORIGINAL TOPSOIL)

GRAY SILTY FINE TO COARSE SAND WITH SOME GRAVEL AND CLAY — MEDIUM DENSE

BEDROCK — GREENISH-YELLOW HIGHLY WEATHERED AND DECOMPOSED SOFT VOLCANIC BRECCIA

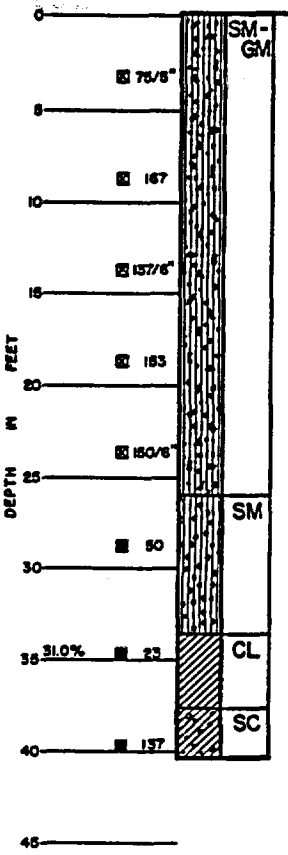
SIMILAR IN APPEARANCE TO VERY DENSE, CLAYEY FINE TO MEDIUM SAND

BORING COMPLETED 1 — 18 — 74

GROUND WATER LEVEL WAS NOT MEASURED

BORING 2

ELEVATION 6617 FEET



ALTERNATING ZONES AND POCKETS OF BROWN SILTY FINE TO COARSE SAND WITH SOME GRAVEL AND CLAY, AND BROWN SILTY GRAVEL WITH SOME FINE TO COARSE SAND AND CLAY — MEDIUM DENSE

GRADES WITH ZONES OF ASHES AND OCCASIONAL COBBLES

COBBLES GRADE MORE NUMEROUS

REDDISH-BROWN SILTY FINE TO MEDIUM SAND WITH SOME CLAY AND COARSE SAND (ORIGINAL TOPSOIL) — MEDIUM DENSE

BROWNISH-GRAY FINE SANDY CLAY WITH SOME SILT AND NUMEROUS ZONES AND POCKETS OF CLAYEY FINE TO MEDIUM SAND — STIFF

REDDISH-BROWN CLAYEY FINE TO COARSE SAND WITH SOME SILT AND GRAVEL — DENSE

BORING COMPLETED 1 — 19 — 74

GROUND WATER LEVEL WAS NOT MEASURED

KEY

A — ■ C

- A FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL
- C BLOWS PER FOOT OF PENETRATION USING A 140 LB. HAMMER DROPPING 30 INCHES
- ■ DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED
- ⊠ DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED
- □ SAMPLING ATTEMPT WITH NO RECOVERY

NOTES

THE DISCUSSION IN THE TEXT UNDER THE SECTION TITLED, "SITE CONDITIONS, SUBSURFACE", IS NECESSARY TO A PROPER UNDERSTANDING OF THE NATURE OF THE SUBSURFACE MATERIALS.

BORING ELEVATIONS WERE INTERPOLATED FROM PRINT TITLED, "PROPOSED TAILINGS POND DEVELOPMENT", BY OLYMPUS AERIAL SURVEYS, INC., FROM PHOTOGRAPHY DATED OCTOBER 26, 1973.

LOG OF BORINGS

DAMES & MOORE

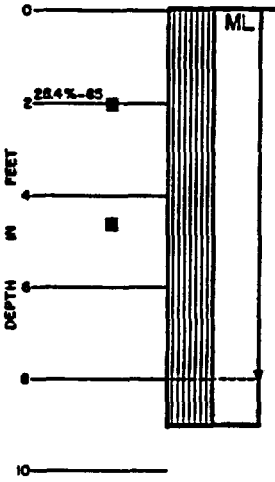
PLATE A-1C

REVISIONS BY ____ DATE ____ BY ____ DATE ____ PLATE ____ OF ____

FILE 8498-003 PARK CITY VENTURES BY ABD-HJT DATE 2-14-74 CHECKED BY [illegible] DATE 3-7-74

TEST PIT 1

ELEVATION 6613.0 FEET



GRAYISH-BROWN SILT WITH TRACE CLAY AND SEAMS OF SILT AND FINE SAND AND ROOTS TO 1.5' – MEDIUM STIFF (TAILINGS)

GRADING LAYERS OF GRAY, GRAYISH-BROWN, BROWN AND DARK GRAY IN COLOR AND SOFT

GRADING ALL DARK GRAY IN COLOR AND VERY SOFT

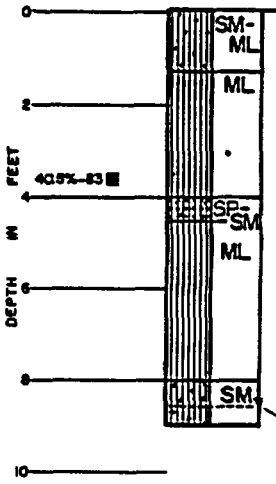
WATER SEEPS THROUGH SAND AND SILT LAYERS

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 2

ELEVATION 6614.0 FEET



LIGHT GRAYISH-BROWN SILTY VERY FINE SAND WITH ROOTS TO 12" AND SEAMS OF CLAYEY SILT – LOOSE (TAILINGS)

GRAYISH-BROWN SILT WITH TRACE CLAY AND SEAMS OF SILT AND FINE SAND – MEDIUM STIFF (TAILINGS)

GRADING GRAYISH-BROWN, BROWN AND DARK GRAY LAYERS

GRADING ALL DARK GRAY IN COLOR AND VERY SOFT

BROWN FINE SAND WITH SOME SILT AND TRACE ROOTS – LOOSE (TAILINGS)

GRAYISH-BROWN SILT WITH TRACE CLAY AND SEAMS OF SILT AND FINE SAND – MEDIUM STIFF (TAILINGS)

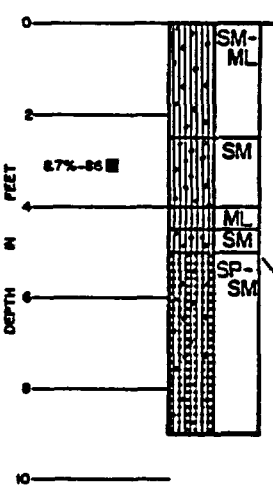
DARK GRAY SILTY FINE SAND WITH LAYERS OF CLAYEY SILT – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 3

ELEVATION 6616.0 FEET



GRAYISH-BROWN SILTY VERY FINE SAND WITH SEAMS OF SILT AND CLAYEY SILT AND ROOTS TO 18" – MEDIUM DENSE (TAILINGS)

2" LAYER OF DARK GRAY CLAYEY SILT

LIGHT GRAYISH-BROWN SILT. FINE SAND – MEDIUM DENSE (TAILINGS)

DARK GRAY SILT WITH TRACE AND SEAMS OF SILT AND FINE SAND – SOFT (TAILINGS)

LIGHT GRAY SILTY FINE SAND WITH 1/4" TO 1/2" LAYERS OF DARK GRAY CLAYEY SILT – LOOSE (TAILINGS)

GRAY FINE TO MEDIUM SAND WITH SOME SILT – LOOSE (TAILINGS)

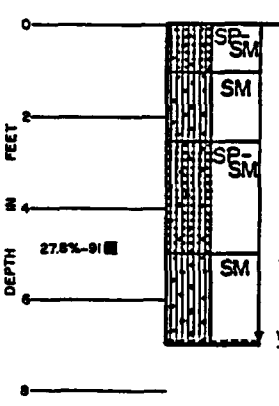
GRADES WITH OCCASIONAL 1/2" TO 1" LAYERS OF SILTY FINE SAND

TEST PIT COMPLETED 10 – 31 – 73

GROUND WATER WAS NOT ENCOUNTERED IN THIS TEST PIT.

TEST PIT 4

ELEVATION 6617.0 FEET



LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT AND ROOTS – LOOSE (TAILINGS)

GRAYISH-BROWN, BROWN, AND DARK GRAY LAYERED SILTY FINE SAND WITH 1/4" TO 1/2" LAYERS OF CLAYEY SILT, ROOTS – MEDIUM DENSE (TAILINGS)

LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT AND OCCASIONAL ROOTS – LOOSE (TAILINGS)

ZONE WITH 1/4" TO 1/2" LAYERS OF DARK GRAY CLAYEY SILT 4.0' TO 4.5'

GRAY SILTY FINE SAND WITH OCCASIONAL ROOTS – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

KEY

A – B ■ C

- A FIELD MOISTURE EXPRESSED AS A PERCENTAGE OF THE DRY WEIGHT OF SOIL
- B DRY DENSITY EXPRESSED IN LBS. PER CUBIC FOOT
- C BLOWS PER FOOT OF PENETRATION USING A 140 LB. HAMMER DROPPING 30 INCHES
- ■ DEPTH AT WHICH UNDISTURBED SAMPLE WAS EXTRACTED
- ⊠ DEPTH AT WHICH DISTURBED SAMPLE WAS EXTRACTED
- ⊠ BULK SAMPLE

MULTIPLE MOISTURE AND/OR DENSITY VALUES INDICATE MULTIPLE TESTS PERFORMED ON DIFFERENT PORTIONS OF THE SAME SAMPLE.

NOTES

TEST PIT NUMBERS 1 THROUGH 9 WERE EXCAVATED IN CONJUNCTION WITH DAMES & MOORE REPORT DATED DECEMBER 6, 1973. THE TEXT OF THIS REPORT UNDER THE SUBSECTION ENTITLED, "SITE CONDITIONS, SUBSURFACE", IS NECESSARY TO A PROPER UNDERSTANDING OF THE SUBSURFACE MATERIALS.

TEST PIT ELEVATIONS WERE INTERPOLATED FROM PRINT TITLED, "PROPOSED TAILINGS POND DEVELOPMENT", BY OLYMPUS AERIAL SURVEYS, INC., FROM PHOTOGRAPHY DATED OCTOBER 26, 1973.

LOG OF TEST PITS

DAMES & MOORE

TEST PIT 5

ELEVATION 6615.0 FEET

DEPTH IN FEET: 0, 2, 4, 6, 8

SM-ML — GRAYISH-BROWN, BROWN, AND LIGHT GRAYISH-BROWN SILTY VERY FINE SAND WITH ROOTS AND OCCASIONAL SEAMS OF CLAYEY SILT – LOOSE (TAILINGS)

GRADING GRAY IN COLOR

ML — DARK GRAY SILT WITH OCCASIONAL SEAMS AND 1/4" TO 1/2" LAYERS OF SILTY FINE SAND – VERY LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 6

ELEVATION 6612.0 FEET

DEPTH IN FEET: 0, 2, 4

ML — LIGHT GRAY SILT WITH TRACE VERY FINE SAND – LOOSE (TAILINGS)

GM — GRAY AND BROWN FINE TO COARSE GRAVEL AND COBBLES IN A MATRIX OF SILTY FINE TO COARSE SAND WITH SOME CLAY – MEDIUM DENSE

GRAVEL AND COBBLE FLOATING IN MATRIX

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 7

ELEVATION 6617.0 FEET

DEPTH IN FEET: 0, 2, 4, 6

SM — LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT – LOOSE (TAILINGS)

ML — DARK GRAY SILT WITH SEAMS OF SILTY FINE SAND AND CLAYEY SILT – MEDIUM DENSE (TAILINGS)

SM — DARK GRAY SILTY FINE SAND WITH ORGANIC MATERIAL AND SEAMS OF CLAYEY SILT – LOOSE (TAILINGS)

ML — DARK GRAY SILT WITH SEAMS OF SILTY FINE SAND AND CLAYEY SILT AND TRACE CLAY – VERY LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

GRADING LIGHT GRAY IN COLOR AND WITH MORE CLAY

TEST PIT COMPLETED 10 – 31 – 73

TEST PIT 8

ELEVATION 6616.0 FEET

DEPTH IN FEET: 0, 2, 4, 6, 8

SM — LIGHT BROWNISH-GRAY SILTY FINE SAND WITH ROOTS – LOOSE (TAILINGS)

GRADING SILTY VERY FINE SAND

SM-ML — GRAY SILTY VERY FINE SAND WITH SEAMS OF SILT – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

OL — BLACK ORGANIC SILT WITH LAYERS OF SILTY FINE SAND AND PEAT – MEDIUM DENSE

36.4%-77

TEST PIT COMPLETED 10 – 31 – 73

NOTE WATER COMING IN ABOVE ORGANIC SILT

TEST PIT 9

ELEVATION 6618.0 FEET

DEPTH IN FEET: 0, 2, 4, 6, 8

SP-SM — LIGHT GRAYISH-BROWN FINE SAND WITH SOME SILT AND ROOTS – LOOSE (TAILINGS)

GRADING SILTY VERY FINE SAND

SM-ML — GRAY SILTY VERY FINE SAND WITH SEAMS OF SILT AND CLAYEY SILT – LOOSE (TAILINGS)

WATER LEVEL 10 – 31 – 73

EXCESSIVE CAVING

OL — BLACK ORGANIC SILT WITH ZONES OF SILTY FINE SAND AND PEAT – LOOSE

TEST PIT COMPLETED 10 – 31 – 73

NOTE

TEST PIT NUMBERS 1 THROUGH 9 WERE EXCAVATED IN CONJUNCTION WITH DAMES & MOORE REPORT DATED DECEMBER 6, 1973. THE TEXT OF THIS REPORT UNDER THE SUBSECTION ENTITLED, "SITE CONDITIONS, SUBSURFACE", IS NECESSARY TO A PROPER UNDERSTANDING OF THE SUBSURFACE MATERIALS.

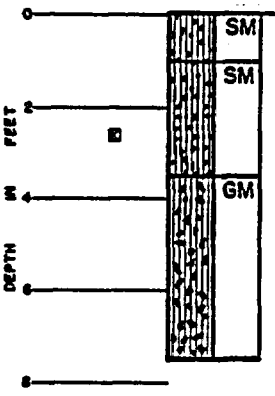
LOG OF TEST PITS

DAMES & MOORE

PLATE A-1E

TEST PIT 10

ELEVATION 6616 FEET



LIGHT TAN SILTY VERY FINE SAND – LOOSE (TAILINGS)

BROWN SILTY FINE SAND WITH OCCASIONAL GRAVEL AND MANY ROOTS TO 3' – DENSE (NATURAL SOIL)

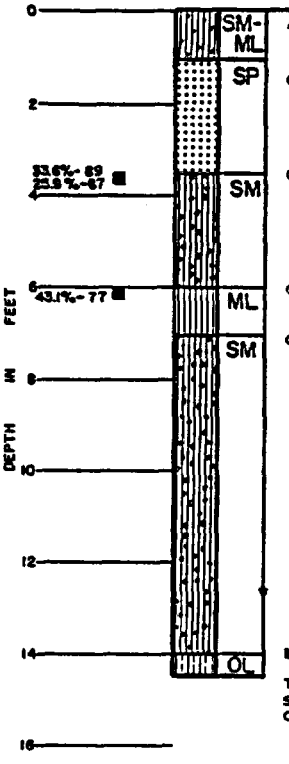
BROWN SILTY GRAVEL WITH SOME FINE SAND AND COBBLES UP TO 4" – DENSE

GRAVEL AND COBBLES LIE IN TIGHT MATRIX OF SILTY SAND

TEST PIT COMPLETED 1 – 15 – 74
GROUND WATER WAS NOT ENCOUNTERED IN PIT. SIDES STOOD VERTICAL.

TEST PIT 11

ELEVATION 6616 FEET



ALTERNATING THIN LAYERS OF GRAYISH-BROWN SILTY FINE SAND AND FINE SANDY SILT – MEDIUM DENSE (TAILINGS)

ORANGE TO GRAY FINE SAND WITH OCCASIONAL THIN LAYERS SILTY FINE SAND AND FINE SANDY SILT – MEDIUM DENSE (TAILINGS)

GRAY SILTY FINE SAND WITH OCCASIONAL THIN LAYERS SILT – MEDIUM DENSE (TAILINGS)

GRAY FINE SANDY SILT – SOFT (TAILINGS)

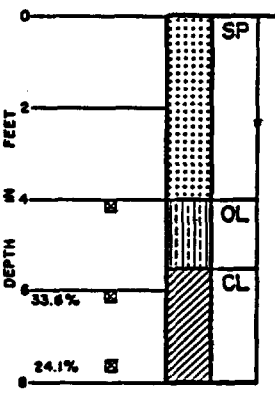
GRAY SILTY FINE SAND WITH OCCASIONAL LAYERS CLEAN FINE SAND, CLEAN MEDIUM SAND, AND FINE SANDY SILT – MEDIUM DENSE (TAILINGS)

BLACK ORGANIC SILT WITH SOME CLAY – MEDIUM STIFF (NATURAL SOIL)

TEST PIT COMPLETED 1 – 15 – 74
SEEPAGE AT 13 FEET. CAVING OF WALLS OF PIT BELOW 8.5 FEET.

TEST PIT 12

ELEVATION 6611 FEET



ALTERNATING LAYERS OF CLEAN FINE AND MEDIUM SAND – MEDIUM DENSE (TAILINGS)

GRADES WITH 6" LAYER OF MEDIUM TO COARSE SAND AT 2.5'

BLACK ORGANIC SILT WITH SOME CLAY AND WITH SMALL ROOT HAIRS – MEDIUM STIFF (NATURAL SOIL)

BROWN SILTY CLAY STIFF

GRADES WITH SOME FINE TO COARSE SAND AND GRAVEL

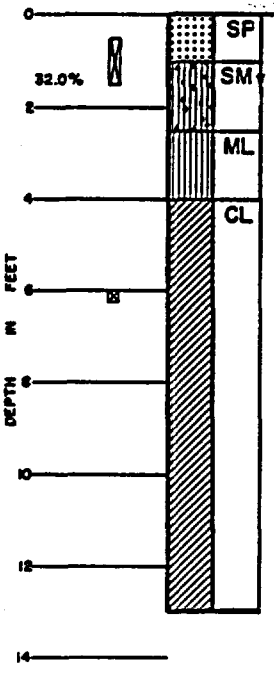
TEST PIT COMPLETED 1 – 15 – 74
HEAVY SEEPAGE AT 2.5 FEET.
EXTENSIVE CAVING ABOVE 4.0 FEET.

LOG OF TEST PITS

DAMES & MOORE

TEST PIT 13

ELEVATION 6616 FEET



ORANGISH-BROWN FINE SAND WITH TRACE SILT – MEDIUM DENSE (TAILINGS)

GRAY SILTY FINE SAND WITH OCCASIONAL THIN SILT LAYERS – MEDIUM DENSE (TAILINGS)

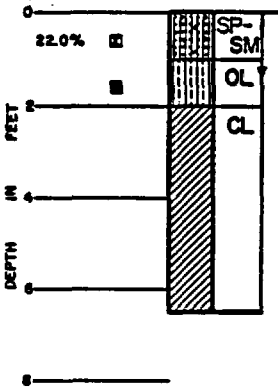
BROWNISH-BLACK CLAYEY SILT WITH SOME ORGANIC MATERIAL AND MAJOR ROOTS – MEDIUM STIFF TO STIFF (NATURAL SOIL)

LIGHT BROWN SILTY CLAY WITH OCCASIONAL THIN SEAMS SILTY FINE SAND AND SLIGHTLY BLOCKY STRUCTURE – STIFF

TEST PIT COMPLETED 1 – 15 – 74
SEEPAGE AT 1.5 FEET
MODERATE CAVING AND SLOUGHING AFTER COMPLETION OF PIT.

TEST PIT 14

ELEVATION 6620 FEET



ALTERNATING LAYERS OF GRAY TO BROWN FINE SAND AND SILTY FINE SAND – MEDIUM DENSE (TAILINGS)

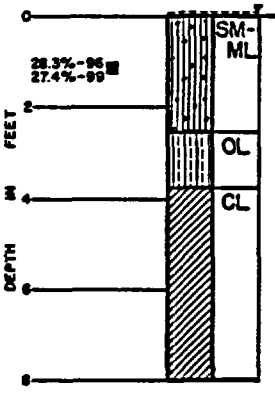
BLACK ORGANIC SILT WITH SOME CLAY AND SMALL ROOTS – SOFT (NATURAL SOIL)

BROWN SILTY CLAY WITH TRACE TO SOME MEDIUM TO COARSE SAND – MEDIUM STIFF

TEST PIT COMPLETED 1 – 15 – 74
SEEPAGE AT 1.5 FEET
MINOR CAVING AND SLOUGHING.

TEST PIT 15

ELEVATION 6616 FEET
WATER LEVEL 1 – 16 – 74



ALTERNATING LAYERS OF BROWN TO GRAY SILTY FINE SAND AND FINE SANDY SILT WITH SOME ROOTS – VERY SOFT (TAILINGS)

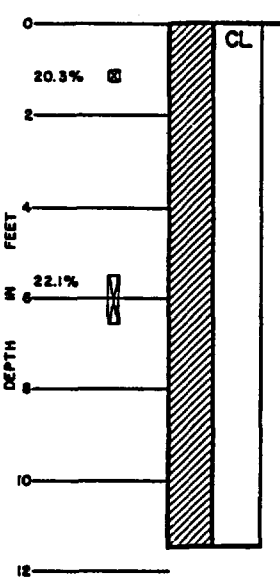
BLACK ORGANIC SILT WITH SOME CLAY – VERY SOFT (NATURAL SOIL)

TAN SILTY CLAY WITH BLOCKY STRUCTURE – VERY STIFF

TEST PIT COMPLETED 1 – 16 – 74

TEST PIT 16

ELEVATION 6625 FEET



DARK BROWNISH-GRAY SILTY CLAY WITH TRACE FINE SAND AND SOME ORGANIC MATERIAL – STIFF (TOPSOIL, MAJOR ROOTS TO 3")

GRADES LIGHT BROWN

GRADES WITH SOME FINE TO COARSE SAND

GRADES TO SOFT, WEATHERED ROCK BELOW 11.5 FEET

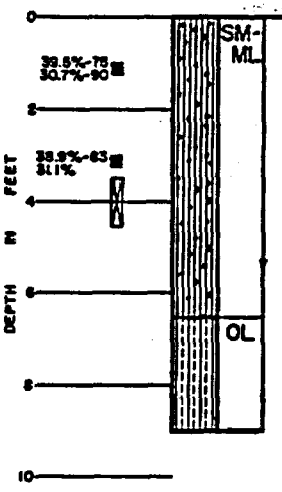
TEST PIT COMPLETED 1 – 16 – 74
MINOR SEEPAGE AT 4.0 FEET

LOG OF TEST PITS

DAMES & MOORE

TEST PIT 17

ELEVATION 6616 FEET



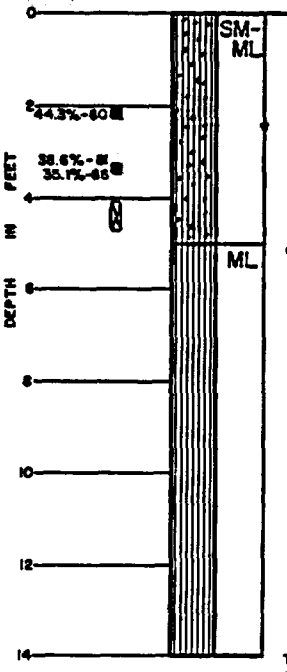
ALTERNATING LAYERS OF GRAY AND BROWN SILTY FINE SAND AND FINE SANDY SILT WITH OCCASIONAL LAYERS CLEAN FINE SAND AND OCCASIONAL PIECES ORGANIC MATERIAL – SOFT TO VERY SOFT (TAILINGS)

BLACK ORGANIC SILT WITH SOME CLAY – SOFT (NATURAL SOIL)

TEST PIT COMPLETED 1 – 16 – 74
SEEPAGE AT 5.5 FEET
EXTENSIVE CAVING

TEST PIT 18

ELEVATION 6614 FEET



ALTERNATING LAYERS OF BROWN AND GRAY SILTY FINE SAND AND FINE SANDY SILT WITH OCCASIONAL LAYERS OF FINE SAND – SOFT (TAILINGS)

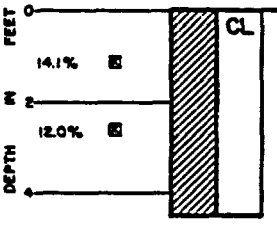
GRADES GRAY

GRAY SILT AND FINE SANDY SILT WITH OCCASIONAL LAYERS OF FINE SAND AND SILTY FINE SAND – SOFT (TAILINGS)

TEST PIT COMPLETED 1 – 16 – 74
SEEPAGE AT 2.5 FEET.
MODERATE CAVING BELOW 2.0 FEET.

TEST PIT 19

ELEVATION 6633 FEET



DARK BROWNISH-GRAY SILTY CLAY – VERY STIFF (TOPSOIL – MAJOR ROOTS TO 3")

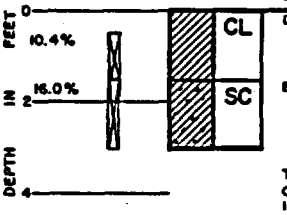
GRADES HARD WITH RELIC ROCK STRUCTURE AND SOME FINE TO COARSE SAND

GRADES TO SOFT BEDROCK BELOW 4.5 FEET

TEST PIT COMPLETED 1 – 16 – 74
GROUND WATER WAS NOT ENCOUNTERED IN PIT.

TEST PIT 20

ELEVATION 6641 FEET



DARK BROWNISH-GRAY SILTY CLAY WITH SOME ORGANIC MATERIAL AND TRACE SAND AND GRAVEL – STIFF (TOPSOIL – MAJOR ROOTS TO 2")

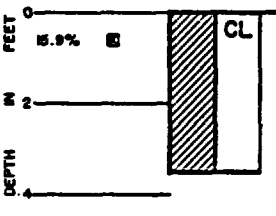
BROWNISH-GRAY FINE TO COARSE SAND WITH TRACE GRAVEL AND TRACE RELIC ROCK STRUCTURE – VERY DENSE

GRADES TO SOFT WEATHERED BEDROCK BELOW 3.0 FEET

TEST PIT COMPLETED 1 – 16 – 74
GROUND WATER WAS NOT ENCOUNTERED IN PIT.

TEST PIT 21

ELEVATION 6634 FEET



DARK BROWNISH-GRAY SILTY CLAY WITH TRACE TO SOME ORGANIC MATERIAL – STIFF (TOPSOIL – MAJOR ROOTS TO 3")

GRADES LIGHT BROWN WITH SOME FINE TO COARSE SAND AND TRACE RELIC ROCK STRUCTURE – HARD

GRADES TO WEATHERED BEDROCK WITH LARGE COBBLES BELOW 3.5 FEET

TEST PIT COMPLETED 1 – 16 – 74
GROUND WATER WAS NOT ENCOUNTERED IN PIT.

LOG OF TEST PITS

DAMES & MOORE

PLATE A-1H

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

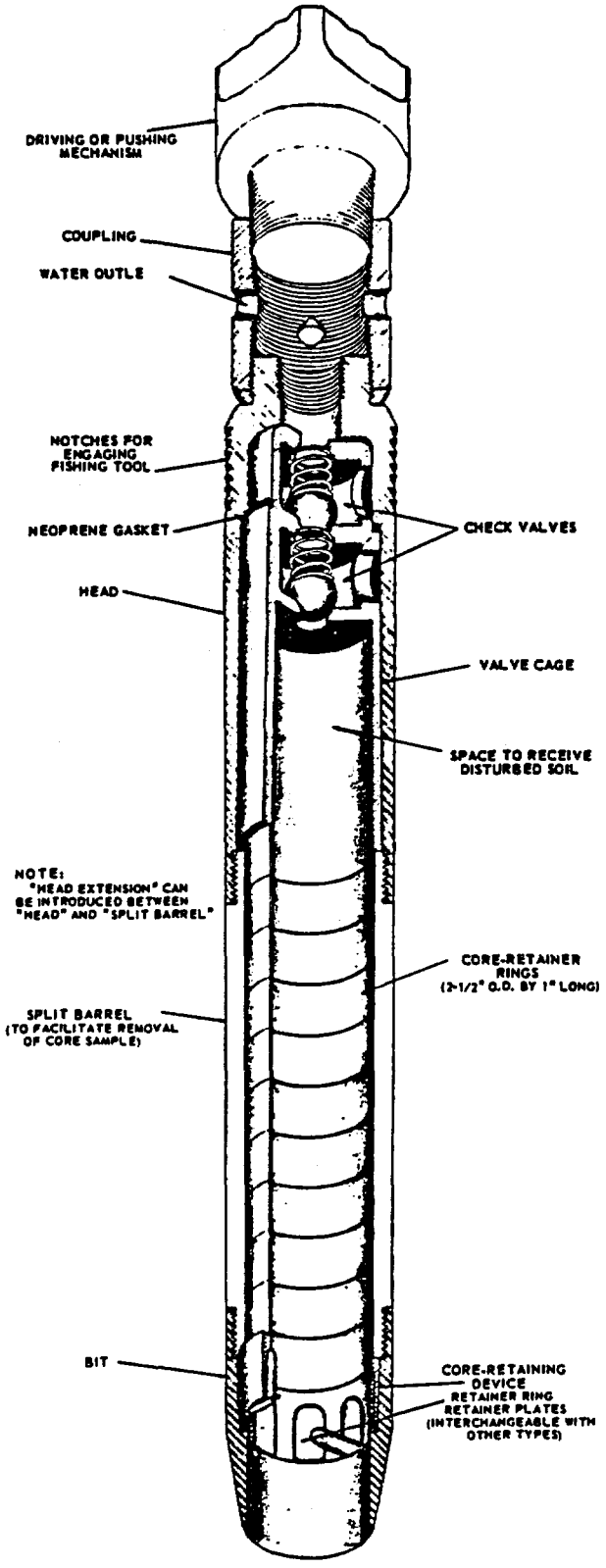
SOIL CLASSIFICATION CHART

UNIFIED SOIL CLASSIFICATION SYSTEM

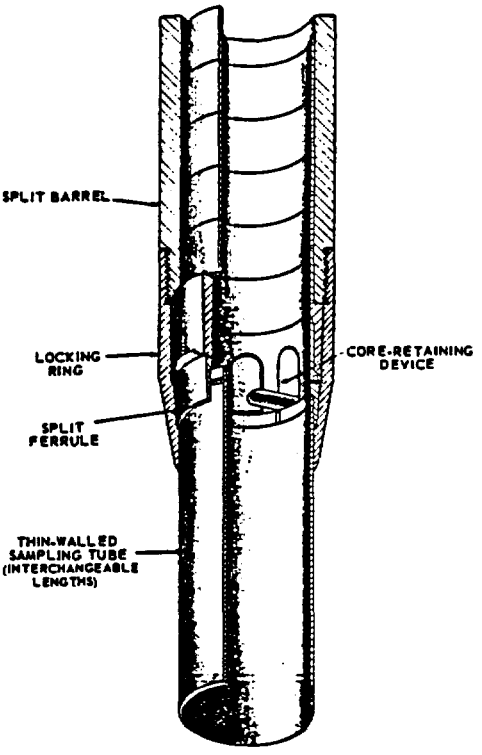
REVISED 11-13-73 SLC

DAMES & MOORE

PLATE A-2



ALTERNATE ATTACHMENTS



SOIL SAMPLER TYPE U

U. S. PATENT NO. 2,318,062

DAMES & MOORE

PLATE A-3

REVISIONS BY _____ DATE _____

FILE _____

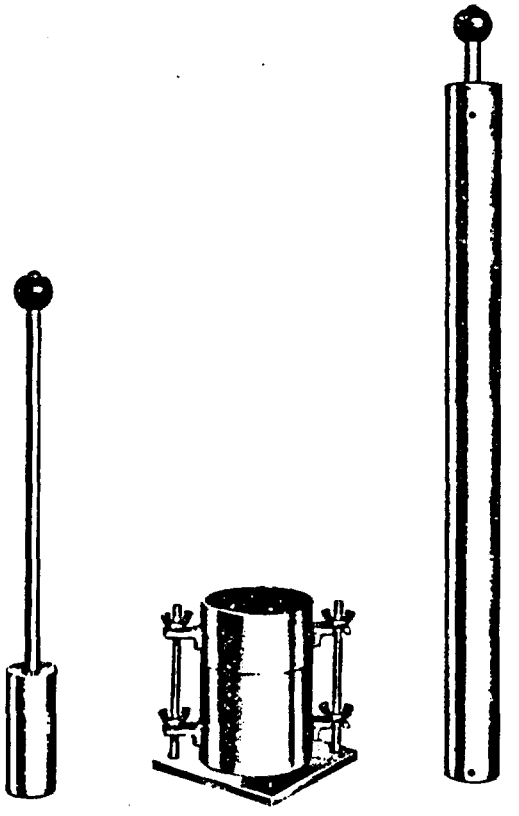
CHECKED BY _____ DATE _____

BY _____

REVISED 11-13-73 S.L.C.

IT HAS BEEN ESTABLISHED THAT WHEN COMPACTING EFFORT IS HELD CONSTANT, THE DENSITY OF A ROLLED EARTH FILL INCREASES WITH ADDED MOISTURE UNTIL A MAXIMUM DRY DENSITY IS OBTAINED AT A MOISTURE CONTENT TERMED THE "OPTIMUM MOISTURE CONTENT," AFTER WHICH THE DRY DENSITY DECREASES. THE COMPACTION CURVE SHOWING THE RELATIONSHIP BETWEEN DENSITY AND MOISTURE CONTENT FOR A SPECIFIC COMPACTING EFFORT IS DETERMINED BY EXPERIMENTAL METHODS. TWO COMMONLY USED METHODS ARE DESCRIBED IN THE FOLLOWING PARAGRAPHS.

FOR THE "STANDARD A.A.S.H.O." (A.S.T.M. D698-58T & A.A.S.H.O. T99-57) METHOD OF COMPACTION A PORTION OF THE SOIL SAMPLE PASSING THE NO. 4 SIEVE IS COMPACTED AT A SPECIFIC MOISTURE CONTENT IN THREE EQUAL LAYERS IN A STANDARD COMPACTION CYLINDER HAVING A VOLUME OF 1/30 CUBIC FOOT, USING TWENTY-FIVE 12-INCH BLOWS OF A STANDARD 5-1/2 POUND RAMMER TO COMPACT EACH LAYER.



SOME APPARATUS FOR PERFORMING COMPACTION TESTS
Shows, from left to right, 5-1/2 pound rammer (sleeve controlling 12" height of drop removed), 1/30 cubic-foot cylinder with removable collar and base plate, and 10 pound rammer within sleeve.

IN THE "MODIFIED A.A.S.H.O." (A.S.T.M. D-1557-58T & A.A.S.H.O. T 180-57) METHOD OF COMPACTION A PORTION OF THE SOIL SAMPLE PASSING THE NO. 4 SIEVE IS COMPACTED AT A SPECIFIC MOISTURE CONTENT IN FIVE EQUAL LAYERS IN A STANDARD COMPACTION CYLINDER HAVING A VOLUME OF 1/30 CUBIC FOOT, USING TWENTY-FIVE 18-INCH BLOWS OF A 10-POUND RAMMER TO COMPACT EACH LAYER. SEVERAL VARIATIONS OF THESE COMPACTION TESTING METHODS ARE OFTEN USED AND THESE ARE DESCRIBED IN A.A.S.H.O. & A.S.T.M. SPECIFICATIONS.

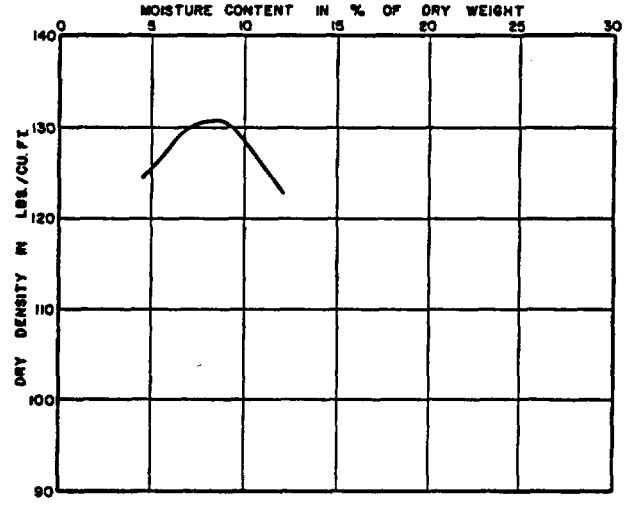
FOR BOTH METHODS, THE WET DENSITY OF THE COMPACTED SAMPLE IS DETERMINED BY WEIGHING THE KNOWN VOLUME OF SOIL; THE MOISTURE CONTENT, BY MEASURING THE LOSS OF WEIGHT OF A PORTION OF THE SAMPLE WHEN OVEN DRIED; AND THE DRY DENSITY, BY COMPUTING IT FROM THE WET DENSITY AND MOISTURE CONTENT. A SERIES OF SUCH COMPACTIONS IS PERFORMED AT INCREASING MOISTURE CONTENTS UNTIL A SUFFICIENT NUMBER OF POINTS DEFINING THE MOISTURE-DENSITY RELATIONSHIP HAVE BEEN OBTAINED TO PERMIT THE PLOTTING OF THE COMPACTION CURVE. THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT FOR THE PARTICULAR COMPACTING EFFORT ARE DETERMINED FROM THE COMPACTION CURVE.

METHOD OF PERFORMING COMPACTION TESTS (STANDARD AND MODIFIED A.A.S.H.O. METHODS)

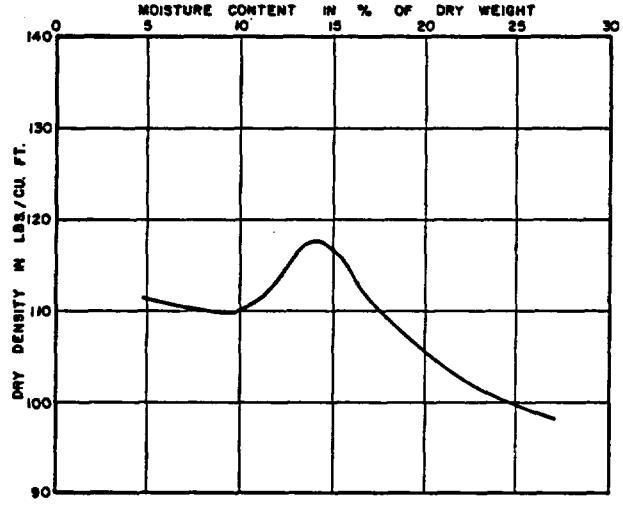
DAMES & MOORE

REVISIONS BY DATE
FILE
CHECKED BY DATE
BY
REVISED 11-13-73 S.L.C.

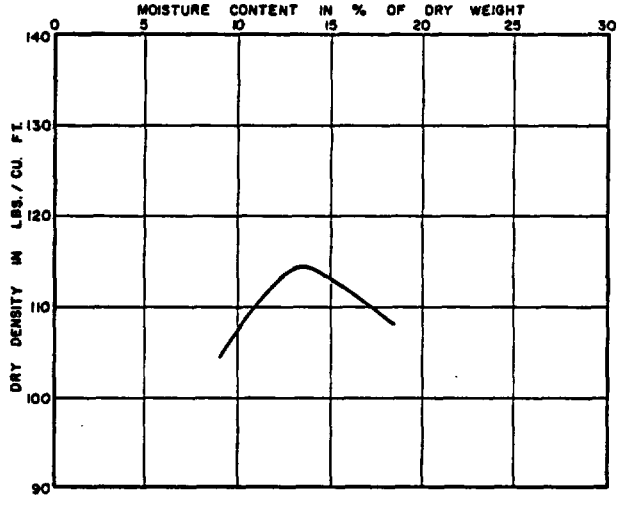
SOIL: SILTY GRAVEL WITH SOME SAND (GM)
LOCATION: GRAVEL PIT
OPTIMUM MOISTURE CONTENT: 8.0 PERCENT
MAXIMUM DRY DENSITY: 131 LBS. PER CUBIC FOOT
METHOD OF COMPACTION: A.A.S.H.O. T-180



SAMPLE: NO. 1 AT 0.5 FEET
SOIL: TAILINGS
LOCATION: TEST PIT 4
OPTIMUM MOISTURE CONTENT: 14.0 PERCENT
MAXIMUM DRY DENSITY: 117 LBS. PER CUBIC FOOT
METHOD OF COMPACTION: A.A.S.H.O. T-180



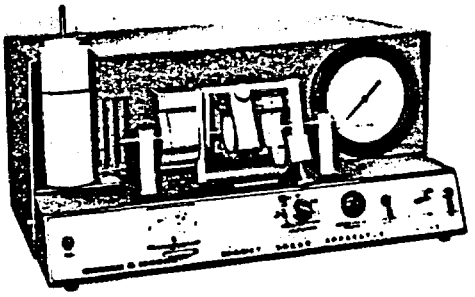
SAMPLE: MIXTURE OF SAMPLES 1 AND 2
SOIL: SANDY CLAY (CL)
LOCATION: TEST PIT 20
OPTIMUM MOISTURE CONTENT: 13.0 PERCENT
MAXIMUM DRY DENSITY: 114 LBS. PER CUBIC FOOT
METHOD OF COMPACTION: A.A.S.H.O. T-180



COMPACTION TEST DATA

DAMES & MOORE

DIRECT SHEAR TESTS ARE PERFORMED TO DETERMINE THE SHEARING STRENGTHS OF SOILS. FRICTION TESTS ARE PERFORMED TO DETERMINE THE FRICTIONAL RESISTANCES BETWEEN SOILS AND VARIOUS OTHER MATERIALS SUCH AS WOOD, STEEL, OR CONCRETE. THE TESTS ARE PERFORMED IN THE LABORATORY TO SIMULATE ANTICIPATED FIELD CONDITIONS.



DIRECT SHEAR TESTING & RECORDING APPARATUS

EACH SAMPLE IS TESTED WITHIN THREE BRASS RINGS, TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.

DIRECT SHEAR TESTS

A THREE-INCH LENGTH OF THE SAMPLE IS TESTED IN DIRECT DOUBLE SHEAR. A CONSTANT PRESSURE, APPROPRIATE TO THE CONDITIONS OF THE PROBLEM FOR WHICH THE TEST IS BEING PERFORMED, IS APPLIED NORMAL TO THE ENDS OF THE SAMPLE THROUGH POROUS STONES. A SHEARING FAILURE OF THE SAMPLE IS CAUSED BY MOVING THE CENTER RING IN A DIRECTION PERPENDICULAR TO THE AXIS OF THE SAMPLE. TRANSVERSE MOVEMENT OF THE OUTER RINGS IS PREVENTED.

THE SHEARING FAILURE MAY BE ACCOMPLISHED BY APPLYING TO THE CENTER RING EITHER A CONSTANT RATE OF LOAD, A CONSTANT RATE OF DEFLECTION, OR INCREMENTS OF LOAD OR DEFLECTION. IN EACH CASE, THE SHEARING LOAD AND THE DEFLECTIONS IN BOTH THE AXIAL AND TRANSVERSE DIRECTIONS ARE RECORDED AND PLOTTED. THE SHEARING STRENGTH OF THE SOIL IS DETERMINED FROM THE RESULTING LOAD-DEFLECTION CURVES.

FRICTION TESTS

IN ORDER TO DETERMINE THE FRICTIONAL RESISTANCE BETWEEN SOIL AND THE SURFACES OF VARIOUS MATERIALS, THE CENTER RING OF SOIL IN THE DIRECT SHEAR TEST IS REPLACED BY A DISK OF THE MATERIAL TO BE TESTED. THE TEST IS THEN PERFORMED IN THE SAME MANNER AS THE DIRECT SHEAR TEST BY FORCING THE DISK OF MATERIAL FROM THE SOIL SURFACES.

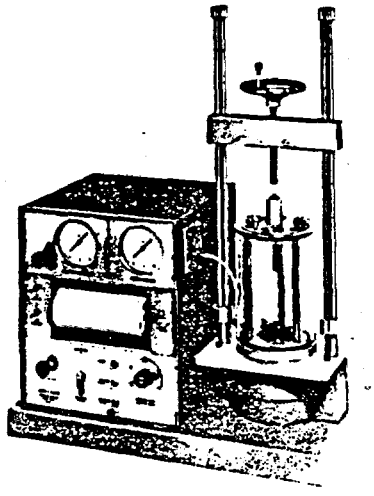
METHOD OF PERFORMING DIRECT SHEAR AND FRICTION TESTS

DAMES & MOORE

REVISIONS BY ____ DATE ____
FILE ____
CHECKED BY ____ DATE ____
REVISED 11-13-73 S.L.C.

THE SHEARING STRENGTHS OF SOILS ARE DETERMINED FROM THE RESULTS OF UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS. IN TRIAXIAL COMPRESSION TESTS THE TEST METHOD AND THE MAGNITUDE OF THE CONFINING PRESSURE ARE CHOSEN TO SIMULATE ANTICIPATED FIELD CONDITIONS.

UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS ARE PERFORMED ON UNDISTURBED OR REMOLDED SAMPLES OF SOIL APPROXIMATELY SIX INCHES IN LENGTH AND TWO AND ONE-HALF INCHES IN DIAMETER. THE TESTS ARE RUN EITHER STRAIN-CONTROLLED OR STRESS-CONTROLLED. IN A STRAIN-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO A CONSTANT RATE OF DEFLECTION AND THE RESULTING STRESSES ARE RECORDED. IN A STRESS-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO EQUAL INCREMENTS OF LOAD WITH EACH INCREMENT BEING MAINTAINED UNTIL AN EQUILIBRIUM CONDITION WITH RESPECT TO STRAIN IS ACHIEVED.



TRIAXIAL COMPRESSION TEST UNIT

YIELD, PEAK, OR ULTIMATE STRESSES ARE DETERMINED FROM THE STRESS-STRAIN PLOT FOR EACH SAMPLE AND THE PRINCIPAL STRESSES ARE EVALUATED. THE PRINCIPAL STRESSES ARE PLOTTED ON A MOHR'S CIRCLE DIAGRAM TO DETERMINE THE SHEARING STRENGTH OF THE SOIL TYPE BEING TESTED.

UNCONFINED COMPRESSION TESTS CAN BE PERFORMED ONLY ON SAMPLES WITH SUFFICIENT COHESION SO THAT THE SOIL WILL STAND AS AN UNSUPPORTED CYLINDER. THESE TESTS MAY BE RUN AT NATURAL MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SOILS.

IN A TRIAXIAL COMPRESSION TEST THE SAMPLE IS ENCASED IN A RUBBER MEMBRANE, PLACED IN A TEST CHAMBER, AND SUBJECTED TO A CONFINING PRESSURE THROUGHOUT THE DURATION OF THE TEST. NORMALLY, THIS CONFINING PRESSURE IS MAINTAINED AT A CONSTANT LEVEL, ALTHOUGH FOR SPECIAL TESTS IT MAY BE VARIED IN RELATION TO THE MEASURED STRESSES. TRIAXIAL COMPRESSION TESTS MAY BE RUN ON SOILS AT FIELD MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SAMPLES. THE TESTS ARE PERFORMED IN ONE OF THE FOLLOWING WAYS:

UNCONSOLIDATED-UNDRAINED: THE CONFINING PRESSURE IS IMPOSED ON THE SAMPLE AT THE START OF THE TEST. NO DRAINAGE IS PERMITTED AND THE STRESSES WHICH ARE MEASURED REPRESENT THE SUM OF THE INTERGRANULAR STRESSES AND PORE WATER PRESSURES.

CONSOLIDATED-UNDRAINED: THE SAMPLE IS ALLOWED TO CONSOLIDATE FULLY UNDER THE APPLIED CONFINING PRESSURE PRIOR TO THE START OF THE TEST. THE VOLUME CHANGE IS DETERMINED BY MEASURING THE WATER AND/OR AIR EXPELLED DURING CONSOLIDATION. NO DRAINAGE IS PERMITTED DURING THE TEST AND THE STRESSES WHICH ARE MEASURED ARE THE SAME AS FOR THE UNCONSOLIDATED-UNDRAINED TEST.

DRAINED: THE INTERGRANULAR STRESSES IN A SAMPLE MAY BE MEASURED BY PERFORMING A DRAINED, OR SLOW, TEST. IN THIS TEST THE SAMPLE IS FULLY SATURATED AND CONSOLIDATED PRIOR TO THE START OF THE TEST. DURING THE TEST, DRAINAGE IS PERMITTED AND THE TEST IS PERFORMED AT A SLOW ENOUGH RATE TO PREVENT THE BUILDUP OF PORE WATER PRESSURES. THE RESULTING STRESSES WHICH ARE MEASURED REPRESENT ONLY THE INTERGRANULAR STRESSES. THESE TESTS ARE USUALLY PERFORMED ON SAMPLES OF GENERALLY NON-COHESIVE SOILS, ALTHOUGH THE TEST PROCEDURE IS APPLICABLE TO COHESIVE SOILS IF A SUFFICIENTLY SLOW TEST RATE IS USED.

AN ALTERNATE MEANS OF OBTAINING THE DATA RESULTING FROM THE DRAINED TEST IS TO PERFORM AN UNDRAINED TEST IN WHICH SPECIAL EQUIPMENT IS USED TO MEASURE THE PORE WATER PRESSURES. THE DIFFERENCES BETWEEN THE TOTAL STRESSES AND THE PORE WATER PRESSURES MEASURED ARE THE INTERGRANULAR STRESSES.

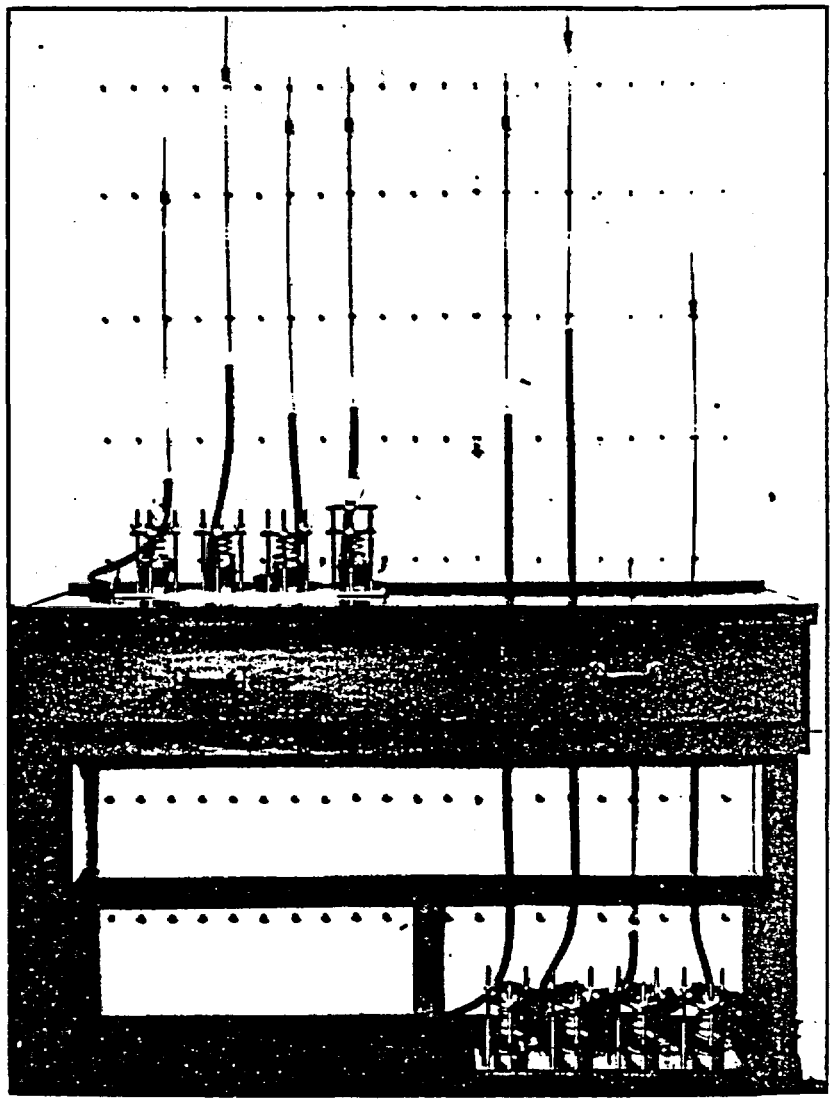
METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

DAMES & MOORE

REVISIONS BY ____ DATE ____
FILE DAMES & MOORE
BY H.B.T. DATE 12-2-66
CHECKED BY ____
REVISED 11-13-73 S.L.G.

The quantity and the velocity of flow of water which will escape through an earth structure or percolate through soil are dependent upon the permeability of the earth structure or soil. The permeability of soil has often been calculated by empirical formulas but is best determined by laboratory tests, especially in the case of compacted soils.

A one-inch length of the core sample is sealed in the percolation apparatus, placed under a confining load, or surcharge pressure, and subjected to the pressure of a known head of water. The percolation rate is computed from the measurements of the volume of water which flows through the sample in a series of time intervals. These rates are usually expressed as the velocity of flow in feet per year under a hydraulic gradient of one and at a temperature of 20 degrees Centigrade. The rate so expressed may be adjusted for any set of conditions involving the same soil by employing established physical laws. Generally, the percolation rate varies over a wide range at the beginning of the test and gradually approaches equilibrium as the test progresses.



APPARATUS FOR PERFORMING PERCOLATIONS TESTS
Shows tests in progress on eight samples simultaneously.

During the performance of the test, continuous readings of the deflection of the sample are taken by means of micrometer dial gauges. The amount of compression or expansion, expressed as a percentage of the original length of the sample, is a valuable indication of the compression of the soil which will occur under the action of load or the expansion of the soil as saturation takes place.

METHOD OF PERFORMING PERCOLATION TESTS

DAMES & MOORE

REVISIONS BY DATE
FILE
CHECKED BY DATE
BY
REVISED 11-13-73 S.L.C.

EXHIBIT 10-D

Dames & Moore Job No. 12058-001-06
Salt Lake City, Utah
November 12, 1980

REPORT ON TAILINGS POND INVESTIGATION
NEAR PARK CITY, UTAH
FOR
NORANDA MINING, INC.

Dames & Moore

November 12, 1980

Noranda Mining, Inc.
986 Atherton Drive
Suite 220
Salt Lake City, UT 84107

Attention: Mr. Allen Gordon

Gentlemen:

Transmitted herewith are six copies of our report entitled "Report on Tailings Pond Investigation, Near Park City, Utah, For Noranda Mining, Inc." This work has been performed under Noranda Purchase Order 10-1805.

The study has investigated the present condition of the existing Park City tailings pond, evaluated its available storage capacity, and assessed the feasibility of using the site and raising the dikes to meet both near-term and long-term tailings storage requirements of the Park City mill. A summary of the study findings is presented on page 2 of the report text.

We appreciate the opportunity of performing this investigation for you. If you have any questions or require additional information, please do not hesitate to contact us.

Yours very truly,

DAMES & MOORE

Steven Vick

Steven G. Vick
Project Engineer

SGV/pc

Attachments

cc: Mr. Bob Zaebst
Mr. Koos Schippers

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REPORT ON TAILINGS POND INVESTIGATION
NEAR PARK CITY, UTAH
FOR
NORANDA MINING, INC.

INTRODUCTION

This report presents the results of our investigation of the existing tailings pond at Noranda's Park City operation. As shown on Plate 1, Vicinity Map, the tailings pond is located in Richardson Flat near the intersection of highways U.S. 40 and Utah 248, known locally as Silver Creek Junction, some three miles northeast of Park City.

With its recent acquisition of the Park City mine from the former joint-venture operator Park City Ventures, Noranda is in the process of reactivating the mill and concentrator and preparing plans for long-term operation. Target production is currently 750 T/day of lead/zinc/silver ore. Sand tailings will be separated in the mill for return underground as stope backfill, and the remaining slimes tailings will be piped through a recently-installed Driscopipe line to the tailings pond. No decant or water return from the tailings pond is currently planned.

Tailings have been discharged onto the present site for at least 30 years by Park City Ventures and its precursor United Park City Mines. As a result, extensive tailings deposits, dikes, and embankments of various ages and conditions are present. The objective of our study has been to assess the overall condition and usefulness of the existing facilities, and to determine what measures will be required for long-term mill tailings disposal from the park City mine.

SUMMARY

Our inspection of the existing tailings pond dike and embankment indicates that its 1974 construction did not follow the intended recommendation in certain important details. While the most objectionable foundation materials appear to have been largely removed, stripping was inadequate in places, sideslopes were locally oversteepened, internal zoning was not as recommended, and compaction was poor overall. In spite of these construction flaws we find no evidence that the structure is presently unstable. We believe that the structure can continue to be operated through the coming winter without major hazard; remedial measures directed toward flattening oversteepened slopes are recommended, however, and further analysis will be required.

The available storage capacity of the impoundment, although probably adequate for the coming winter, is very limited. A very approximate water balance using assumed discharge and seepage parameters indicates that the rate of solids, rather than water, accumulation will govern the rate at which dike raises must be constructed. For near-term operation we believe it is feasible to provide several years' additional capacity by bringing the dike crest up to a uniform, horizontal elevation of 6624 feet. This will involve adding an average three to four feet of fill on the crest of the existing dike. Construction of this first raise should begin in 1981.

Subsequent raises can feasibly be constructed by the so-called "downstream" method, whereby fill is placed on the crest and downstream slope of the preceeding raise without using the tailings deposit as a structural element. Approximately three additional raises of about three feet in height each will be sufficient to provide a total of 20 years' tailings storage

capacity. Discharge of tailings should be from the dike perimeter by either spigots or frequently-relocated single point discharge; discharge from a fixed point projecting into the impoundment should be discontinued.

This summary provides only a brief and condensed overview of our study findings. Important additional information, assumptions, and qualifications are contained in subsequent sections of the report.

PURPOSE AND SCOPE

The purpose of this investigation is to familiarize Noranda personnel with the background and former operation of the tailings pond, to inspect and evaluate the condition of existing structures, and to perform conceptual-level planning for renewed use of the facilities. More detailed engineering studies will be required prior to future construction. The scope of our work was presented in our initial proposal dated February 25, 1980 and modified in our revised proposal dated July 17, 1980. The scope of work authorized by Noranda Purchase Order 10-1805 is the same as that of our July 17 proposal with deletion of issues pertaining to Resource Conservation and Recovery Act (RCRA) compliance. Specifically, the scope of work carried out for this study has included the following:

1) Review of recent aerial mapping provided by Noranda and comparison with older maps in our files to determine the configuration and extent of the most recently-constructed dike and embankment.

2) Review of information contained in previous Dames & Moore studies of the tailings pond performed for Park City Ventures.

3) Discussions with local contractors relative to methods and materials used in construction of the existing dike and embankment.

4) A field reconnaissance and inspection, including the excavation of several test pits in and around the existing dike.

5) Calculation of available tailings pond storage volume and capacity requirements for both short-term and long-term mill operation.

6) Calculations of approximate design storm runoff inflows.

7) Assessment of feasible methods and materials for future dike construction.

8) Recommendations for additional work needed.

9) Preparation of this report summarizing our findings.

It should be noted that pending Federal legislation may have a major impact on the design of mine tailings impoundments, to the extent that tailings are classified as toxic or hazardous materials under the provisions of RCRA. At Noranda's request we have not considered the implications of any such rule-making on design or operation of the Park City tailings pond.

BACKGROUND

The origin of the existing tailings deposit is unclear, but tailings were first introduced into the area known as Richardson Flat prior to the 1950's. Even before tailings deposition, much of the site was likely poorly-drained and swampy, fed by small springs issuing from the hillside to the north. As shown on Plate 1, the original tailings deposit covered considerably more area than is now enclosed by the present dikes, extending out to and beyond the existing UPRR tracks. The initial area was dammed off by a low embankment on the extreme northwest end of Richardson Flat. It is reported that the old tailings pond, as well as the original embankment itself, was once used as the Park City garbage dump. Subsequent borings and exposures during construction confirmed that the old embankment contained organic soils and trash.

Dames & Moore's first involvement with the tailings pond dates back to 1973 when Park City Ventures was in the process of constructing the Ontario mill. Two reports were prepared, as shown below:

Title	Date	Subject
Report of Ground Water Monitoring and Seepage Study, Tailings Pond Development, Near Park City, Utah For Park City Ventures Corporation.	12/06/73	Evaluation of ground water quality and seepage potential for then-proposed tailings pond.
Report of Embankment and Dike Design Requirements, Proposed Tailings Pond Development, Near Park City, Utah, For Park City Ventures Corporation.	03/08/74	Design and construction recommendations for new tailings pond dikes.

The first report evaluated water quality considerations for reactivating the old tailings pond. The second report in March, 1974 involved a subsurface investigation and design study for a new tailings pond dike. Much of our

background data concerning site conditions and soils has been derived from this second report.

It was found that two primary soil types were present beneath the tailings deposit. Beneath much of the northern half of the area were silty sands and gravels, such as those now exposed in the diversion channel near the main embankment. The southern and eastern portions of the area were found to be underlain primarily by silts and clays, with gravelly clays and clayey gravels present on the hillsides to the northeast.

The 1974 Dames & Moore design report provided recommendations for repairing and raising the main embankment on the northwest end of the tailings pond as well as constructing an additional 5,000 feet of perimeter dike across the surface of the old tailings deposit. The configuration of the main embankment and dike are shown on Plate 2, Plot Plan. Major considerations in design of the dike centered around removal of unsuitable foundation materials. It was recommended that a major portion of the organic fill comprising the main embankment be excavated, removed, and replaced with a zoned-compacted earthfill containing a clayey core, a silty gravel shell, and a drainage zone at the downstream toe. It was also recommended that loose tailings be removed from the foundation of the perimeter dike out of concern that these materials might liquefy in a major earthquake.

Dames & Moore was not involved in construction inspection when the dike was actually built in 1974, so most of our information on the composition of the fill and foundation treatment must be based on inspection of the present structures and discussions with personnel present during construction. We

have been able to find no records of fill testing or inspection performed by Park City Ventures.

The dike had been designed for a uniform crest elevation of 6627 feet, but actual construction did not reach this elevation. It appears that tailings were discharged along the perimeter of the embankment for a period of time, at least along the north end where a beach is present. Discharge during the final stages of operation, however, was from a trestle-supported pipe projecting into the pond. This has produced the conical pile of tailings now evident on the surface in the western portion of the impoundment as shown on Plate 2. Water from Noranda mill discharge and discharge from springs collects in a pond about 10 acres in size in the extreme northern portion of the impoundment at the toe of the U.S. 40 highway embankment.

EVALUATION OF EXISTING STRUCTURES

CONDITION OF EXISTING FACILITIES

Plate 2 shows the present structures in plan view and the configuration of the tailings within the impoundment as of August, 1980. On the extreme northwestern end of the impoundment is the main embankment. This embankment abuts onto a dike enclosing the west and south perimeter of the impoundment. This dike is no more than six to eight feet high in most areas; along the eastern end of the perimeter it projects only a few feet and is difficult to distinguish from the natural ground surface. A shallow diversion ditch runs between the 6630 and 6650 contours on the hillside to the north of the impoundment, as shown on Plate 2. This shallow ditch empties into a larger and deeper diversion channel which parallels the entire dike perimeter offset about 50 feet from the dike toe. Borrow pits used in 1974 construction of the dike are still visible between the west edge of the impoundment and the UPRR tracks.

Plate 3 shows selected cross-sections through the main embankment and dike. Also shown are pre-construction 1973 profiles at these same sections. Comparison of the pre- and post-construction ground contours shows that the main embankment (Sec. A-A) was constructed downstream from the original embankment, as intended. Inspection of Sections B-B, C-C, and D-D through the dike suggests that relatively little material was actually placed as fill, probably only several feet, and that much of the exposed dike slopes were constructed in cut, with the excavated material used as borrow.

Our site inspection, test pits, and discussions with Mr. Ross Lloyd of Lloyd Bros. Construction in Heber indicate that the existing embankment and dike conform only in an approximate way to recommendations provided in Dames &

Moore's March 8, 1974 report to Park City Ventures. The configuration of the dike, while following the same centerline, was changed in regard to crest elevation and sideslopes. The crest, rather than being constructed to a uniform 6627 elevation, has a maximum elevation of 6624 near the present tailings discharge point, with a downward slope both northwest and southeast from this point. The minimum crest elevation on the extreme eastern protion of the dike is about 6618, some 10 feet lower than originally planned. Sideslopes are locally steeper than the 2.0:1.0 design slope, approximately 1.5:1.0 in many areas. Of some concern are oversteepened slopes on the main embankment face on the extreme northwest end of the pond, as shown on Plate 3, Section A-A. Here the embankment reaches its maximum height of 25 feet.

Since no engineering inspection or control took place during construction of the existing sturcture, it is difficult to determine whether the structure was internally zoned or compacted according to recommendations. As best we can determine from available information, considerable effort was devoted during construction to removal of organic fill and trash which comprised the former dike now overlain by the main embankment at the extreme northwest end of the pond. Much of this material was reportedly excavated and removed down to firm, clayey natural soils as had been recommended. In addition, it appears that all or most of the tailings were removed from the foundation area of the dike in the southern areas of the impoundment. Although there is evidence of inadequate stripping of soft foundation soils and roots particularly in the eastern dike foundation area, on the whole the most objectionable foundation materials appear to have been removed. A major consideration in performing the 1974 foundation excavation was reportedly to remove permeable foundation materials in order to limit potential seepage.

In an attempt to determine the nature of materials placed as fill and to assess their degree of compaction, the fill was visually inspected in several shallow test pits at the approximate locations shown on Plate 2. The main embankment and the adjoining dike southeastward to the point where the access road intersects the dike appear to be constructed largely of silty sand and gravel. The southeastern portion of the dike appears to be constructed principally of clay and gravelly clay excavated near Highway 40 above and northeast of the tailings pond. There is no evidence that internal zoning of the main embankment was provided or that the recommended drainage zone was installed at its downstream toe. Compaction of the fill was reportedly accomplished with a sheepsfoot roller and by wheel-rolling with scrapers. The overall compaction of the fill, however, is poor; some areas of the fill appear reasonably dense while others are loose or contain loose pockets. Judging particularly from the more clayey fill materials, it appears that placement moisture content was not controlled.

There is evidence of considerable seepage in the form of small seeps and marshy areas on the northwest abutment and at the downstream toe of the main embankment on the northwest end of the impoundment. Although the seepage is believed to consist largely of natural ground water, seepage of tailings pond water may also be a contributing factor.

A short dike on the extreme northern edge of the ponded water was not constructed as planned. Ponded water therefore presently encroaches on the right-of-way of Highway 40 at the toe of an embankment.

HYDROLOGY CONSIDERATIONS

Hydrology analyses were performed to determine the degree of hazard posed by flood overtopping. From available maps the total pond drainage area was determined to be 273 acres, accounting only for diversion by highway cuts and neglecting the influence of the sidehill diversion ditch. From the 100-year, 24-hour precipitation of 3.0 inches (Miller, et.al., 1973) and assuming 10 percent infiltration, a runoff volume of 61 acre-feet was computed. With the present pond water elevation, available pond capacity would be sufficient to contain the 100-year, 24-hour storm runoff without overtopping.

In addition, the Probable Maximum Precipitation (PMP) was derived from hydrometerological data (Hansen, et.al., 1977). Both general storm and local storm values were derived, and the local storm PMP of 12.0 inches was found to control. Assuming 10 percent infiltration, a PMP runoff volume of 246 acre-feet results. Available mapping indicates that the impoundment dike would overtop in the very unlikely event of a storm of this magnitude, although water might still be retained by tailings which are piled along the inside dike crest to a slightly higher elevation. Even in the event of overtopping, catastrophic failure would not result since the dike at the low point on the crest is only about two feet high.

Based on these analyses we believe the hazard to the existing structure due to flood overtopping is small.

DAM SAFETY CONSIDERATIONS

Overall, we cannot conclude that the existing structure was built according to recommendations or that the fill was properly engineered during

construction. However, our inspection indicates no visible features or conditions which would lead us to believe that the structure is in danger of failing or poses a significant safety hazard to life or property. The low height of the dikes and small quantity of stored water make the structure less susceptible to construction flaws than might otherwise be the case. The negligible potential for damage due to flood overtopping and the current lack of downstream development are also mitigating factors. Consequently, we feel that near-term operation of the impoundment can be continued without posing a major hazard. We do recommend that future construction be performed to correct some potential problems, and that the impoundment be operated in a way which accounts for some of the potential weaknesses in the existing structure.

DISCUSSIONS AND RECOMMENDATIONS

POND CAPACITY AND VOLUME REQUIREMENTS

Pond volume calculations have been performed in order to determine the extent of modifications required to accommodate tailings discharge from both near-term and long-term mill operation. One of the more important parameters in determining capacity requirements is mill discharge, but the present limited mill operating experience makes the tailings discharge rate and pulp density difficult to specify precisely. The present target rate for mill production is 750 dry T/day, with a corresponding production rate for whole tailings. From this amount of whole tailings, the sand fraction will be separated by cyclones and returned underground for stope backfill. The actual sand/slimes split depends on such factors as structural requirements of the backfill and operating performance of the cyclones, and cannot be precisely estimated. In addition, it is likely that sand/slime separation will not be a continuous operation but may be performed intermittently depending on scheduling of underground operations. For these reasons it has been necessary for us to base our calculations on an assumed average sand/slime split. From discussions with Mr. Bob Zaebst of Noranda, we have assumed an average 50 percent sand/slimes split. Further, we have assumed continuous 365 day/year discharge of slimes to the tailings pond at a pulp density of 40 percent. This is equivalent to 375 dry tons/day solids and 94 gpm water. Calculations of pond capacity and filling rates are relatively sensitive to these numbers, and actual operating experience could change our estimates.

Since no decant or water return from the tailings pond is planned, the first step in capacity determination is to establish whether the volume

requirements of the impoundment are controlled by the buildup of water or solids. This factor, which has a major influence on the design and operation of the impoundment, has been evaluated by performing an estimated water balance. Of the total 273-acre drainage area, 148 acres is diverted by the small hillside diversion ditch, resulting in a net drainage area of 125 acres: 99 acres are enclosed by the impoundment at elevation 6620 and 26 acres are external. Based on our knowledge of the previous operating history of the pond, we have assumed a ponded water area of 40 acres, or 40 percent of the total impoundment surface.

Average runoff from the above-water portions of the impoundment drainage area has been estimated as 5.0 in/yr (Langbein, 1949). For the ponded water surface, average annual precipitation and lake evaporation of 20 and 34 in/yr, respectively, have been used, resulting in a net evaporation of 14 in/yr (Butler and Marsell, 1972; U.S. Weather Bureau, 1959). In addition, based on our experience and judgement, the assumed pond size, and the characteristics of the tailings and underlying native soils, we have assumed a seepage rate on the order of 90 gpm.

Water inflows then total 5.0 in/yr runoff over 85 acres, and 94 gpm tailings slurry water. Outflows are 14 in/yr net evaporation over 40 acres and 90 gpm seepage. Subtracting outflows from inflows results in balanced water flow. These calculations are based on a number of assumed values which need to be verified based on actual operating experience and measurements. However, we believe that the general conclusion is valid: that water will not build up faster than the solids in the pond, and that pond capacity will be controlled by the rate of solids deposition.

Given this conclusion, pond capacity data on Plate 4 has been prepared from recent topographic mapping. Storage volume for a given elevation on Plate 4 should be considered approximate, since the slope of the tailings beach, which will likely amount to several feet, has been neglected. Plate 4 shows that for the lowest elevation of the present dike crest, about 6618, only a limited amount of storage capacity is available. While this capacity should be sufficient for operation through the coming winter and spring, construction of additional raises should be started during the summer of 1981.

NEAR-TERM DEVELOPMENT

The sloping crest of the existing dike suggests that additional storage capacity could be gained relatively easily by bringing low portions of the dike up to the present maximum crest elevation of 6624. This would involve raising the dike by an average two to four feet, and we recommend that this be done during the first stage of construction in 1981. The existing crest is wide enough in most areas so that additional fill can feasibly be placed on top of the existing dike without widening its base, provided that the new crest width is reduced to about 15 feet. Plate 4 shows that a crest elevation of 6624, after subtracting 246 A-ft for storage of PMP runoff and an additional 2.0 feet to compensate for beach slope, would result in about four years' additional capacity, given all the assumptions of the previous section.

In addition, we recommend that near-term 1981 construction include flattening of the oversteepened slope of the main embankment (see Plate 3, Sec. A-A) by placement of additional fill. To provide drainage for abutment springs and internal seepage control, and to compensate for the apparent lack of internal zoning of the main embankment, additional fill material should consist of clean, free-draining sands and gravels.

Selection of materials and design of slopes for both the 1981 dike raise and the above-described remedial measures should be based on more detailed laboratory testing and engineering analysis. Conceptual-level quantity estimates indicate that very roughly 25,000 cubic yards of fill material would be required to construct the recommended 1981 construction. Of this amount, about 7,000 cubic yards would be for embankment slope flattening, with the remainder for the dike raise.

LONG-TERM DEVELOPMENT

Referring to Plate 4, it can be seen that the average elevation of the tailings will rise at roughly one foot per year over the long term. Additional capacity for the next 20 years of mill operation under the assumed mill output can be gained by a total increase of about 15 feet in impoundment height. Barring major regulatory changes in tailings disposal technology over the long term, an elevation increase of this magnitude can feasibly be constructed at the existing site along the present dike and embankment alignment.

In general terms, tailings embankments can be raised by either the "upstream" or the "downstream" method. Upstream construction, such as commonly practiced in the copper industry in the southwestern U.S., involves constructing perimeter dike raises on the tailings beach above and immediately upstream from the crest of the preceeding dike. A sand beach along the entire perimeter is usually necessary to provide firm foundation support and internal drainage of the embankment. Because of the length of the dike and the fact that most of the sand in the Noranda tailings will be removed for backfill, we believe the remaining tailings discharged into the pond will be too fine to assure deposition of a uniform, sandy beach. In addition, upstream-constructed

embankments can be susceptible to seismically-induced liquefaction, and we believe this is a consideration due to the proximity of the site to the seismically active Wasatch Fault System. The probable future development of the area surrounding and downstream from the site may make the future hazard from seismic liquefaction greater than is now apparent. For these reasons we feel that upstream construction is unsuitable in this case, and that long-term pond development should be by downstream-constructed raises.

The general procedure of constructing the raises is illustrated on Plate 5, which shows the typical raising sequence at Section D-D on the northwest portion of the dike. The first raise consists of the 6624 lift previously discussed on the crest of the existing dike. Subsequent raises would be constructed in approximate three-foot height increments and at roughly three to four year intervals by adding compacted fill on the top and downstream slope of the preceeding dike stage. Four raises, sufficient for roughly 20 years' tailings storage, would bring the dike crest to elevation 6633 and would extend the downstream toe outward to the edge of the diversion ditch. Further raises according to this general procedure would also be feasible, but would require relocation of the diversion ditch.

Materials, internal zoning, and slope design for long-term pond development should be based on further engineering studies. Conceptual-level estimates indicate that very roughly 200,000 cubic yards of fill would be required to raise the dike from the 6624 to the 6633 crest elevation. Fill materials could consist of compacted hillside clays, silty sands and gravels, tailings, imported gravels, or some combination of these materials in a zoned configuration.

OPERATING PROCEDURES

Because of the construction of the existing dike and embankment, water should not be allowed to pond against or near the dike. We recommend that ponded water be maintained at least 500 feet from the dike and embankment at all locations. By doing so the potential for high internal phreatic surfaces and concentrated seepage along poorly stripped or compacted fill/foundation interfaces will be minimized.

The location of ponded water and the distribution of tailings within the impoundment should be controlled by perimeter discharge of tailings. This can be accomplished by discharging from a header pipe along the dike crest with spigots at closely-spaced intervals. Alternatively, a single-point discharge can be used, provided it is frequently relocated along the crest to allow for uniform beach buildup. Discharge from trestles extending into the interior of the impoundment should be discontinued.

Much of the remaining capacity behind the existing dike is present in the eastern portion of the impoundment, and discharge in this area during the coming winter would make most effective use of the available capacity. It should be noted that excavated tailings spoil has been piled along the eastern dike perimeter just inside the dike. This spoil, which extends above the low dike crest, should not be used to impound or retain tailings or water.

ADDITIONAL WORK

We recommend that several items receive attention as soon as possible. First, at least one slotted-PVC piezometer should be installed in the crest of the main embankment to a depth of 40 feet. Water levels in this piezometer

should be measured and recorded monthly during the coming winter and spring to monitor the response of embankment phreatic levels to renewed tailings discharge.

In addition, the shallow diversion ditch on the hillside north of the pond should be inspected, mucked out, and deepened as necessary prior to spring runoff.

Finally, it was previously noted that water balance calculations used in projecting future pond capacity requirements are sensitive to assumed inputs and seepage values. To confirm these values we recommend that all discharge to the pond of both solids and liquids be monitored and recorded for the next 12 months. By a relatively simple re-survey of the ponded water area next year, actual seepage rates can be backfigured from the actual pond water balance, providing considerably more confidence in present estimates of future storage requirements.

More detailed engineering studies should be performed for design of the 1981 dike raise and embankment flattening work. The scope of these design studies should include:

1) A field exploration program to evaluate dike, embankment, and foundation materials consisting of the drilling, sampling, and logging of roughly four to six borings through the dike and embankment crest. Field permeability tests should also be performed in the borings. The field exploration program should also include backhoe test pits to identify and obtain samples of borrow material. In addition, sampling and water quality and/or tracer analyses should be performed on the embankment abutment seeps to determine to what degree pond water, as opposed to natural ground water, contributes to the seepage.

2) A laboratory testing program on undisturbed samples and recompacted samples of potential borrow soils to establish physical properties, strength, compressibility, permeability, and compaction characteristics.

3) Analyses to determine materials and stable slopes under static and seismic conditions for the proposed embankment stabilization measures.

4) Recommendations for materials, configuration, and compaction of dike raise fill, including analyses of dike stability as indicated by field and laboratory investigations.

Respectfully submitted,

DAMES & MOORE

Steven Vick

Steven G. Vick
Project Engineer

SGV/pc

LIST OF REFERENCES

Butler, E. and Marsell, R.E., 1972, Cloudburst Floods in Utah, 1939-69, Developing A State Water Plan: U.S.G.S. in cooperation with Utah Dept. Nat. Res., Cooperative-Investigations Report No. 11.

Dames & Moore, 1973, Report of Ground Water Monitoring and Seepage Study, Tailings Pond Development, Near Park City, Utah, For Park City Ventures Corporation, dated December 6, 1973.

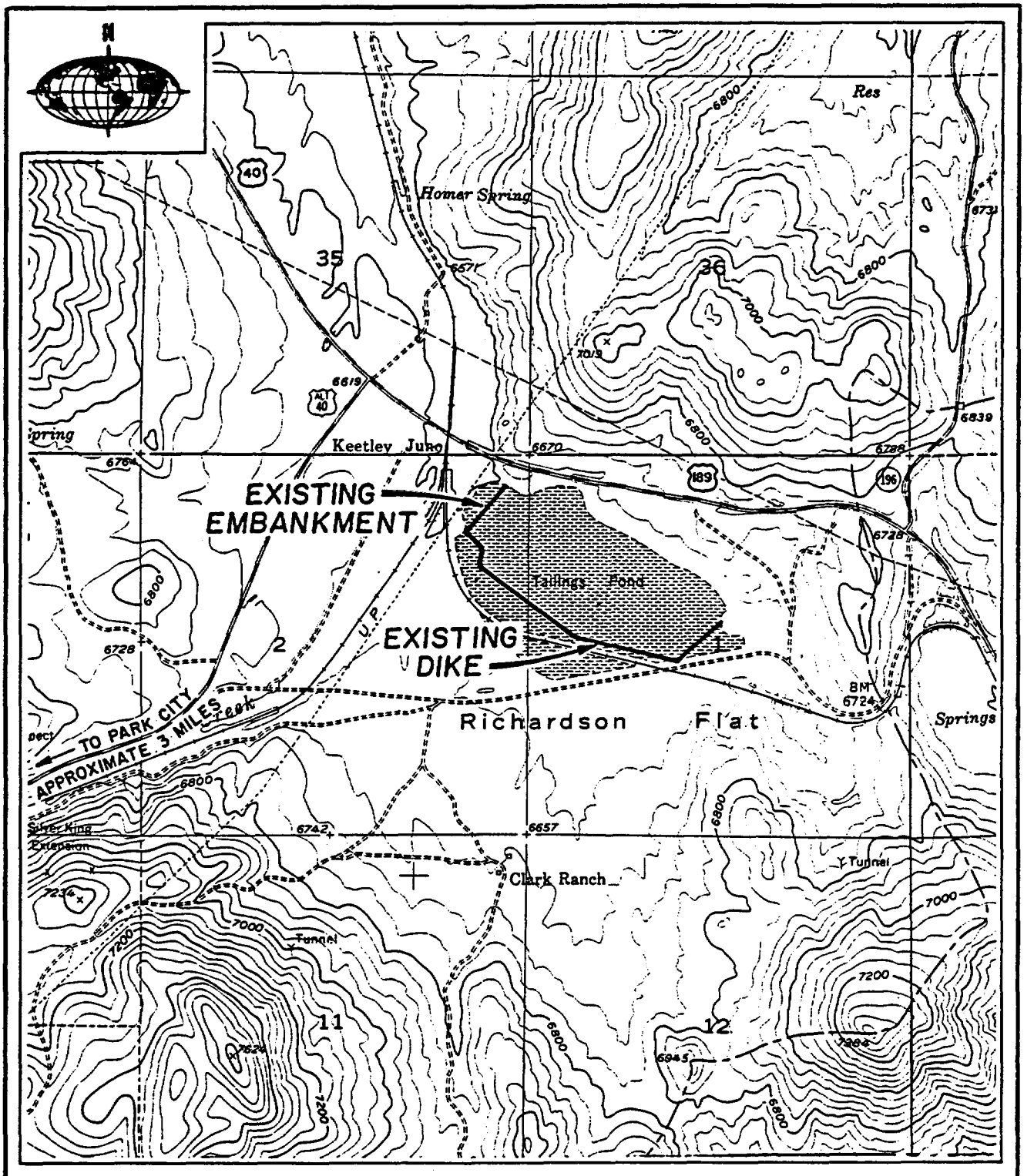
_____, 1974, Report of Embankment and Dike Design Requirements, Proposed Tailings Pond Development, Near Park City, Utah, For Park City Ventures Corporation, dated March 8, 1974.

Hansen, E., et.al, 1977, Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages, Hydrometerological Report No. 49, U.S. Dept. of Commerce, NOAA.

Langbein, W., 1949, Annual Runoff in the U.S., U.S.G.S., Circ. 52.

Miller, J., et.al., 1973, Precipitation-Frequency Atlas of the Western U.S., Vol. VI - Utah, U.S. Dept. of Commerce, NOAA.

U.S. Weather Bureau, 1959, Technical Paper 37.



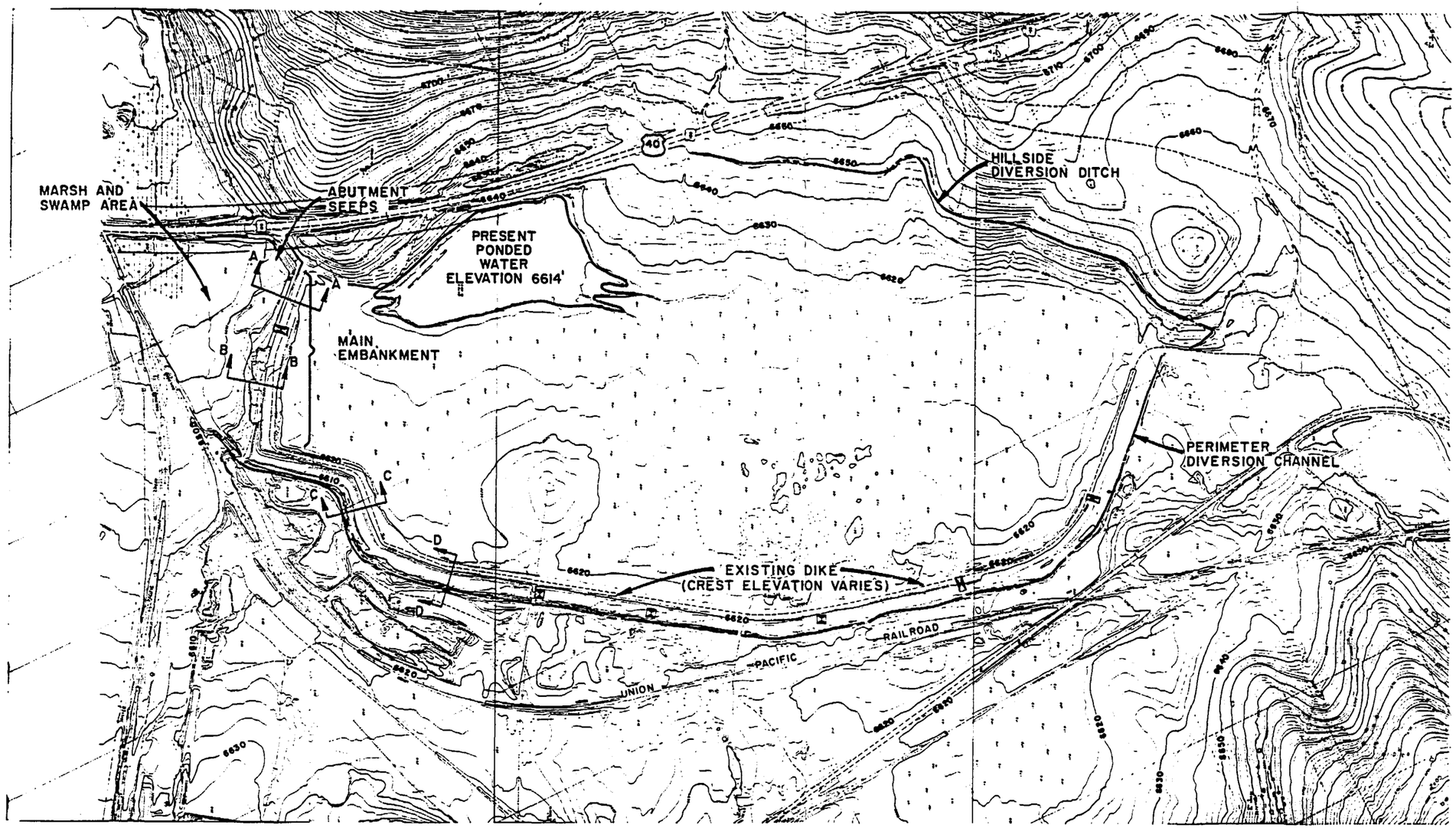
SCALE IN FEET
1000 0 1000 2000

VICINITY MAP

REFERENCE
U.S.G.S. QUADRANGLE SHEET ENTITLED "PARK CITY EAST, UTAH" DATED 1955.

DAMES & MOORE

PLATE 1



FEET
250 0 500 750

KEY:

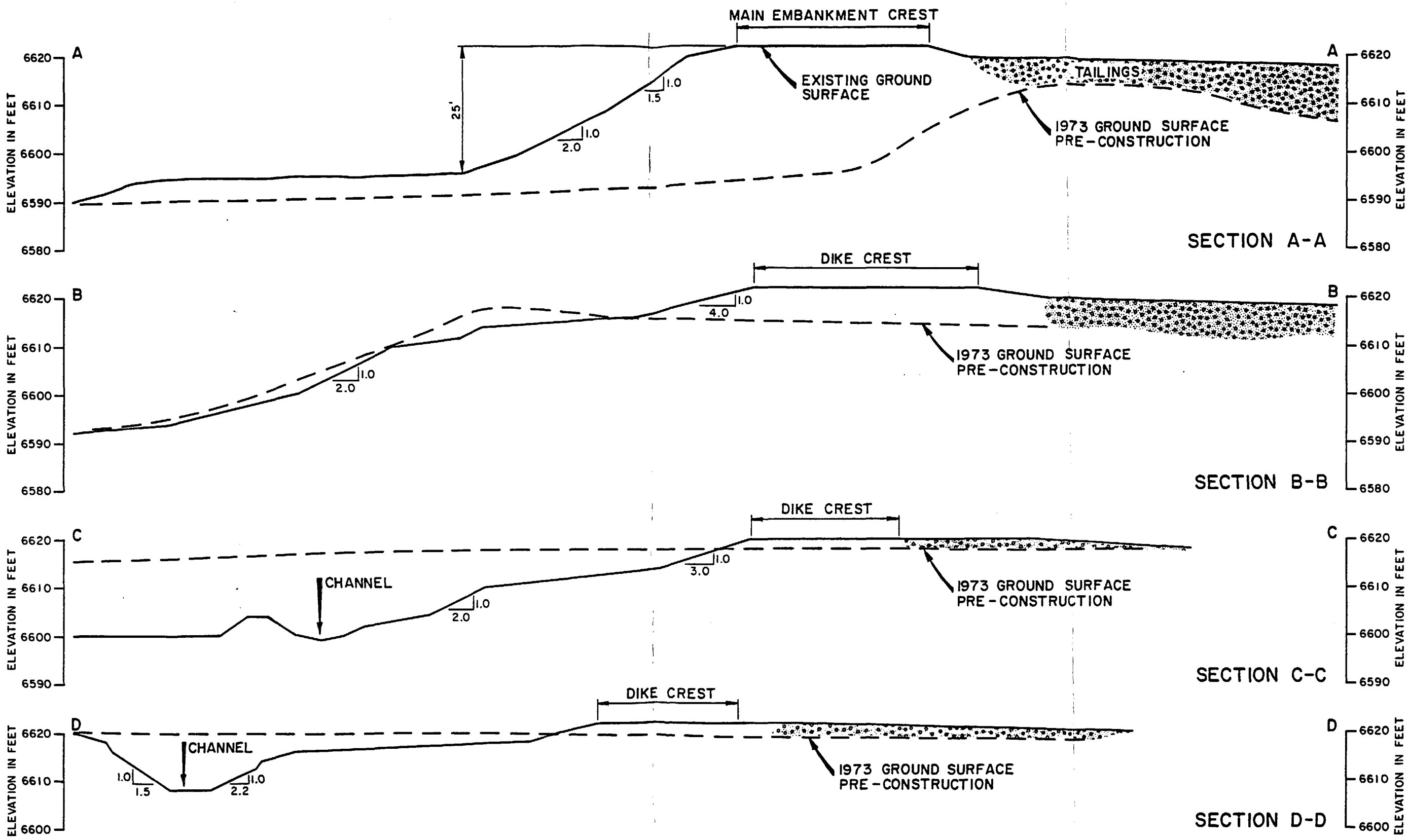
▭ APPROXIMATE LOCATION OF EXPLORATION TEST PIT OR TRENCH

REFERENCE:
AERIAL PHOTOGRAPH BY OLYMPUS AERIAL SURVEY INC.
PHOTOGRAPHY DATE AUGUST 24, 1980.

PLOT PLAN

DAMES & MOORE

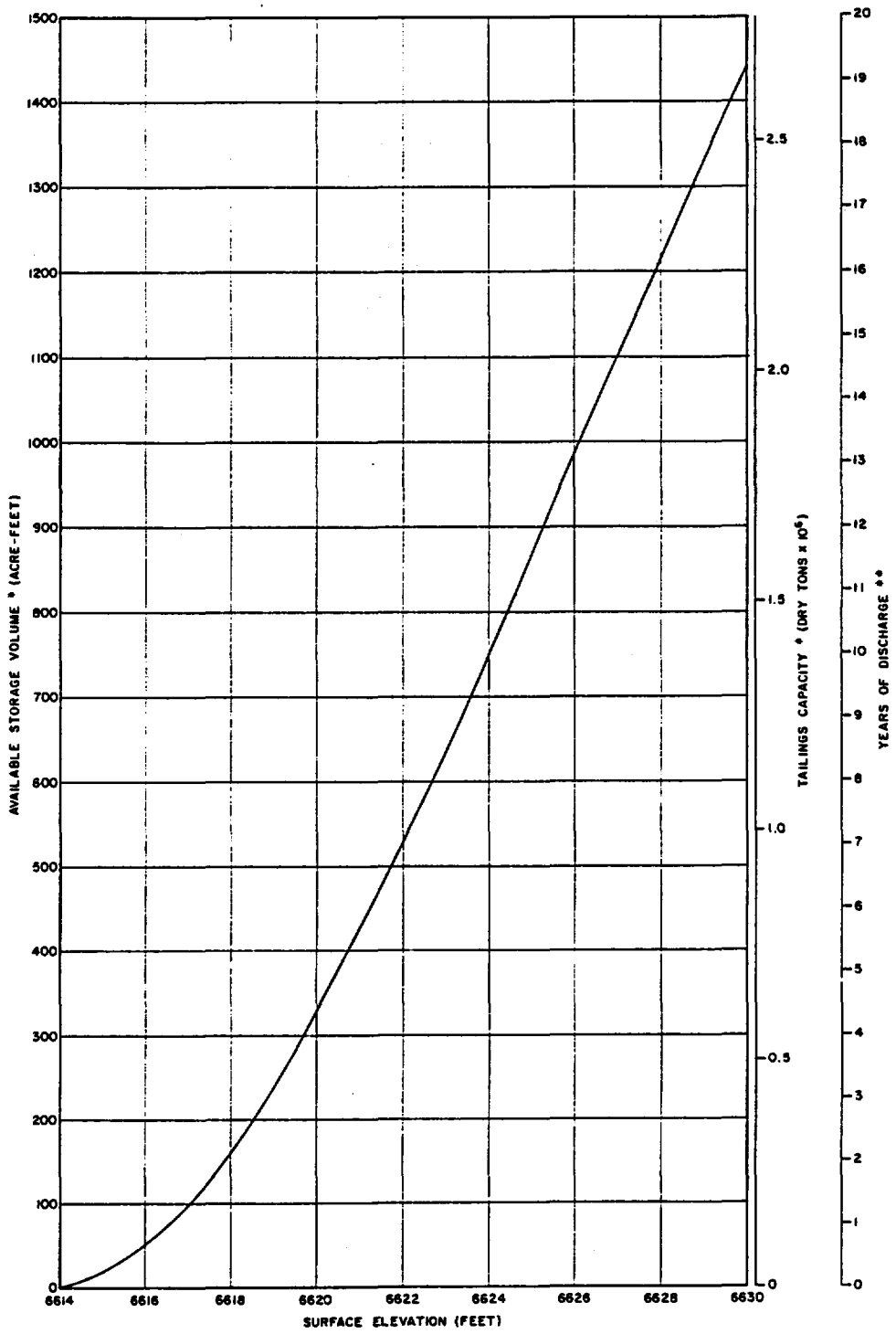
PLATE 2



EMBANKMENT CROSS-SECTIONS

DAMES & MOORE

PLATE 3



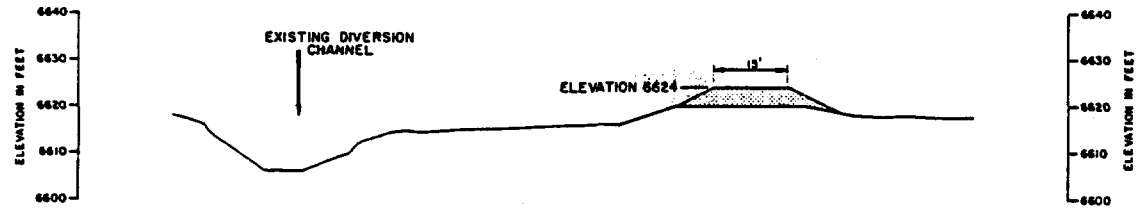
POND CAPACITY DATA

NOTE :

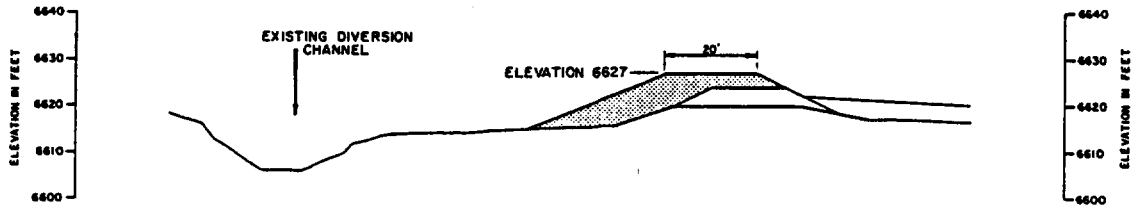
- * ASSUMES HORIZONTAL TAILINGS SURFACE AND NEGLECTS ALLOWANCES FOR STORM RUNOFF
- ** ASSUMES CONTINUOUS DISCHARGE OF 375 T/DAY AT 85 PCF

DAMES & MOORE

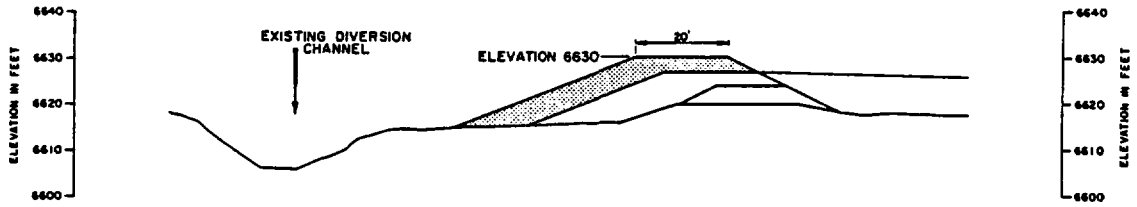
PLATE 4



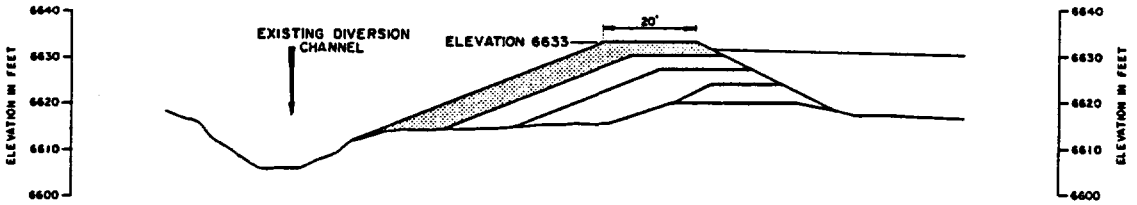
FIRST RAISE - 1981 CONSTRUCTION



SECOND RAISE



THIRD RAISE



FOURTH RAISE

TYPICAL RAISING SEQUENCE
SECTION D-D

FEET
10 5 0 10 20 30 40 50

DAMES & MOORE

PLATE 5

STATE OF UTAH-L ARTMENT OF SOCIAL SERVICES

CALVIN L. RAMPTON
Governor

PAUL S. ROSE
Executive Director

EXHIBIT 10-E

DIVISION OF HEALTH
44 MEDICAL DRIVE
SALT LAKE CITY, UTAH 84113
AREA CODE 801

328-6146

Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

LYMAN J. OLSEN, M.D., M.P.H.
Director of Health

BUREAU OF ENVIRONMENTAL HEALTH
72 East 4th South
Salt Lake City, Utah

May 29, 1974

Frank W. Millsaps
Concentrator Supt.
Park City Ventures
Star Route No. 1 Box 40
Heber City, Utah 84032

Dear Mr. Millsaps:

We have completed review of the Dames & Moore Report 8998-003-06 on the Park City Ventures Corporation Proposed Tailings Pond Development, and your letters of April 23, 1974, and May 13, 1974.

As a result, the plans for this tailings pond are approved and a construction permit, as constituted by this letter is hereby issued subject to the following conditions:

1. Monitoring results of Silver Creek, the Diversion ditch and the Monitoring wells should be submitted to this office.

2. At least two feet of freeboard shall be maintained during periods of tailings disposal.

This proposal is for an embankment, dikes and a diversion ditch to totally contain the mill tailings. The embankment is to be built to a height of approximately 40 feet on the northwest corner of the existing tailings disposal area. It is to be constructed with a cutoff trench to bedrock, a zone of silty or sandy clay, and a zone of silty sands and gravels having a slope of 2 horizontal to 1 vertical. In addition approximately 5,300 feet of dikes will be built to contain the tailings. This proposal also specifies a runoff diversion ditch at least 50 feet outside of the dikes.

Since this proposal is for an embankment greater than ten feet high and covers an area greater than 20 acres, you should also clear your plans with the State Division of Water Rights before commencing construction. The single set of plans received has been placed in our files.

Very truly yours,

UTAH WATER POLLUTION COMMITTEE

Calvin K. Sudweeks,
Executive Secretary

SMcN:sb
cc: EPA Denver - Evan Dildine
EPA Salt Lake - Cecil Carroll
State Division of Water Rights
Morgan - Summit County Health Dept.

EXHIBIT 10-G

May 2, 1973

BUREAU OF ENVIRONMENTAL HEALTH
DIVISION OF HEALTH

MEMORANDUM

TO: File

FROM: Dennis Downs & Joel Smith

SUBJECT: Park City Solid Waste Disposal Site Inspection

On 5 April 1973, we met in Park City, Summit County with officials to inspect proposed new solid waste disposal site. New site was inspected and was found to have adequate soil for working and covering refuse. The area was so located that surface drainage would not be a problem. Trenches were dug to a depth of about 20 ft. and no ground water was observed. The site appeared to be very adequate for use as a solid waste disposal facility. Operation of a sanitary landfill was discussed with city officials.

Closing of the old dump was also discussed.

Those in attendance were:

Joel C. Smith, State Division of Health
Dennis R. Downs, State Division of Health
Keith Baily, Park City Manager
Clem Hansen, Park City Councilman
Jan Wilking, Greater Park City Corporation

STATE OF UTAH—DEPARTMENT OF SOCIAL SERVICES

CALVIN L. RAMPTON
Governor

PAUL S. ROSE
Executive Director

EXHIBIT 10-F

DIVISION OF HEALTH
44 MEDICAL DRIVE
SALT LAKE CITY, UTAH 84113
AREA CODE 801
328-6163

May 7, 1973

Board of Health
Air Conservation Committee
Health Facilities Council
Medical Examiner Committee
Nursing Home Advisory Council
Water Pollution Committee

...TMAN J. OLSEN, M.D., M.P.H.
Director of Health

BUREAU OF ENVIRONMENTAL HEALTH
72 East 4th South
Salt Lake City, Utah

Mr. Keith Bailey
City Manager
Park City Hall
Park City, Utah 84060

Dear Mr. Bailey:

This letter is to acknowledge receipt of plans for a sanitary landfill to serve Park City and vicinity.

Review of the plans and supporting documents which were submitted has been completed. The plans appear to be in conformance with Utah State Division of Health standards and recommended sanitary landfill procedures and are hereby approved.

This approval is given on condition the disposal site be operated as a sanitary landfill.

You are to be commended for the thorough manner in which your plans have been developed.

If we may be of further assistance, please feel free to contact this office.

Yours very truly,

Howard M. Hurst, Director
Bureau of Environmental Health

DRD:nh

EXHIBIT 10-H

Park City Municipal Corporation

PARK CITY, UTAH

WILLIAM P. SULLIVAN, MAYOR

RECEIVED
APR 30 1973
Utah State Div. of Health
Environmental Health

April 10, 1973

Dennis Downs
Department of Health
and Sanitation
State of Utah

Dear Mr. Downs:

It was a pleasure meeting with you on April 5, 1973, concerning our 20 acre Sanitary Landfill Site. We believe that the proposed site should prove to be most successful for the Park City area. We, therefore, would like to make preparations to have this site dedicated as our Sanitary Landfill.

Enclosed you will find the following information that should put us well on our way to achieving the above goal:

(1). Geological reconnaissance of the proposed Park City / Summit County Sanitary Landfill Site.
(2). Map showing location, boundries, description and size of proposed landfill.
(3). Site Lease Agreement, with legal description.

The Park City Municipal Corporation and its City Manager will administer the Sanitary Landfill operation. The City Manager will be administrating officer and will see that proper management of the site is evident. We have yet to determine who will actually operate the landfill, but, whether we do it ourselves or contract the operation, our plans are for an exemplary Sanitary Landfill operation. The Park City Municipal Corporation will maintain jurisdiction regardless.

The City owns a D-6 caterpillar dozer and this can be housed on the site. A fence six feet high will be placed around a 2½ acre piece and moved as required.

There are approxiamately 1700 people living in the city of Park City. The adjacent areas of Park West, Synderville, and Summit Park would add an additional 600 people. We would

Park City Municipal Corporation

PARK CITY, UTAH

WILLIAM P. SULLIVAN, MAYOR

RECEIVED
APR 30 1973
Utah State Div. of Health
Environmental Health

April 10, 1973

project that by 1980, there could be 10,00 people using the Sanitary Landfill with no increase over 10,00 people. In any event, our 20 acre site will be adequate for at least a 20 year period.

With a water table at about 30 feet below the surface, there should be no problem with subwater. All surface water will be directed around the Landfill Site. This will be a very minor problem.

It is our plan to abandon the old garbage site to Greater Park City Corporation. It is in our contract with Greater Park City Corporation that the city poison the dump and to supervise the covering process. We, the City, would like to involve the State Board of Health in the abandoning process.

The Park City Municipal Corporation would like to do everything possible to dedicate this site as their new Sanitary Landfill. We hope we have made the initial steps in this process. Please let me know how we stand and what we must do in the future to bring the dedication of this site about. We want it in use this Spring or early Summer.

Thank You!

Sincerely,

Keith R. Bailey

Keith R. Bailey
City Manager

KRB/lm
Enclosure

EXHIBIT 10-I

REPORT OF INVESTIGATION NO. 69

UTAH GEOLOGICAL & MINERALOGICAL SURVEY

RECEIVED
APR 30 1973
Utah State Div. of Health
Environmental Health

GEOLOGICAL RECONNAISSANCE OF THE PROPOSED PARK CITY/SUMMIT COUNTY SANITARY LANDFILL SITE

By

Bruce N. Kaliser, Engineering Geologist
Utah Geological and Mineralogical Survey

SEPTEMBER 27, 1972

GEOLOGICAL ASSOCIATES [illegible]

PARK CITY/SUMMIT COUNTY SANITARY LANDFILL SITE

The writer inspected the proposed site for a new sanitary landfill operation on Richardson Flat in Section 2, T. 2S., R. 4E., with Park City and Summit County officials on September 25, 1972. Twenty acres are available at the site for a sanitary landfill. The operation is to replace an open burning dump which has been in operation for decades at the foot of Masonic Hill, about 2-1/2 miles southwest of the newly proposed site.

The site is on an alluvial flat with the alluvial thickness probably increasing towards the north end. The writer can find no record of probings of the alluvium at the site so there is no knowledge of its thickness. To the west of the site there are records for two water wells. The data for these wells as extracted from the State Division of Water Rights' files is to be found in the Appendix to this report. Unfortunately the wells are too far removed from the site to provide data on geologic materials and the water table beneath the site. The wells tap groundwater from depths in excess of one hundred feet from fractured bedrock (andesite). It is likely that a water table shallower than this depth exists beneath the site.

Borings will be necessary to satisfactorily explore the site. Four borings are suggested to depths of 50 to 75 feet. One boring each should be located at the northeast and southwest extremities of the property and the other two about 665 feet southwest and northeast from the first two, respectively. The borings must be geologically logged and any water encountered must be noted. Water levels in the holes should be monitored for several days following completion of the borings.

If saturated alluvium is encountered, a minimum of one hole should be set with perforated casing to monitor future water level fluctuation and to extract groundwater samples in the future. The hole should be pumped for a sample soon after its completion. Bacteriological and chemical analyses (complete) should be run for each water sample taken. Following the acquisition of this data an evaluation of the site can be made that can be presented to the State Division of Environmental Health.

Surface drainage in the site vicinity appears to be quite satisfactory. This will be especially true if the drainage barrier is re-established immediately to the south of the site so that flood runoffs will be diverted to flow in already existent drainage paths to the east.

The two backhoe-constructed testpits that were examined do not go sufficiently deep to determine the nature of the material to be removed. The top six or seven feet is a cobbly, gravelly silt. The deeper test hole exposed a clayey silt layer beneath the bed. The borings, supplemented with additional testpits should provide considerably more data on the fill material from which workability and handling judgements can be made. No serious problems are envisioned but cobbles may interfere in providing a thin daily cover and the silt will enable relatively deep frost penetration.

Upon taking the steps recommended herein a proper hydrogeological evaluation of the site can be made.

Submitted by:

Bruce N. Kaliser

Bruce N. Kaliser
Engineering Geologist

APPENDIX

Well No. 34833 (D-2-4) 2 cbd

Owner: Ray Wortley - new

Location: 1144' S., 982' E. of W. 1/4 corner, Sec. 2, T 2S, R.4E.

Use: Domestic Drilling Method: Rotary

Casing: 4-1/2" Perforations: 110-130 ft., 180-200 ft.

No screen or gravel packing

Static level: 42' (5/30/64) Discharge test: 30 gpm

Log:

0 - 3'	soil
3 - 19'	clay
19 - 59'	andesite
59 - 65'	clay, moist
65 - 147'	red andesite
147 - 210'	grey andesite
210 - 216'	red shale
216 - 220'	gray sandstone

Well No. 34356 (D-2-4) 2 cb

Owner: Mark Cornaby - new

Location: 320' S., 812' E., W-1/4 corner, Sec. 2, T.2 N., R.4E.

Use: Domestic Drilling Method: Rotary

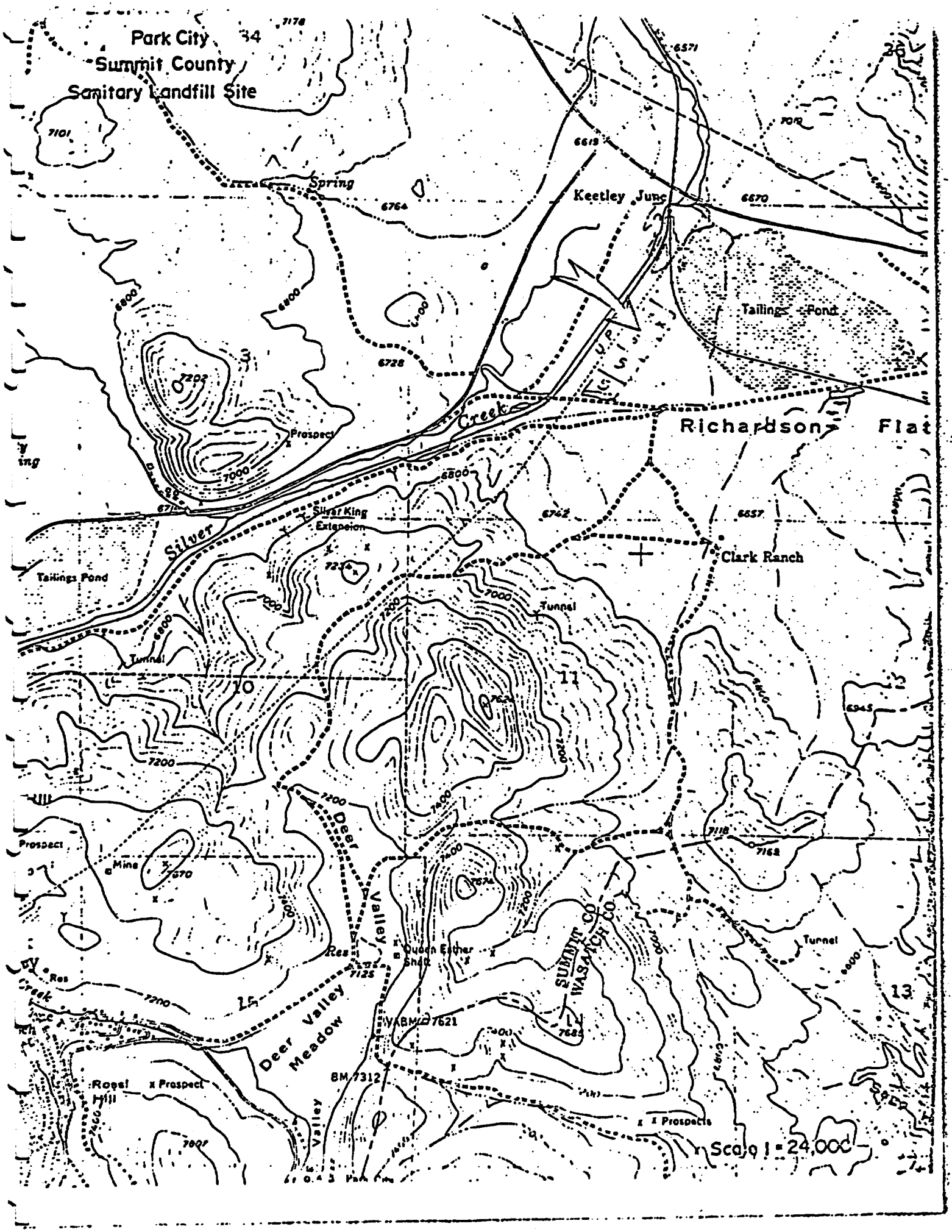
Casing: 6" Perforations: 165-171, 190-222 ft.

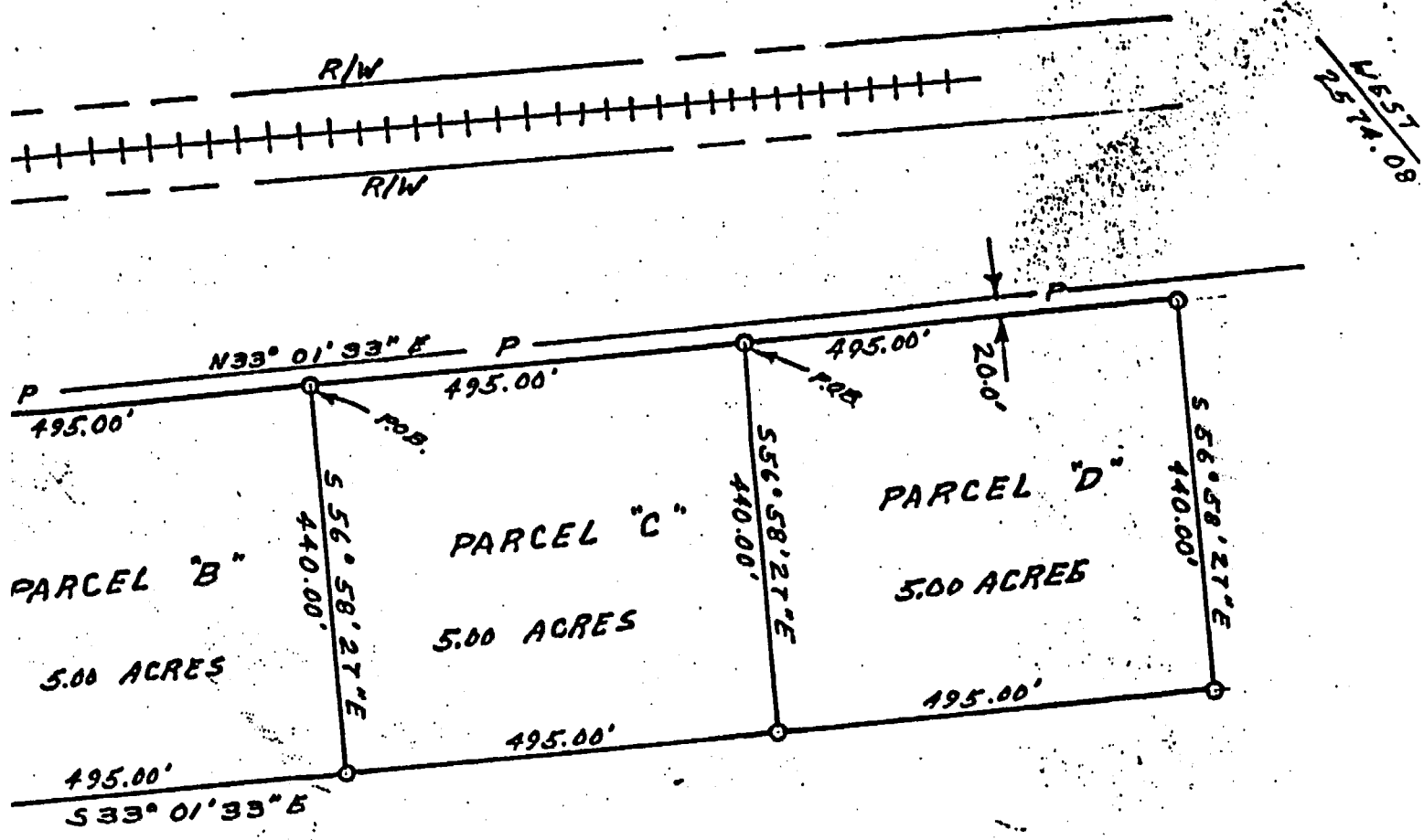
No screen, gravel - 1/4" from 190-222 ft.

Static level: 55' (8/19/62) Discharge test: ---------

Log:

0 - 3'	soil
3 - 10'	brown clay
10 - 30'	yellow clay
30 - 90'	Decomposed andesite
90 - 95'	yellow clay
95 - 108'	andesite
108 - 130'	gray clay
150 - 175'	fractured andesite
175 - 198'	gray clay
198 - 207'	fractured andesite
207 - 214'	sand
214 - 221'	fractured andesite
221 - 222'	clay


Park City
Summit County
Sanitary Landfill Site
Spring
Keetley Junc
Tailings Pond
Richardson Flat
Creek
Silver
Silver King Extension
Prospect
Clark Ranch
Tailings Pond
Tunnel
Deer Valley
Deer Valley Meadow
Queen Esther Shaft
SUMMIT CO
WASATCH CO
VABM 7621
BM 7312
Roost Hill
Prospects
Scale 1 = 24,000


R/W
R/W
WEST
2574.08
P
N33° 01' 33" E
P
495.00'
495.00'
P.O.B.
495.00'
P.O.B.
20.0'
S 56° 58' 27" E
440.00'
PARCEL "B"
5.00 ACRES
S 56° 58' 27" E
440.00'
PARCEL "C"
5.00 ACRES
S 56° 58' 27" E
440.00'
PARCEL "D"
5.00 ACRES
S 56° 58' 27" E
440.00'
495.00'
495.00'
495.00'
495.00'
S 33° 01' 33" E

PARK CITY VENTURES

SUMMARY OF MINING STATISTICS

DEC 1976

	Month	Year-to-Date
Tons of Ore Mined	13,355	174,888
Cost per Ton (1)	45.62	40.44
Tons of Ore Treated	13,355	187,325
Cost per Ton (1)	10.08	8.62
Grade of Ore Treated:		
Silver, ozs./Ton	3.5	3.3
Lead %	5.2	5.2
Zinc %	6.6	7.4
Percent Recovery thru Milling:		
Silver	88.7	86.9
Lead	92.3	89.4
Zinc	89.2	87.0

(1) Includes direct charges, service department charges and allocated general expenses.

PARK CITY VENTURES

SUMMARY OF LEAD & ZINC

PRODUCTION AND SHIPMENTS
1/1-12/31/76

	Lead	Zinc
PRODUCTION:		
Wet Tons of Conc.		
Moisture %		
Dry Tons of Conc.	13,014	21,576
Grade %	68.0	54.9
Contained Tons of Metal	8,844	11,835

	Lead		Zinc	
	Anaconda	ASARCO	Anaconda	ASARCO
SHIPMENTS:				
Wet Tons of Conc.				
Moisture %				
Dry Tons of Conc.	7,689	5,217	13,145	8,551
Grade %	67.9	68.0	54.8	55.2
Contained Tons of Metal	5,223	3,546	7,199	4,719
ENDING INVENTORIES (In Transit):				
Wet Tons of Conc.				
Moisture %				
Dry Tons of Conc.	212	284	262	169
Grade %	70.3	69.0	53.8	53.2
Contained Tons of Metal	149	196	141	90

	Lead	Zinc
ENDING INVENTORIES (On Site):		
Wet Tons of Conc.		
Moisture %		
Dry Tons of Conc.	56	56
Grade %	66.7	52.0
Contained Tons of Metal	37	29

PARK CITY VENTURES
DAILY ORE TALLY FOR 12/30/77
PAGE- 7

COMB FLANK

CUSTOM LEASE ORE

DAILY TONS HOISTED	MONTHLY TONS HOISTED
0.0	846.0

YEAR TO DATE TONS HOISTED (LEASE ORE) 13747.7

YEAR TO DATE TONS HOISTED (INCLUDING MINE ORE) 133330.5

PARK CITY VENTURES
DAILY ORE TALLY FOR 12/30/77
PAGE- 6

COMB FLANK

DAILY SUMMARY OF MINE (EXCLUDING WASTE)

TONS MINED	TONS WANTED	AVERAGE GRADE TODAY AG.	PB.	ZN.
50.6	140	3.9	5.7	5.7

TONS HOISTED	EXCESS TONS MINED
0.0	50.6

DAILY SUMMARY OF MINE (INCLUDING WASTE)

TONS MINED	TONS WANTED	AVERAGE GRADE TODAY AG.	PB.	ZN.
50.6	140	3.9	5.7	5.7

TONS HOISTED	EXCESS TONS MINED
0.0	50.6

TO DATE THIS MONTH (EXCLUDING WASTE)

TONS MINED	TONS WANTED	AVERAGE GRADE THIS MONTH AG.	PB.	ZN.
4664.4	4828	4.2	6.9	7.3

TONS HOISTED	EXCESS TONS MINED
4582.2	82.2

TO DATE THIS MONTH (INCLUDING WASTE)

TONS MINED	TONS WANTED	AVERAGE GRADE THIS MONTH AG.	PB.	ZN.
4664.4	4828	4.2	6.9	7.3

TONS HOISTED	EXCESS TONS MINED
4582.2	82.2

TO DATE THIS YEAR

TONS MINED	TONS WANTED	AVERAGE GRADE THIS YEAR AG.	PB.	ZN.
117601.4	132284	4.1	6.0	7.0

TONS HOISTED
119582.8

115,000 Op. Rep.

Wed, Dec. 29, 1976

TONS MINED	TONS WANTED	AVERAGE GRADE TODAY AG.	PB.	ZN.
636.0	700	2.9	5.0	6.0

TONS HOISTED	EXCESS TONS MINED
562.8	73.2

TO DATE THIS MONTH (EXCLUDING WASTE)

TONS MINED	TONS WANTED	AVERAGE GRADE THIS MONTH AG.	PB.	ZN.
14586.0	17290.0	3.9	5.4	6.7

TONS HOISTED	TONS ON HAND
13561.8	1024.2

TO DATE THIS MONTH (INCLUDING WASTE)

TONS MINED	TONS WANTED	AVERAGE GRADE THIS MONTH AG.	PB.	ZN.
15180.0	17290.0	3.7	5.2	6.4

TONS HOISTED	TONS ON HAND
13561.8	1618.2

TO DATE THIS YEAR

TONS MINED	TONS WANTED	AVERAGE GRADE THIS YEAR AG.	PB.	ZN.
167530.0	202179.0	4.2	5.6	7.4

TONS HOISTED
159637.

CUSTOM LEASE ORE

DAILY TONS HOISTED	MONTHLY TONS HOISTED
0	0

YEAR TO DATE TONS HOISTED, (LEASE ORE)..... 17508.6

YEAR TO DATE TONS HOISTED, (INCLUDING MINE ORE)..... 177146.

YEAR TO DATE METALLURGICAL BALANCE FOR TONNAGE OF 1-31-78 ONTARIO

PRODUCT	DRY TONS	AG	PB	ZN
HEADS	4448.216	4.111	6.720	9.523
PB.CONCT.	387.577	40.117	68.869	4.624
ZN.CONCT.	656.980	1.713	2.069	55.788
TAILS	3403.662	0.474	0.541	1.151

METAL CONTENTS

PRODUCT	AG/OZ	PB/TONS	ZN/TONS
HEADS	18285.982	298.938	423.597
PB.CONCT.	15548.400	266.921	17.922
ZN.CONCT.	1125.558	13.594	366.515
TAILS	1612.024	18.422	39.163

RECOVERIES-PERCENT

PRODUCT	AG	PB	ZN
PB.CONCT.	85.029	89.290	4.231
ZN.CONCT.	6.155	4.547	86.524
TAILS	8.816	6.162	9.245

EXHIBIT 11-B

noranda

Noranda Mining Inc.
Ontario Project
P. O. Box 1450
Park City, Utah 84060

noranda/pamour

Sep/08/81

To: Brian West
From: Bob Zaebst
Subject: Metallurgical Results - Ontario Project

In response to your request, please find the metallurgical results of the Ontario Project, Aug/10/80 through Aug/31/81.

Tonnage (DST)	
Ontario	72,566
Reed Bros.	5,349
Betty O'Neil	4,354
Daly West	3,387
Total	85,656
Metallurgical Results (DST)	74,773
Feed	
Silver	3.00
Lead	4.65
Zinc	5.36
Copper	.109
Iron	7.09
Lead Concentrate (DST)	4,794
Silver	39.8
Lead	64.6
Zinc	5.56
Copper	.831
Iron	3.86
Zinc Concentrate (DST)	6,510
Silver	1.83
Lead	2.12
Zinc	54.2
Copper	.268
Iron	3.09
Recoveries (%)	
Lead Concentrate	
Silver	85.0
Lead	89.1
Zinc	6.6
Copper	48.9
Iron	3.5

Metallurgical Results (Con'd)

Zinc Concentrate	
Silver	5.3
Lead	4.0
Zinc	88.0
Copper	21.4
Iron	3.8

Silver = ozs/ton
Lead = %
Zinc = %
Copper = %
Iron = %

Bob

ONTARIO ORE PROJECT TO DATE WITH DALY WEST AND REED BROS BLEND
DAILY METALLURGICAL BALANCE FOR TONNAGE OF SEPT/08/81

	DRY TONS	AG	PB	ZN	CU	FE
HEADS	74772.616	3.004	4.647	5.364	0.109	7.089
PB.CONCT.	4793.692	39.814	64.597	5.557	0.831	3.863
ZN.CONCT.	6509.774	1.829	2.116	54.200	0.268	3.087
TAILS	63469.152	0.344	0.378	0.340	0.038	7.743

METAL CONTENTS

PRODUCT	AG/OZS	PB/TONS	ZN/TONS	CU/TONS	FE/TONS
HEADS	224617.840	3474.393	4010.480	81.417	5300.531
PB.CONCT.	190857.344	3096.584	266.395	39.824	185.162
ZN.CONCT.	11905.971	137.722	3528.290	17.460	200.976
TAILS	21854.562	240.087	215.795	24.133	4914.394

RECOVERIES-PERCENT

PRODUCT	AG	PB	ZN	CU	FE
PB.CONCT.	84.970	89.126	6.642	48.914	3.493
ZN.CONCT.	5.301	3.964	87.977	21.445	3.792
TAILS	9.730	6.910	5.381	29.641	92.715

TOTAL CONCENTRATE RECOVERIES-PERCENT

PRODUCT	AG	PB	ZN	CU	FE
CONC.	90.270	93.090	94.619	70.359	7.285
TAILS	9.730	6.910	5.381	29.641	92.715

OPERATING TIME 2068.1

Foremen - Day Shift _____

Afternoon Shift _____

Graveyard Shift Bailey

Date _____

3-29-76

EXHIBIT 11-C

	Day shift		Afternoon Shift		Graveyard Shift	
Ball Mill	Dosage ml/min	Remarks	Dosage ml/min	Remarks	Dosage ml/min	Remarks
ZnSO4 10%	1360		1360		1360	
NaCN 10%	1800		1800		1800	
Cyclone O-flow						
~~NaCN 10%~~						
Z-11 10%	56		55		55	
Z-6 10%	26		27		28	
Pb Roughers						
DF-250 100%	off		off			
Z-11 (3rd cell) 10%						
Z-11 (5th cell) 10%						
MIBC	7		6½		5	
Zn Conditioner						
CuSO4 16%	2845		2830		2830	
Z-11 10%	330		330		330	
Zn Roughers						
AF-65 (clners) 25%						
Z-200 (3rd cell) 100%						
Z-200 (5th cell) 100%						
CuSO4 (5th cell) 100%						
MINERIC 1331 (3rd cell)	off		off			

Response of United Park City Mines Company, 01/15/88

QUESTION 11

Please provide information regarding your mining and milling operations that are (were) the source of the mine tailings disposed of at Richardson Flat. Include in your description the type of milling process, the dates the mill was in operation, the amount of ore mined and milled on an annual basis, and the amount of tailings/waste material generated on an annual basis, any chemicals used in the milling process (acids, etc.), amount of water used in the mining/ milling process and the source of the water.

RESPONSE

From United Park City Mines Company's incorporation in 1953 until August, 1969 when it ceased mining and leased its properties to Park City Ventures, United Park City Mines Company sold all of the crude ore mined from its properties directly to various smelters. The crude ore was shipped without beneficiation, enrichment or concentration by any milling process and therefore, no mill tailings were produced. United Park City Mines Company has never operated a mill in connection with its mining operations.

Two of United Park City Mines Company's "assigns" or lessees, operated a mill which was the source of mill tailings disposed of at Richardson Flat. These "assigns" were:

1. Park City Ventures
   c/o The Anaconda Co. and Atlantic Richfield Co.
   555 17th Street
   Denver, Colorado 80217
   or
   c/o ASARCO (American Smelting and Refining Co.)
   180 Maiden Lane
   New York, New York 10038

2. Noranda Mining Inc.
   P. O. Box 45
   Commerce Court West
   Toronto, Ontario, Canada M5L 1B6

Continued on next page

PARK CITY VENTURES

The Ontario Mill was constructed by Park City Ventures and became operational in approximately May, 1975. The mill was designed to be a 750 ton per day flotation concentrator. Capacity was increased to 1000 tons per day in 1977. The concentrator operated intermittentley from about May of 1975 to September of 1981. The most activity was in the period from June of 1975 to January of 1978. During this period, it is estimated that about 435,112 tons of material were milled which consisted of 391,420 tons mined and 31,255 tons of custom lease ore. This generated an estimated 319,486 tons of tailings material. A breakdown of this production is listed below.

	1975	1976	1977	1978
Mined	94,483	174,888	117,601	4,448
Milled	94,483	187,325	117,601	4,448
Tailiings	71,381	152,735	91,967	3,403
Custom		17,508	13,748	

Attached as exhibit 11-A are copies of portions of Park City Ventures production reports. United Park City Mines Company does not have all reports for each year Park City Ventures operated. Therefore, some of the figures which are above summarized are estimates.

NORANDA MINING INC.

Noranda Mining Inc. purchased the Ontario Mill from Park City Ventures when Noranda Mining Inc. assumed the lease of United Park City Mines Company's properties from Park City Ventures. Noranda Mining Inc. operated the Ontario Mill intermittently from August 10, 1980 to August 31, 1981. From Noranda Mining Inc.'s milling activities, approximately 63,469 tons of mill tailings were produced. Exhibit 11-B is a breakdown of the production.

GENERAL INFORMATION

The information available that would indicate the type and amounts of reagents used in the processing of the ores is very incomplete. However, one of the shift reports for the

Continued on next page

Park City Ventures' operation has been found. Exhibit 11-C is a copy of this report. The information needed to determine the quantities of reagents used per ton of ore treated is not currently available to United Park City Mines Company.

Water for the mill as operated by Park City Ventures was obtained from two sources. One was a pump located at a fire hydrant that was fed by the Park City Municipal Water System. The other was a pump located on the 750 foot level of the mine. The water from both sources was pumped to tanks located above the operation.

Noranda Mining Inc. obtained water for the mill by pumping from the 750 foot level of the mine and from Judge Lake located about 15,000 feet from the mill.

The amount of water needed for both operations of Park City Ventures and Noranda Mining Inc. is not known.

United Park City Mines Company reserves the right to supplement this response as additional information and documents become available.

Response of United Park City Mines Company, 01/15/88

QUESTION 12

Please state whether the tailings have been re-worked, the source of the ores (i.e., what mines), location of the mine(s), mill, distance from mine to mill to Richardson Flat, how the tailings were conveyed from the mill to Richardson Flat (e.g., trucked, pipeline, etc.)

RESPONSE

It is not known whether the tailings have been re-worked.

The ores that fed the Ontario Mill operated by Park City Ventures were from the Ontario Mine which is adjacent to the mill. In addition, Park City Ventures processed ore from a deposit believed to be located within the confines of the Bingham Canyon Open-pit copper mine (roughly 70 miles from the mill). This material was known as the Reed Brothers ore and was transported to the mill via trucks. Park City Ventures also processed ore from the Deer Trail Mine located near Marysvale, Utah. Marysvale, Utah is located about 300 miles south of Park City, Utah.

Noranda Mining Inc. operated the Ontario Mill constructed by Park City Ventures after assuming Park City Ventures lease of United Park City Mines Company's properties. The ores processed by Noranda Mining Inc. in the mill originated in the Ontario Mine, which is adjacent to the mill. They also processed ore from the Reed Brothers as well as the Deer Trail Mine. In addition, Noranda Mining Inc. processed ore they called "Betty O'Neil". See Exhibit 12-A. The location of the mine from which the "Betty O'Neil" ores originated is not known. Noranda Mining Inc. also milled a portion of the Daly West Dump in an effort to generate sufficient sand for their underground back-fill operations.

The tailings from the Ontario Mill operated by Park City Ventures and Noranda Mining Inc. were transported to Richardson Flat via slurry line steel and "Driso" pipe. The Ontario Mill is located approximately 6 miles to the southwest from Richardson Flat.

United Park City Mines Company reserves the right to supplement this response as additional information and documents become available.

EXHIBIT 11-A

PARK CITY VENTURES

SUMMARY OF LEAD & ZINC

COST OF PRODUCTION & SHIPMENTS.

May 1, 1975 to December 31, 1975

Tons of Ore Treated	94,483

PRODUCTION COSTS:

	Amount	Cost/Ton
Mining	3,291,397.24	34.84
Milling	1,135,377.29	12.02
Production Taxes	48,350.79	.51
Property & Net. Proc. Taxes	104,530.28	1.11
Amort. of Deferred Development	369,384.06	3.91
Amort. of Deferred Mgmt. Fee	18,619.83	.20
Depreciation - Mining	93,933.57	.99
Depreciation - Milling	240,495.65	2.55
TRANSPORTATION TO R. R.	56,049.93	.59
ANACONDA MANAGEMENT FEE	258,501.37	2.74
SUB TOTAL COSTS	5,616,640.01	59.46
CHANGE IN INVENTORY	(240,931.40)	(2.55)
TOTAL COST	5,375,708.61	56.91

PARK CITY VENTURES

SUMMARY OF LEAD & ZINC

PRODUCTION AND SHIPMENTS

May 1, 1975 to December 31, 1975

	Lead	Zinc
PRODUCTION:		
Wet Tons of Conc.	9,024	14,078
Moisture %	9.4	10.1
Dry Tons of Conc.	8,176	12,656
Grade %	66.4	55.2
Contained Tons of Metal	5,430	6,989

	Lead		Zinc	
	Anaconda	ASARCO	Anaconda	ASARCO
SHIPMENTS:				
Wet Tons of Conc.	5223	3374	8128	5336
Moisture %	9.4	9.4	10.1	10.[illegible]
Dry Tons of Conc.	4731	3057	7307	4797
Grade %	66.8	65.1	55.5	54.[illegible]
Contained Tons of Metal	3161	1988	4055	2620
ENDING INVENTORIES (In Transit):				
Wet Tons of Conc.	77	314	386	159
Moisture %	9.1	9.2	10.6	10.7
Dry Tons of Conc.	70	285	346	142
Grade %	71.4	73.0	56.9	57.0
Contained Tons of Metal	50	207	197	81

	Lead	Zinc
ENDING INVENTORIES (On Site):		
Wet Tons of Conc.	36	71
Moisture %	9.4	10.1
Dry Tons of Conc.	33	64
Grade %	71.2	56.1
Contained Tons of Metal	24	36

Metallurgical Results (Con'd)

Zinc Concentrate	
Silver	5.3
Lead	4.0
Zinc	88.0
Copper	21.4
Iron	3.8

Silver = ozs/ton
Lead = %
Zinc = %
Copper = %
Iron = %

Bot

ONTARIO ORE PROJECT TO DATE WITH DALY WEST AND REED BROS BLEND
DAILY METALLURGICAL BALANCE FOR TONNAGE OF SEPT/00/81

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METAL CONTENTS

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PRODUCT	AG	PB	ZN	CU	FE
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OPERATING TIME 2068.1

noranda
Noranda Mining Inc.
Ontario Project
P. O. Box 1450
Park City, Utah 84060

EXHIBIT 12-A

noranda/pamour

Sep/08/81

To: Brian West
From: Bob Zaebst
Subject: Metallurgical Results - Ontario Project

In response to your request, please find the metallurgical results of the Ontario Project, Aug/10/80 through Aug/31/81.

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Iron	3.86
Zinc Concentrate (DST)	6,510
Silver	1.83
Lead	2.12
Zinc	54.2
Copper	.268
Iron	3.09
Recoveries (%)	
Lead Concentrate	
Silver	85.0
Lead	89.1
Zinc	6.6
Copper	48.9
Iron	3.5

Response of United Park City Mines Company, 01/15/88

QUESTION 13

Please give specific locations other than the Richardson Flat site where United Park City Mines disposed of tailings.

RESPONSE

From United Park City Mines Company's incorporation in 1953 until August, 1969 when it ceased mining and leased it properties to Park City Ventures, United Park City Mines Company sold all of the crude ore mined from its properties directly to various smelters. The crude ore was shipped without beneficiation, enrichment or concentration by any milling process. United Park City Mines Company has never operated a mill in connection with its mining operations. Accordingly, United Park City Mines Company has neither produced or disposed of any mill tailings in the Park City, Utah area.

United Park City Mines Company reserves the right to supplement this response as additional information and documents become available.

Response of United Park City Mines Company, 01/15/88

QUESTION 14

Please indentify any person who may have removed mine tailings from the Richardson Flat site. Please include address and phone number of such person, if known and the dates when removal occurred.

RESPONSE

George W. and Ray L. Wortley, The Wortley Company
P. O Box 102
Park City, Utah 84060

Telephone: 801-649-8016

Dates of mill tailings removal are unknown. Refer to copies of leases previously submitted as Exhibits 1-C-3 & 1-C-4 in answer to Question 1.

United Park City Mines Company reserves the right to supplement this response as additional information and documents become available.