Hay Waite	Stan Leja	6859 3238
SIC M1230
Site 8R24
Stan Leja

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

In the Matter of Remedial Action at:

Reichhold, Inc.
3320 Lincoln Avenue
Tacoma, Washington 98421

AGREED ORDER
No. 1577

By: Reichhold, Inc.
P.O. Box 13582
Research Triangle Park, NC 27709-3582

TABLE OF CONTENTS

ATTACHMENTS

I. JURISDICTION

This Agreed Order ("Order") is issued pursuant to the authority of RCW 70.105D.050(1).

II. DEFINITIONS

Unless otherwise specified, the definitions set forth in Chapter 70.105D RCW and Chapter 173-340 WAC shall control the meanings of the terms used in this Order.

Additional definitions are as follows:

1. Agreed Order or Order means this Order issued under WAC 173-340-530. The term includes the text of this Order, all Attachments to this Order, and all Ecology-approved submittals required pursuant to this Order. Order Attachments and Ecology approved submittals are incorporated into this Order by this reference and are enforceable parts of this Order as if fully set forth herein.

2. Area of Concern (AOC) means any area of the Facility where a release of dangerous constituents (including dangerous waste and hazardous substances) has occurred, is occurring, is suspected to have occurred, or threatens to occur.

3. Blair Backup Property means a tract of land lying in Section 35 and the west half of Section 36, T. 21 N., R. 3 E., W.M., in Pierce County, Washington, described more fully on Attachment 6, hereto.

4. Blair Waterway Property means a parcel of land in Section 35, T 21 N., R. 3 E., W.M., described more fully on Attachment 6, hereto.

5. Cleanup Action Plan (CAP) means the document issued by Ecology under WAC 173-340-360 which selects facility specific corrective measures and specifies cleanup standards (cleanup levels, points of compliance, and other requirements for corrective measures).

6. Cleanup Standards means the standards developed for the Site under WAC 173-340-700(3) and that consist of the following: (a) Cleanup levels (concentrations of hazardous substance in soil, water, air or sediment that are determined to be protective of human health and the environment under specified exposure conditions) for hazardous substances present at the site; (b) The location where

these cleanup levels must be met (point of compliance); and (c) Other regulatory requirements that apply to the site because of the type of action and/or location of the site ("applicable state and federal laws").

7. Corrective Action means any activities including investigations, studies, characterizations and corrective measures, including actions taken pursuant to Chapter 70.105D RCW and Chapter 173-340 WAC, undertaken in whole or in part to fulfill the requirements of WAC 173-303-646, or applicable EPA requirements.

8. Corrective Action Management Unit (CAMU) means the area within the Facility that is designated by Ecology pursuant to WAC 173-303-646(4), (5), and (6) for the purpose of implementing the corrective action requirements of WAC 173-303-646(2). A CAMU may be used only for the management of remediation wastes pursuant to implementing corrective action requirements at the Facility.

9. Corrective Measure means any measure or action to control, prevent, or mitigate releases and/or potential releases of dangerous constituents (including dangerous waste and hazardous substances) reviewed and approved by Ecology for the facility and set forth in a facility specific Cleanup Action Plan (CAP) prepared in compliance with the requirements of Chapter 173-340 WAC, including WAC 173-340-360. Corrective measures may include interim actions as defined by Chapter 173-340 WAC. Interim actions will not necessarily be set forth in a facility specific CAP.

10. Dangerous Constituent means any constituent identified in WAC 173-303-9905 or 40 CFR Part 264 Appendix IX, any constituent which caused a waste to be listed or designated as dangerous under the provisions of Chapter 173-303 WAC, and any constituent defined as a hazardous substance at RCW 70.105D.020(7).

11. Dangerous Waste means any solid waste designated in WAC 173-303-070 through 173-303-100 as dangerous or extremely hazardous or mixed waste. As used in this Order and in any attachments or submittals hereto, the term dangerous waste includes the terms hazardous waste and acute hazardous waste as defined in EPA regulations and Ecology regulations. Dangerous wastes are considered hazardous substances under RCW 70.105D.020(7).

12. Dangerous Waste Constituent means any constituent listed in WAC 173-303-9905 and any other constituent that has caused a waste to be a dangerous waste under Chapter 173-303 WAC.

13. Dangerous Waste Management Unit (DWMU) is a contiguous area of land on or in which dangerous waste is placed, or the largest area in which there is a significant likelihood of mixing dangerous waste constituents in the same area, as defined in WAC 173-303-040.

14. Ecology means the Department of Ecology.

15. EPA means the U.S. Environmental Protection Agency.

16. Facility or Site means the property owned and occupied by Reichhold, Inc. (Reichhold) located at 3320 Lincoln Avenue, Tacoma, Washington, and all property contiguous thereto also controlled by Reichhold, and all property, regardless of control, affected by releases or threatened releases of hazardous substances, including dangerous wastes and dangerous constituents, at and from these areas.

17. Feasibility Study (FS) means the focused investigation and evaluation of potential corrective measures performed in accordance with the Feasibility Study (FS) requirements of WAC 173-340-350, which includes the substantive requirements for a RCRA Corrective Measures Study, and undertaken in whole or in part to fulfill the corrective action requirements of WAC 173-303-646.

18. HWMA means the Washington Hazardous Waste Management Act, chapter 70.105 RCW.

19. MTCA means the Model Toxics Control Act, chapter 70.105D RCW.

20. Permit or Permitting Requirement, unless otherwise specified, means the requirements of Chapter 173-303-WAC for applying for, obtaining, maintaining, modifying, and terminating dangerous waste management facility permits.

21. RCRA means the federal Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 et seq.

22. RCRA Facility Assessment (RFA) means the investigation conducted by EPA and Ecology of releases and potential releases at the Facility and the information contained in the report

entitled Reichhold Chemicals, Inc. - RCRA Facility Assessment, dated July 1987 ("RFA Report"). The RFA Report is incorporated into this Order by this reference as if fully set forth herein.

23. Release means any intentional or unintentional spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of dangerous waste or dangerous constituents into the environment. It also includes the abandonment or discarding of barrels, containers, and other receptacles containing dangerous waste or dangerous constituents and includes the definition of release in RCW 70.105D.020(20).

24. Remedial Actions or Remedial Activities, means any action or expenditure consistent with the purposes of chapter 70.105D RCW to identify, eliminate, or minimize any threat posed by hazardous substances to human health or the environment including any investigating and monitoring activities with respect to any release or threatened release of a hazardous substance and any health assessments or health effects studies conducted in order to determine the risk or potential risk to human health.

25. Remedial Investigation (RI) means a focused investigation and characterization performed in accordance with the requirements of Chapter 173-340 WAC, which includes the substantive requirements for a RCRA facility investigation, undertaken in whole or in part to fulfill the corrective action requirements of WAC 173-303-646.

26. Solid Waste Management Unit (SWMU) means any discernible location at the Facility where solid wastes have been placed at any time, irrespective of whether the location was intended for the management of solid or dangerous waste. Such locations include any area at the dangerous waste management facility at which solid wastes, including spills, have been routinely and systematically released. Such units include regulated units as defined by Chapter 173-303 WAC.

III. OBJECTIVES

The objectives of this Order are as follows:

1. Reichhold shall complete a focused remedial investigation and feasibility study to be approved by Ecology and in accordance with the requirements of Chapter 173-340 WAC. The purpose

of the RI/FS shall, in part, be to concurrently satisfy the substantive requirements of a RCRA facility investigation and RCRA corrective measures study, undertaken in whole or in part to fulfill the corrective action requirements of WAC 173-303-646. Concurrently, a corrective action management unit (CAMU) will be established through Agreed Interim Action Administrative Order No. 1578 (CAMU Order).

The focused RI will fill in existing data gaps by supplementing information collected during earlier investigations, and interim actions. A basic objective of the focused RI will be the calculation of cleanup levels for constituents of concern (COCs) that meet the requirements of MTCA Method B surface water cleanup levels as stated in WAC 173-340-730, and other applicable state and federal regulations. The scope of the focused RI is addressed in Attachment 3 to this Order.

The focused FS will develop remedial action alternatives for the site that will be capable of treating impacted soils to meet appropriate soil cleanup levels, achieving hydraulic control of groundwater in the intermediate aquifer containing contaminant concentrations above groundwater cleanup levels, or developing in-situ treatment of contaminated ground water in the event hydraulic control cannot be achieved. The focused FS also will evaluate the feasibility of using in-situ treatment of contaminated groundwater as an alternative to hydraulic control. The scope of the focused FS is addressed in Attachment 4 to this Order.

2. After completion and approval of the remedial investigation and feasibility study, Reichhold will prepare a draft Cleanup Action Plan (CAP) for Ecology according to the requirements of WAC 173-340-380. Ecology and Reichhold intend to initiate procedures to negotiate a Consent Decree pursuant to RCW 70.105D.040(4) that will provide for the implementation of a CAP to satisfy the requirements of WAC 173-340-400, and concurrently satisfy the corrective action requirements of WAC 173-303-646.

3. After public review and comment on the Consent Decree, the Cleanup Action Plan will be finalized and Reichhold will be required to design, construct, operate, and monitor the selected cleanup or corrective actions in accordance with the Consent Decree.

IV. FINDINGS OF FACT

Ecology makes the following Findings of Fact, which Reichhold neither admits nor denies.

1. Reichhold has owned and operated the Facility since 1956 for, among other things, the production of a variety of chemical products, including pentachlorophenol, formaldehyde, calcium chloride solution, and formaldehyde catalyst. Reichhold ceased all of its manufacturing operations at the Facility in September 1990, and currently conducts only soil and ground water remediation activities at the Site.

2. Reichhold owned and operated the Facility as a dangerous waste management facility on or after November 19, 1980, the date which subjects facilities to RCRA permitting requirements pursuant to Section 3005 of RCRA and implementing regulations thereunder, including authorized state regulations promulgated in Chapter 173-303 WAC.

3. In August 1980, Reichhold submitted a Notification of Hazardous Waste Activity (EPA Form 8700-12) for the Facility to EPA. The Notification indicated that Reichhold was engaged in the generation, transportation, and treatment/storage/disposal of hazardous waste. EPA assigned the Facility I.D. No. WAD009252891. In April 1985, Reichhold submitted a subsequent Notification of Hazardous Waste Activity, which indicated that generation was the only hazardous waste activity conducted at the Facility.

4. In November 1980, Reichhold submitted a RCRA Part A application (EPA Forms 3510-1 and 3510-3) to EPA. Reichhold submitted revised Part A applications in September 1982, January 1986, July 1986, and October 1986 to EPA with copies to Ecology. Reichhold submitted Part B applications in February 1986 and October 1986 to EPA with copies to Ecology. Both versions of the 1986 Part B application covered the Facility's wastewater treatment area, spoil disposal area and drum storage area.

5. On June 30, 1986, Reichhold entered into a Consent Agreement and Order (No. 1086-04-33-3008) (1986 Order) with EPA Region 10 and Ecology to undertake an investigation to characterize the Site soils and hydrogeology and to research and identify areas at the Facility that would correspond to

RCRA regulated units, SWMUs and Areas of Concern. The 1986 Order was terminated when the 1988 RCRA Permit, described in paragraph 7, below, became effective.

6. In July 1987, EPA performed a RCRA Facility Assessment (RFA) at the Facility. Pursuant to the RFA Report and the 1986 Order, among other information, EPA and Ecology identified various RCRA-regulated units, SWMUs and Areas of Concern at the Facility. Reichhold evaluated each of these units and areas to determine whether any of them potentially could release hazardous substances into the environment. Based on the results of this evaluation, which was conducted with the review and concurrence of EPA and Ecology, a subset of the total number of the identified RCRA-regulated units, SWMUs, and Areas of Concern was determined to warrant further investigation and possible corrective action.

7. Reichhold submitted a revised Part B application in January 1988. Reichhold's Part B application covered three active units (a proposed new drum storage area, existing drum storage area, and pilot plant area drum storage area), and five inactive units (former main disposal area, former construction debris area, former wastewater treatment ponds, former resin tank farm, and former pentachlorophenol plant area). Based upon this application, EPA issued a RCRA storage and corrective action permit, effective since December 4, 1988 (1988 RCRA Permit). The Facility has conducted RCRA corrective action activities under the 1988 RCRA Permit. On June 3, 1998, Reichhold submitted renewal Part A and Part B RCRA Permit applications to both EPA and Ecology. Because Reichhold submitted timely RCRA Permit renewal applications to both EPA and Ecology, the 1988 RCRA Permit was administratively continued pursuant to WAC 173-303-806(7) and provision I.H. of the 1988 RCRA Permit, until the permit was replaced or terminated.

8. Working with both EPA and Ecology under the 1986 Order and the 1988 RCRA Permit, Reichhold has undertaken several investigations and corrective actions at the Facility to address those RCRA-regulated units, SWMUs, and Areas of Concern that were determined to require further investigation. As of the effective date of this Order, Reichhold has submitted documents to EPA and

Ecology concerning these investigations and corrective actions. A partial list of these documents is included in Attachment 1.

9. In 1991, under EPA and Ecology oversight, Reichhold closed unit No. 3, the wastewater treatment ponds in accordance with the closure requirements of the 1988 RCRA Permit.

10. In 1999, under EPA and Ecology oversight, Reichhold closed unit No. 4, the drum storage area and unit No. 32, the pilot plant drum storage in accordance with the closure requirements of the 1988 RCRA Permit.

11. In 2004, under EPA and Ecology oversight, Reichhold closed unit No. 51, the drum storage building, in accordance with the closure requirements of the 1988 RCRA Permit.

12. Under Ecology's authorization to implement RCRA and HWMA corrective action requirements through MTCA and the regulations promulgated thereunder, Ecology will issue a Dangerous Waste Management Permit for Corrective Action, this separate enforceable order under MTCA for a remedial investigation and feasibility study (Agreed Order No. 1577), and the CAMU Order to establish a CAMU at the facility. The Orders will be incorporated by reference into Reichhold's Dangerous Waste Management Permit for Corrective Action. Upon completion of RI/FS activities, Ecology and Reichhold intend to negotiate a Consent Decree under MTCA to implement final remedial actions that will likewise satisfy HWMA corrective action requirements at the facility.

13. A list of known hazardous substances and dangerous waste constituents for soil treated at the Site is contained in the July 22, 2002, letter from Ecology for Reichhold, which is contained in Attachment No. 1 to the CAMU Order. Based on documents referenced above and in Attachment No. 1 to this Agreed Order, soil at the Facility is contaminated with hazardous substances and dangerous waste constituents including, but not limited to, pentachlorophenol, 2,4,6-trichlorophenol, 2,4-dichlorophenol, phenol, other chlorinated phenols, PCBs (Arochlor 1248), formaldehyde, styrene, toluene, ethylbenzene, tetrachloroethylene, trichloroethylene, and molybdenum.

14. Based on documents referenced above and in Attachment 1 to this Agreed Order, groundwater at the Facility and beyond the Facility boundaries is contaminated with hazardous

substances and dangerous waste constituents including, but not limited to, pentachlorophenol, 2,4,6-trichlorophenol, 2-4 dichlorophenol, phenol, other chlorinated phenols, formaldehyde, acetone, trichloroethylene, and molybdenum.

15. On October 20, 2000, Reichhold submitted an application for designation of a CAMU at the Facility in the form of a document entitled *Technical Summary, RCRA Corrective Action Management Unit Summary, Reichhold, Inc., 3320 Lincoln Avenue, Tacoma, WA 98421.* Ecology reviewed the application and determined that it was substantially complete in a letter dated November 22, 2000.. Reichhold submitted revised versions of this document in November 2001 and March 2004.

V. ECOLOGY DETERMINATIONS

Ecology makes the following determinations, which Reichhold neither admits nor denies.

1. Reichhold is a person within the meaning of RCW 70.105D.020(14).

2. Reichhold is the owner and operator of a dangerous waste management facility that has operated, and is operating, under a RCRA permit and is subject to the corrective action requirements thereunder, including authorized state regulations in Chapter 173-303 WAC

3. Certain waste and constituents found at the Facility are dangerous wastes and/or dangerous constituents as defined by Chapter 173-303 WAC, and shown in Section IV of this Order.

4. These dangerous wastes and dangerous constituents are considered hazardous substances within the meaning of RCW 70.105D.020(7).

5. Based on the Findings of Fact and the administrative record, Ecology has determined that releases and potential releases of hazardous substances at and/or from the Facility present a potential threat to human health and the environment.

6. By letter dated March 2, 2000, Ecology notified Reichhold of its status as a "potentially liable person" under RCW 70.105D.040. By letter of March 29, 2000, Reichhold agreed not to contest Ecology's determination that Reichhold is a "potentially liable person" under RCW 70.105D.040.

7. Pursuant to RCW 70.105D.030(1) and RCW 70.105D.050, the Department may require potentially liable persons to investigate or conduct other remedial actions with respect to the release or threatened release of hazardous substances, whenever it believes such action to be in the public interest.

8. The actions, including ongoing interim actions, investigations and feasibility studies required by this Order are in the public interest.

9. The document entitled *Technical Summary, RCRA Corrective Action Management Unit Summary, Reichhold, Inc., 3320 Lincoln Avenue, Tacoma, WA 98421* (CAMU Summary Document), dated March 2004, addresses the requirements for the CAMU pursuant to WAC 173-303-646(5)(b).

10. Under the CAMU Order, a CAMU is designated at the Facility pursuant to WAC 173-303-646(4), (5), and (6) for the purpose of implementing the corrective action requirements of WAC 173-303-646(2).

11. The RCRA regulated units at the Facility (former main disposal area, former construction debris area, former resin tank, and former pentachlorophenol plant) are incorporated into the CAMU Order, and are incorporated into this Agreed Order, pursuant to WAC 173-303-646(6).

12. Pursuant to WAC 173-303-610(1)(d), the closure requirements included in the CAMU Summary Document dated March 2004 will serve to meet the alternative requirements for closure for the regulated units incorporated into the CAMU Order, and are incorporated into this Agreed Order.

13. Pursuant to WAC 173-303-620(1)(d), the financial assurance requirements for regulated units addressed in the CAMU Order are met through the alternative requirements for financial assurance for regulated units set forth under Section VII.3 of this Agreed Order.

14. Pursuant WAC 173-303-645(1)(e), the groundwater monitoring requirements included in this Agreed Order will serve to meet the alternative requirements for groundwater monitoring for the regulated units incorporated into the CAMU Order.

15. Based on existing information, no further action is required for the portion of the Facility known as "Parcel A," which is shown on the map and described more particularly in Attachment 5 to this Agreed Order. Based on existing information, no further action is required for the portion of the Facility

known as Regulated Unit #3 (wastewater treatment ponds). Based on existing information, no further action is required for the portion of the Facility known as Area #49 (off-site storage area).

VI. WORK TO BE PERFORMED

Based on the foregoing Facts and Determinations, Reichhold agrees to take the following remedial actions:

1. Maintenance of current remediation activities.

A. Groundwater Remediation. Reichhold shall continue its groundwater remedial activities under Attachment 2 of this Order. These groundwater remedial activities may be altered or eliminated as warranted by Site conditions, and through work to be performed under this Order subject to Ecology's approval. The hydraulic containment system currently is composed of:

1. A shallow interceptor drain (SID).
2. An operating groundwater extraction and collection system.
3. A water treatment system.

B. Management of Remediation Waste and Onsite Soils. Reichhold shall continue to operate its onsite soil cells to reduce the concentration of hazardous constituents in excavated soils on the Site according to the requirements of the CAMU Order.

C. Groundwater Monitoring. Reichhold shall implement groundwater monitoring at the Site in accordance with Attachment 2 hereto.

2. Focused remedial investigation (RI) work plan. Within ninety (90) days of the effective date of this Agreed Order, Reichhold shall prepare a focused RI work plan, including a schedule, in accordance with Attachment 3, hereto. Within sixty (60) days of receiving Reichhold's draft RI work plan, Ecology shall endeavor to provide comments on the draft RI work plan. If Ecology is unable to provide comments within sixty (60) days, Ecology shall so notify Reichhold. Within sixty (60) days of receiving Ecology's comments on the draft RI work plan, Reichhold shall prepare and submit for Ecology's approval a revised RI work plan. Ecology will then approve, approve with conditions, or disapprove of Reichhold's revised RI work plan. If Ecology disapproves of the revised RI work plan,

Ecology will provide comments to Reichhold and the parties will establish a mutually agreed upon date for Reichhold's resubmittal of the RI work plan, not to exceed sixty (60) days after Reichhold's receipt of Ecology's comments. Reichhold will then submit a revised RI work plan that addresses Ecology's comments.

3. Focused remedial investigation (RI) report. Reichhold shall prepare a focused RI report in accordance with, and pursuant to the schedule included in the approved focused RI work plan. Within sixty (60) days of receiving Reichhold's draft RI report, Ecology shall endeavor to provide comments on the draft RI report. If Ecology is unable to provide comments within sixty (60) days, Ecology shall so notify Reichhold. Within sixty (60) days of receiving Ecology's comments on the draft RI report, Reichhold shall prepare and submit for Ecology's approval a revised RI report. Ecology will then approve, approve with conditions, or disapprove of Reichhold's revised RI report. If Ecology disapproves of the revised RI report, Ecology will provide comments to Reichhold and the parties will establish a mutually agreed upon date for Reichhold's resubmittal of the RI report, not to exceed sixty (60) days after Reichhold's receipt of Ecology's comments. Reichhold will then submit a revised RI report that addresses Ecology's comments.

4. Focused Feasibility study (FS) work plan. No later than ninety (90) days after Ecology's written approval of the revised focused RI report, Reichhold will submit to Ecology a draft feasibility study (FS) work plan including a schedule for implementation of the work plan. Nothing in this section shall preclude Reichhold from submitting the draft FS work plan earlier than ninety (90) days after receiving Ecology's written approval of the focused RI report. The work plan will address the tasks included in Attachment 4 to this Order. Within sixty (60) days of receiving Reichhold's draft FS work plan, Ecology shall endeavor to provide comments on the draft FS work plan. If Ecology is unable to provide comments within sixty (60) days, Ecology shall so notify Reichhold. Within sixty (60) days of receiving Ecology's comments on the draft FS work plan, Reichhold shall prepare and submit for Ecology's approval a revised FS work plan. Ecology will then approve, approve with conditions, or disapprove of Reichhold's revised FS work plan. If Ecology disapproves of the revised FS work plan,

Ecology will provide comments to Reichhold and the parties will establish a mutually agreed upon date for Reichhold's resubmittal of the FS work plan, not to exceed sixty (60) days after Reichhold's receipt of Ecology's comments. Reichhold will then submit a revised FS work plan that addresses Ecology's comments.

5. Focused Feasibility study (FS) report. According to the schedule in the approved FS work plan, Reichhold will submit to Ecology for its approval, a draft FS report. Within sixty (60) days of receiving Reichhold's draft FS report, Ecology shall endeavor to provide comments on the draft FS report. If Ecology is unable to provide comments within sixty (60) days, Ecology shall so notify Reichhold. Within sixty (60) days of receiving Ecology's comments on the draft FS report, Reichhold shall prepare and submit for Ecology's approval a revised FS report. Ecology will approve, approve with conditions, or disapprove of Reichhold's revised FS report. If Ecology disapproves of the revised FS report, Ecology will provide comments to Reichhold and the parties will establish a mutually agreed upon date for Reichhold's resubmittal of the FS report, not to exceed ninety (90) days after Reichhold's receipt of Ecology's comments. Reichhold will then submit a revised FS report that addresses Ecology's comments.

6. Cleanup action plan. No later than ninety (90) days after receiving Ecology's written approval of the RI/FS, Reichhold shall submit a draft cleanup action plan (CAP) for Ecology's consideration that fulfills the requirements of WAC 173-340-380. Nothing in this section shall preclude Reichhold from submitting the draft CAP earlier than ninety (90) days after receiving Ecology's written approval of the RI/FS.

Within sixty (60) days of receiving Reichhold's draft CAP, Ecology shall endeavor to provide comments on the draft CAP. If Ecology is unable to provide its comments within sixty (60) days, it shall so notify Reichhold. Within ninety (90) days of receiving Ecology's comments on the draft CAP Reichhold will prepare and submit to Ecology a revised CAP for Ecology adoption. Ecology will then adopt the revised CAP, rewrite the CAP on its own, or allow Reichhold the opportunity to continue revising the CAP until Ecology is prepared to adopt the revised CAP. If Reichhold does not wish to

continue revising the CAP, Reichhold shall notify Ecology, and Ecology may then rewrite the CAP. After an appropriate public comment period, and changes by Ecology, if any, in light of public comment, the parties intend that the CAP will be implemented under the purview of a mutually satisfactory Consent Decree, to be negotiated with Reichhold pursuant to RCW 70.105D.040(4).

7. Reichhold shall notify Ecology's project manager in writing of any newly-identified SWMU(s), and newly-discovered areas of concern at the facility no later than fifteen (15) days after discovery. Reichhold shall notify Ecology's project manager of newly discovered releases from known SWMUs under the groundwater monitoring or other Site programs in accordance with Attachment 2 to this Agreed Order.

VII. TERMS AND CONDITIONS OF ORDER

1. Public Notices: Ecology shall be responsible for providing public notice and reserves the right to modify or withdraw any provisions of this Order should public comment disclose facts or considerations which indicate to Ecology that the Order is inadequate or improper in any respect.

2. Remedial and Investigative Costs: Reichhold agrees to pay costs incurred after June 8, 2000, by Ecology pursuant to this Order. These costs shall include work performed by Ecology or Ecology's contractors concerning this Order, including investigations, remedial actions, and Order preparation, negotiations, oversight and administration of this Order. Ecology costs shall include costs of direct activities and support costs of direct activities as defined in WAC 173-340-550(2). Reichhold agrees to pay the required amount, except for those costs that Reichhold disputes, within ninety (90) days of receiving from Ecology an itemized statement of costs that includes a summary of costs incurred, an identification of involved staff, a description of work performed as contained in site logs, and the amount of time spent by involved staff members on the project. Itemized statements will be prepared quarterly. Failure to pay Ecology's costs, other than disputed costs, within ninety (90) days of receipt of the itemized statement of costs will result in interest charges as authorized by State law. Reichhold shall pay any disputed costs that remain after completion of the dispute resolution process set forth below within ninety (90) days of a final determination by Ecology. Payments mailed via the U.S. Postal Service

should be addressed to: Cashiering Section, PO Box 5128, Lacey, Washington 98509-5128. Payments sent by a messenger/overnight delivery service should be addressed to: Cashiering Section, 300 Desmond Drive, Lacey Washington 98503. So it is properly credited, Reichhold should indicate the check is for cost recovery on the Reichhold Facility and enclose the bottom portion of Ecology's invoice.

3. Financial Assurance:

A. Reichhold shall establish and maintain financial assurance for corrective action in the amount necessary to implement current corrective actions at the Facility, and the operation and closure of the CAMU as required by WAC 173-303-646. In the absence of final regulations governing financial assurance for corrective action, the Financial Assurance for Corrective Action Proposed Rule, 51 FR 37853 (October 24, 1986) the financial assurance provisions of Corrective Action for Releases from Solid Waste Management Units Advance Notice of Proposed Rulemaking, 61 FR 19432 (May 1, 1996), and the Interim Guidance on Financial Assurance for Facilities Subject to RCRA Corrective Aciton (U.S. EPA, September 30, 2003), or other guidance that may be available at the time, shall be used as guidance. The financial assurance provisions of the Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities, 55 FR 30798 (July 27, 1990), may be used as secondary guidance at the discretion of Ecology. Acceptable mechanisms include trust funds, surety bonds guaranteeing performance, letters of credit, insurance, the financial test, and corporate guarantee or another instrument if Reichhold demonstrates to the satisfaction of Ecology that another instrument provides an acceptable level of financial assurance. Reichhold shall provide Ecology's project manager and Ecology's financial assurance officer with documentation of this financial assurance within sixty (60) days of Ecology's issuance of this Order.

The date that final original financial assurance documentation is received by Ecology's financial assurance officer is the "financial assurance anniversary date" of this Order.

B. Reichhold shall adjust the financial assurance coverage and provide Ecology's project manager and Ecology's financial assurance officer with documentation of the updated financial assurance for:

1. Inflation, annually, within thirty (30) days of the financial assurance anniversary date, as defined above; or, if applicable, the modified financial assurance anniversary date, that has been set in paragraph 2 below.

2. Changes in cost estimates, which shall be submitted to Ecology within thirty (30) days of Ecology's issuance of a Modified Order. Within sixty (60) days of Ecology's approval of the change in cost estimate, Reichhold shall adjust the financial assurance coverage and provide Ecology's project manager and Ecology's financial assurance officer with documentation of the updated financial assurance. The receipt of the updated financial assurance documents modifies the financial assurance anniversary date.

C. Reichhold shall notify Ecology's project manager and Ecology's financial assurance officer by certified mail of the commencement of a voluntary or involuntary bankruptcy proceeding under Title 11, United States Code, naming Reichhold as debtor, within ten (10) days after commencement of the proceeding. A guarantor of a corporate guarantee must make such a notification if he is named as debtor as required under the terms of the corporate guarantee.

Once Reichhold has established financial assurance for corrective action with an acceptable mechanism, mentioned above, Reichhold will be deemed to be without the required financial assurance:

1. In the event of bankruptcy of the trustee or issuing institution; or
2. The authority of the trustee institution to act as trustee has been suspended or revoked; or
3. The authority of the institution issuing the surety bond, letter or credit, or insurance policy has been suspended or revoked.

In the event of bankruptcy of the trustee or a suspension or revocation of the authority of the trustee institution to act as a trustee, Reichhold must establish financial assurance by any means specified in WAC 173-303-620 within sixty (60) days after such an event.

D. Ecology's financial assurance officer is:

Name:	Jim Knudson
Address:	Department of Ecology, Hazardous Waste and Toxics Reduction Program P.O. Box 47600 Olympia, Washington 98504-7600
Telephone:	(360) 407-6693
FAX:	(360) 407-6715
E-mail:	jknu461@ecy.wa.gov

4. Designated Project Coordinators:

The project manager for Ecology is:

Name:	Stan Leja
Address:	Department of Ecology, Southwest Regional Office P.O. Box 47775 Olympia, Washington 98504-7775
Telephone:	(360) 407-6345
FAX:	(360) 407-6305
E-mail:	slej461@ecy.wa.gov

The project manager for Reichhold is:

Name:	William L. Schmithorst
Address:	P.O. Box 13582, Research Triangle Park, NC 27709-3582
Telephone:	(919) 990-7500
FAX:	(919) 558-7167
E-mail:	bill.Schmithorst@reichhold.com

The project manager(s) shall be responsible for overseeing the implementation of this Order. To the maximum extent possible, communications between Ecology and Reichhold, and all documents, including reports, approvals, and other correspondence concerning the activities performed pursuant to the terms and conditions of this Order shall be directed through the project manager(s). Should Ecology or Reichhold change project manager(s), written notification shall be provided to Ecology or Reichhold at least ten (10) calendar days prior to the change if possible.

5. Performance: All work performed by Reichhold pursuant to this Order shall be under the direction and supervision, as necessary, of a professional engineer or licensed hydrogeologist, or similar expert, with appropriate training, experience and expertise in hazardous waste facility investigation and cleanup. Reichhold shall notify Ecology as to the identity of such engineer(s) or hydrogeologist(s), and

of any contractors to be used in carrying out the terms of this Order, in advance of their involvement at the Facility. Reichhold shall provide a copy of this Order to all agents, contractors and subcontractors retained to perform work required by this Order and shall ensure that all work undertaken by such agents and contractors will be in compliance with this Order.

Except where necessary to abate an emergency situation, Reichhold shall not perform any active remedial actions at the Facility other than those required by this Order or another Order, permit, or written authorization issued by Ecology, unless Ecology concurs, in writing, with such additional actions. For purposes of this paragraph, "active remedial actions" shall mean on-the-ground investigation (including sampling), remedy construction, operation of remedial systems, or similar activities.

WAC 173-340-400(6)(b)(i) requires that "construction" performed on the facility for purposes of implementing this Order must be under the supervision of a professional engineer registered in Washington.

6. Access: Ecology or any Ecology authorized representative shall have the authority to enter and freely move about the facility at all reasonable times for the purposes of, among other things, inspecting records, operation logs, and contracts related to the work being performed pursuant to this Order; reviewing the progress in carrying out the terms of this Order; conducting such tests or collecting samples as Ecology or the project manager may deem reasonable and necessary; using a camera, sound recording, or other documentary type equipment to record work done pursuant to this Order; and verifying the data submitted to Ecology by Reichhold. Ecology shall ensure that any Ecology authorized representative shall follow Ecology's health and safety plan while at the Facility. Ecology shall allow split or replicate samples to be taken by Reichhold during an inspection unless doing so interferes with Ecology's sampling. Under this Agreed Order, Reichhold shall provide seven (7) days written notice to Ecology's project manager prior to conducting field activities governed by this Order, unless Ecology has provided Reichhold with a written exemption from notification. Reichhold shall provide timely notice to the Puyallup Tribe prior to conducting field activities governed by this Order that are on the Blair Waterway Property or the Blair Backup Property or that are reasonably expected to affect property

owned by the Tribe. Reichhold shall provide split samples to Ecology upon request. Without limitation on Ecology's rights under this Section, Ecology shall notify Reichhold prior to any sample collection activity and shall endeavor to notify Reichhold prior to any access activity.

7. Reporting. All work plans require Ecology approval prior to initiation of remedial activities. Reports, including progress reports, sampling data, quarterly and annual ground water monitoring reports and QA/QC reports, must be submitted to Ecology for Ecology's approval. Once approved or modified and approved in writing by Ecology, submittals are incorporated by reference and become enforceable parts of this Order as if fully set forth herein.

With respect to implementation of this Order, Reichhold shall provide the results of all soil and ground water sampling, laboratory reports, and/or test results generated by it, or on its behalf, to Ecology within forty five (45) days of receipt of validated laboratory data. If requested by Ecology, Reichhold shall provide unvalidated laboratory data. Reichhold shall submit to Ecology written reports for remedial actions. At a minimum these reports shall include the following:

A. A list of the remedial activities completed;

B. Brief descriptions of any deviations from required tasks not otherwise documented in project plans or amendment requests;

C. Descriptions of all deviations from the schedule; and

For any deviation in schedule, a plan for recovering lost time and maintaining compliance with the schedule.

8. Retention of Records: Reichhold shall preserve in a readily retrievable fashion, during the pendency of this Order and for ten (10) years from the date of issuance by Ecology of written notification that all requirements of this Order have been satisfactorily completed, reports, documents, and underlying data in its possession relevant to this Order. Should any portion of the work performed hereunder be undertaken through contractors of Reichhold, then Reichhold agrees to include in its contracts with prime contractors a record retention requirement meeting the terms of this paragraph.

9. Dispute Resolution: In the event a dispute arises as to an approval, disapproval, proposed modification or other decision or action by Ecology's project manager, Ecology and Reichhold shall utilize the dispute resolution procedure set forth below:

A. Upon receipt of the Ecology project manager's decision, Reichhold has fourteen (14) days within which to notify Ecology's project manager of its objection to the decision.

B. Reichhold and Ecology's project managers shall then confer in an effort to resolve the dispute. If the project managers cannot resolve the dispute within fourteen (14) days, Ecology's project manager shall issue a written decision.

C. Reichhold may then request Ecology management review of the decision. This request shall be submitted in writing to the regional section manager of Ecology's Hazardous Waste and Toxics Reduction Program (Section Manager) within fourteen (14) days of receipt of Ecology project manager's decision.

D. Ecology's Section Manager shall conduct a review of the dispute and shall issue a written decision regarding the dispute within thirty (30) days of Reichhold's request for review.

E. Reichhold may then request additional Ecology management review of the Section Manager's decision. This request shall be submitted in writing to the Program Manager of Ecology's Hazardous Waste and Toxics Reduction Program (Program Manager) within fourteen (14) days of receipt of Ecology Section Manager's decision.

F. Ecology's Program Manager shall conduct a review of the dispute and shall issue a written decision within thirty (30) days of Reichhold's request for additional review. The Program Manager's decision shall be Ecology's final decision on the disputed matter. Reichhold is not relieved of any requirement of this Order during the pendency of the dispute and remains responsible for timely compliance with the terms of this Order unless otherwise provided by Ecology in writing.

10. Reservation of Rights/No Settlement: This Agreed Order is not a settlement under Chapter 70.105D RCW. Ecology's signature on this Order in no way constitutes a covenant not to sue or a compromise of any Ecology rights or authority. Ecology will not, however, bring an action against

Reichhold to recover remedial action costs paid to and received by Ecology under this Agreed Order. In addition, Ecology will not take additional enforcement actions against Reichhold for matters addressed in this Agreed Order, provided Reichhold complies with this Agreed Order.

Ecology reserves the right; however, to seek to require additional remedial actions at the facility should it deem such actions necessary.

Ecology also reserves all rights regarding the injury to, destruction of, or loss of natural resources resulting from the releases or threatened releases of hazardous substances from the Facility.

In the event Ecology determines that conditions at the Facility are creating or have the potential to create a threat to the health or welfare of the people on the Facility or in the surrounding area or to the environment, Ecology may order Reichhold to stop further implementation of this Order for such period of time as needed to abate the threat. In such a case, Reichhold shall not be subject to any enforcement action for stopping or delaying implementation of this Order.

Reichhold reserves all rights and defenses with respect to any additional actions that Ecology may seek to require at the Site.

11. Transfer of Property: Prior to any voluntary or involuntary conveyance or relinquishment of title, easement, leasehold, or other interest in any portion of the Facility, Reichhold shall provide for continued implementation of all requirements of this Order and implementation of any remedial actions found to be necessary as a result of this Order.

Prior to transfer of any interest Reichhold may have in the Facility or any portions thereof, Reichhold shall serve a copy of this Order upon any prospective purchaser, lessee, transferee, assignee, or other successor in such interest. At least ninety (90) days prior to finalization of any transfer that results in a change in owner or operator status, Reichhold shall notify Ecology of the contemplated transfer by submitting a request for modification of its HWMA permit.

12. Compliance with Other Applicable Laws:

A. All actions carried out by Reichhold pursuant to this Order shall be done in accordance with all applicable federal, state, and local requirements, including requirements to obtain necessary permits, except as provided in paragraph B of this section.

B. Pursuant to RCW 70.105D.090(l), Reichhold, under this Order, is exempt from the procedural requirements of chapters 70.94, 70.95, 75.20, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals for the remedial action under this Order.

Reichhold has a continuing obligation to determine whether additional permits or approvals addressed in RCW 70.105D.090(1) would otherwise be required for the remedial action under this Order. In the event Reichold determines that additional permits or approvals addressed in RCW 70.105D.090(1) would otherwise be required for the remedial action under this Order, it shall promptly notify Ecology of this determination. Ecology shall determine whether Ecology or Reichhold shall be responsible to contact the appropriate state and/or local agencies. If Ecology so requires, Reichhold shall promptly consult with the appropriate state and/or local agencies and provide Ecology with written documentation from those agencies of the substantive requirements those agencies believe are applicable to the remedial action. Ecology shall make the final determination on the additional substantive requirements that must be met by Reichhold and on how Reichhold must meet those requirements. Once established by Ecology, the additional requirements shall be enforceable requirements of this Order. Reichhold shall not begin or continue the remedial action potentially subject to the additional requirements until Ecology makes its final determination. Ecology shall ensure that notice and opportunity for comment is provided to the public and appropriate agencies prior to establishing the substantive requirements under this section.

C. Pursuant to RCW 70.105D.090(2), an exemption from complying with the procedural requirements of the laws referenced in RCW 70.105D.090(l) shall not apply if Ecology determines that the exemption would result in the loss of approval from a federal agency which is necessary for the State to administer any federal law. In such a case Reichhold shall comply with both

the procedural and substantive requirements of the specific law at issue. Such a determination by Ecology shall not affect the applicability of the exemption to any of the other statutes referenced in RCW 70.105D.090(l).

13. Obligations with Respect to Land Owned by Puyallup Tribe: Ecology recognizes that the Facility is defined in this Order to include property that is owned by the Puyallup Tribe. Reichhold agrees that it will use its reasonable best efforts to implement this Order with respect to property owned by the Puyallup Tribe. Reichhold shall confer with Ecology after Reichhold believes it has exhausted its "reasonable best efforts" to implement this Order with respect to property owned by the Puyallup Tribe. The contact for the Puyallup Tribe is Bill Sullivan, Director, Environmental Protection Department, Puyallup Tribe of Indians, 1850 East Alexander Avenue, Tacoma, WA 98421.

VIII. SATISFACTION OF THIS ORDER

The provisions of this Order shall be deemed satisfied upon Reichhold's receipt of written notification from Ecology that Reichhold has completed the obligations required by this Order, as amended by any modifications, and that all other provisions of this Agreed Order have been complied with, or upon the incorporation of the remaining applicable terms and conditions of this Agreed Order into a Consent Decree for the Site, whichever is earlier.

IX. ENFORCEMENT

1. Pursuant to RCW 70.105D.050, this Order may be enforced as follows:

A. The Attorney General may bring an action to enforce this Order in a state or federal court.

B. The Attorney General may seek to recover, by filing an action if necessary, the amounts spent by Ecology for investigative and remedial actions and orders related to the facility.

C. In the event Reichhold refuses, without sufficient cause, to comply with any term of this Order, Ecology may seek to hold Reichhold liable for:

(1) Up to three times the amount of any costs incurred by the state of Washington as a result of its refusal to comply; and

(2) civil penalties of up to $25,000 per day for each day it refuses to comply.

D. This Order is not appealable to the Washington Pollution Control Hearings Board. This Order may be reviewed only as provided under RCW 70.105D.060.

Effective date of this Order July 30, 2004:

REICHHOLD, INC.

BY _____

Daniel E. Uyesato
General Counsel and Secretary

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

BY K Seiler

K. Seiler, Section Manager
Hazardous Waste and Toxics Reduction Section
Southwest Regional Office

ATTACHMENT 1

Focused Remedial Investigation

Per the requirements of Attachment 3 to this Order, the following SWMUs will be compared to the calculated cleanup levels of that Attachment:

1) SWMU 6 – Resin Tank Farm
2) SWMU 10 – Hydrochloric Acid (HCL) Pond
3) SWMU 11 – Catalyst Reclaim Sludge Area
4) SWMU 24 – Pentachlorophenol Plant
5) SWMU 25 – Butylphenol Process Area

Summary of Historical Investigations and Interim Actions at the Tacoma Site

Soil Investigations

Between 1986 and the present, regulated units, SWMUs, and other areas of interest were investigated and/or remediated to cleanup levels allowed by the Permit. These included the following:

Regulated Units
- Unit 1 - Main Disposal Area (MDA) – part of the Spoils Disposal Area (SDA)
- Unit 2 - Construction Debris Area (CDA) – part of the Spoils Disposal Area (SDA)
- Unit 3 - Wastewater Treatment Ponds
- Unit 4 - Drum Storage Area

Solid Waste Management Units
- SWMU 6 - Resin Tank Farm
- SWMU 7 - North Extension Area
- SWMU 8 - Carbon Storage Area
- SWMU 9 - Future Tank Farm
- SWMU 10 - Hydrochloric Acid (HCL) Pond
- SWMU 11 - Catalyst Reclaim sludge Area (Molybdenum Pond)
- SWMU 12 - Septic Tank and Leach Field Area

Areas of Interest
- Area 33 – Offsite area south of the Resin Tank Farm
- Area 44 – Offsite area south of the Resin Tank Farm
- Area 49 – Offsite area south of the CDA
- Area 50 – Ditches located in the non-process area

Additional Sampling Areas
- Area 24 - Pentachlorophenol (PCP) Plant
- Area 25 - Butylphenol Process Area
- Area 26 - Puget Chemco
- Background Area

Soil Interim Actions

Interim Actions have been completed at regulated units and a number of SWMUs where COCs were detected at concentrations exceeding the 1988 Permit. These included:

- Main Disposal Area – Part of the Spoils Debris Area
- Construction Debris Area
- North Extension Area
- Septic Tank and Leach Field
- Pentachorophenol Plant

Ground Water Investigations

- The 1987 Pre-Closure Investigation and Hydrogeologic Assessment
- 1989 Pump Tests
- Interim Status Ground Water Monitoring 1985 – 1987
- Tidal Studies

Ground Water Interim Actions

- Extraction and Treatment of Contaminated Ground Water
  - Construction of a Water Treatment System
  - Shallow Aquifer – Installation of the SID
  - Intermediate Aquifer – Installation and Startup of Extraction Wells
  - Interim Corrective Action Ground Water Monitoring 1987-1988
  - Pre-Corrective Action Ground Water Monitoring Program 1988-1993
  - Corrective Action Ground Water Monitoring Program 1993-Present

Following are documents submitted by Reichhold to EPA and Ecology for each of the investigations and interim actions completed as noted above:

RCRA Corrective Action Element	Date Completed	Report Title for Completed Element
RCRA Facility Assessment (RFA)[a]	July 1987	*Reichhold Chemicals, Inc.–RCRA Facility Assessment*
RCRA Facility Investigation (RFI)	February 1987	*Preclosure Investigation and Hydrogeologic Assessment Report*
	May 1987	*Groundwater Assessment Report*
	January 1988	*Non-Process Area Soil Report*
	June 1988 March 1989	*Geophysical Survey of North Extension, West Perimeter, and Offsite SWMU 49*
Interim Measures	November 1988 – 1992	*Design and Construction of Water Treatment System–Corrective Action Package No. 3*
	March 1989	*Expanded Geophysical Surveys*
	March 1989	*Offsite Soils Investigation Report*
	June 1989	*Retrofit of Unit No. 51 for container*

RCRA Corrective Action Element	Date Completed	Report Title for Completed Element
		storage of remediation wastes–Corrective Action Package No. 5
	September 1989	*Resin Tank Farm (RTF)–Soil removal and concrete cover construction–Corrective Action Package No. 1*
	October 1989	*Intermediate Aquifer Extraction Wells–Onsite-Corrective Action Package No. 2*
	October 1989	*Intermediate Aquifer Extraction Wells–Offsite-Corrective Action Package No. 2*
	November 1989	*Septic Tank and Unit 50*
	February 1990	*Shallow Interceptor Drain (SID)–Corrective Action Package No. 4*
	August 1990	*Expanded Soils Investigation and Remediation Report Removal–Corrective Action Package No. 7*
	October 1990	*Design and Construction of Site Cover–Corrective Action Package No. 6*
	August 1992	*Offsite Extraction Wells Operation–Package No. 10*
	December 1993	*Stormwater Collection System–Package No. 11*
	July 1994	*Design and Construction of Marine Outfall–Corrective Action Package No. 12*
Closure and Closure Reports	December 1991	*Certification of Closure Report Wastewater Ponds (1, 2, 3 and 4) (Corrective Action Package No. 8, 9)*
	May 2000	*Closure of Drum Storage Areas Units 4 and 32*
Corrective Measures Study (CMS)	September 1987	*Interim Measures Corrective Action Report*
	January 1988	*Interim Corrective Action Plan (ICAP)*
	June 1989	*Soils Corrective Measures Study*
	July 1992	*Revised ICAP*

[a] This element was completed by EPA Region 10 and distributed to Reichhold.

Attachment 2

Groundwater Monitoring Program Requirements

Introduction

According to Section VI.1(C) of this Agreed Order, Reichhold will implement a groundwater monitoring program at the Tacoma site. This Attachment describes the hydrogeologic setting of the Reichhold site, defines the scope of the groundwater monitoring program to be implemented under this Agreed Order, and describes ongoing groundwater extraction activities as well as reporting requirements.

Historically, groundwater monitoring has been performed at the Reichhold facility since 1985 within a regulatory framework consisting of four distinct programs. These programs and associated timeframes are:

1. Interim Status Monitoring (October 1985 to December 1987)
2. Interim Corrective Action Groundwater Monitoring (December 1987 to September 1988)
3. Pre-corrective Action Monitoring Program (PCAMP) (December 1988 to March 1993)
4. Corrective Action Monitoring Program (CAMP) (July 1993 to present)

The groundwater monitoring program described in this attachment constitutes the fifth program implemented at the site since monitoring began in 1985.

Site Hydrogeologic Setting

Site Hydrostratigraphy

The Reichhold Tacoma site is underlain by three near-surface aquifers and two near-surface aquitards, or confining layers. The three aquifers are referred to as the shallow, intermediate, and deep aquifers. The two aquitards are referred to as the upper and lower aquitards. The relationship of these units is shown in hydrogeologic cross sections constructed from data collected during well installation at the site. The location of the cross sections are shown in Figure 2-1. These hydrogeologic cross sections are presented as Figures 2-2 through E2-7.

Underlying the uppermost aquifers is up to 400 feet of generally fine-grained marine sediments. These fine-grained sediments provide a low-permeability base that separates the three uppermost aquifers beneath the site from the underlying deep regional aquifer, a glacially derived unit of alternating layers of fine- and coarse-grained materials (Walters and Kimmel, 1968).

The Reichhold Tacoma facility is located in the Tacoma tideflats, a regional groundwater discharge area. Groundwater flows from recharge areas at higher elevations toward discharge areas along Commencement Bay and its adjacent waterways, such as the Blair Waterway. Because of this situation, vertical groundwater flow is typically upward from deep to shallow. For example, the deep regional aquifer is artesian because groundwater levels in wells tapping the deep aquifer are higher than the surrounding land surface.

A summary of these five uppermost hydrologic units beneath the Reichhold Tacoma site is presented in Table 2-1 and a brief description is provided below.

Shallow Aquifer

The shallow aquifer is defined as the saturated material below the water table and above the upper aquitard. The saturated thickness of the shallow aquifer varies from 0 to 10 feet across the site. In areas of the Reichhold Tacoma site, such as in the vicinity of the southern and southeastern property boundaries, the shallow aquifer is commonly dry during the low-water level conditions in the summer and fall.

The shallow aquifer generally consists of fine to medium sand and silty sand. The material is primarily dredge spoils from the Hylebos and Blair waterways deposited during the 1950s. In some areas, sandy gravel and cobble mixtures occur at the surface in the upper 2 to 3 feet.

Upper Aquitard

The upper aquitard is the uppermost native formation at the site and consists primarily of silt, organic silt, and clayey silt. This interval is considered to represent the former ground surface of the salt marsh that existed at the site prior to filling. Zones of organic material and peat, as well as interbedded silt, silty sand, and sandy silt are common. The upper aquitard ranges in thickness from less than 1 foot to approximately 20 feet based on drilling logs (CH2M HILL 1998).

Intermediate Aquifer

The intermediate aquifer consists primarily of fine to medium sand and silty sand. Zones of interbedded sand, silty sand, and silt are common within the intermediate aquifer. Shell fragments and wood chips were also noted in soil samples collected while drilling in the intermediate aquifer. In some locations there is a transitional zone of increasing silt content in the lower portion of the aquifer rather than a sharp boundary between the intermediate aquifer and the lower aquitard. The intermediate aquifer ranges in thickness from 4 to approximately 31.5 feet based on drilling logs (CH2M HILLL 1998).

Lower Aquitard

The lower aquitard separates the intermediate and deep aquifers at the site. The aquitard consists of silt, organic silt, and clayey silt, with occasional very fine sandy silt and peat interbeds. Zones of organic material and shell fragments are common. Data from drilling logs indicate the lower aquitard ranges in thickness from approximately 5.5 to 18 feet based on drilling logs (CH2M HILL 1998).

Deep Aquifer

The deep aquifer consists primarily of alternating fine to medium sand and silty sand, with occasional silt interbeds. Some zones of wood and shell fragments were noted in drilling logs. The total thickness of the deep aquifer is not known; however, regional studies indicate that the sand might reach a thickness of 80 feet or more in the vicinity of the Reichhold Tacoma site (Walters and Kimmel, 1968). Deep aquifer wells at the Reichhold Tacoma site penetrate approximately 6.5 to 23.5 feet into the formation.

Groundwater Flow Conditions

Groundwater flow conditions at the site have been monitored for over 12 years. Since 1992, groundwater flow in the shallow and intermediate aquifers has been influenced by operation of

the SID in the shallow aquifer and the extraction wells in the intermediate aquifer. The groundwater contour maps presented in this attachment are representative of groundwater conditions since operation of the extraction system was initiated. Groundwater flow conditions have been relatively consistent, both during the period prior to installation of the extraction systems and after operation of the systems commenced. A brief discussion of groundwater flow conditions prior to the installation of the extraction system is also presented. Annual groundwater system performance reports, which have been submitted to EPA annually since 1990, summarize the groundwater flow data collected each year.

Horizontal hydraulic gradients and flow velocities are provided for the shallow, intermediate, and deep aquifers. Linear groundwater flow velocities were based on groundwater elevation contours from the quarterly water level monitoring events in 1997 and were estimated using a modified form of Darcy's Law:

$$V = (K)(i)/n$$

Where:

V	=	linear velocity (feet per day)
K	=	hydraulic conductivity (feet per day)
i	=	hydraulic gradient (foot per foot)
n	=	effective porosity (volume per volume)

Shallow Aquifer

The shallow aquifer is unconfined and the configuration of the water table varies throughout the site as a function of seasonal recharge, topography, surface cover material, subsurface structures, the influence of surface water bodies including ponds and ditches, and, since 1993, the operation of the SID.

The shallow aquifer saturated zone thickness, and, therefore, depth to water, varies seasonally. In general, the depth to water ranges from the ground surface (most commonly during the winter or early spring in wells along the eastern segment of the SID) to below the bottom of some wells during the dry season (more than about 10 feet below ground surface). These water levels indicate that the shallow aquifer ranges from being fully saturated to the ground surface during the wet season along the eastern segment of the SID, to unsaturated conditions during the dry season along the southwestern property line. This pattern has been observed both recently as well as prior to installation of the SID.

Groundwater Flow Direction and Gradients

The groundwater flow pattern in the shallow aquifer is generally radial from the interior of the site toward the SID, as shown in the groundwater elevation contour maps of the shallow aquifer for 2003 (Figures 2-8 through 2-11). This flow pattern has been consistent since the installation of the SID. The layout of the SID roughly follows the Reichhold Tacoma site's property boundary, with the exception of the eastern segment of the SID, which separates the process area from the non-process area of the site.

During 1997, a typical year for groundwater conditions, hydraulic gradients ranged from 0.006 to 0.028 foot per foot in the shallow aquifer, as shown in Table 2-2. Horizontal groundwater gradients are consistently steepest along the interior of the southern section of the SID.

Typically, horizontal gradients in the shallow aquifer do not exhibit notable seasonal variability. Tidal influences have not been observed in the shallow aquifer at the Reichhold Tacoma site.

Prior to the startup of the wastewater treatment system and groundwater extraction from the SID, the shallow aquifer exhibited a generally radial flow pattern similar to the flow pattern observed after operation of the SID began. This was caused by the effect of shallow ditches located along the northern and southern property lines. Areas where the SID altered the native flow conditions are along the eastern portion of the property and the offsite area between the southwestern property line and Alexander Avenue. Prior to installing the SID, groundwater gradients in the eastern portion of the property were relatively flat but were directed radially either eastward or to the north and south. In the offsite area between the southwestern property line and Alexander Avenue, the groundwater gradient directions varied between being fairly flat to flowing southwestward towards the Blair Waterway (CH2M HILL, 1992).

Hydraulic Conductivity

Slug tests were performed in wells MW-13S, MW-14S, MW-15S, MW-16S, and MW-17S to evaluate the hydraulic conductivity of the shallow aquifer. The estimated hydraulic conductivity of the shallow aquifer ranges from 0.2 to 17 feet/day (CH2M HILL, 1987). Hydraulic conductivity values vary with location in the shallow aquifer. This variability is evident in the slug test results, as well as by qualitative observations made during groundwater sampling in the shallow aquifer. Many shallow aquifer wells such as MW-9S, MW-12S, MW-14S, and MW-33S produce water at such a slow rate that they must be sampled over a period of several hours to several days. Other shallow aquifer wells such as MW-56S, MW-21S2, and MW-1S are noticeably more productive.

Groundwater Flow Velocity

Groundwater flow velocities in the shallow aquifer for 1997 were calculated in five areas (Table 2-3). The groundwater velocity calculation in each area was based on a hydraulic conductivity measured in the closest well, the measured hydraulic gradient in that area, and an assumed effective porosity of the shallow aquifer of 0.2, based on soil classifications obtained from samples obtained during well installation.

As summarized in Table 2-3, calculated groundwater flow velocities in the shallow aquifer ranged from less than 0.01 foot/day to 1.5 feet/day.

Upper Aquitard

The estimated vertical hydraulic conductivity of the uppermost aquitard ranges from 0.0002 to 0.0045 feet/day. These values are based on falling head permeability tests performed in the laboratory (CH2M HILL, 1987b).

Vertical gradients in the upper aquitard, both prior to installation and during operation of the SID and extraction wells, are typically downward, from the shallow aquifer to the intermediate aquifer.

Intermediate Aquifer

The intermediate aquifer beneath the Reichhold Tacoma site is confined; however, semi-confined conditions may exist at locations based on the observed response to tidal fluctuations. In addition, the former graving dock excavation (described below) extended into the intermediate

aquifer, resulting in an area of unconfined conditions. An average seasonal fluctuation range of approximately 2 feet exists in the intermediate aquifer.

Groundwater Flow Direction and Gradient

Groundwater elevation contours drawn from data collected during quarterly monitoring events in 1997 are shown in Figures 2-12 through 2-15. These groundwater elevation contour maps indicate that groundwater flows across the eastern (non-process area) portion of the site is generally from east to west, toward the Blair Waterway and Commencement Bay. The groundwater flow patterns for the remainder of the site and the offsite area are dominated by the influence of the groundwater extraction system. As shown in Figures 2-12 through 2-15, well pairs EW-11/EW-12, EW-6/EW-7 and EW-4/EW-10 exhibit a strong influence on groundwater flow patterns.

Prior to installation and startup of the extraction system, the general groundwater flow pattern across the site was towards the Blair Waterway to the west, becoming more southwesterly in the offsite area, closer to the Blair Waterway.

Localized, temporary horizontal groundwater flow direction reversals caused by tidal fluctuations in the Blair Waterway have been observed in the intermediate aquifer offsite southwest of Alexander Avenue. Tidal influences are discussed in more detail below.

Horizontal hydraulic gradients for the intermediate aquifer, presented in Table 2-4, were calculated using the groundwater elevation contours presented in CH2M HILL (1998). The highest calculated groundwater gradients in the intermediate aquifer were toward offsite extraction wells EW-4 and EW-10. Wells EW-8 and EW-9 do not produce sufficient yields for sustained pumping and, therefore, develop smaller cones of depression and generate flatter gradients than toward the other extraction wells. Calculated average groundwater gradients in the intermediate aquifer ranged from 0.002 to 0.010 foot per foot.

Hydraulic Conductivity

The estimated hydraulic conductivity of the intermediate aquifer ranges from 10 feet/day to 106 feet/day based on constant rate pumping tests conducted in 1989 at extraction wells EW-3, EW-4, EW-5 and EW-7 (CH2M HILL, 1990). Nine slug tests were conducted in intermediate aquifer wells during the Preclosure Investigation (CH2M HILL, 1987), with a range of 0.28 feet per day to 25 feet per day. Tested wells were MW-3I, MW-6I, MW-8I, MW-9I, and MW-13I through MW-17I.

As with the shallow aquifer, hydraulic conductivity varies with location in the intermediate aquifer. During the aquifer testing performed in 1989 (CH2M HILL, 1990), intermediate aquifer extraction well EW-7 was pumped at 56 gpm for over an hour. This performance is significantly different from extraction wells EW-8 and EW-9, which are so unproductive that they pump intermittently.

Groundwater Flow Velocity

Groundwater flow velocities in the intermediate aquifer for 1997 were calculated for the four pumping center areas (Table 2-5). The groundwater velocity calculation in each area was based on a hydraulic conductivity measured in the nearest well(s), the measured hydraulic gradient in that area, and an assumed effective porosity of the shallow aquifer of 0.2, based on soil classifications obtained from samples collected during well installation.

As presented in Table 2-5, calculated groundwater flow velocities ranged from 0.04 foot/ day to 3.7 feet/day. The lowest velocities were observed in the area of extraction wells EW-8 and EW-9. This is to be expected, given the low productivity of these two wells.

Lower Aquitard

The lower aquitard separates the intermediate and deep aquifers. Vertical gradient directions and magnitudes through the lower aquitard are evaluated by measuring water levels in cluster wells completed in the intermediate and deep aquifers. The differences in groundwater elevations in these two zones are divided by the thickness of the aquitard at the well cluster to arrive at a value for the vertical gradient across the aquitard.

The lower aquitard has the following physical properties, as noted in the *Revised RCRA Part B Permit Application* (CH2M HILL, 1988a):

- Thickness: 5.5 to 18 feet
- Vertical hydraulic conductivity: 0.0002 to 0.005 foot per day
- Assumed effective porosity: 0.2

The low vertical hydraulic conductivity of the confining layer causes the rate of groundwater movement across this layer to be very slow. In addition, tidal influences often reverse the vertical gradient multiple times during a day (see below). For these reasons, transient vertical gradients based on discrete water level measurements or a few days of data logger measurements are essentially insignificant in documenting net groundwater flow across the aquitard. Instead, average vertical gradients that occur over a longer time period—on the order of several years—will determine the net groundwater flow across the confining layer (both direction and rate).

Table 2-6 documents that the net vertical gradient between the intermediate and deep aquifers at the site was upward during 1997 at all monitored well clusters. Transient downward vertical gradients occurred at some well clusters for one to two quarters. To evaluate the possible significance of these transient downward vertical gradients, an analysis of vertical flow was completed, as presented in Table 2-7. This analysis was completed for well cluster MW-13I/13D, which had the most extreme transient downward vertical gradient observed in 1997, considering both duration and magnitude.

As shown in Table 2-7, during the first two quarters of 1997, a downward vertical gradient was observed and groundwater moved downward approximately 0.096 foot (0.067 foot in January and 0.029 in April). This downward gradient was likely the result of heavy rainfall in the weeks preceding both measurement events. This distance represents less than one percent of the thickness of the confining layer at MW-13I/13D (approximately 12.5 feet) (CH2M HILL, 1988a). In the last two quarters of 1997 at this well, the hydraulic gradient reversed and became vertically upward, yielding a net upward vertical flow from the deep to the intermediate aquifer of 0.20 foot (0.144 foot in August and 0.055 foot in October). Consequently, the transient downward vertical gradients that were observed in 1997 at some wells at the site were insignificant. The net groundwater flow distance between the deep and intermediate aquifers during 1997, as estimated in Table 2-7, is 0.10 foot upward.

The total vertical flow distance for the period from September 1994 until October 1997 in the six cluster wells was also calculated. As shown in Table 2-8, for all six well clusters the total

vertical flow since September 1994 has been upward and ranged in magnitude from 0.008 feet to 7.046 feet.

Deep Aquifer

Groundwater in the deep aquifer occurs under confined conditions as indicated by the potentiometric surface of the deep aquifer, which is generally 20 to 30 feet above the top of the deep aquifer. Water level data indicate a seasonal fluctuation of approximately 2 feet within the deep aquifer. Because no corrective action activities have been necessary in the deep aquifer, groundwater flow within this aquifer has been relatively consistent since monitoring began in 1985.

Groundwater Flow Direction and Gradient

Groundwater elevation contours drawn from data collected during quarterly monitoring events in 2003 are shown in Figures 2-16 through 2-19. As shown in these maps, groundwater flow in the deep aquifer is generally to the southwest, towards the Blair Waterway. Hydraulic gradients in the deep aquifer are strongly influenced by tide cycles as described later in this Attachment.

As presented in Table 2-9, the hydraulic gradient for the deep aquifer ranged from 0.0006 to 0.0012 foot per foot. The gradients on-and-offsite appear similar. The deep aquifer groundwater gradients are lower in magnitude than gradients in either the shallow or the intermediate aquifers. Horizontal groundwater gradients in the deep aquifer do not appear to have seasonal fluctuations.

Hydraulic Conductivity

Based on slug tests performed on six deep aquifer wells (MW-1D, MW-4D, MW-7D, MW-11D, MW-13D, and MW-14D), the hydraulic conductivity of the deep aquifer ranges from 2 to 11 feet/day (CH2M HILL, 1987a).

Slug test results as well as field-observed yields in deep aquifer wells are not as variable as in the shallow and intermediate aquifers, indicating that the hydraulic conductivity of the deep aquifer is less variable than the shallow or intermediate aquifers.

Groundwater Flow Velocities

Groundwater flow velocities in the deep aquifer for 1997 were calculated using the average of the hydraulic conductivity values (7 feet/day) measured in the six deep aquifer wells and an assumed effective porosity of 0.2 based on soil classifications from samples obtained during well installation and groundwater gradients summarized in Table 2-9.

As shown in Table 2-10, groundwater flow velocities in the deep aquifer ranged from 0.021 to 0.042ft/day (7.7 to 15 feet per year). Groundwater velocities in the onsite and offsite areas are comparable. Because of the combination of low hydraulic conductivity and low hydraulic gradients, the groundwater flow velocities are substantially less in the deep aquifer than in either the shallow or the intermediate aquifers.

Tidal Influences

The Reichhold Tacoma facility lies on an artificial peninsula created by the construction of the Blair and Hylebos Waterways. These waterways, which were created beginning in the 1950s by dredging along roughly parallel alignments southeastward from Commencement Bay, transmit

tides from the bay to the vicinity of the site. Because it is closer to the facility, only the Blair Waterway affects hydraulic gradients in the site vicinity. The Blair Waterway has a four-part tidal cycle, (low-low, low- high, high-low, and high-high), which has a frequency of approximately one day. The maximum amplitude of tidal fluctuation in the Blair Waterway (i.e., the difference between low-low and high-high tides) is about 11.8 feet.

The Blair Waterway is an active shipping channel that is maintained and has been periodically enlarged to accommodate changing shipping requirements. For example, in 1996 the Blair Waterway was widened by 80 feet by dredging from the frontage along the Blair Waterway property southwest of the site. The ship-turning basin southeast of the site recently was enlarged, and the Port of Tacoma and U.S. Army Corps of Engineers currently are evaluating the feasibility of deepening the Blair Waterway to a depth of 50 feet mean low-low water level (MLLW, equivalent to 43.5 feet NGVD) from its current depth of 45 to 48 feet MLLW (38.5 to 41.5 NGVD) (Port of Tacoma, 1998). Because of its depth, tidal fluctuations in the Blair Waterway affect both the intermediate and deep aquifers near the Reichhold Tacoma facility. Tidal fluctuations have not been noted in the shallow aquifer at the site because it occurs above the typical highest tidal elevation in the Blair.

Tidal fluctuations in the intermediate aquifer have been examined by Reichhold using periodic water level measurement "snapshots" and continuous water level measurements in selected wells made with pressure transducers and electronic data loggers. These measurements have shown that high tides cause a localized reversal in the hydraulic gradient in the offsite area south of Alexander Avenue. In other words, during high tide conditions, the hydraulic gradient in this area temporarily reverses from the normal gradient *towards* the Blair Waterway to a reversed gradient *away* from the Blair Waterway. Water level measurements show that this effect is temporary—quickly dissipating after the high tide peak is over—and is limited to the area south of Alexander Avenue. On the Reichhold Tacoma site, gradients in the intermediate aquifer remain directed toward the Blair Waterway regardless of tide conditions. Figure 2-20 is a plot of water levels in the Blair Waterway and in several monitoring wells near the Waterway that shows the inland influence of tidal cycles. The data for this plot was collected using data loggers and pressure transducers prior to extraction well operations (CH2M HILL, 1990). It is clear that the effect of tidal fluctuations, in particular local temporary gradient reversals, are limited to the offsite area southeast of Alexander Avenue.

To evaluate the significance of the observed intermediate aquifer tidal gradient reversal on net groundwater flow from the site to the intermediate aquifer discharge area at the Blair Waterway, the mean hydraulic gradient in the intermediate aquifer was calculated using a method developed by Serfes (1991). The analysis, which is described in detail in Appendix E3-5 of the 1998 Permit Renewal Application (CH2M HILL 1998), used continuous water level data collected in October 1989 for the extraction well startup study (CH2M HILL, 1990) to determine the magnitude of the mean hydraulic gradient between the site and the Blair Waterway. The resulting mean gradient for the offsite area (from MW-40I to MW-44I) was 0.0022 foot per foot. The gradient nearest the Blair Waterway (from MW-45I to MW-44I) was slightly less: 0.0018 foot per foot. These gradients are about one-quarter those listed for the offsite area (toward wells EW-4 and EW-10) in Table 2-4, indicating that operation of the current extraction system is creating artificially high gradients towards the extraction wells and is pulling groundwater offsite at a rate approximately four times higher than would occur under native (non-extraction) conditions.

The limited effect of tidal fluctuations on the intermediate aquifer suggests that the intermediate aquifer exists under semi-confined conditions. Under these conditions, tidal fluctuations are transmitted relatively inefficiently because the saturated thickness of the aquifer has to locally increase for the tidal pulse to be transmitted. Stated another way, water has to physically move into unsaturated pore spaces before the tidal pulse moves inland. A fully confined aquifer, such as the deep aquifer, efficiently transmits tidal pulses because the response to tidal fluctuations is entirely a pressure response rather than a change in saturated thickness. Because water has negligible compressibility, pressure responses in confined aquifers are transmitted rapidly and efficiently.

Tidal effects in the deep aquifer have not been studied as extensively as in the intermediate aquifer because chlorinated phenols have not been detected in the deep aquifer beneath the Reichhold Tacoma site. As shown in the annual groundwater monitoring reports, hydraulic gradients in the deep aquifer are temporarily reversed away from the Blair Waterway during high tide events. Because the deep aquifer is confined, tidal fluctuations are transmitted quickly inland, allowing the effect of high tides to be reflected in most, if not all of the wells at the site. Although an analysis of net hydraulic gradient has not been conducted for the deep aquifer, the net gradient is expected to be towards the Blair Waterway, which is the closest waterway to the site.

The direction of the vertical hydraulic gradient between deep and intermediate aquifer cluster wells is measured quarterly. In response to requirements contained in its 1988 RCRA permit, Reichhold has made manual measurements at intermediate/deep aquifer cluster wells during the time when a downward vertical gradient direction is most likely. The tidal influence magnitude is greater in the deep aquifer than the intermediate aquifer; therefore, a downward vertical gradient is most likely during low tide. Because most of the cluster wells are located inland, far from the Blair Waterway, tidal time lags should be considered to determine the time when a downward vertical gradient direction is most likely for each cluster well location. Tidal influence lag time for the Reichhold site is defined as the time between the occurrence of a high or low tide in Commencement Bay and the time the maximum or minimum effect reaches a particular well cluster.

Initial estimates of tidal lag times were evaluated based on data from the *Extraction Well Startup Testing Summary* (CH2M HILL, 1990). Later in the CAMP program, water level data obtained at 15-minute intervals over a period of several days from the MW-10, MW-11, MW-13, and MW-1 well clusters were used to evaluate tidal time lags. These data show the following:

- The tidal time lag for well clusters MW-10, MW-11, and MW-13 is approximately 2.5 hours
- The tidal time lag for the MW-1 cluster is 4.5 hours
- Based on its proximity to the MW-19, -11, and -13 clusters, the tidal time lag in the MW-4 cluster is assumed to be 2.5 hours
- The tidal delay at the MW-40 cluster is assumed negligible because of its proximity to the Blair Waterway.

Former Graving Dock

The former graving dock, a decommissioned dry dock, was located between the Reichhold Tacoma site and the Blair Waterway (Figure 2-1). It was formerly used to manufacture concrete pontoons for several floating bridges in the region from mid-1981 until 1986. The graving dock fully penetrated the shallow aquifer and partially penetrated the intermediate aquifer. It had a bottom elevation of -4 feet MLLW (-10.5 feet NGVD) (Hart Crowser, 1981). The graving dock was dewatered by pumping from the dock interior. A combination of a french drain system and dewatering wells penetrating the shallow and intermediate aquifers along the perimeter of the graving dock was used to maintain dry working conditions within the dock after dewatering. A removable sheet pile gate was used to prevent water from the Blair Waterway from entering the graving dock when it was dewatered. The pumping rate necessary to maintain dry working conditions in the dock after initial dewatering was estimated to be 100 gallons per minute; a relatively small amount of water, considering the graving dock occupied approximately 6 acres (Hodges, 1981).

Although actual operational records of the graving dock are unavailable, the dock was proposed to be dewatered most of the time during use. It was planned to be used for three construction cycles, with two brief (approximately 48-hour) flooding cycles to float the pontoons out to the waterway (Salo, 1981). After the final pontoon construction period, the graving dock was flooded for the last time in 1985 or 1986 (based on aerial photographs) and remained in that condition until it was filled with dredge spoils from the Blair Waterway widening project in 1996.

A 2-foot layer of ASARCO slag was placed in the bottom of the excavation to provide a stable working surface. However, testing indicated that heavy metals were present and could potentially leach out as the slag was deposited and pulverized during construction activities. In May 1981, with Ecology's approval, gravel was used to cover the slag on the bottom of the excavation. Slag continued to be used as riprap to stabilize the sidewalls of the excavation.

Because available records indicate that the graving dock was dewatered for much of the early 1980s, the operation of the graving dock is expected to have had a significant effect on groundwater flow southeast of the Reichhold Tacoma facility. Use of the graving dock is anticipated to have had the following principal effects on groundwater flow and constituent transport:

- A localized increase in the horizontal gradient from the site toward the graving dock in both the shallow and intermediate aquifers would occur. This effect would have increased the potential for offsite migration from the Reichhold Tacoma facility.
- The predominantly south-southwesterly groundwater flow direction in the offsite intermediate aquifer would change to a more pronounced westerly or west-northwesterly flow direction along the east side of the graving dock. This situation would be caused by the groundwater divide that would be formed between the Blair Waterway-dominated flow field southwest of the graving dock and the inland aquifer-dominated flow field northeast of the graving dock. The effect of this situation would be to cause the offsite chlorinated phenol plume to widen in a west-northwestward direction toward MW-45I, which is located next to the former graving dock.

- The downward vertical gradient between the shallow and intermediate aquifers would be increased. This effect would have increased the potential for downward migration between the shallow and intermediate aquifers.

In summary, the past operation of the graving dock is expected to have had a substantial role in expanding the vertical and horizontal extent of the offsite plume on the Blair Waterway property southwest of the site.

Beneficial Use of Groundwater

Introduction

This section presents an analysis of the current and reasonably likely future beneficial uses of the groundwater in the near-surface aquifers at the Reichhold Tacoma facility.

Surrounding Land Use

All surrounding land uses are zoned M-2 or M-3 (both heavy industrial). The Reichhold Tacoma property is zoned M-3. The closest residential areas are located approximately 1 mile to the southeast in Fife and 0.8 mile to the north in north Tacoma (CH2M HILL 1998).

The Reichhold Tacoma facility is designated to remain an industrial use, potentially to be redeveloped as a marine terminal. Marine terminals are explicitly cited as an example of an industrial property in the definition of "industrial properties" in MTCA (WAC 173-340-200). The City of Tacoma Generalized Land Use Plan designates this area to remain as "high intensity" industrial land in the future (City of Tacoma, 1996). The Generalized Land Use Plan specifies that the Port area in which the Reichhold Tacoma facility is located "possesses the greatest potential for new industrial growth" and that "continued growth in marine import-export activities will cause the Port of Tacoma to increase in its prominence in the local, regional, state, and national economy" (City of Tacoma, 1996). Based on this information, the Reichhold Tacoma facility currently meets and will continue to meet criteria for industrial land use. In addition, planned development of the facility into a marine terminal is in alignment with the City of Tacoma's economic development goals.

Current Beneficial Uses of Groundwater

Four current beneficial uses of groundwater in the three near-surface aquifers were evaluated: drinking water, irrigation, industrial, and recharge to surface water. Only one—recharge to surface water—was determined to be a current or reasonably likely future beneficial use of the three near-surface aquifers. A description of the evaluation of the four potential beneficial uses is provided in the following subsections.

A survey of water supply wells within a 1-mile radius of the site was conducted in May 1997 (CH2M HILL 1998). The results of the survey indicate that three water supply wells are located within a 1-mile radius of the Reichhold Tacoma site. All three of these wells are very deep (788 to 901 feet below ground surface), substantially below what is considered the "deep aquifer" at the Reichhold Tacoma site (encountered at approximately 35 to 40 feet below ground surface), and draw water from the deep regional aquifer. Well logs are provided in CH2M HILL (1998).

Drinking Water Use

Groundwater within the shallow, intermediate, and deep aquifers within a 1-mile radius of the property is not used for drinking water. As described above, there is a City of Tacoma

municipal well located almost 1 mile to the northwest that is screened in the deep regional aquifer. This well would not be affected by the Reichhold Tacoma site because:

- It is separated from the uppermost aquifer at the site by more than 400 vertical feet of a confining layer made up of clay, silt, and cemented gravel
- It is not located downgradient of the shallow, intermediate, or deep aquifers
- Commencement Bay, including man-made water bodies such as the Blair Waterway, is a regional groundwater discharge area. Artesian groundwater conditions in the deep regional aquifer show that an upward vertical gradient exists between the deep regional aquifer and the uppermost aquifer at the site; therefore, groundwater (and dissolved contaminant) movement would be upward toward the uppermost aquifer and, subsequently, to Commencement Bay rather than downward toward the deep regional aquifer.

In addition, groundwater occurring at depths shallower than 35 feet (shallow and intermediate aquifers) is barred from use for drinking water purposes by the Settlement Agreement for the Blair Waterway and the Blair Backup properties, both of which are adjacent to the site. Reichhold intends to implement institutional controls on its property prohibiting use of the shallow, intermediate, or deep aquifers for any purpose, including supplying drinking water.

Irrigation Water Use
Groundwater within a 1-mile radius of the site is not used for irrigation.

Industrial Water Use
Groundwater within the shallow, intermediate, and deep aquifers within a 1-mile radius of the property is not used for industrial purposes. As described above, two deep production wells located at the former Kaiser Aluminum site are located almost 1 mile southeast of Reichhold. These wells are screened in the deep regional aquifer, separated from the uppermost aquifer by a thick confining layer composed of clay, silt, and cemented gravel. These wells are not located downgradient of the shallow, intermediate, or deep aquifers, therefore, these two deep industrial wells would not be affected by the Reichhold Tacoma site.

Surface Water Recharge
The Reichhold Tacoma site is located between two man-made marine waterways, the Blair Waterway to the south and the Hylebos Waterway to the north. The Blair and Hylebos Waterways are used for ship access to industrial sites and marine terminals along both sides of the waterways.

Three surface water drainage ditches border the Reichhold Tacoma site. The North ditch and Lincoln Avenue ditch are located along the north and west property boundaries. The South ditch is located along a portion of the southeast property boundary. All three ditches are man-made urban drainage ways constructed to convey runoff to the Blair Waterway. The North and South ditches are ephemeral, flow only when precipitation runoff or high groundwater levels cause inflow into them, and typically either go dry or cease to flow and become stagnant during dry summer conditions. The Lincoln Avenue ditch, which receives runoff from several industrial and urban properties northeast of the Reichhold Tacoma site, enters a concrete culvert adjacent to the Reichhold site and is piped directly to the Blair Waterway. When groundwater levels are sufficiently high, groundwater from the shallow aquifer discharges to these ditches under normal conditions (i.e., when the shallow interceptor trench [SID] is not

operating). The intermediate and deep aquifers beneath the site, under normal conditions, discharge into the Blair Waterway. The extraction system in the intermediate aquifer currently provides a hydraulic barrier for affected groundwater discharging to the Blair Waterway.

In summary, groundwater at the site provides a beneficial use as surface water recharge to the Blair Waterway.

Reasonably Likely Future Beneficial Uses

Four potential future beneficial uses of the groundwater in the three near surface aquifers were evaluated: drinking water, irrigation, industrial, and surface water recharge. Of these four, three (drinking water, irrigation, and industrial) were determined to be unlikely.

Drinking Water Use Not Likely

The City of Tacoma has supplied water to the area within a 1.5-mile radius of the Reichhold Tacoma facility since the area originally was developed. The City of Tacoma plans to continue supplying water to the area (Evancho, 1998). In addition, groundwater occurring at depths shallower than 35 feet is barred from use for drinking water purposes by the Settlement Agreement for the Blair Waterway and the Blair Backup properties, both of which are adjacent to the site. Reichhold intends to implement institutional controls barring groundwater use for any purpose on the Reichhold Tacoma property. Therefore, it is highly unlikely that water from the three near-surface aquifers would be used for drinking water purposes.

For all three near-surface aquifers, water quality is such that several secondary drinking water maximum contaminant levels (MCLs) are exceeded, conflicting with the Washington Department of Health regulation (WAC 246-290-135) requiring that purveyors obtain drinking water from the highest quality source feasible and the source meets water quality standards in WAC 246-290-310. Total dissolved solids (TDS) concentrations in the shallow, intermediate, and deep aquifer are compared with two criteria: (1) the federal secondary MCL level of 500 milligrams per liter (mg/L) and (2) the state and federal minimum criterion for classifying an aquifer as an underground source of drinking water (10,000 mg/L).

Using EPA's guidelines for groundwater classification (EPA 1986), groundwater in the three near-surface aquifers is classified as Class IIIB groundwater units. Class III groundwater units are defined as "groundwater not a potential source of drinking water and of limited beneficial use." EPA's groundwater classification guidance document indicates that the near-surface aquifers (the shallow, intermediate, and deep aquifers) would be classified as Class IIIB groundwater for the following reasons:

- Not considered a vulnerable or irreplaceable resource
- Not current sources of drinking water
- Not within a protected watershed
- Either contain TDS concentrations greater than 10,000 milligrams per liter (mg/L) or would require treatment methods beyond those reasonably employed in public water supply systems
- Not hydraulically connected to surface water or groundwater units of a higher class and are naturally isolated from sources of drinking water.

The basis for this analysis is described below.

Shallow Aquifer

The saturated thickness of the shallow aquifer at the site varies seasonally. During the dry season, the saturated thickness over a large portion of the shallow aquifer shrinks to the extent that little or no water is observed in shallow monitoring wells located near the Reichhold Tacoma facility southwestern property line. These observations indicate that the shallow aquifer is incapable of reliably supplying groundwater throughout the year. For the adjacent Blair Backup property, Hart Crowser (1991) estimated that the yield of the shallow aquifer is less than 0.5 gallons per minute (gpm). WAC 173-340-720(1)(a)(ii)(A) states that groundwater is not a potential source of drinking water if the groundwater is present in insufficient quantity to yield greater than 0.5 gallons per minute on a sustainable basis. Therefore, the shallow aquifer in the site vicinity has neither the yield nor the sustainability to be considered a potential source of drinking water.

The natural water quality of the shallow aquifer is unsuitable for drinking water use because water from the shallow aquifer exceeds the secondary MCL of 500 mg/L TDS. The MCL for dissolved solids is based on unpalatable mineral taste, possible physiological effects, and the higher costs associated with additional treatment or resulting from corrosion and the reduced service life of household appliances and systems (i.e., piping, faucets, and toilet flushing mechanisms). TDS values for the shallow aquifer are based on sampling and analysis in 1987; the results are summarized in CH2M HILL (1998). TDS concentrations in the shallow aquifer wells ranged from 209 to 5,980 mg/L, with an arithmetic average of 1,480 mg/L. The arithmetic average exceeds the TDS MCL by nearly a factor of three. Of the 26 shallow wells, 23 (88 percent) had average TDS concentrations exceeding the TDS MCL.

Intermediate Aquifer

The natural water quality of the intermediate aquifer is also unsuitable for drinking water purposes. The intermediate aquifer contains TDS levels ranging from 935 mg/L to 31,800 mg/L (CH2M HILL 1998). The TDS arithmetic average of 10,140 mg/L exceeds the TDS MCL by more than 20 times. All 26 of the intermediate aquifer wells monitored for TDS had concentrations exceeding the secondary MCL.

Because its TDS concentration is above 10,000 mg/L, the intermediate aquifer fails to meet the minimum criterion for classifying an aquifer as an underground source of drinking water under both Washington State Department of Ecology's (Ecology's) regulations (WAC 173-340-720(1)(a)(ii)(B)) and under EPA's regulations promulgated in response to the Safe Drinking Water Act ((40 CFR 146). The U.S. Geological Survey classifies water with a TDS concentration over 10,000 mg/L as "very saline" (Hem, 1970).

The wells at the Reichhold Tacoma facility that have average TDS concentrations below 10,000 mg/L are interspersed with wells whose TDS exceeds 10,000 mg/L. Moreover, the facility is on a narrow peninsula surrounded by marine waterways that are hydraulically connected to the intermediate aquifer. If an attempt was made to develop a drinking water supply in the intermediate aquifer in a well where TDS was below 10,000 mg/L, more saline water would be drawn to the pumping well, either from surrounding saline portions of the aquifer or from adjacent marine waterways. Therefore, the intermediate aquifer cannot reliably supply water suitable for drinking water use.

Deep Aquifer

As with the shallow and intermediate aquifers, the natural water quality of the deep aquifer is not suitable for drinking water supply. The deep aquifer contains TDS concentrations ranging from 1,120 mg/L to 18,000 mg/L, with an arithmetic average of 6,384 mg/L (CH2M HILL 1998). Water with TDS concentrations between 3,000 mg/L and 10,000 mg/L is defined by the U.S. Geological Survey as "moderately saline" (Hem, 1970).

The minimum detected TDS value in the deep aquifer is more than twice the TDS MCL of 500 mg/L, and the average concentration exceeds the TDS MCL by more than 12 times. For water with TDS concentrations in this range, potable use would require treatment methods considered by EPA (1986) to not be reasonably employed in public water systems, making it highly unlikely that groundwater from the deep aquifer would be a potential source of drinking water.

The deep aquifer is also hydraulically connected to the surrounding waterways. Similar to the intermediate aquifer, extended pumping of the deep aquifer would draw this marine water from the waterways into the aquifer, further degrading the groundwater quality.

Irrigation Water Use Not Likely

There is no agricultural land within one mile of the site. In addition, crops are sensitive to elevated chloride levels such as those in the shallow, intermediate, and deep aquifers at the site. Therefore, future use of groundwater from the three near surface aquifers for irrigation is highly unlikely.

Industrial Water Use Not Likely

Shallow Aquifer

As described above, the shallow aquifer was evaluated to have a yield of less than 0.5 gpm in the adjacent Blair Backup Property (Hart Crowser, 1991) and is dry in portions of the Reichhold Tacoma site during the summer. Because high quality water is reliably available at reasonable cost from the City of Tacoma, it is highly unlikely that an industry would attempt to develop a water supply in the shallow aquifer, which is a low-productivity, unreliable source that would require expensive treatment to meet the minimum quality required by typical industrial processes.

Intermediate and Deep Aquifers

These aquifers are more transmissive than the shallow aquifer, yielding up to 20 gpm to wells in their most productive areas. Typical well yields, however, are in the range of 5 to 6 gpm. Industrial facilities typically require wells that yield several hundred to several thousand gpm.

As described above, the intermediate and deep aquifers have average TDS concentrations of 10,140 mg/L and 6,384 mg/L, respectively. The maximum acceptable TDS concentration in water used in various industrial uses is summarized below, assuming treatment is not required (EPA, 1976). The TDS range for boiler makeup water is dependent on the boiler pressure and also assumes that treatment is not required (Nalco, 1987).

Industry	Maximum Acceptable TDS Concentration in Water Used in Process (mg/L)
Textile production	150[a]
Pulp and paper mills	1,000[a]
Chemical plants	2,500[a]
Petroleum refineries	3,500[a]
Boiler makeup water	300-4,000[b]

Sources:
[a]EPA, 1976
[b]Nalco, 1987

It is technically feasible to treat water with TDS concentrations as high as those in the intermediate and deep aquifers to meet industrial standards; however, the economics of such treatment make this situation highly unlikely. The most common treatment approach for reducing the salinity of water is reverse osmosis. To use reverse osmosis as a treatment method for groundwater at the Reichhold Tacoma facility would require the expense of adding an iron removal step because iron concentrations in these zones have exceeded 100 mg/L. Adding iron removal would increase the cost of an already-expensive reverse osmosis treatment system by approximately 50 percent. Consequently, it is highly unlikely that an industry would commit the capital and invest in operation and maintenance of an expensive treatment system for a low-yielding saline water source when the City of Tacoma provides a high-quality, reliable water supply to the area at reasonable cost.

Surface Water Recharge

The only remaining use of groundwater in the shallow, intermediate, and deep aquifers is discharge to surface water. As described above, the Blair Waterway is the receptor for all groundwater discharged from the site. As discussed with Ecology, Reichhold has committed to develop groundwater cleanup levels for the Tacoma facility that protect potential receptors in the Blair Waterway.

Beneficial Use Conclusions

Based on the analysis presented above, the one current beneficial use of groundwater in the three near-surface aquifers (shallow, intermediate, and deep) at the Reichhold Tacoma facility is surface water recharge to the Blair Waterway. A summary of current and reasonably likely future beneficial uses of the near-surface aquifer is provided in Table 5. It is highly unlikely that groundwater will be put to other uses in the foreseeable future for the following reasons:

- Recharge to surface water is the only current beneficial use of the three near-surface aquifers.

- The three near-surface aquifers meet the criteria for Class IIIB groundwater units defined as "ground-water not a potential source of drinking water and of limited beneficial use" (EPA, 1986).
- Groundwater occurring at depths less than 35 feet below the ground surface is barred from use for drinking water purposes by the Settlement Agreement for the Blair Waterway and the Blair Backup properties, both of which are adjacent to the Reichhold Tacoma facility. Reichhold will place institutional controls on its property prohibiting groundwater use for any purpose.
- The natural water quality in the shallow, intermediate, and deep aquifers does not meet secondary drinking water standards and would require prohibitively expensive treatment for most uses (e.g. drinking or industrial).
- Typical well yields in the shallow aquifer are less than 0.5 gpm, which does not meet the minimum requirements for domestic supply and would not be sufficient for industrial or irrigation use. Well yields in the intermediate and deep aquifer are insufficient for industrial use.
- The average TDS concentration (10,140 mg/L) in the intermediate aquifer exceeds the MTCA threshold designating groundwater containing greater than 10,000 mg/L TDS not practical for drinking water and, therefore, not a potential future drinking water source (WAC 173-340-720(1)(a)(ii)(B)).
- Moderately and very saline water found in the intermediate and deep aquifers would be an extremely unlikely choice for an industrial user because of the treatment requirements and, consequently, treatment costs, given the high levels of both TDS and iron.
- The City of Tacoma's public water supply system is available throughout the area, with distribution infrastructure already in place. This supply provides a more reliable, prolific, higher quality, and cost-effective water source than is available from the shallow, intermediate, and deep aquifers.
- The land in the vicinity of the Reichhold Tacoma facility is zoned for industrial use and will remain so for the foreseeable future.
- The Reichhold Tacoma facility is designated to be redeveloped as a marine terminal. Reichhold will implement institutional controls barring future use of groundwater on the property as well as downgradient properties.

Monitoring Program Purpose

Groundwater monitoring at the Reichhold site encompasses all three aquifers identified beneath the site in previous investigations through the collection of water quality and hydraulic head data. The objectives of the monitoring program implemented under this Agreed Order are:

- Shallow Aquifer
  - Monitor groundwater quality along the downgradient site perimeter
  - Characterize shallow groundwater near the former pentachlorophenol (PCP) plant

  - Monitor the effectiveness of the shallow interceptor drain (SID) in intercepting groundwater by collecting hydraulic head data within and downgradient of the site

- Intermediate Aquifer
  - Monitor groundwater quality along the downgradient site perimeter
  - Monitor an offsite area where groundwater containing chlorinated phenols historically had migrated offsite as the concentrations decline
  - Monitor the effectiveness of the pump-and-treat system by collecting hydraulic head data within and downgradient of the site

- Deep Aquifer
  - Collect hydraulic head data within and downgradient of the site
  - Monitor the deep aquifer groundwater to confirm the absence of constituents of concern

Groundwater Quality Monitoring

Groundwater quality monitoring will be implemented under this Agreed Order to document that the quality of groundwater passing the property boundary meets cleanup levels for groundwater established for the site.. In addition, monitoring in the intermediate aquifer will include sampling in the offsite area where chlorinated phenols historically had migrated offsite, and monitoring in the shallow aquifer will include sampling in an interior site well where chlorinated phenols have been detected.

The objectives of this monitoring program are:

1. Documenting that the remedy for the site remains protective of human health and the environment

2. Facilitating redevelopment of the property and a return to beneficial use of the real estate

The first objective will be met by documenting that groundwater exiting the site is at or below risk-based cleanup standards; and, if not, is either being captured and treated by the groundwater extraction system or being treated in-situ using a technology approved by Ecology. The second objective will be met by sequentially stopping extraction well operations as cleanup levels are met in the future and by abandoning groundwater monitoring wells after well cleanup criteria have been achieved for four consecutive samples collected over a one-year period.

Monitoring Frequency

Groundwater quality monitoring will be conducted annually and quarterly in response to hydraulic performance standards. If either hydraulic performance standard 1 or 2 (described later in this Attachment) is not met in any quarter, samples will be collected in the subsequent quarter, as described in this Attachment. This quarterly response sampling will focus on assessing the potential water quality effect of the failure to meet the specific performance standard.

Description of Wells

Wells included in the proposed groundwater quality monitoring program are located along the designated points of compliance in the shallow and intermediate aquifers and are listed in Table 2-12. Wells included in quarterly response sampling are described later in this Attachment and listed in Tables 2-15 and 2-16 for the shallow and intermediate aquifers, respectively. As shown in Table 2-12, a total of 13 shallow aquifer wells are included in the proposed corrective action monitoring program annual sampling; 12 wells along the site perimeter and one internal well (MW-14S). MW-14S will be monitored annually for site characterization information purposes; however, it will not be used to assess compliance with the groundwater protection standard. Shallow aquifer monitoring wells are shown in Figure 2-21.

Six onsite wells screened in the intermediate aquifer along the downgradient perimeter of the site are included in the proposed corrective action monitoring program annual sampling. Four additional offsite wells will also be sampled annually to monitor the quality of the offsite intermediate aquifer. A total of 10 existing intermediate aquifer wells are included in the proposed annual sampling as shown in Figure 2-22. During the focused remedial investigation, up to three additional wells will be constructed onsite along the downgradient perimeter of the site(two between MW-5(I) and MW-13(I) and one between MW-10(I) and MW-13(I)). To provide further information on groundwater conditions east of the offsite extraction well network, groundwater will be sampled annually using direct-push sampling equipment along the Alexander Avenue easement between the between MW-30(I) and MW-29(I). If site-related constituents remain above groundwater cleanup levels, a monitoring well will be installed after redevelopment activities in this area are sufficiently completed.

Five deep wells listed in Table 2-12, located along the downgradient site boundary, will be monitored for four consecutive quarterly monitoring events beginning no later than summer 2008 to document that they do not contain site-related constituents as was previously demonstrated in the early 1990s. After this demonstration is made, deep water quality monitoring will cease at the site. If constituents are detected, Reichhold will calculate risk-based groundwater cleanup levels applicable to the deep aquifer for comparison. If concentrations exceed risk-based cleanup levels, Reichhold will meet with Ecology to determine an appropriate response.

Constituents to Be Monitored

The groundwater monitoring constituents are shown in Table 2-13. The selected constituents are based on detections of constituents that were previously identified by EPA in the 1988 Permit as constituents of interest (Table 7 of the 1988 Permit).

Sampling and Analysis Plan

Within 60 days of the effective date of this Agreed Order, Reichhold shall prepare and submit for Ecology's approval a revised groundwater Sampling and Analysis Plan to reflect the monitoring program described in this Attachment. The sampling and analysis plan will meet the requirements described in WAC 173-340-820, including a list of practical quantitation limits and laboratory methods to be used to achieve them.

Annual Monitoring

During the annual monitoring events, groundwater samples will be analyzed for the constituents on Table 2-13. A sample of the water treatment plant influent will be analyzed for the list of 40 CFR 264 Appendix IX constituents, as modified in the 1998 RCRA permit renewal application for the site to reflect potential site-related constituents (CH2M HILL 1998, Table J2-8). If the nature and concentration of constituents detected in water treatment plant influent is steady or decreasing as shown in time-concentration plots, the frequency and/or scope of influent monitoring will be reduced over time with Ecology's approval.

Quarterly Response Monitoring

Quarterly response monitoring will be conducted in response to noncompliance with the hydraulic performance standards, as described later in this Attachment. If compliance cannot be demonstrated during quarterly monitoring at a specific segment of the SID in the shallow aquifer or a specific pumping center in the intermediate aquifer, sampling focused on that segment or pumping center will be conducted during the following quarterly monitoring event. Constituents analyzed during these events will be any constituent detected above groundwater cleanup levels in the respective aquifer during the preceding two years.

Groundwater Extraction and Hydraulic Performance Standards

Groundwater Extraction

To meet groundwater remediation requirements described in the 1988 Permit, three significant interim measures and corrective actions for groundwater have been completed at the Reichhold Tacoma site. Key site corrective actions for groundwater achievements have included installing and operating an interim hydraulic containment system for shallow and intermediate groundwater. These systems are described below.

Shallow Aquifer

A shallow interceptor drain (SID) was installed in 1989 around the perimeter of the manufacturing portion of the facility. The SID intercepts and collects groundwater from the shallow aquifer, which is pumped to the water treatment system for treatment and discharged to Blair Waterway under conditions of the site NPDES permit. The objectives of the SID are to (1) capture shallow aquifer groundwater before it migrates offsite, and (2) induce flow to the SID from the offsite areas.

The drain, located at a depth of approximately 10 feet below ground surface, consists of a perforated drainpipe bedded in an imported granular material, which promotes groundwater flow to the drain. Cleanout access is provided at the ends of the lines and along sections with long runs. SID piezometers are installed adjacent to the SID along the full alignment. The SID piezometers provide a means of monitoring water levels so that comparison to the 1988 Permit-required hydraulic containment standards can be evaluated.

Intermediate Aquifer

A groundwater extraction and collection system was designed to remediate the intermediate aquifer in the vicinity of the Reichhold site in accordance with the 1988 Permit. Twelve intermediate extraction wells (EW-1 through EW-12) have been installed as part of corrective

action activities at the site. The current extraction well system consists of eight active extraction wells located onsite and offsite. Two of the extraction wells are inactive because one (EW-1) is too shallow and the other (EW-2) is screened in a zone of low permeability within the intermediate aquifer. Extraction wells EW-8 and EW-9 are screened in an area of low hydraulic conductivity and as a result pump intermittently and at a lower rate than the other extraction wells. EW-3 and EW-5 are inactive because they were replaced by new wells EW-11 and EW-12 in 2002 as part of soil excavation activities in the Construction Debris Area. Wells EW-6 and EW-7 provide hydraulic control for the northwestern corner of the site. Offsite extraction wells EW-4 and EW-10 control the chlorinated phenol plume within and downgradient of the southwestern portion of the site. During the feasibility study, a phased shutdown of extraction wells EW-4 and EW-10 will be completed. If capture of contaminated offsite ground water using extraction wells EW-11 and EW-12 is demonstrated, extraction wells EW-4 and EW-10 will be decommissioned. After site-specific cleanup levels are approved by Ecology and after groundwater cleanup progresses sufficiently to reduce concentrations of site-related constituents in groundwater below approved cleanup levels, Reichhold's duty to hydraulically contain groundwater will be reduced to focus only on aquifer areas affected by site-related constituents above cleanup levels. As appropriate, Reichhold will petition Ecology to allow unneeded extraction wells to be abandoned in accordance with state well regulations. Ecology will approve the shutdown and abandonment of extraction wells only after subsequent ground water monitoring demonstrates that site related constituents in the areas affected by the extraction wells do not rebound above ground water cleanup levels.

The extraction wells were constructed in accordance with Ecology design standards (WAC 173-160). A typical operating extraction well is constructed of either 4- or 6-inch-diameter schedule 40 PVC or stainless steel with a well screen placed through the entire thickness of the intermediate aquifer. Each active extraction well is equipped with a submersible pump.

Hydraulic Performance Standards

Three hydraulic performance standards are established for the facility to document the effectiveness of the groundwater corrective action program. The hydraulic performance standards are summarized below.

Description of Hydraulic Performance Standards

Hydraulic Performance Standard No. 1–Shallow Aquifer

Hydraulic performance standard No. 1 requires that the shallow interceptor drain (SID) capture or prevent the offsite migration of shallow aquifer groundwater that, as a result of facility operations, has concentrations of hazardous constituents above groundwater cleanup standards.

Hydraulic Performance Standard No. 2—Intermediate Aquifer

Hydraulic performance standard No. 2 requires that the intermediate aquifer groundwater extraction system capture groundwater that, as a result of facility operations, contains hazardous constituents above the groundwater cleanup levels.

Hydraulic Performance Standard No. 3—Intermediate and Deep Aquifers

Hydraulic performance standard No. 3 requires that a net groundwater flow gradient exists from the deep aquifer to the intermediate aquifer within the area of the intermediate aquifer

that, as a result of facility operations, contains hazardous constituents above the groundwater cleanup levels.

Meeting Hydraulic Performance Standards

The demonstration of compliance with the performance standards, and the response if compliance is not demonstrated, is summarized below and in Table 2-14.

Hydraulic Performance Standard No. 1–Shallow Aquifer

Compliance with hydraulic performance standard No. 1 will be demonstrated by lower water levels in specific SID piezometers compared to water levels in specific surrounding wells, as listed in the Table 2-15. Because the SID was constructed in six segments separated by clean-out ports, compliance with performance standard No. 1 will be evaluated on a segment by segment basis, or if a water level measuring point is located near the ends of two segments, by comparing water levels in each segment to the water level measuring point as appropriate. It is anticipated that pumping from the SID will be terminated sequentially in the future along segments where compliance with the groundwater protection standard has been demonstrated. The locations of the SID segments are shown in Figure 2-23.

If any one of the comparison criteria for each segment is not met during a quarterly monitoring event, the subsequent quarterly event will include response sampling, as described in the third column of Table 2-15. Quarterly response sampling will be focused on the area of the SID segment failing to meet the performance standard. For example, if during a quarterly monitoring event the water levels in SID-15 and SID-1 are higher than in MW-43(S), hydraulic performance standard No. 1 in Segment S-1 is not being met. Therefore, during the following quarterly event, wells MW-33(S), MW-43-(S), and MW-27(S) would be sampled. In two locations, the SID piezometer that happens to be located closest to a groundwater monitoring well location actually is located in a different SID segment than the segment nearest the monitoring well. This situation occurs in the following locations (see Figure 2-23):

- Near MW-21(S)2, which is closest to SID segment S-4, yet which is near SID-6, completed in SID segment S-4
- Near PZ-7S, which is closest to SID segment S-4, yet which is near SID-9, completed in SID segment S-5

Reichhold will install new SID piezometers (SID-16 and SID-17) as close as reasonably practicable to the SID backfill near MW-21(S)2 and PZ-7S respectively to provide additional shallow aquifer water level monitoring points at these locations.

In some areas, wells used to document compliance with hydraulic performance standard No. 1 are seasonally dry. In this case, groundwater flow is negligible and the hydraulic performance standard will be satisfied.

Hydraulic Performance Standard No. 2—Intermediate Aquifer

Compliance with hydraulic performance standard No. 2 will be demonstrated for each pumping center by interpreting contour maps constructed with measured water level data and comparing them to the extent of groundwater currently affected by former site activities to show that pumping centers are capturing affected groundwater. The contour maps will include

shaded areas showing where groundwater concentrations exceed cleanup levels for site-related constituents to aid in assessing hydraulic containment. These contour maps and determinations will be submitted to Ecology for approval. Quarterly response sampling will be conducted in the area downgradient of an area where compliance is not demonstrated. Table 2-16 lists the proposed quarterly response sampling to be done in response to failing to meet performance standard No. 2 at a specific pumping center. With Ecology's approval, this performance standard progressively terminates as the groundwater cleanup levels are met within the capture zone of the extraction well clusters.

Hydraulic Performance Standard No. 3—Intermediate and Deep Aquifers

Demonstration of compliance with hydraulic performance standard No. 3 will be made by calculating net annual gradients from water level measurements at clustered wells to show an upward net vertical gradient. For each quarter, a running annual average gradient will be calculated at each cluster by averaging the gradient calculated from measurements made in the current quarter with those made over the preceding three quarters. If a net downward gradient is documented to have existed at one or more clusters over a period of four consecutive quarters, Reichhold will sample the two deep wells closest to the affected well cluster(s), except for the MW-40(I)/MW-40(D) cluster, which is located 600 feet downgradient of the next closest deep monitoring well. The response to a determination of noncompliance with performance standard No. 3 at the MW-40(I)/MW-40(D) cluster will be to sample MW-40(D). If site-related constituents are detected in the deep wells, an additional response subject to the review and approval of Ecology will be required. This response will focus on the specific situation involved, and could include additional hydraulic study, groundwater quality monitoring, and/or remedial actions. This demonstration will no longer be required when groundwater quality in the intermediate aquifer meets groundwater cleanup levels in the vicinity of the well cluster.

Reporting

Quarterly reports will be submitted to Ecology in accordance with Section VII.7, and will include:

- Hydraulic head data
- Water quality data if required
- Groundwater contour maps for the quarter
- Interpretations of compliance with hydraulic performance standards

If one or more hydraulic performance standards are not met during the quarter, the quarterly report also will describe the response monitoring that will be conducted. Quarterly reports will be submitted to Ecology within 90 days of the hydraulic head or water quality measurement date.

Annual reports will be submitted to Ecology and will include:

- Summary of water quality monitoring results collected during the year
- Comparison to groundwater cleanup levels
- Compliance with hydraulic performance standards during the year and responses taken if compliance was not demonstrated

The annual report will be provided to Ecology no later than March 1 following the year in which monitoring was conducted.

References

CH2M HILL. *Preclosure Investigation and Hydrogeologic Assessment Report, Reichhold Chemicals, Inc., Tacoma Facility*. February 1987a.

———————. *Aquifer Test Results at the Reichhold Tacoma Facility*. October 16, 1987b.

———————. *Groundwater Assessment Report*. 1987c.

———————. *Revised RCRA Part B Application*. January 1988a.

———————. *Revised Interim Corrective Action Plan*. June 1988b.

———————. *Summary Report, Drilling and Well Installations 1988*. November 1988c.

———————. *Extraction Well Startup Testing Summary*. January 1990.

———————. *Annual Groundwater Elevation Data, Analysis, and Constituent Listing*. March 1992.

———————. *Aquifer Testing and Monitoring*. May 1993.

———————. *RCRA Permit Renewal Application Part A and Part B. Reichhold, Inc. Tacoma Facility WAD 009 252 891*. June 1998.

City of Tacoma. Generalized Land Use Plan. June 1993, amended December 1996.

EPA. Quality Criteria for Water. EPA-440/9-76-023. Washington, D.C. 1976.

EPA. *Final Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy*. December 1986.

Evancho, J. City of Tacoma Resource Planning Manager. Personal communication. March 19, 1998.

Hart Crowser. *Field Exploration and Geotechnical Engineering Study: Proposed J.A. Jones Graving Dock*. March 26, 1981.

Hart Crowser. *Final Draft Investigation Report, Blair Backup Property, Port of Tacoma.*

Hem, J. Study and Interpretation of the Chemical Characteristics of Natural Water. Second Edition. U.S. Geological Survey Water-Supply Paper 1473. 1970.

Hodges, J.F. Personal Communication. Letter from J.F. Hodges, project manager for J.A. Jones Construction Company to Richard Pierce, Washington Department of Ecology. May 5, 1981.

Nalco Chemical Company, *The Nalco Water Handbook,* Second Edition. Ed. F. Kemmer. McGraw-Hill Book Company. 1987.

Port of Tacoma. "The Blair Waterway 2010 Plan–A Road Map for Two Decades of Growth." *Pacific Gateway.* Winter 1991.

Port of Tacoma. *Pacific Gateway Journal.* Winter 1998.

Salo, E.O. Personal Communication. Letter from Ernest O. Salo, Professor and Consultant, University of Washington Fisheries Research Institute, to Erik Prestegaard, Storch Corporation. February 11, 1981.

Serfes, M. "Determining the Mean Hydraulic Gradient of Groundwater Affected by Tidal Fluctuations." *Groundwater.* Vol. 29, No. 4. 1991.

U.S. EPA. Federal Register, Volume 57, Number 138, Page 31786. July 17, 1992.

————————. Letter from Dr. David Bartus/EPA to John Oldham/RCI. April 1993.

Walters and Kimmel. "Groundwater Occurrence and Stratigraphy of Unconsolidated Deposits, Central Pierce County, Washington." *USGS Water Supply Bulletin No. 22.* 1968.

Attachment 2 Tables

TABLE 2-1
Summary of Site Hydrogeologic Properties
Reichhold Tacoma Site

Unit	Groundwater Conditions	Unit Description	Unit Thickness (feet)	Hydraulic Conductivity (feet/day)	
				Horizontal	Vertical
Shallow Aquifer	Unconfined	Fine to medium sand and silty sand. Primarily dredged material from Blair and Hylebos waterways.	<10	0.2 – 17 [a]	
Upper Aquitard	--	Silt, organic silt, and clayey silt. The former salt marsh surface prior to filling with dredge spoils.	<1 - 20		0.0002 - 0.0045
Intermediate Aquifer	Confined with possible locally semiconfined conditions	Fine- to medium-grained sand and silty sand with interbedded zones of sand, silty sand, and silt	4 – 31.5	10 – 110 [c]	
Lower Aquitard	--	Silt, organic silt, and clayey silt	5.5 – 18		0.0002 - 0.005
Deep Aquifer	Confined	Alternating fine- to medium-grained sand and silty sand with occasional silt interbeds	Unknown >80?[1]	2 – 11	

[a] Based on slug test data (CH2M HILL 1987b)
[b] Based on laboratory permeability tests (CH2M HILL 1987b)
[c] Based on slug test data (CH2M HILL 1987b) and pumping test data (CH2M HILL 1990)
[d] Walters and Kimmel, 1968

TABLE 2-2
1997 Shallow Aquifer Hydraulic Gradient[a]

Measurement Location	Average Horizontal Hydraulic Gradient (foot per foot)			
	January 30, 1997	April 25, 1997	August 1, 1997	October 14, 1997
Northern section of SID[b] (interior)	0.015	0.009	0.011	0.017
Eastern section of SID[c] (interior)	0.012	0.012	0.018	0.016
Eastern section of SID[c] (exterior)	not measurable[e]	0.002	0.008	0.006
Southern section of SID[d] (interior)	0.021	0.021	0.023	0.027
Southern section of SID[d] (exterior)	0.028	0.006	0.006	dry[f]

[a]Hydraulic gradients calculated using shallow aquifer groundwater contour maps (CH2M HILL 1998).
[b]Includes the area of the site along the SID segment between SID piezometer 9 westward to SID piezometer 14.
[c]Includes the area of the site along the SID segment between SID piezometer 5 northward to SID piezometer 9.
[d]Includes the area of the site along the SID segment between SID piezometer 15 eastward to SID piezometer 5.
[e]Insufficient data to evaluate gradients in this area.
[f] Several shallow aquifer measuring points were dry in this area, yielding widely spaced data and indicating little potential for groundwater flow

TABLE 2-3
1997 Shallow Aquifer Groundwater Flow Velocity

Measurement Location	Linear Velocity (feet/day)							
	January 30, 1997		April 25, 1997		August 1, 1997		October 14, 1997	
	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]
Northern section of SID (interior)	0.02	1.28	0.01	0.77	0.01	0.94	0.02	1.5
Eastern section of SID (interior)	0.01	1.02	0.01	1.0	0.02	1.5	0.02	1.4

TABLE 2-3
1997 Shallow Aquifer Groundwater Flow Velocity

Measurement Location	Linear Velocity (feet/day)							
	January 30, 1997		April 25, 1997		August 1, 1997		October 14, 1997	
	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]
Eastern section of SID (exterior)	NA[c]	NA[c]	<0.01	0.17	<0.01	0.68	<0.01	0.51
Southern section of SID (interior)	0.02	1.79	0.02	1.79	0.02	2.0	0.03	2.3
Southern section of SID (exterior)	0.03	2.4	<0.01	0.51	<0.01	0.51	NA	NA

[a]Calculated using hydraulic conductivity of 0.2 ft/day and estimated hydraulic gradient from Table 2-2.
[b]Calculated using hydraulic conductivity of 17 ft/day and estimated hydraulic gradient from Table 2-2.
[c]NA-Not available because hydraulic gradient data for that area are not available.

TABLE 2-4
1997 Intermediate Aquifer Hydraulic Gradients[a]

Measurement Location	Average Horizontal Hydraulic Gradient (foot per foot)			
	January 30, 1997	April 25, 1997	August 1, 1997	October 14, 1997
Toward EW-3, EW-5 [c]	0.004	0.006	0.005	0.006
Toward EW-4, EW-10	0.008	0.009	0.010	0.008
Toward EW-6, EW-7	0.004	0.006	0.003	0.007
Toward EW-8, EW-9	0.003	0.002	not measurable[b]	not measurable[b]

[a]Hydraulic gradients calculated from 1997 intermediate aquifer groundwater elevation contour maps (CH2M HILL 1998).
[b]Gradients are flat, indicating limited groundwater flowing this area.
[c]EW-11 and EW-12 are replacements for EW-3 and EW-5

TABLE 2-5
1997 Intermediate Aquifer Groundwater Flow Velocity

Measurement Location	Linear Velocity (feet/day)							
	January 30, 1997		April 25, 1997		August 1,1997		October 14, 1997	
	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]
Toward EW-3, EW-5[d]	0.20	2.1	0.30	3.2	0.25	2.7	0.30	3.2
Toward EW-4, EW-10	0.40	4.2	0.45	4.8	0.50	5.3	0.40	4.2
Toward EW-6, EW-7	0.20	2.12	0.30	3.2	0.15	1.6	0.35	3.7
Toward EW-8, EW-9	0.15	1.6	0.10	1.1	NA[c]	NA[c]	NA[c]	NA[c]

[a]Calculated using hydraulic conductivity of 10 ft/day and estimated hydraulic gradient from Table 2-4.
[b]Calculated using hydraulic conductivity of 110 ft/day and estimated hydraulic gradient from Table 2-4.
[c]NA-Not available because hydraulic gradient data for that area are not available.
[d]EW-11 and EW-12 are replacements for EW-3 and EW-5

Table 2-6
1997 Vertical Hydraulic Gradients in Intermediate/Deep Aquifer Well Clusters

Monitoring Well Cluster	Estimated Low Low Tide Time Lag (hours)	Vertical Distance Between Screened Zones (ft)	January 30, 1997		April 24, 1997		August 1, 1997		October 14, 1997			
			Water Level Elevation[e] (ft NGVD)	Vertical Gradient[i]	Water Level Elevation[f] (ft NGVD)	Vertical Gradient[i]	Water Level Elevation[g] (ft NGVD)	Vertical Gradient[i]	Water Level Elevation[h] (ft NGVD)	Vertical Gradient[i]	Annual Net Gradient	Annual Net Gradient Direction
MW-1(I)	4.5[a]	32.5	3.63		2.41		1.69		1.69			
MW-1(D)			3.07	-0.017	2.22	-0.006	1.78	+0.003	2.42	+0.022	+0.001	Upward
MW-4(I)2	2.5[b]	22.0	2.11		1.29		0.56		1.02			
MW-4(D)			2.90	+0.036	1.67	+0.017	1.72	+0.053	1.98	+0.044	+0.037	Upward
MW-10(I)	2.5[b]	31.3	3.79		1.99		0.65		1.17			
MW-10(D)2			2.85	-0.030	2.98	+0.032	0.87	+0.007	1.93	+0.024	+0.008	Upward
MW-11(I)2	2.5[b]	27.0	3.58		1.33		0.17		0.45			
MW-11(D)2			2.80	-0.029	2.58	+0.046	0.63	+0.017	1.58	+0.042	+0.019	Upward
MW-13(I)	2.5[b]	20.9	3.72		2.42		1.90		1.98			
MW-13(D)			3.11	-0.029	2.16	-0.012	3.21	+0.063	2.48	+0.024	+0.011	Upward
MW-40(I)	negligible[c]	18.0	0.03	not	-1.66		-1.64		-1.25			
MW-40(D)			unmeasurable[d]	available	1.00	+0.148	0.96	+0.144	1.17	+0.134	+0.107	Upward

[a] CH2M HILL 1987 Preclosure Investigation and Hydrogeologic Assessment Report (page 3-12).

[b] Based on field measurements.

[c] Tidal time-lag negligible at this location because of its proximity to the Blair Waterway.

[d] Well was not accessible due to flooding, however, during previous monitoring events, the gradient in well cluster MW-40(I)/40(D) has been consistently upward.

[e] Datalogger data from low low tide 2/4/97 to low low tide 2/6/97 used for MW-1, MW-10, MW-11, and MW-13 well clusters.

[f] Datalogger data from high high tide 4/28/97 to high high tide 5/1/97 used for MW-1, MW-10, MW-11, and MW-13 well clusters.

[g] Datalogger data from high high tide 8/1/97 to high high tide 8/4/97 used for the MW-13 well cluster.

[h] Datalogger from high high tide 10/14/97 to high high tide 10/17/97 used for the MW-1 and MW-13 well clusters.

[i] Positive value indicates upward gradient, negative value indicates downward gradient.

TABLE 2-7
1997 Vertical Flow Path Analysis, MW-13(I)/13(D) Well Cluster[a]

Quarter	Vertical Gradient[b] (foot per foot)	Vertical Flow Distance[c] (feet)	Flow Direction
First quarter (January)[b]	-0.029	-0.067	Downward
Second quarter (April)	-0.012	-0.028	Downward
Third quarter (August)	+0.063	+0.144	Upward
Fourth quarter (October)	+0.024	+0.055	Upward
	Net flow for year	**+0.10**	**Upward**

[a]MW13(I)/13(D) cluster had the largest downward vertical gradient observed during 1997.
[b]Calculated in Table E3-8.
[c]Calculated using the highest hydraulic conductivity measured for lower confining unit (0.005 ft/day), an assumed effective porosity of 0.2 and a quarter duration of 91.25 days. Flow distance = (vertical hydraulic conductivity*vertical gradient*duration)/porosity.

Table 2-8
Vertical Flow Distances - Lower Aquitard (September 1994 - October 1997)

Monitoring Well Cluster	Aquitard Thickness (feet) (a)	September 30, 1994			January 23, 1995			April 17, 1995			July 11, 1995			September 23, 1995			January 26, 1996			April 19, 1996		
		Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)
Time between sampling events (days):				81			115			84			85			74			125			84
MW-1(I)	15.0	-			3.11			2.77			1.61			0.91			3.68			3.04		
MW-1(D)		-			3.40	+0.019	+0.056	2.24	-0.035	-0.074	2.24	+0.042	+0.089	1.74	+0.055	+0.102	2.82	-0.057	-0.179	2.92	-0.008	-0.017
MW-4(I)2	12.0	0.79			1.93			1.39			0.84			0.73			2.30			1.60		
MW-4(D)		2.08	+0.108	+0.218	3.17	+0.103	+0.297	2.21	+0.068	+0.144	1.46	+0.052	+0.110	1.76	+0.086	+0.159	2.64	+0.028	+0.089	1.68	+0.007	+0.014
MW-10(I)	8.0	0.25			3.20			2.06			0.46			0.02			3.32			1.8		
MW-10(D)2		1.55	+0.163	+0.329	3.26	+0.007	+0.022	2.12	+0.008	+0.016	1.28	+0.103	+0.218	0.06	+0.005	+0.009	2.43	-0.111	-0.348	1.85	+0.006	+0.013
MW-11(I)2	9.0	-0.53			2.72			1.70			-0.32			-0.44			1.99			0.39		
MW-11(D)2		1.50	+0.226	+0.457	2.83	+0.012	+0.035	1.72	+0.002	+0.005	1.19	+0.168	+0.357	1.00	+0.160	+0.296	2.50	+0.057	+0.177	1.75	+0.151	+0.317
MW-13(I)	12.5	1.1			3.41			2.78			1.70			1.05			3.29			2.55		
MW-13(D)		1.24	+0.011	+0.023	3.57	+0.013	+0.037	2.67	-0.009	-0.018	2.43	+0.058	+0.124	1.87	+0.066	+0.121	2.69	-0.048	-0.150	3.00	+0.036	+0.076
MW-40(I)	8.5	-0.38			1.16			0.18			-0.39			-0.91			-0.42			-1.02		
MW-40(D)		1.50	+0.221	+0.448	2.32	+0.136	+0.392	0.38	+0.024	+0.049	0.02	+0.048	+0.103	0.61	+0.179	+0.331	3.70	+0.485	+1.515	2.12	+0.369	+0.776

Monitoring Well Cluster	Aquitard Thickness (feet) (a)	July 16, 1996			October 22, 1996			January 30, 1997			April 24, 1997			August 1, 1997			October 14, 1997			Total Vertical Flow (September 1994 thru October 1997)
		Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	Water Level Elevation (ft NGVD)	Vertical Gradient (b,c)	Vertical Flow Distance (feet) (c,d)	
Time between sampling events (days):				88			98			100			84			99			74	
MW-1(I)	15.0	1.35			1.71			3.63			2.41			1.69			1.69			
MW-1(D)		1.42	+0.005	+0.010	1.93	+0.015	+0.036	3.07	-0.037	-0.093	2.22	-0.013	-0.027	1.78	+0.006	+0.015	2.42	+0.049	+0.090	**+0.008**
MW-4(I)2	12.0	0.72			1.29			2.11			1.29			0.56			1.02			
MW-4(D)		1.62	+0.075	+0.165	1.78	+0.041	+0.100	2.9	+0.066	+0.165	1.67	+0.032	+0.067	1.72	+0.097	+0.239	1.98	+0.080	+0.148	**+1.913**
MW-10(I)	8.0	0.90			0.50			3.79			1.99			0.65			1.17			
MW-10(D)2		2.23	+0.166	+0.366	1.28	+0.098	+0.239	2.85	-0.118	-0.294	2.98	+0.124	+0.260	0.87	+0.028	+0.068	1.93	+0.095	+0.176	**+1.073**
MW-11(I)2	9.0	-0.79			-0.15			3.58			1.33			0.17			0.45			
MW-11(D)2		0.70	+0.166	+0.364	1.22	+0.152	+0.373	2.8	-0.087	-0.217	2.58	+0.139	+0.292	0.63	+0.051	+0.127	1.58	+0.126	+0.232	**+2.814**
MW-13(I)	12.5	1.79			1.36			3.72			2.42			1.90			1.98			
MW-13(D)		2.36	+0.046	+0.100	1.45	+0.007	+0.018	3.11	-0.049	-0.122	2.16	-0.021	-0.044	3.21	+0.105	+0.259	2.48	+0.040	+0.074	**+0.498**
MW-40(I)	8.5	-1.38			-0.96			0.03	not		-1.66			-1.64			-1.25			
MW-40(D)		1.43	+0.331	+0.727	1.69	+0.312	+0.764	unmeasurabled	available	--	1.00	+0.313	+0.657	0.96	+0.306	+0.757	1.17	+0.285	+0.527	**+7.046**

Notes:

a. Aquifer thickness based on boring logs.
b. Vertical gradient = (intermediate well water level elevation - deep well water level elevation) / aquifer thickness.
c. Positive value indicates upward gradient, negative value indicates downward gradient.
d. Vertical flow distance calculated using the highest hydraulic conductivity measured for the lower confining unit (0.005 ft/day), an assumed effective porosity of 0.2 and calculated time (days) between sampling events. Flow distance = (vertical hydraulic conductivity * vertical gradient * duration) / porosity.

TABLE 2-9
1997 Deep Aquifer Hydraulic Gradient[a]

Measurement Location	Average Hydraulic Gradient (foot per foot)			
	January 30, 1997	April 25, 1997	August 1, 1997	October 14, 1997
Onsite	0.0006	0.0012	0.0009	0.0009
Offsite	not calculated	0.0008	0.0009	0.0009

[a]Hydraulic gradients calculated from deep aquifer groundwater elevation contour maps (Figures E3-15 through E3-18).
[b]Not calculated because the offsite deep well (MW-40D) was flooded at the time of measurement

TABLE 2-10
1997 Deep Aquifer Groundwater Flow Velocity Results

Measurement Location	Linear Velocity (feet/day)							
	January 30, 1997		April 25, 1997		August 1, 1997		October 14, 1997	
	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]	Min[a]	Max[b]
Onsite	0.006	0.033	0.012	0.066	0.009	0.050	0.009	0.050
Offsite	NA[c]	NA[c]	0.008	0.044	0.009	0.050	0.009	0.050

[a] Calculated using hydraulic conductivity of 2.0 ft/day and hydraulic gradient from Table E3-11.
[b] Calculated using hydraulic conductivity of 11 ft/day and hydraulic gradient from Table E3-11.
[c]NA-Not available because hydraulic gradient data for that area are not available.

TABLE 2-11
Summary of Groundwater Beneficial Uses in the Near-Surface Aquifers at the Reichhold Tacoma Facility

	Uppermost Aquifers	
Beneficial Uses	**Current**	**Reasonably Likely Future**
Drinking Water[a]	No	No
Irrigation	No	No
Industrial	No	No
Surface Water[b]	Yes	Yes

[a] Currently, there are institutional controls downgradient of the site in the shallow and intermediate aquifers barring drinking water use. Future institutional controls onsite will bar any use of the shallow, intermediate, and deep aquifers.

[b] The surface water receptor of groundwater is Blair Waterway, a manmade marine shipping channel. Beneficial uses include aquatic life, and, much less likely, recreational and subsistence fishing use.

TABLE 2-12
Wells Included in the Groundwater Monitoring Program [a]

	Shallow Aquifer Wells	**Intermediate Aquifer Wells** [c]	**Deep Aquifer Wells**
Conditional point of compliance wells	MW-1(S) MW-2(S)2 MW-4(S) MW-5(S) MW-9(S) MW-10(S) MW-11(S)2 MW-12(S) MW-13(S) MW-25(S)2 MW-56(S)	MW-2(I) MW-4(I)2 MW-5(I) MW-10(I) MW-11(I)2 MW-13(I)	MW-4(D) MW-10(D)2 MW-11(D)2 MW-13(D) MW-60(D)

TABLE 2-12
Wells Included in the Groundwater Monitoring Program [a]

	Shallow Aquifer Wells	Intermediate Aquifer Wells [c]	Deep Aquifer Wells
Wells monitored for site characterization information purposes[b]	MW-57(S) MW-14(S)	MW-30(I) MW-41(I) MW-44(I) MW-45(I)	

[a] The groundwater monitoring program will be adjusted as needed to reflect changes in groundwater extraction activities. For example, the offsite monitoring program in the intermediate aquifer will be adjusted with Ecology's approval as EW-4 and EW-10 are sequentially shut down under Attachment 3 of this order

[b] Samples collected for information on site conditions. However, results will not be used for assessing compliance because the wells are not located along the site perimeter

[c] In addition to these wells, Ecology has requested that two intermediate aquifer wells be installed between existing monitoring wells MW-5(I) and MW-13(I), one additional well between existing wells MW13(I) and MW-10(I), and groundwater grab samples, potentially followed by a monitoring well installation as redevelopment activities permit, be collected in the offsite area between MW-40(I) and MW-41(I)

TABLE 2-13
Groundwater Monitoring Constituents

Inorganics[a]	Semivolatiles	Volatiles
Molybdenum	2,3,4,6-Tetrachlorophenol	1,1-Dichloroethane
	2,4,6-Trichlorophenol	Acetone
	2,4-Dichlorophenol	Benzene
	2-Benzyl-4-chlorophenol	Ethylbenzene
	2-Chlorophenol	Formaldehyde
	2-Methylphenol	Tetrachloroethene
	4-chloro-3-methylphenol	Toluene
	4-Methylphenol	Trans-1,2-dichloroethene
	Acenaphthene	Trichloroethene
	Pentachlorophenol	Vinyl Chloride
	Phenol	
	2-methylnaphthalene	

[a] Molybdenum based on analysis of field-filtered samples.

TABLE 2-14
Hydraulic Performance Standards Summary
Reichhold, Inc., Tacoma, Washington

Aquifer	Hydraulic Performance Standard	Demonstration	Response
Shallow	SID captures, or prevents the offsite migration of, shallow aquifer groundwater that contains concentrations above groundwater cleanup levels caused by releases from the facility	See Table 2-15	See Table 2-15
Intermediate	Intermediate aquifer groundwater extraction system captures groundwater along the downgradient perimeter of the site that contains concentrations above groundwater cleanup levels caused by releases from the facility	Evaluation of capture based on contour maps constructed with measured water level data.	See Table 2-16

TABLE 2-14
Hydraulic Performance Standards Summary
Reichhold, Inc., Tacoma, Washington

Aquifer	Hydraulic Performance Standard	Demonstration	Response
Deep	A net groundwater flow exists from the deep aquifer to the intermediate aquifer within the area in which the intermediate aquifer contains concentrations above groundwater cleanup levels caused by releases from the facility	Net annual vertical gradient calculated from measurements.	If four consecutive quarters of net downward hydraulic gradient are determined to have occurred, Reichhold will sample the deep aquifer as described in the accompanying text. If contamination is detected in the deep aquifer, Reichhold will propose an appropriate response, for Ecololgy approval. The response will include additional hydraulic study, groundwater quality monitoring, or remedial action.

TABLE 2-15
Demonstration of Compliance With Hydraulic Performance Standard No. 1–Shallow Aquifer

SID Segment [a]	Water Level Comparison	Response if Compliance Is Not Demonstrated [b]
Segment S-1		Sample MW-33(S), MW-43(S) and MW-27S the following quarter
SID-15 to SID-1	SID-15/SID-1 mean water level lower than MW-43(S)	
SID-1 to SID-2	SID-1/SID-2 mean water level lower than MW-27(S)	
Segment S-2		Sample MW-42(S)2 and MW-54(S) the following quarter
SID-3 to SID-4	SID-3/SID-4 mean water level lower than MW-42(S)2	
Segment S-3		Sample MW-55(S) the following quarter
SID-4	SID-4 lower than MW-55(S)	
SID-5 to SID-6	SID-5 water level lower than MW-55(S)	
Segment S-4		Sample MW-21(S)2, MW-16(S), and MW-22(S) the following quarter
SID-16[c] to SID-7	SID-16 lower than MW-21(S)2	
SID-7 to SID-8	SID-7/SID-8 mean water level lower than PZ-5(S)	
SID-8 to SID-17[c]	SID-17 lower than PZ-7S	

TABLE 2-15
Demonstration of Compliance With Hydraulic Performance Standard No. 1–Shallow Aquifer

Segment S-5		Response to be determined subject to Ecology approval after results of RI/FS tasks are available
SID-9	SID-9 water level lower than MW-57(S)	
SID-10	SID-10 water level lower than MW-56(S)	
Segment S-6		Response to be determined subject to Ecology approval after results of RI/FS tasks are available
SID-12	SID-12 lower than MW-1(S)/MW-2(S)2 mean water level	
SID-13	SID-13 lower than MW-2(S)2/MW-4(S) mean water level	
SID-14	SID-14 water level lower than PZ-3(S)	

[a] See Figure 2-23 for SID segment locations
[b] Responses will occur if water level comparisons described yield a difference greater than or equal to 0.1 foot.
[c] SID-16 and SID-17 to be installed with Ecology's approval

TABLE 2-16
Demonstration of Compliance With Hydraulic Performance Standard No. 2–Intermediate Aquifer

Extraction Well Pumping Center	Response if Hydraulic Performance Standard No. 2 Is Not Demonstrated
EW-6/EW-7	Sample MW-36(I) and MW-37(I)
EW-8/EW-9	Sample MW-36(I) and MW-50(I)
EW-11/EW-12	Sample MW-30(I) and three to four additional offsite wells to be identified after completion of the RI/FS activities
EW-4/EW-10	Sample MW-44(I) and up to three additional offsite wells to be identified after completion of the RI/FS activities

Attachment 2 Figures

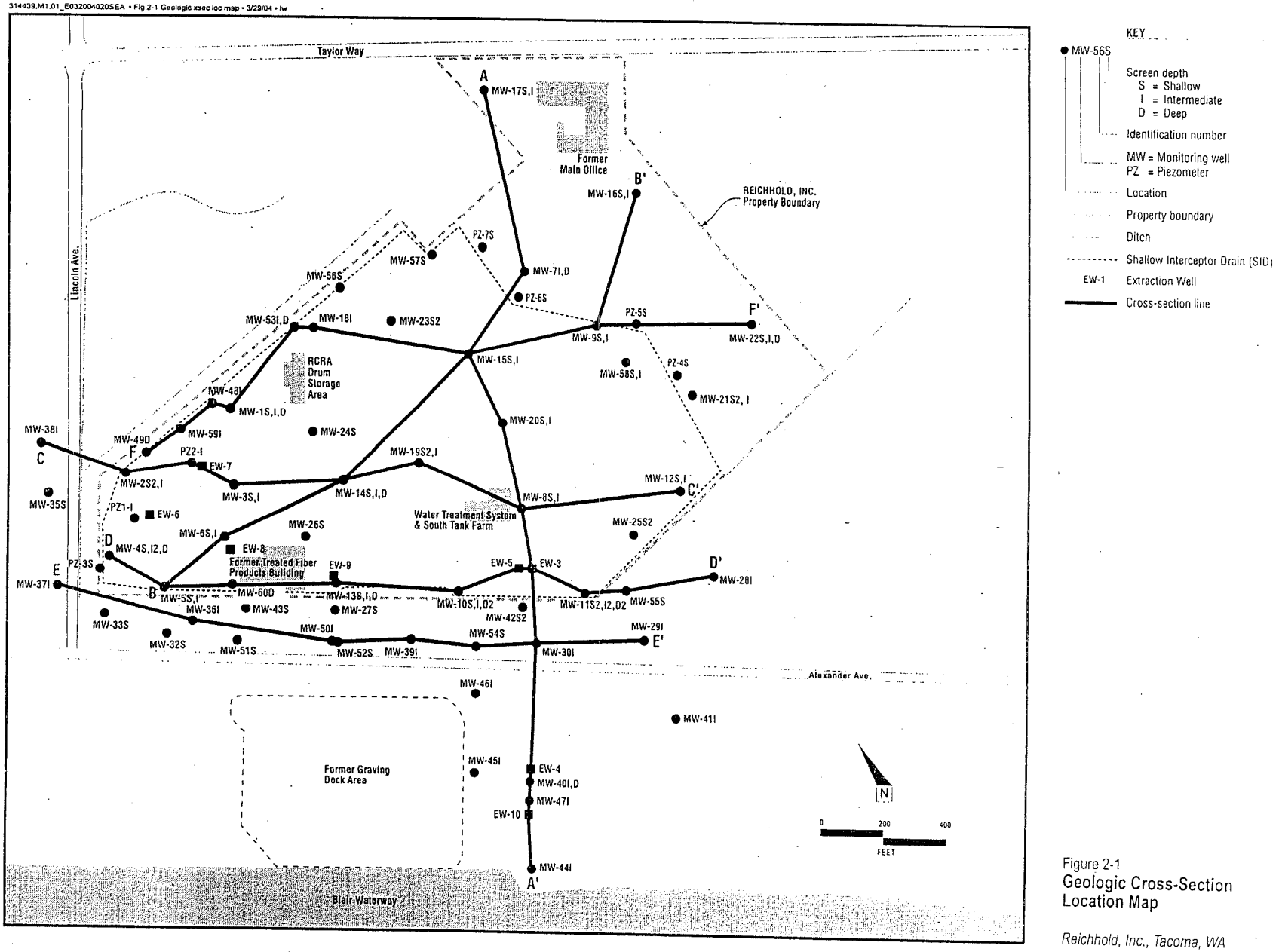
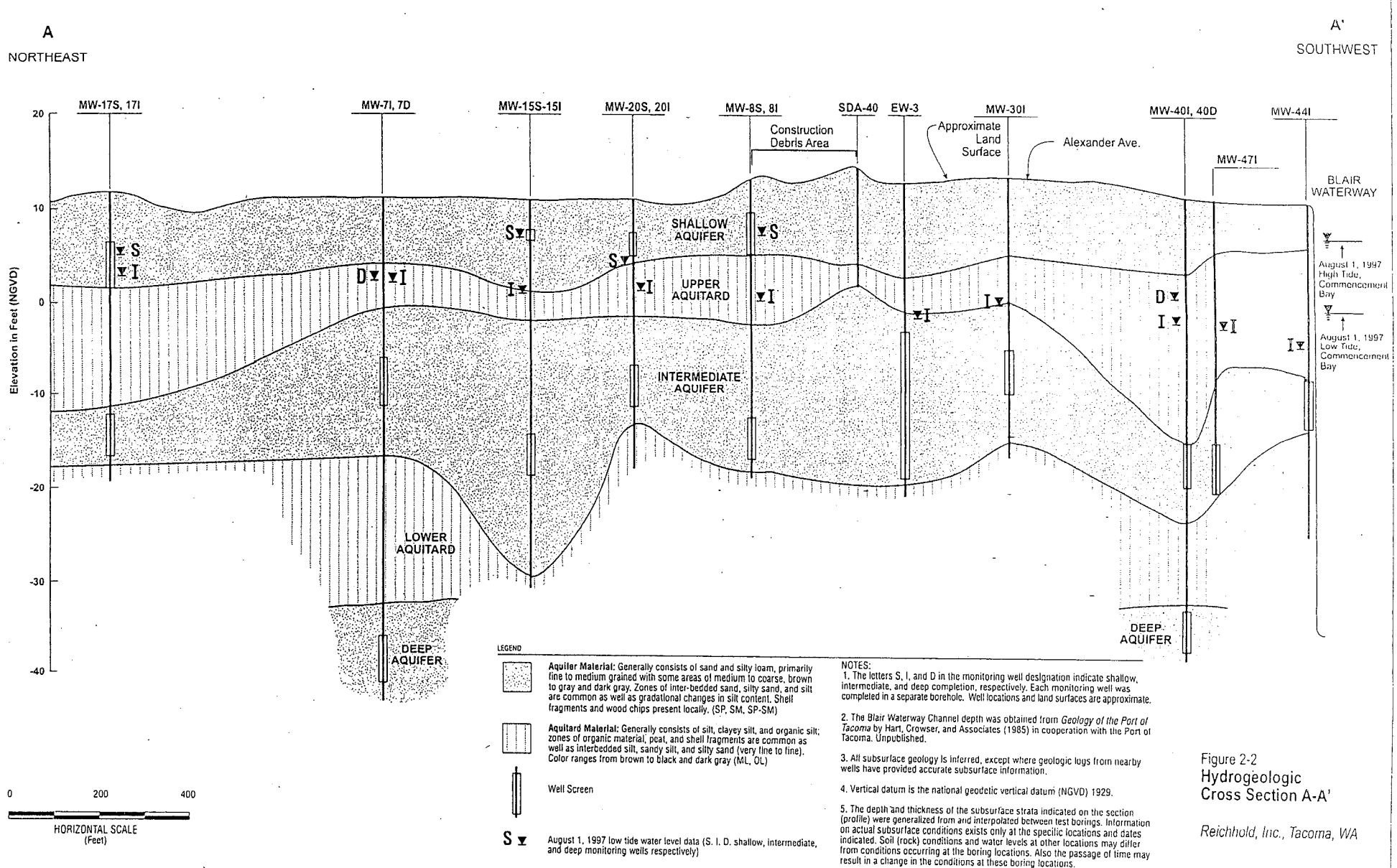


Figure 2-1
Geologic Cross-Section Location Map

Reichhold, Inc., Tacoma, WA



NOTES:
1. The letters S, I, and D in the monitoring well designation indicate shallow, intermediate, and deep completion, respectively. Each monitoring well was completed in a separate borehole. Well locations and land surfaces are approximate.

2. The Blair Waterway Channel depth was obtained from *Geology of the Port of Tacoma* by Hart, Crowser, and Associates (1985) in cooperation with the Port of Tacoma. Unpublished.

3. All subsurface geology is inferred, except where geologic logs from nearby wells have provided accurate subsurface information.

4. Vertical datum is the national geodetic vertical datum (NGVD) 1929.

5. The depth and thickness of the subsurface strata indicated on the section (profile) were generalized from and interpolated between test borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil (rock) conditions and water levels at other locations may differ from conditions occurring at the boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Figure 2-2
Hydrogeologic Cross Section A-A'

Reichhold, Inc., Tacoma, WA

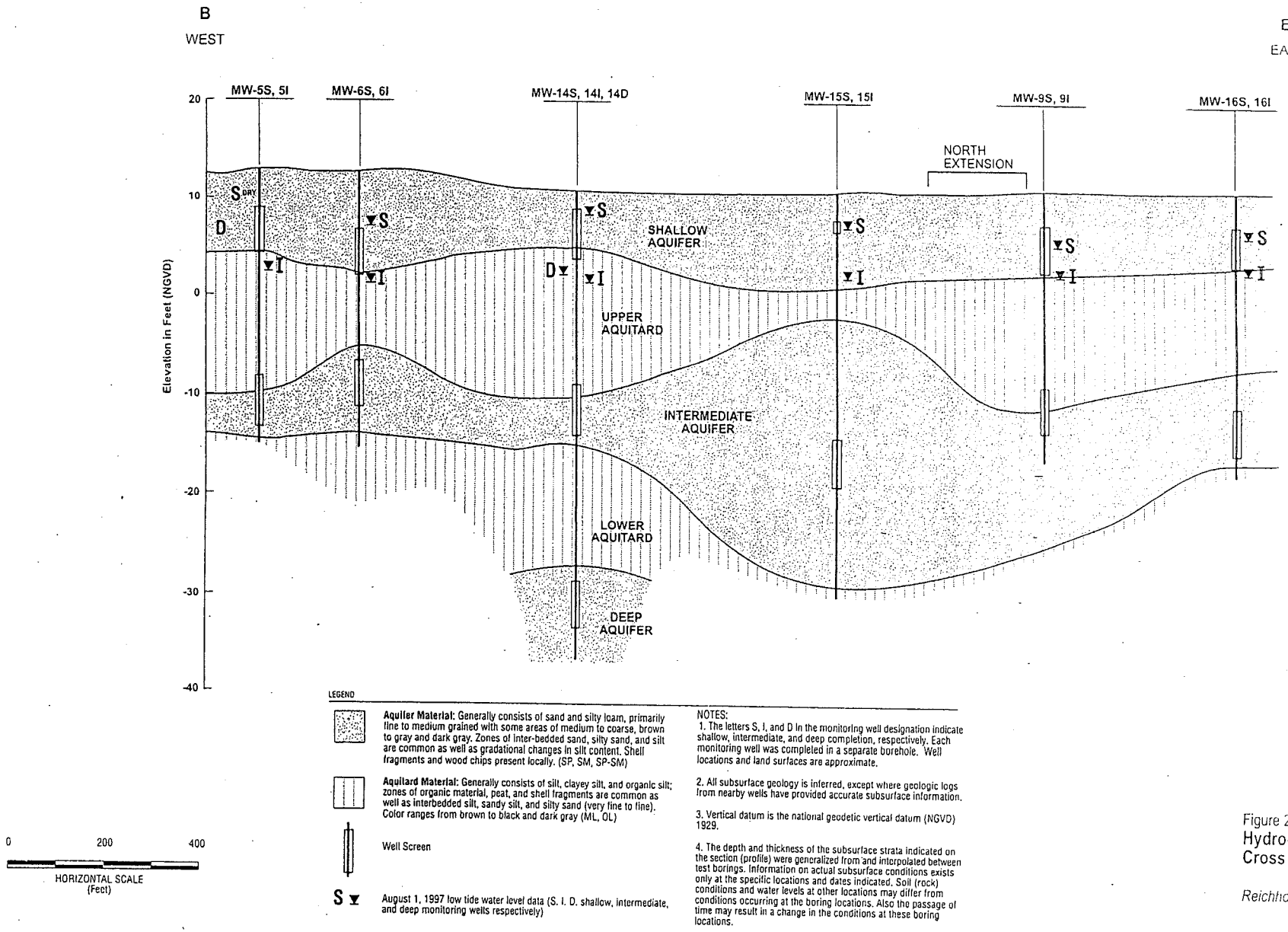


Figure 2-3
Hydrogeologic
Cross Section B-B'

Reichhold, Inc., Tacoma, WA

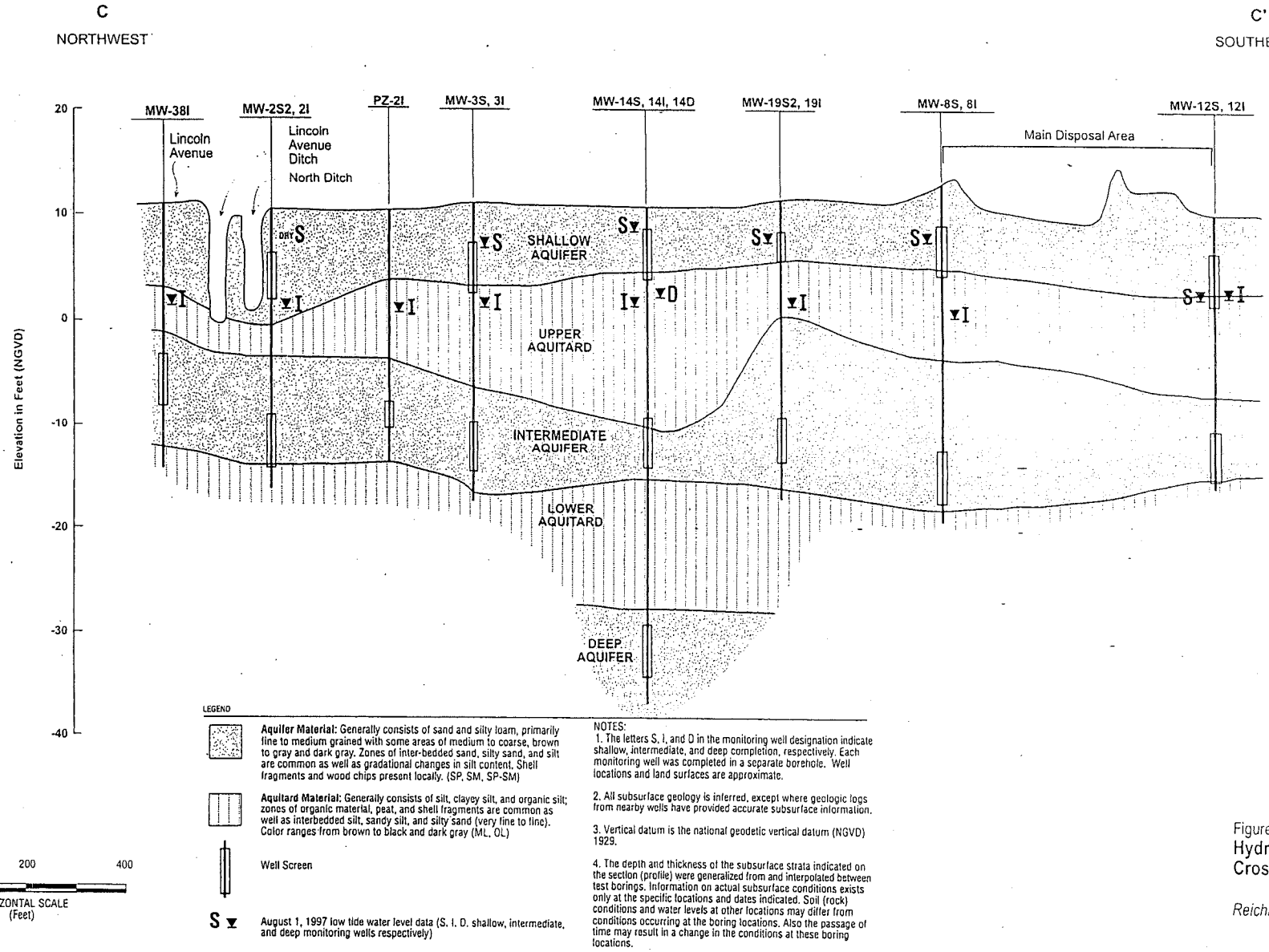
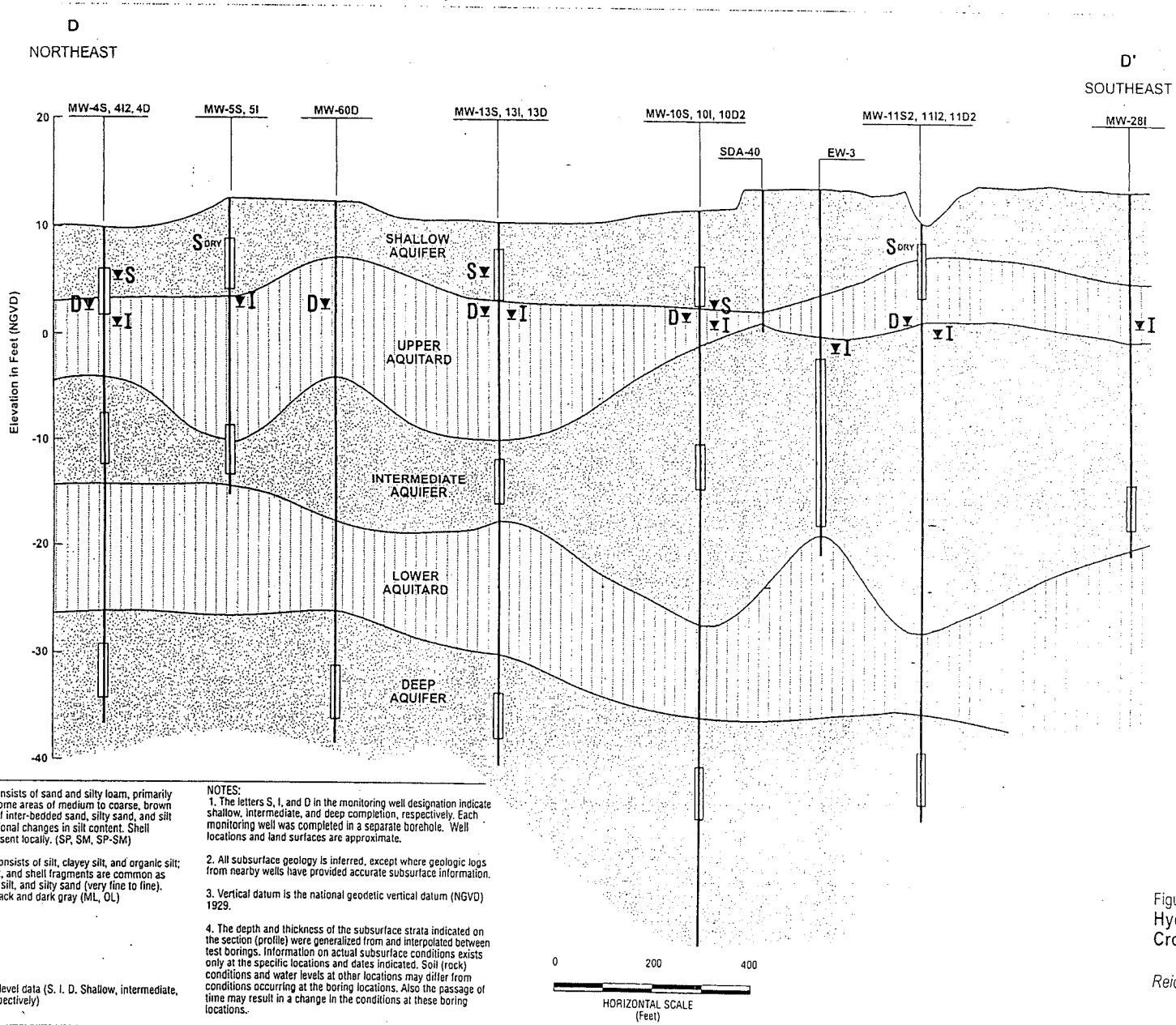


Figure 2-4
Hydrogeologic Cross Section C-C'

Reichhold, Inc., Tacoma, WA



LEGEND

Aquifer Material: Generally consists of sand and silty loam, primarily fine to medium grained with some areas of medium to coarse, brown to gray and dark gray. Zones of inter-bedded sand, silty sand, and silt are common as well as gradational changes in silt content. Shell fragments and wood chips present locally. (SP, SM, SP-SM)

Aquitard Material: Generally consists of silt, clayey silt, and organic silt; zones of organic material, peat, and shell fragments are common as well as interbedded silt, sandy silt, and silty sand (very fine to fine). Color ranges from brown to black and dark gray (ML, OL)

Well Screen

S ▼ August 1, 1997 low tide water level data (S. I. D. Shallow, intermediate, and deep monitoring wells respectively)

NOTES:

1. The letters S, I, and D in the monitoring well designation indicate shallow, intermediate, and deep completion, respectively. Each monitoring well was completed in a separate borehole. Well locations and land surfaces are approximate.

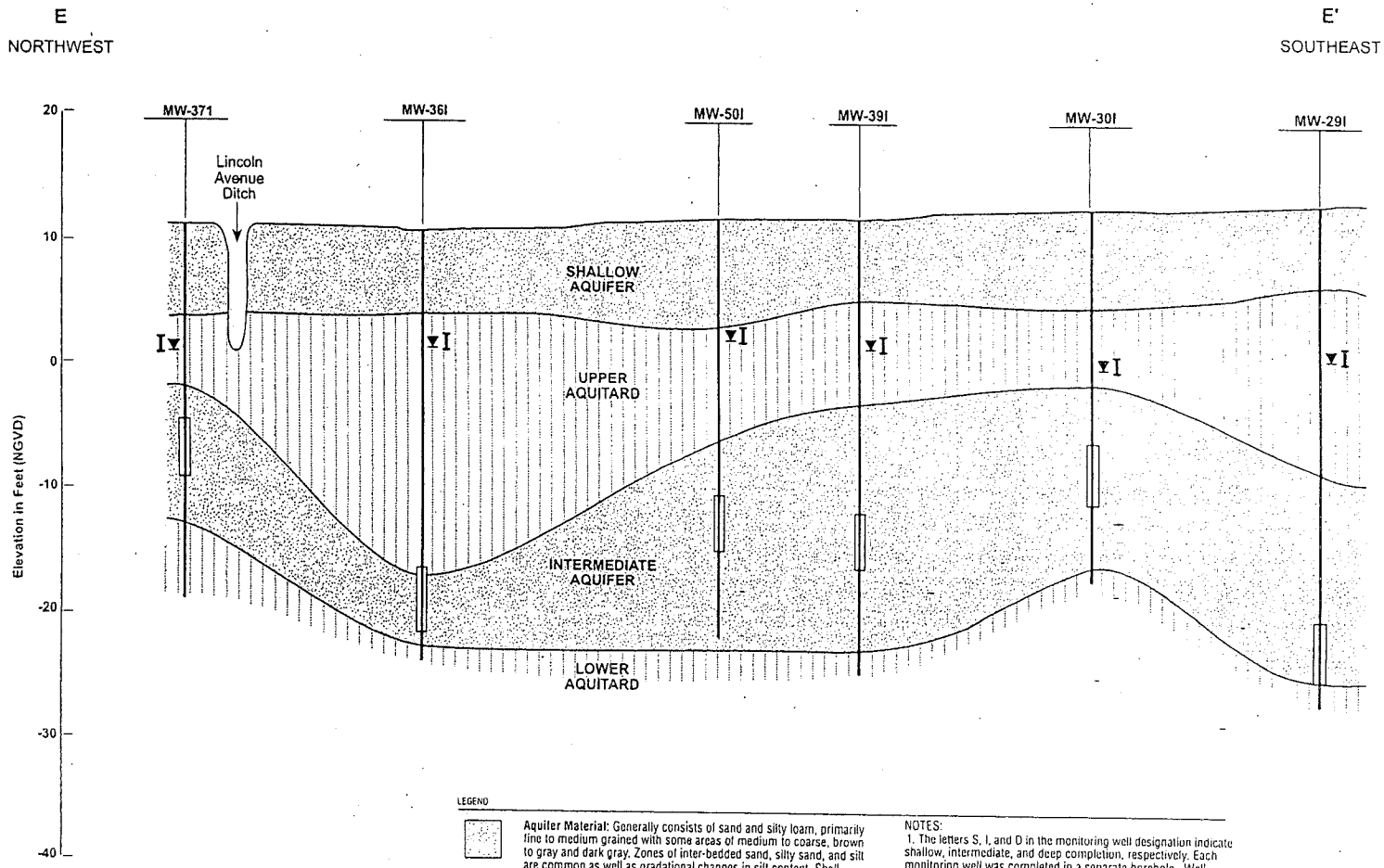
2. All subsurface geology is inferred, except where geologic logs from nearby wells have provided accurate subsurface information.

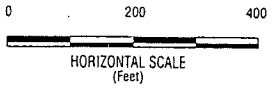
3. Vertical datum is the national geodetic vertical datum (NGVD) 1929.

4. The depth and thickness of the subsurface strata indicated on the section (profile) were generalized from and interpolated between test borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil (rock) conditions and water levels at other locations may differ from conditions occurring at the boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Figure 2-5
Hydrogeologic
Cross Section D-D'

Reichhold, Inc., Tacoma, WA





LEGEND

Aquifer Material: Generally consists of sand and silty loam, primarily fine to medium grained with some areas of medium to coarse, brown to gray and dark gray. Zones of inter-bedded sand, silty sand, and silt are common as well as gradational changes in silt content. Shell fragments and wood chips present locally. (SP, SM, SP-SM)

Aquitard Material: Generally consists of silt, clayey silt, and organic silt; zones of organic material, peat, and shell fragments are common as well as interbedded silt, sandy silt, and silty sand (very fine to fine). Color ranges from brown to black and dark gray (ML, OL)

Well Screen

S ▼ August 1, 1997 low tide water level data (S. I. D. shallow, intermediate, and deep monitoring wells respectively)

NOTES:

1. The letters S, I, and D in the monitoring well designation indicate shallow, intermediate, and deep completion, respectively. Each monitoring well was completed in a separate borehole. Well locations and land surfaces are approximate.

2. All subsurface geology is inferred, except where geologic logs from nearby wells have provided accurate subsurface information.

3. Vertical datum is the national geodetic vertical datum (NGVD) 1929.

4. The depth and thickness of the subsurface strata indicated on the section (profile) were generalized from and interpolated between test borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil (rock) conditions and water levels at other locations may differ from conditions occurring at the boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Figure 2-6
Hydrogeologic Cross Section E-E'

Reichhold, Inc., Tacoma, WA

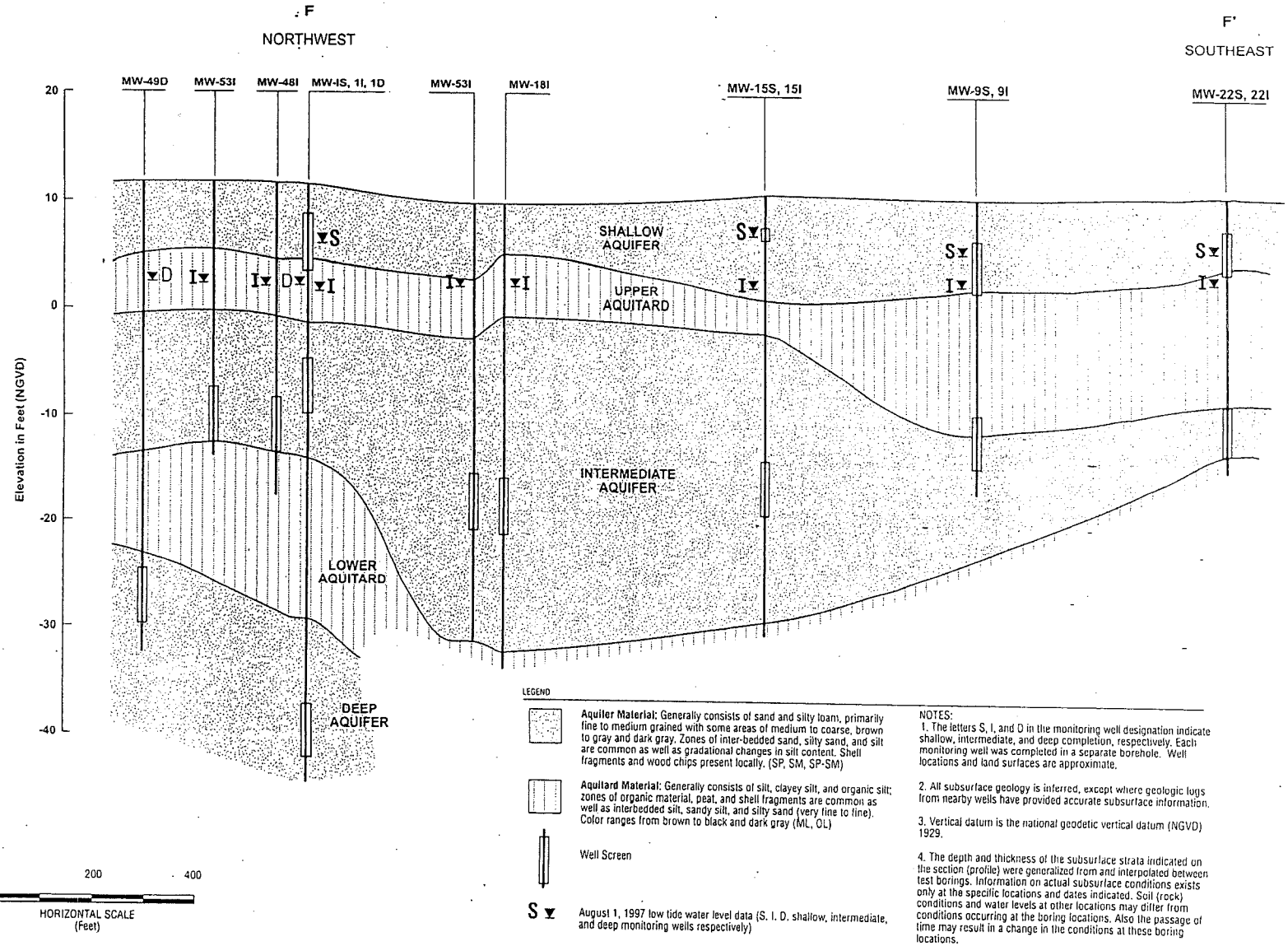
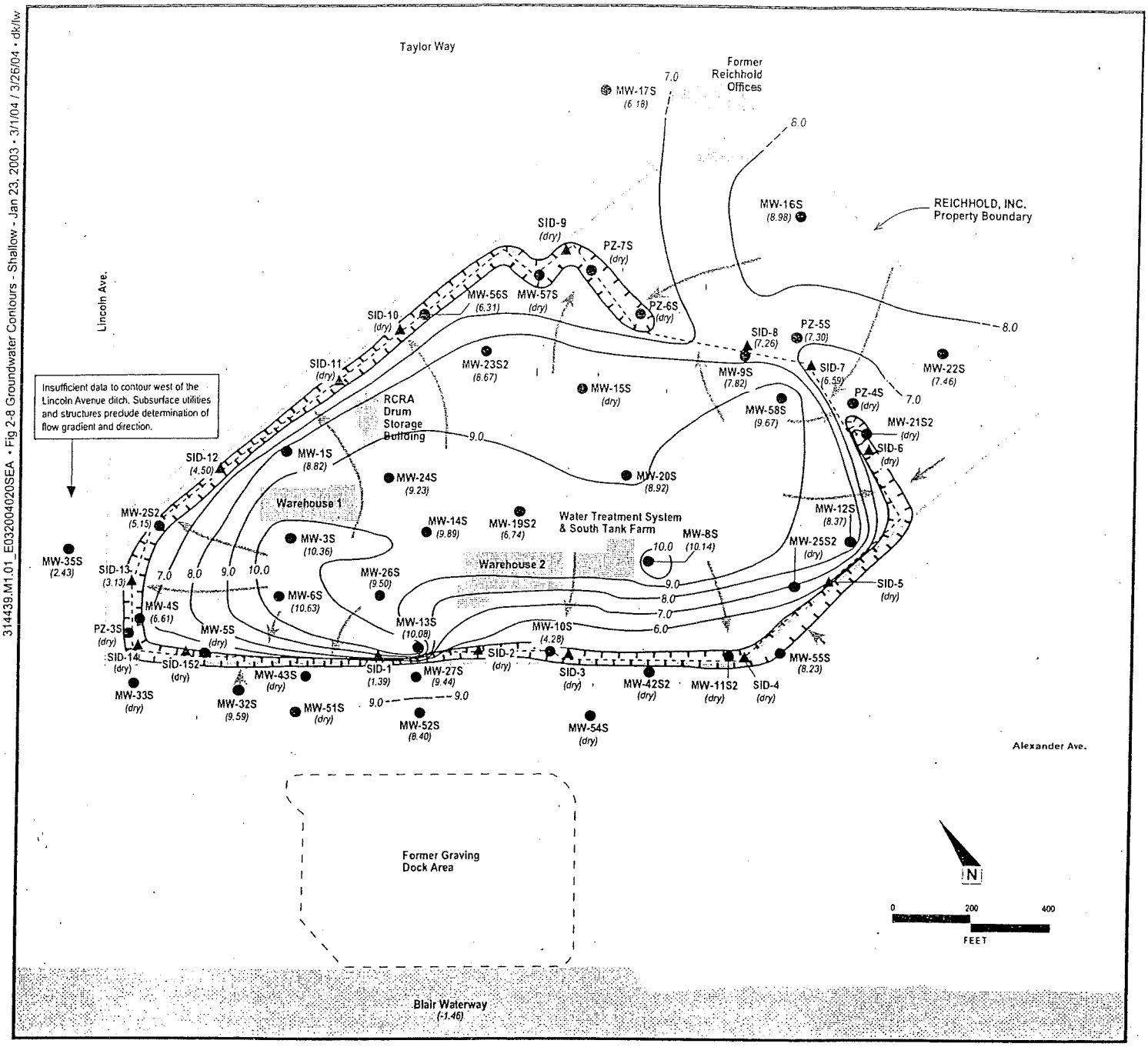


Figure 2-7
Hydrogeologic Cross Section F-F'

Reichhold, Inc., Tacoma, WA



KEY

- MW-56S
  - Aquifer Monitored
  - Well number
  - Well location
- Property boundary
- Ditch
- Shallow Interceptor Drain (SID)
- ▲ SID-1 SID Piezometer
- 3.0 Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction
- Groundwater depression

Contour interval equals 1.0 foot

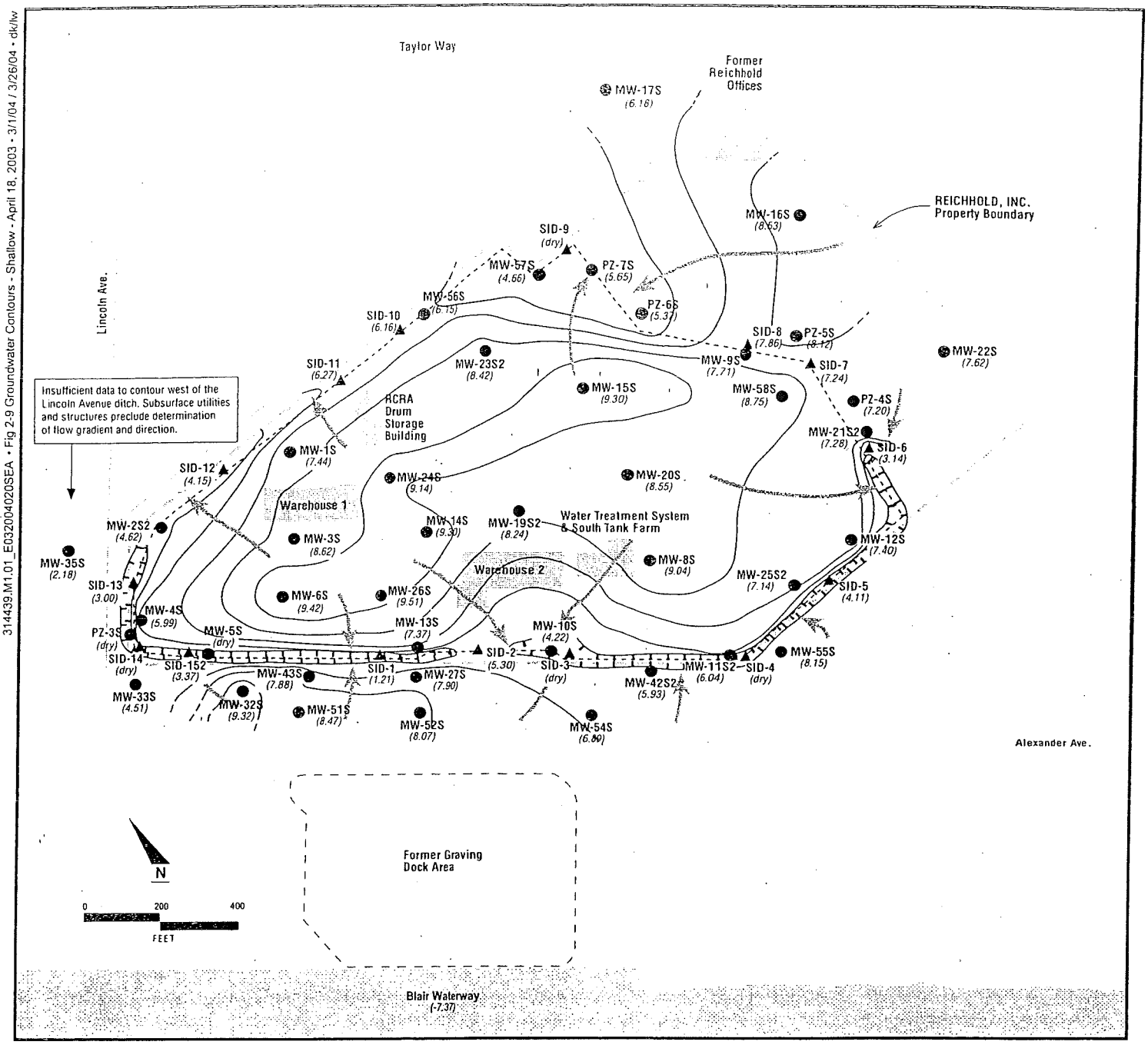
Tide Table for January 23, 2003

Low Low Tide Time: 0154 Elevation (NGVD): -5.7	High Low Tide Time: 1514 Elevation (NGVD): -2.7
Low High Tide Time: 2043 Elevation (NGVD): 2.8	High High Tide Time: 0848 Elevation (NGVD): 6.9

Time Range for Water Level Measurements = 1240 to 1355

Figure 2-8
Groundwater Contour Map
Shallow Aquifer
January 23, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-56S — Aquifer monitored / Well number
- Well location
- Property boundary
- Ditch
- Shallow Interceptor Drain (SID)
- ▲ SID-1 — SID Piezometer
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction
- Groundwater depression

Contour interval equals 1.0 foot

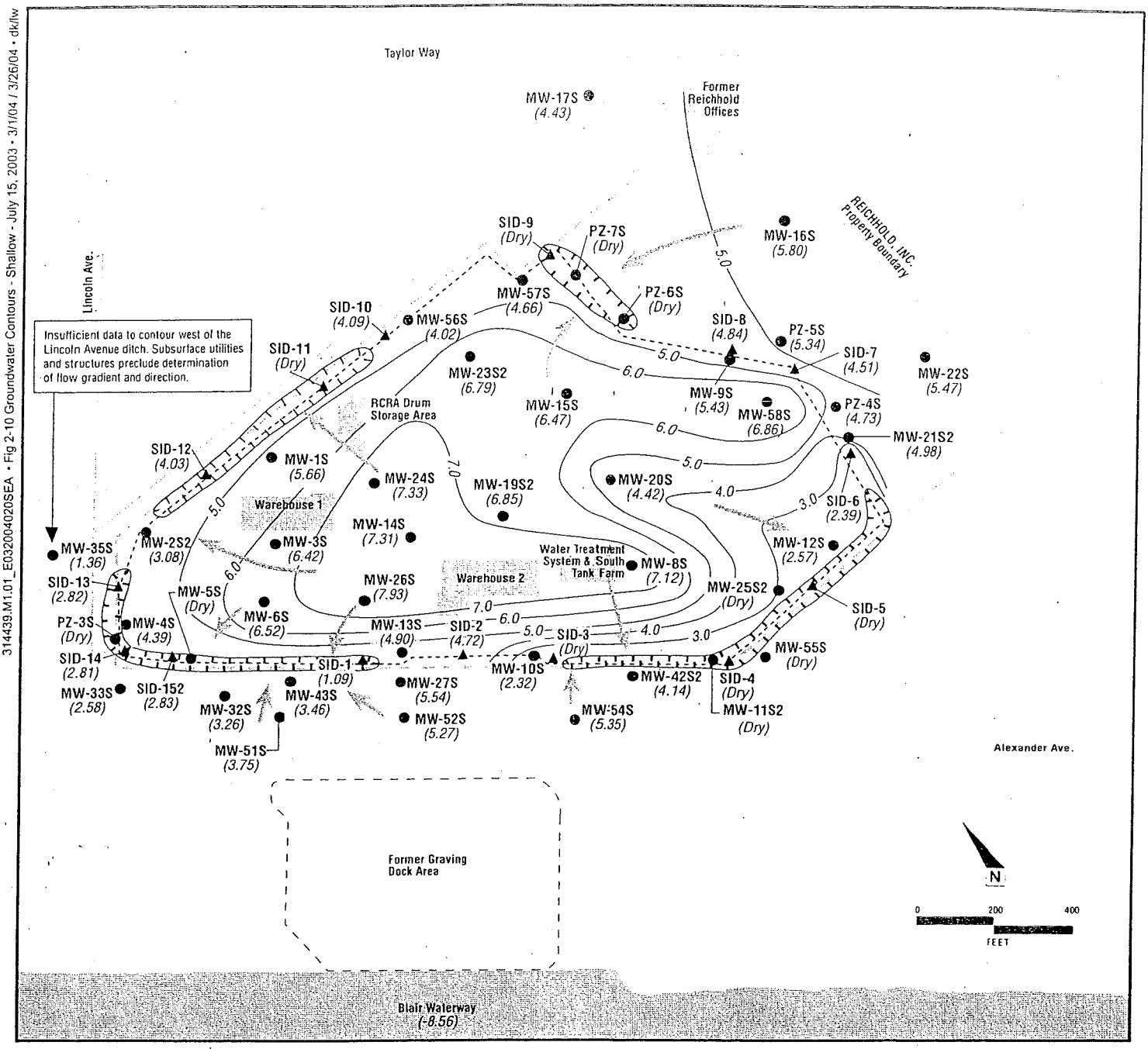
Tide Table for April 18, 2003

Low Low Tide Time: 1301 Elevation (NGVD): -8.5	High Low Tide Time: 0034 Elevation (NGVD): -2.4
Low High Tide Time: 1954 Elevation (NGVD): 5.8	High High Tide Time: 0609 Elevation (NGVD): 5.9

Time Range for Water Level Measurements = 1036 to 1144

Figure 2-9
Groundwater Contour Map
Shallow Aquifer
April 18, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-56S — Aquifer Monitored
- Well number
- Well location
- Property boundary
- Ditch
- Shallow Interceptor Drain (SID)
- ▲ SID-1 — SID Piezometer
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction
- Groundwater depression

Contour interval equals 1.0 foot

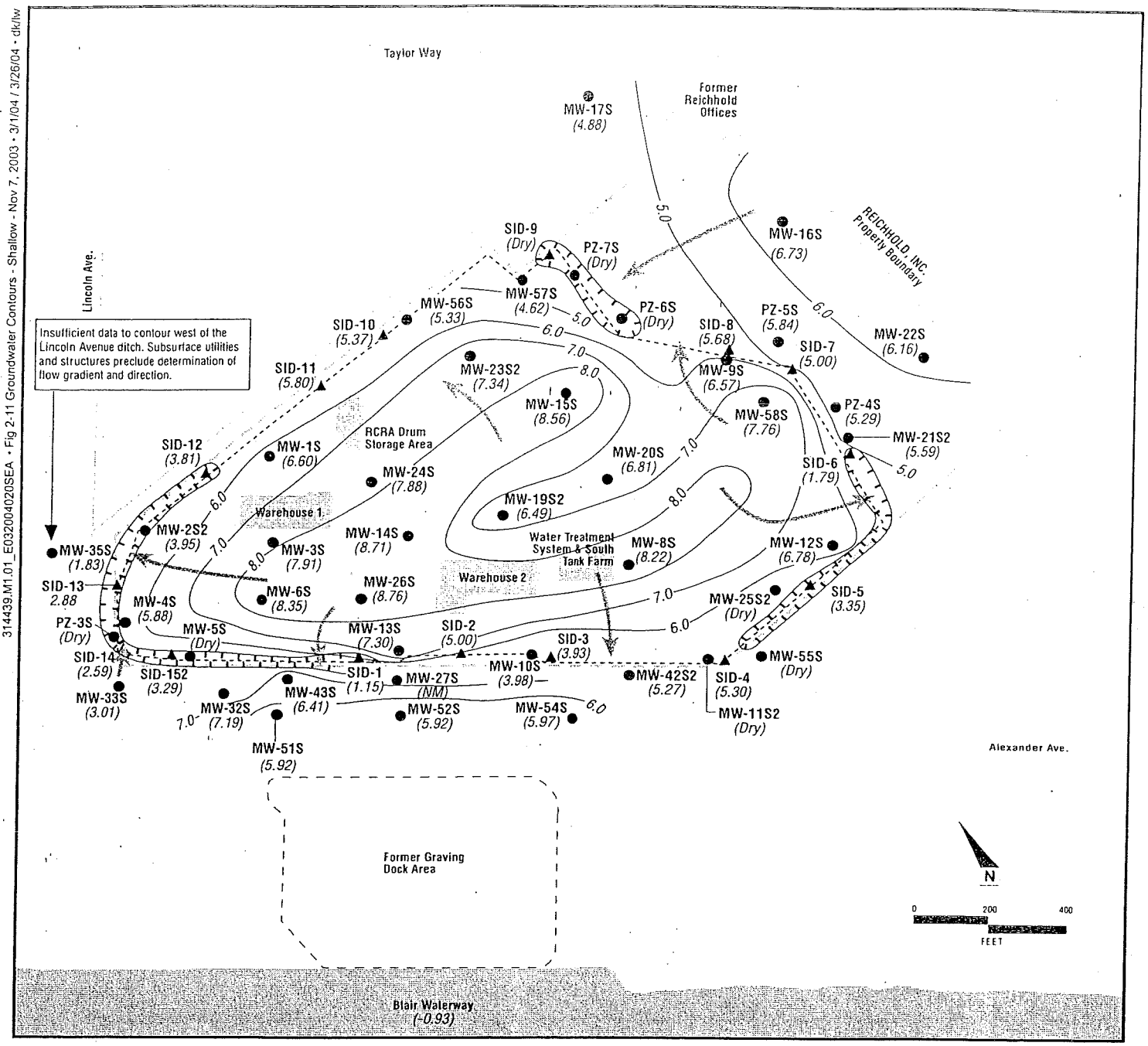
Tide Table for July 15, 2003

Low Low Tide Time: 1148 Elevation (NGVD): -9.89	High Low Tide Time: 0000 Elevation (NGVD): 0.38
Low High Tide Time: 0454 Elevation (NGVD): 4.48	High High Tide Time: 1906 Elevation (NGVD): 5.65

Time Range for Water Level Measurements = 1001 to 1130
Tidal data for Tacoma, Commencement Bay, WA, Station ID-9446484, from NOAA Web Page: *www.co-ops.nos.NOAA.gov*

Figure 2-10
Groundwater Contour Map
Shallow Aquifer
July 15, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-56S — Aquifer Monitored / Well number
- Well location
- Property boundary
- Ditch
- Shallow Interceptor Drain (SID)
- SID-1 — SID Piezometer
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction
- Groundwater depression

NM = Not Measured

Contour interval equals 1.0 foot

Tide Table for November 7, 2003

Low Low Tide Time: 2206 Elevation (NGVD): -6.71	High Low Tide Time: 0948 Elevation (NGVD): -2.07
Low High Tide Time: 0412 Elevation (NGVD): 3.53	High High Tide Time: 1524 Elevation (NGVD): 4.62

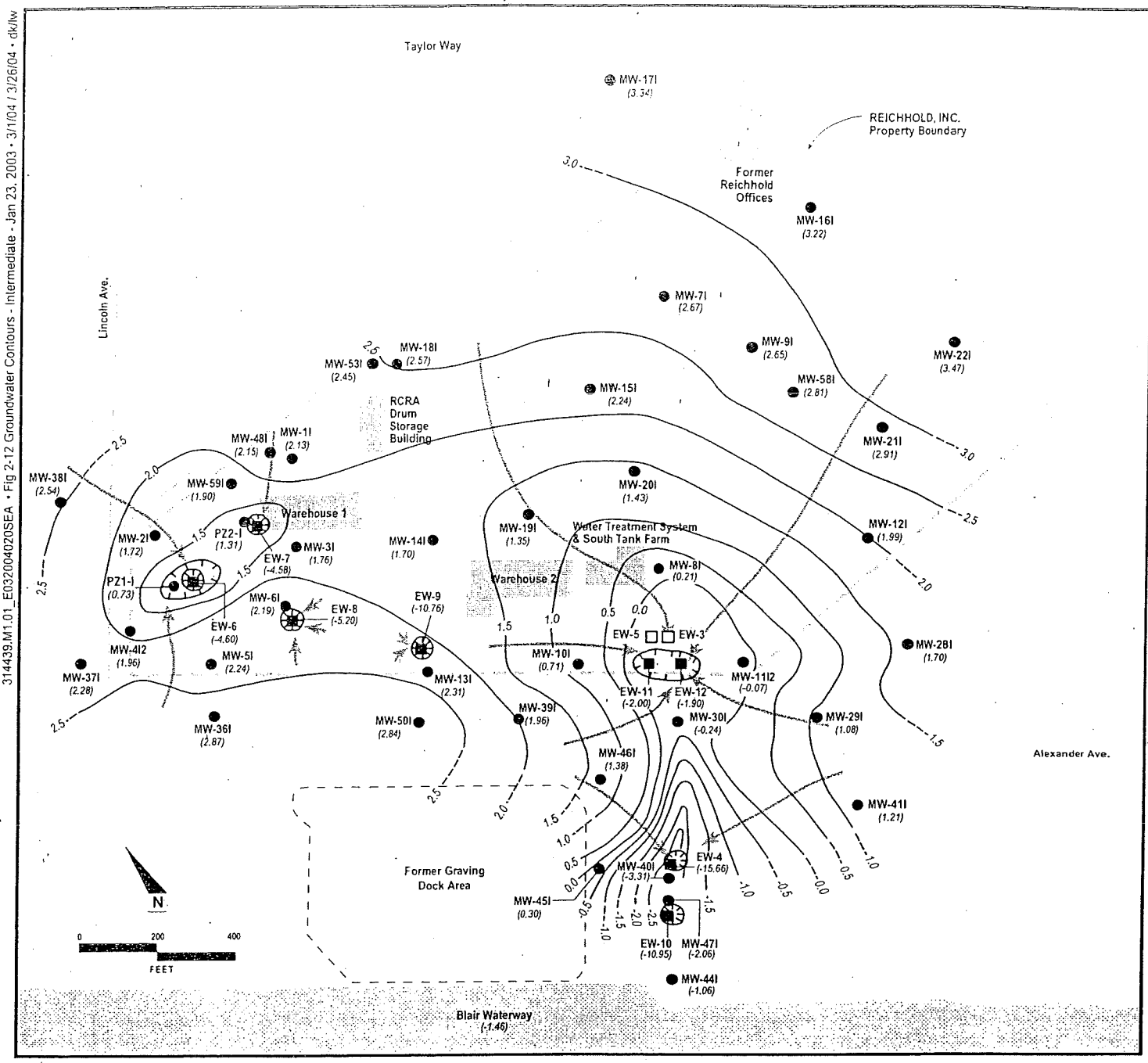
Time Range for Water Level Measurements = 1018 to 1157

Tidal data for Tacoma, Commencement Bay, WA, Station ID-9446484, from NOAA Web Page:*www.co-ops.nos.NOAA.gov*

Figure 2-11

Groundwater Contour Map Shallow Aquifer November 7, 2003

Reichhold, Inc., Tacoma, WA



KEY

MW-53I — Aquifer monitored; Well number

Well location

Property boundary

Ditch

EW-3 — Inactive extraction well

EW-7 — Active extraction well

3.0 — Approximate location of potentiometric surface contour (dashed where inferred)

Inferred groundwater flow direction

Groundwater depression

Contour interval equals 0.5 foot

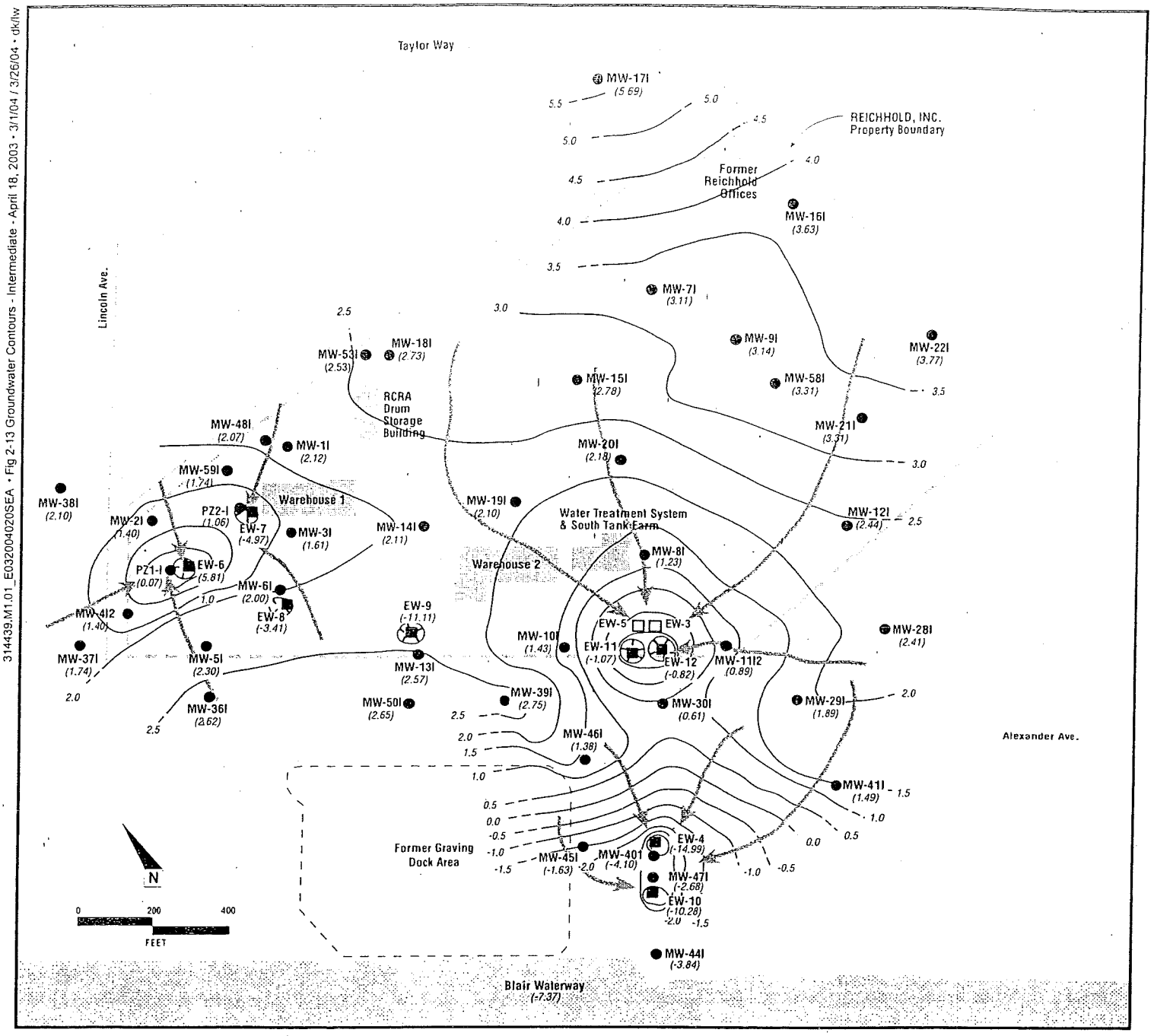
Tide Table for January 23, 2003

Low Low Tide Time: 0154 Elevation (NGVD): -5.7	High Low Tide Time: 1514 Elevation (NGVD): -2.7
Low High Tide Time: 2043 Elevation (NGVD): 2.8	High High Tide Time: 0848 Elevation (NGVD): 6.9

Time Range for Water Level Measurements = 1429 to 1542

Figure 2-12
Groundwater Contour Map Intermediate Aquifer
January 23, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-56S — Aquifer monitored
- Well number
- Well location
- Property boundary
- EW-3 — Inactive extraction well
- EW-7 — Active extraction well
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction
- Groundwater depression

Contour interval equals 0.5 foot

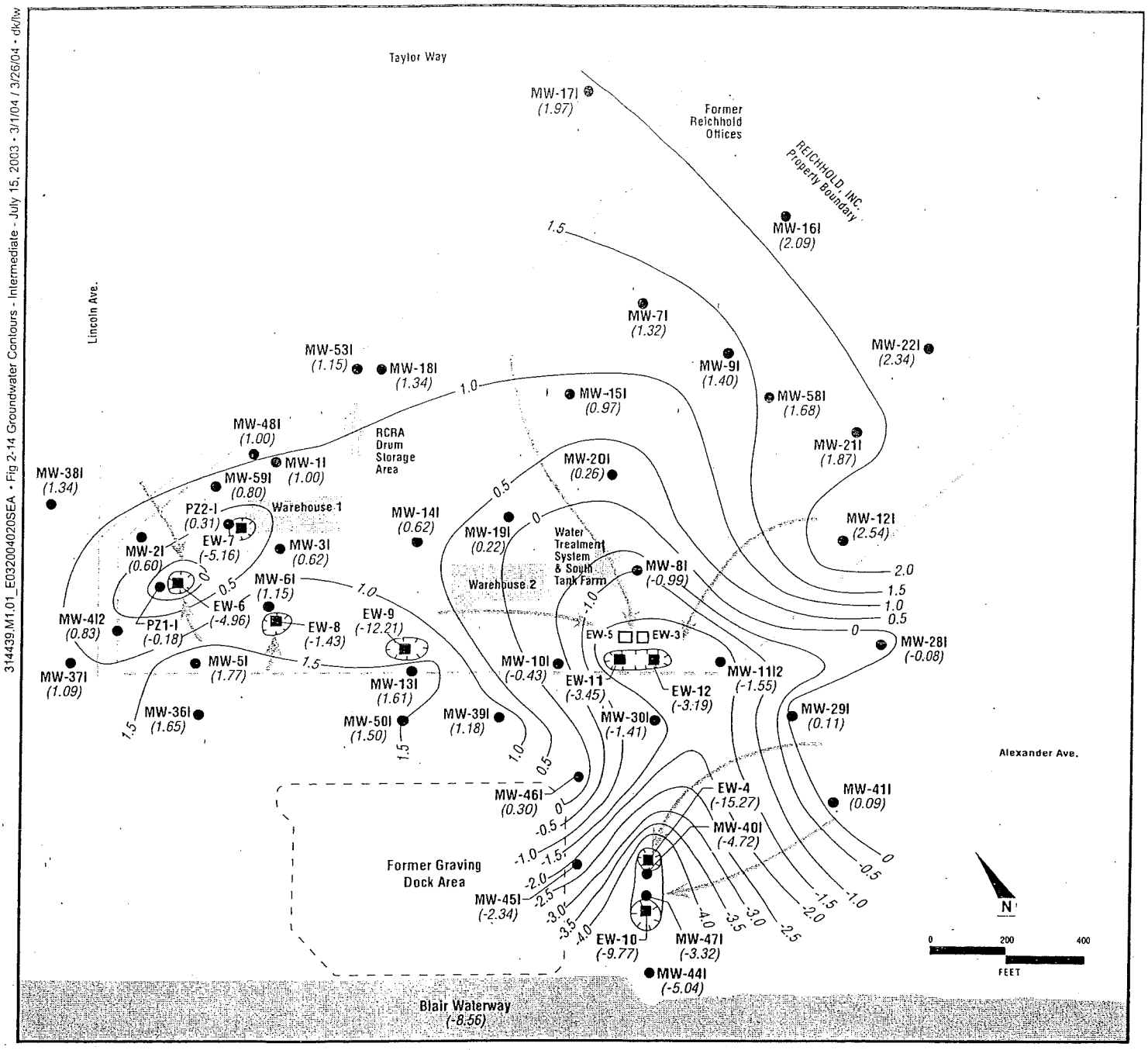
Tide Table for April 18, 2003

Low Low Tide Time: 1301 Elevation (NGVD): -8.5	High Low Tide Time: 0034 Elevation (NGVD): -2.4
Low High Tide Time: 1954 Elevation (NGVD): 5.8	High High Tide Time: 0609 Elevation (NGVD): 5.9

Time Range for Water Level Measurements = 1216 to 1321

Figure 2-13
Groundwater Contour Map
Intermediate Aquifer
April 18, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-50I
- Aquifer monitored
- Well number
- Well location
- Property boundary
- EW-3 Inactive extraction well
- EW-7 Active extraction well
- Ditches
- Inferred groundwater flow direction
- Groundwater Depression

Contour Interval = 0.5 foot

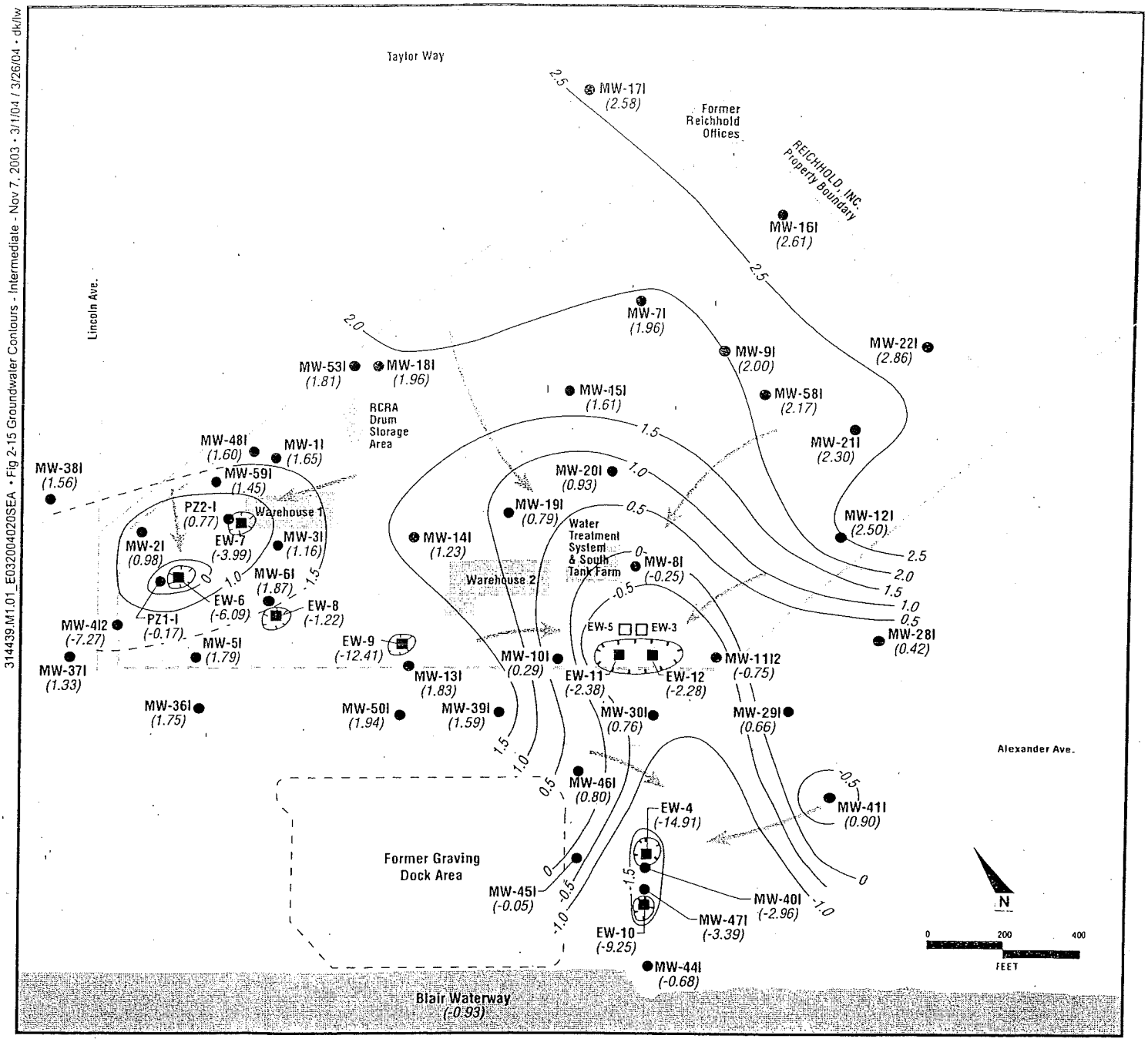
Tide Table for July 15, 2003

Low Low Tide Time: 1148 Elevation (NGVD): -9.89	High Low Tide Time: 0000 Elevation (NGVD): 0.38
Low High Tide Time: 0454 Elevation (NGVD): 4.48	High High Tide Time: 1906 Elevation (NGVD): 5.65

Time Range for Water Level Measurements = 1216 to 1350
Tidal data for Tacoma, Commencement Bay, WA, Station ID-9446484, from NOAA Web Page: *www.co-ops.nos.NOAA.gov*

Figure 2-14
Groundwater Contour Map Intermediate Aquifer July 15, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-50I — Aquifer monitored; Well number
- Well location
- Property boundary
- EW-3 — Inactive extraction well
- EW-7 — Active extraction well
- Ditches
- Inferred groundwater flow direction
- Groundwater Depression

Contour Interval = 0.5 foot

MW-41I2 data not contoured.
Value inconsistent with historic data and elevations measured in surrounding wells.

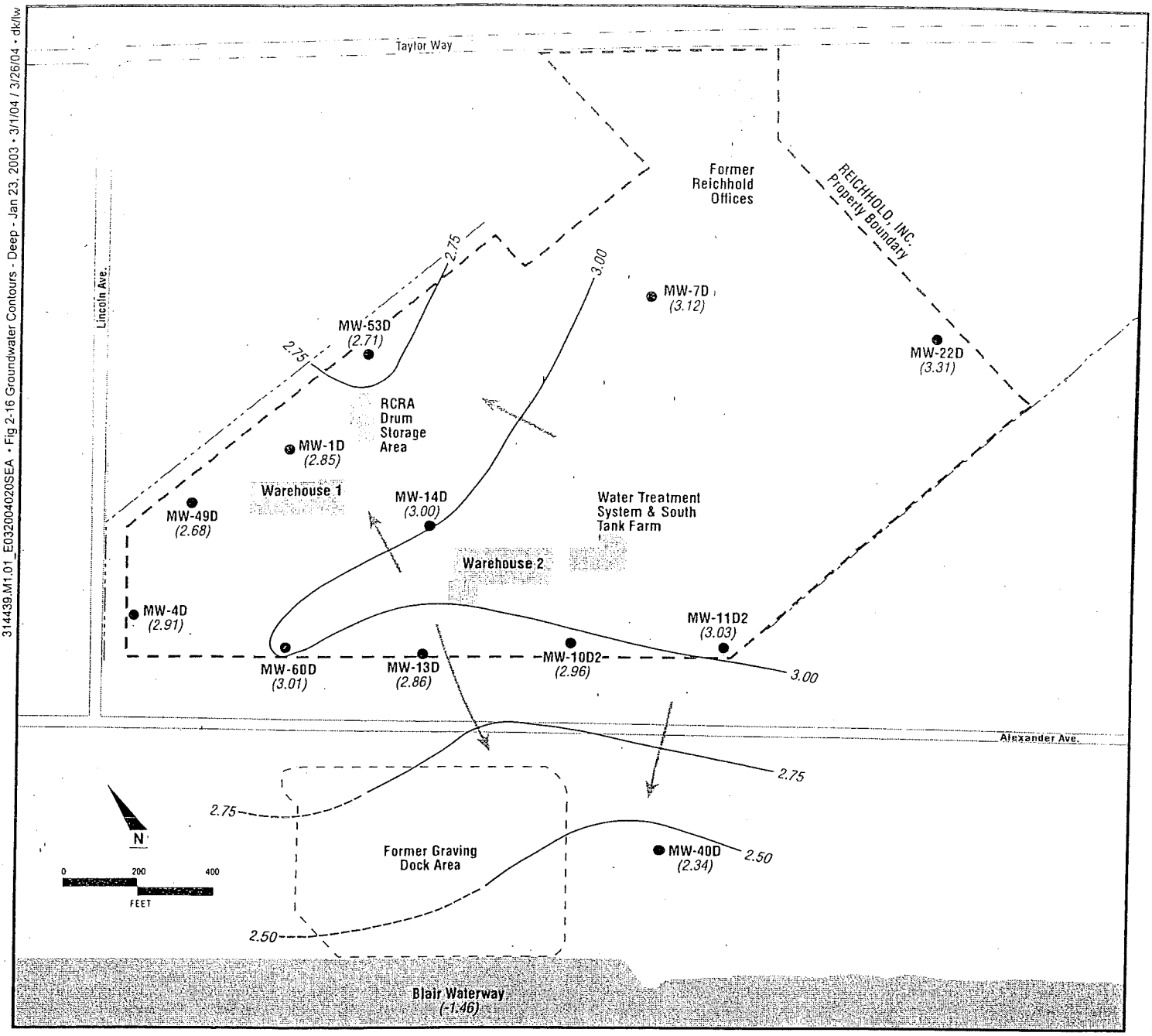
Tide Table for November 7, 2003

Low Low Tide Time: 2206 Elevation (NGVD): -6.71	High Low Tide Time: 0948 Elevation (NGVD): -2.07
Low High Tide Time: 0412 Elevation (NGVD): 3.53	High High Tide Time: 1524 Elevation (NGVD): 4.62

Time Range for Water Level Measurements = 0911 to 1024
Tidal data for Tacoma, Commencement Bay, WA, Station ID-9446484, from NOAA Web Page: *www.co-ops.nos.NOAA.gov*

Figure 2-15
Groundwater Contour Map Intermediate Aquifer November 7, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-53D
  - Well screen depth
  - Well number
  - Well location
- Property boundary
- Ditch
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction

Contour interval equals 0.25 foot

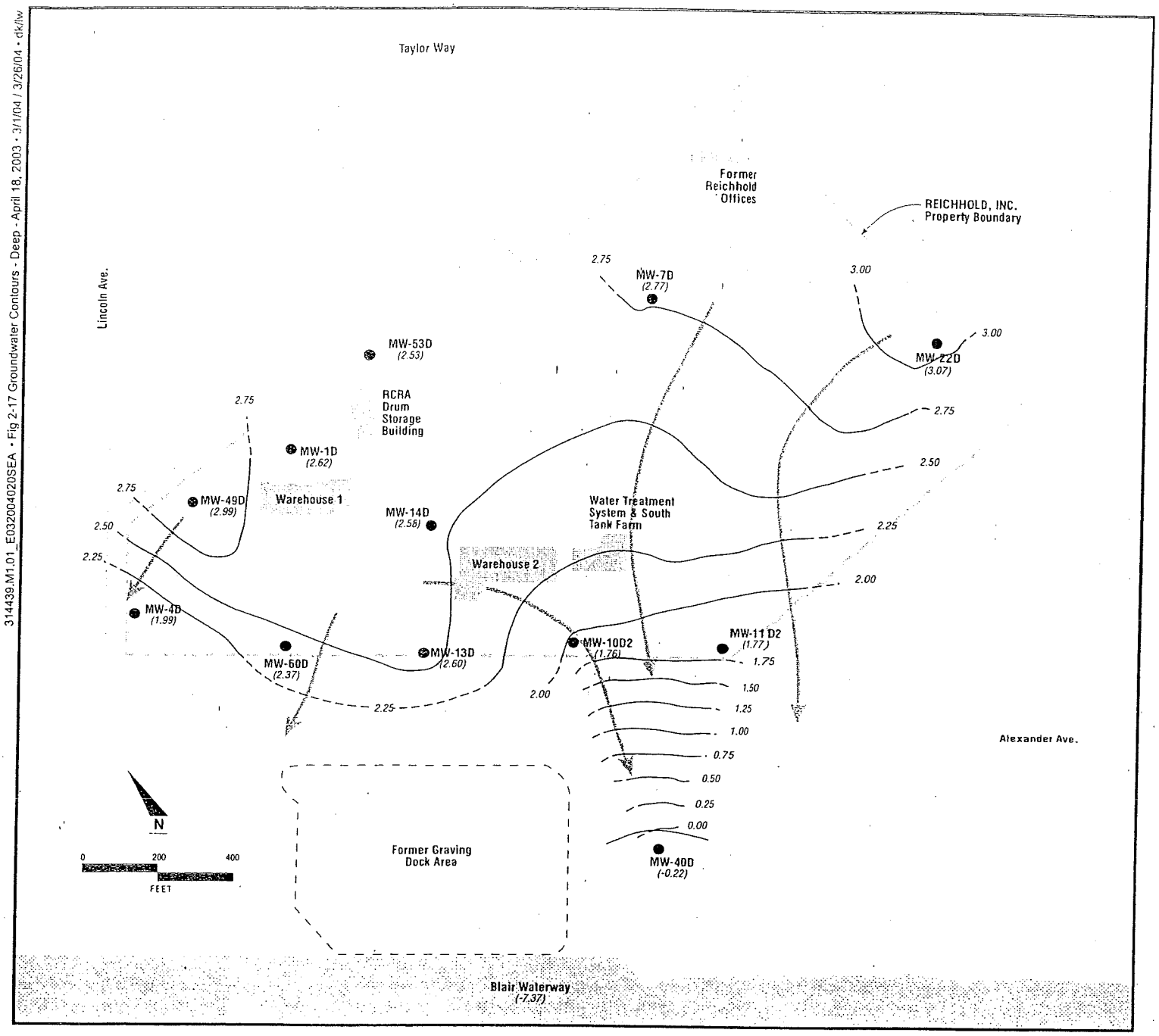
Tide Table for January 23, 2003

Low Low Tide Time: 0154 Elevation (NGVD): -5.7	High Low Tide Time: 1514 Elevation (NGVD): -2.7
Low High Tide Time: 2043 Elevation (NGVD): 2.8	High High Tide Time: 0848 Elevation (NGVD): 6.9

Time Range for Water Level Measurements = 1432 to 1533

Figure 2-16
Groundwater Contour Map
Deep Aquifer
January 23, 2003

Reichhold, Inc., Tacoma, WA



KEY

- ● MW-56S — Aquifer monitored
- — Well number
- — Well location
- — Property boundary
- — Ditch
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- — Inferred groundwater flow direction

Contour interval equals 0.25 foot

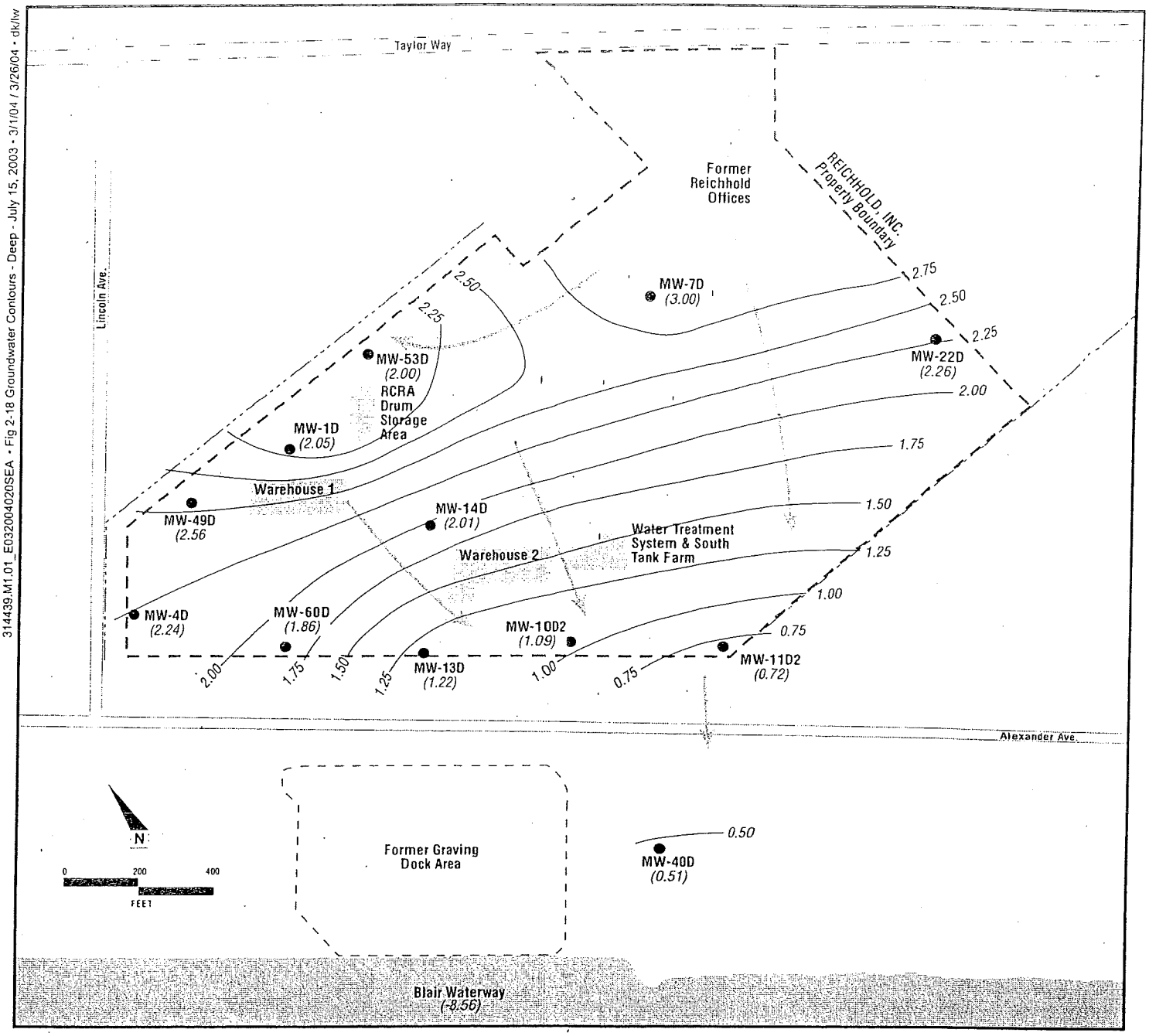
Tide Table for April 18, 2003

Low Low Tide Time: 1301 Elevation (NGVD): -8.5	High Low Tide Time: 0034 Elevation (NGVD): -2.4
Low High Tide Time: 1954 Elevation (NGVD): 5.8	High High Tide Time: 10609 Elevation (NGVD): 5.9

Time Range for Water Level Measurements = 1217 to 1305

Figure 2-17
Groundwater Contour Map
Deep Aquifer
April 18, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-53D
  - Well screen depth
  - Well number
  - Well location
- Property boundary
- Ditch
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction

Contour interval equals 0.25 foot

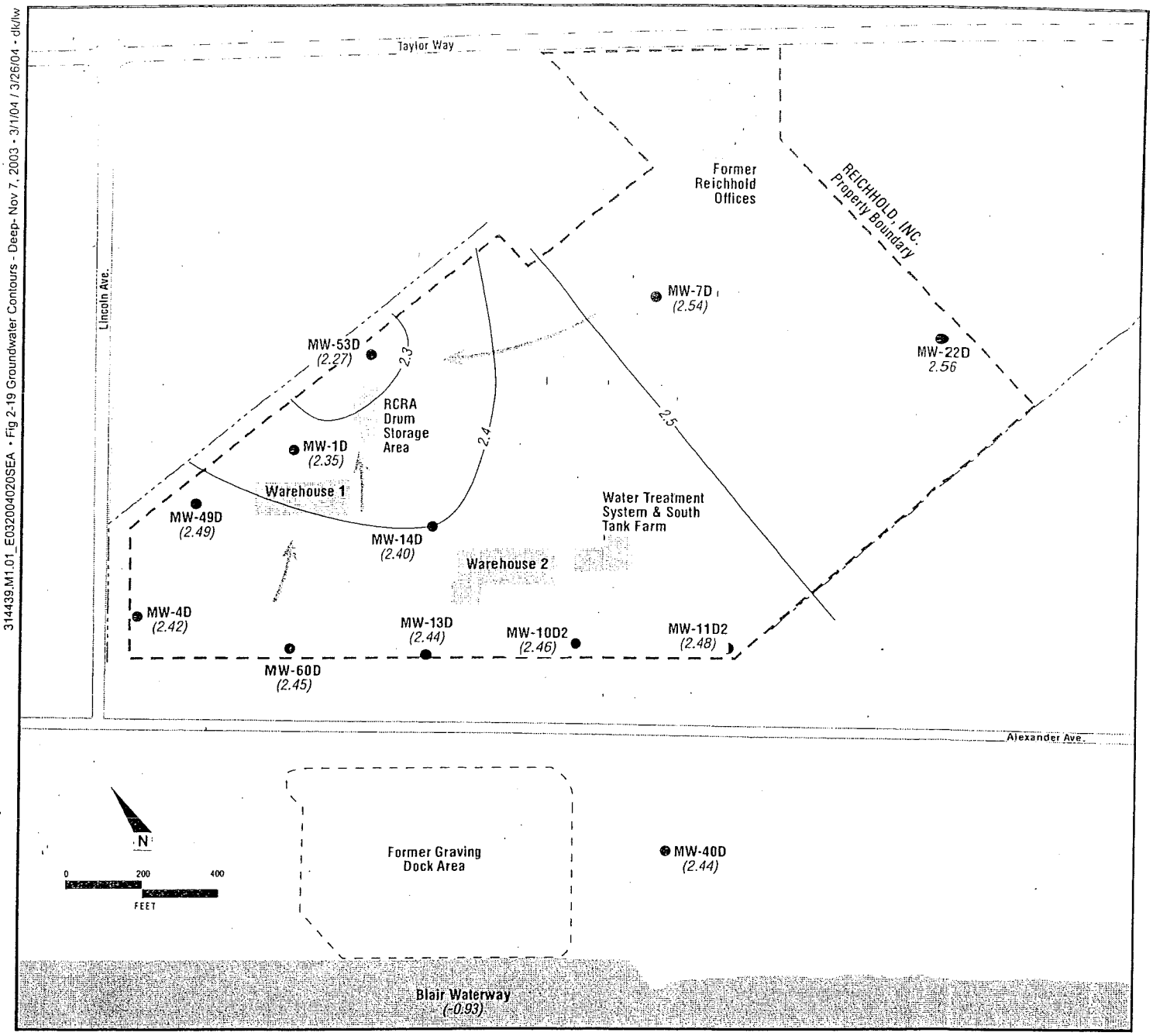
Tide Table for July 15, 2003

Low Low Tide Time: 1148 Elevation (NGVD): -9.89	High Low Tide Time: 0000 Elevation (NGVD): 0.38
Low High Tide Time: 0454 Elevation (NGVD): 4.48	High High Tide Time: 1906 Elevation (NGVD): 5.65

Time Range for Water Level Measurements = 1221 to 1335
Tidal data for Tacoma, Commencement Bay, WA, Station ID-9446484, from NOAA Web Page: *www.co-ops.nos.NOAA.gov*

Figure 2-18
Groundwater Contour Map Deep Aquifer
July 15, 2003

Reichhold, Inc., Tacoma, WA



KEY

- MW-53D
  - Well screen depth
  - Well number
  - Well location
- Property boundary
- Ditch
- 3.0 — Approximate location of potentiometric surface contour (dashed where inferred)
- Inferred groundwater flow direction

Contour interval equals 0.10 foot

Tide Table for November 7, 2003

Low Low Tide Time: 2206 Elevation (NGVD): -6.71	High Low Tide Time: 0948 Elevation (NGVD): -2.07
Low High Tide Time: 0412 Elevation (NGVD): 3.53	High High Tide Time: 1524 Elevation (NGVD): 4.62

Time Range for Water Level Measurements = 0916 to 1016
Tidal data for Tacoma, Commencement Bay, WA, Station ID-9446484, from NOAA Web Page: *www.co-ops.nos.NOAA.gov*

Figure 2-19
Groundwater Contour Map Deep Aquifer
November 7, 2003

Reichhold, Inc., Tacoma, WA

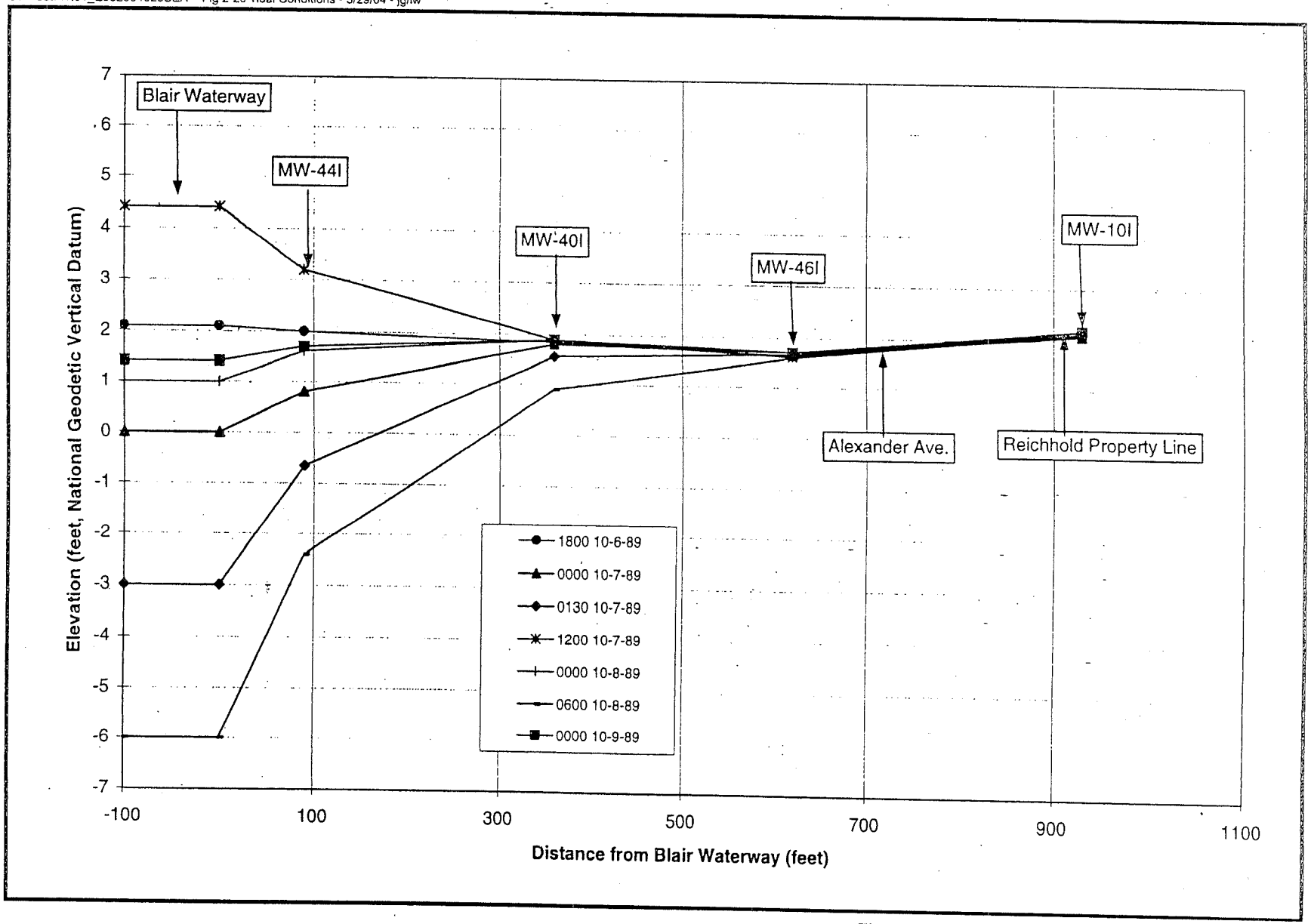
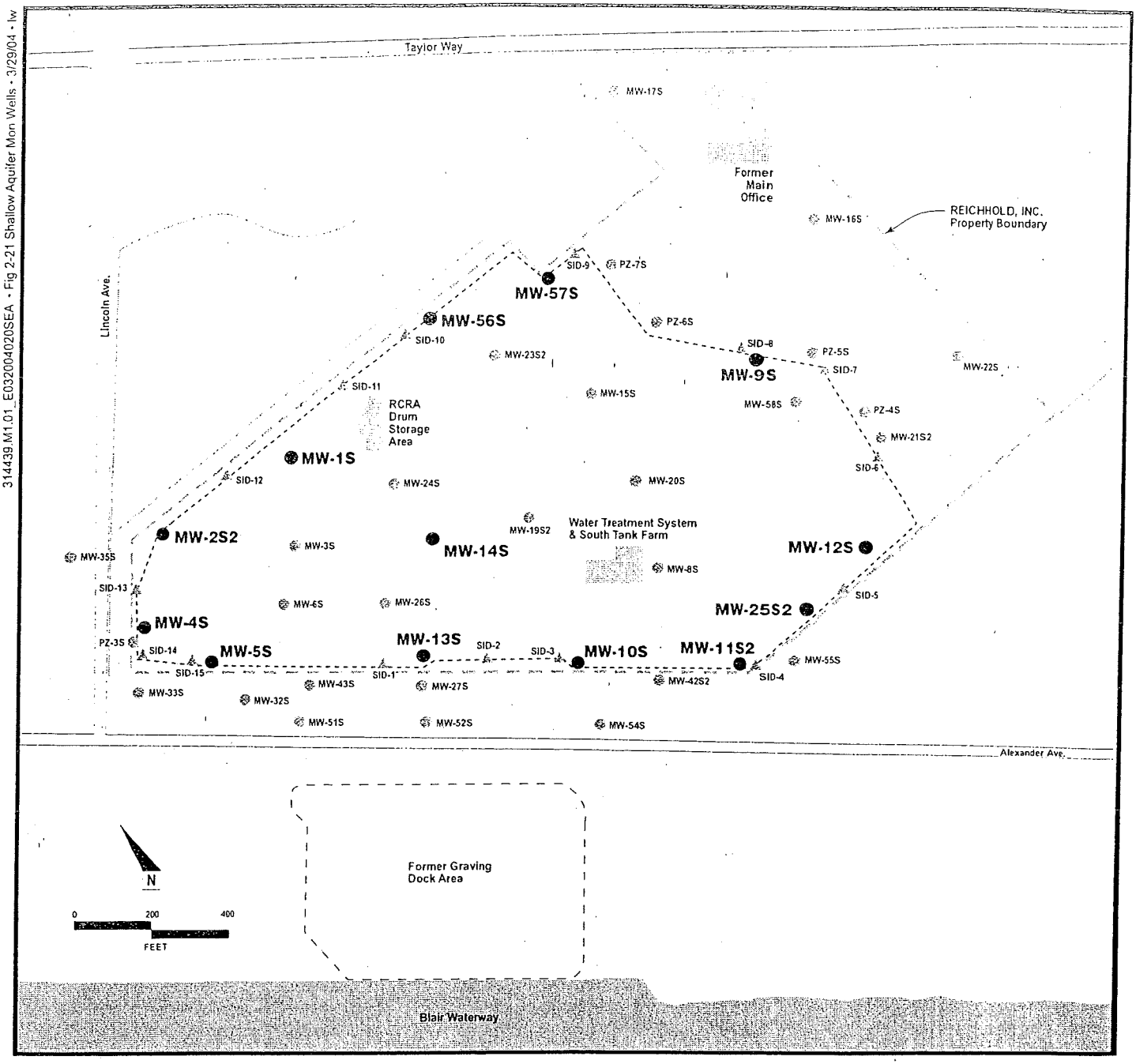


Figure 2-20
Groundwater Elevation Versus Distance During Different Tidal Conditions

Reichhold, Inc., Tacoma, WA

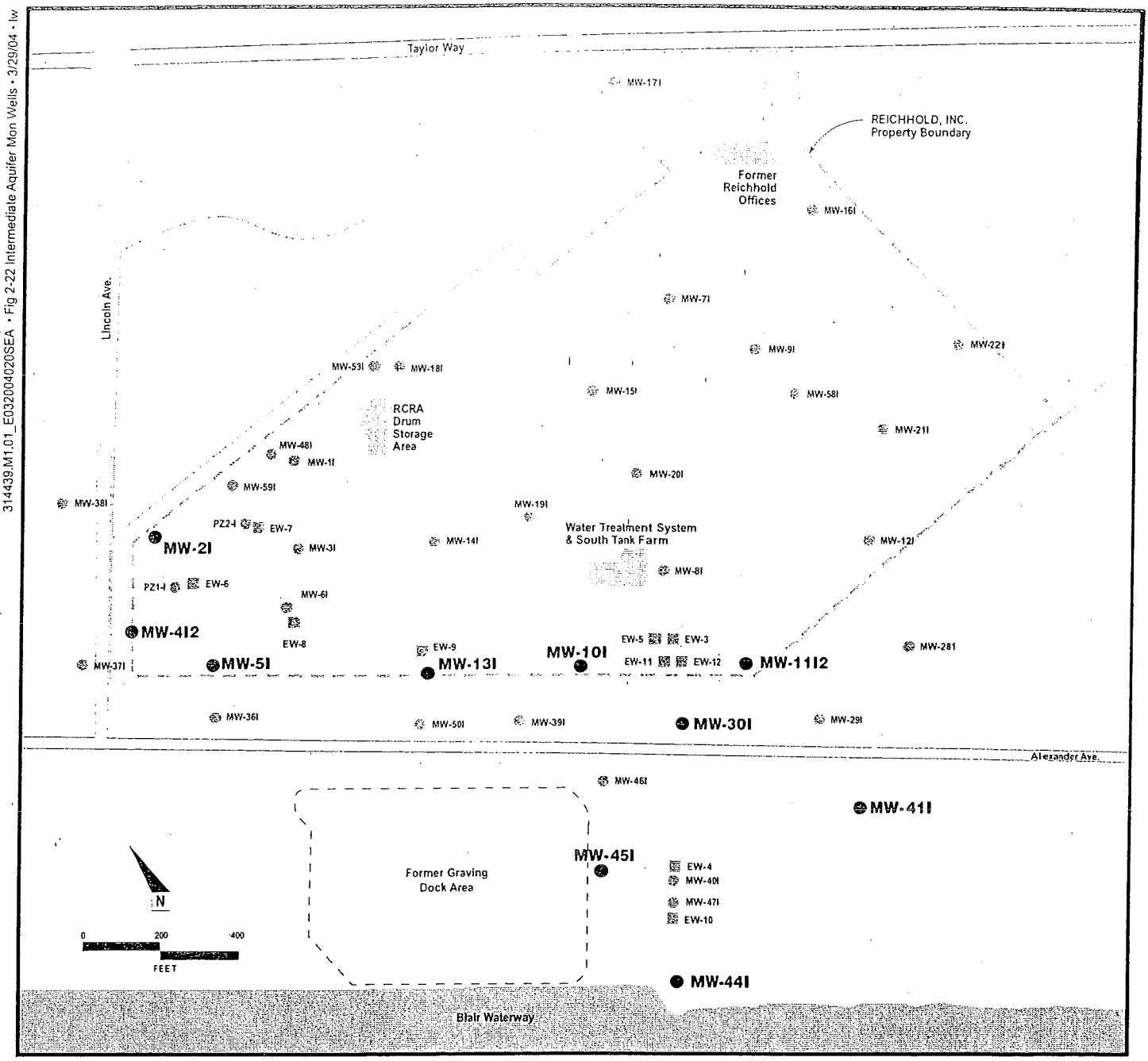


KEY

- MW-56S — Well number
- Well screen depth
- Property boundary
- Ditch
- Shallow Interceptor Drain (SID)
- SID-1 — SID Piezometer

Figure 2-21
Shallow Aquifer Monitoring Wells

Reichhold, Inc., Tacoma, WA

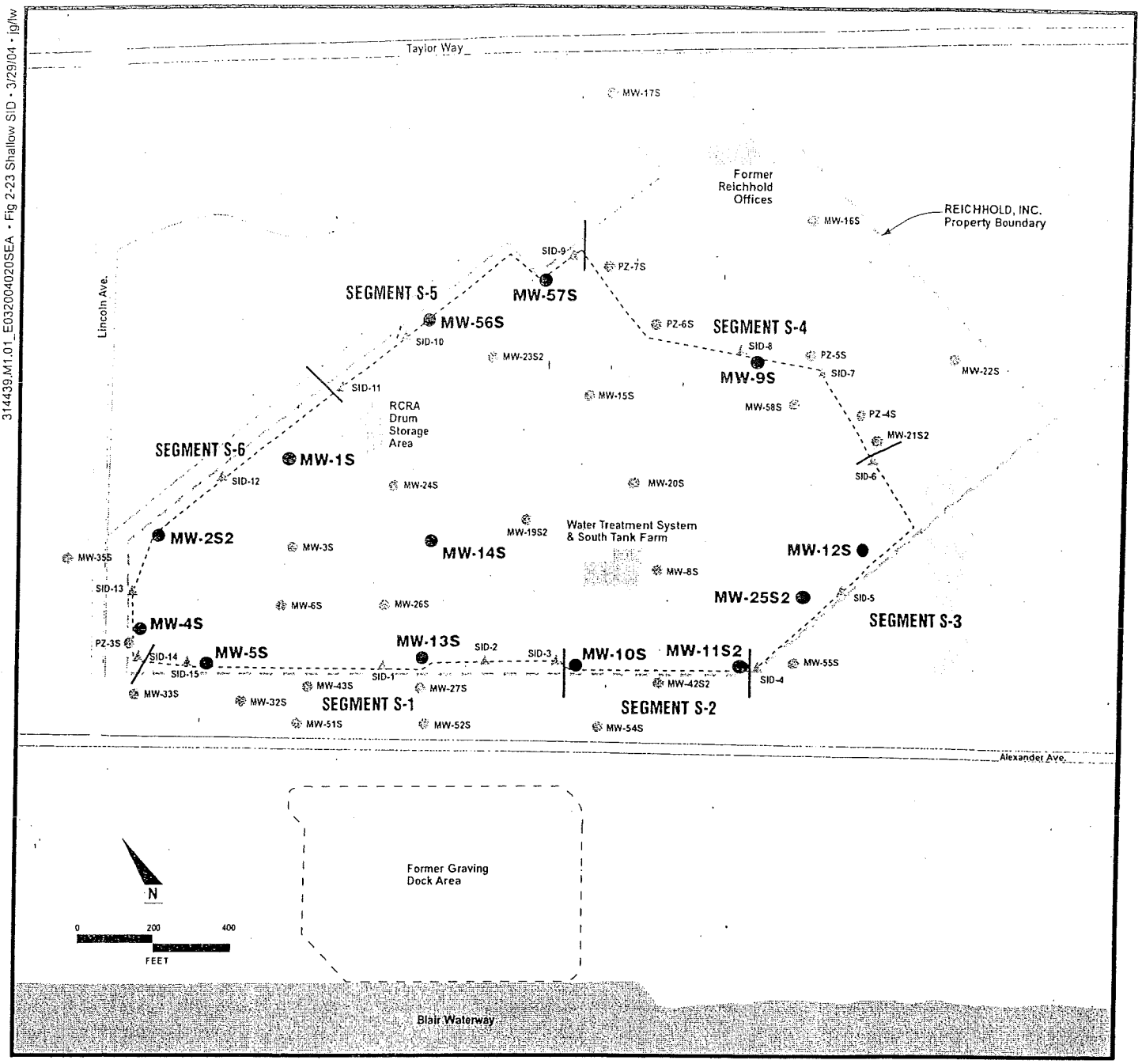


KEY

- MW-56S
- Well screen depth
- Well number
- Property boundary
- Ditch
- Shallow Interceptor Drain (SID)
- SID-1 SID Piezometer

Figure 2-22
Intermediate Aquifer Monitoring Wells

Reichhold, Inc., Tacoma, WA



KEY

MW-56S — Well screen depth

Well number

Property boundary

Ditch

Shallow Interceptor Drain (SID)

SID-1 SID Piezometer

Figure 2-23
Shallow Interceptor Drain (SID) Segments

Reichhold, Inc., Tacoma, WA

ATTACHMENT 3

Focused Remedial Investigation Tasks

Summary Requirements and Tasks

Ecology has determined that Reichhold must conduct a focused remedial investigation at the site to augment the investigations completed to date. The purpose of the focused remedial investigation (RI) is to perform necessary supplemental activities to sufficiently reduce uncertainty regarding the extent of past releases at SWMUs and in the aquifers beneath and downgradient of the site, and to collect the data needed to demonstrate hydraulic control of contaminated groundwater is maintained. Within ninety (90) days after this Agreed Order becomes effective, Reichhold will prepare a draft focused remedial investigation work plan and submit the plan for Ecology's review and approval. The work plan will address the following tasks:

Task 1. Calculate MTCA Method B surface water cleanup levels. Reichhold will calculate surface water cleanup levels in accordance with MTCA Method B surface water protocols described in Chapter 173-340 WAC and, when appropriate, Chapter 173-205 WAC. Reichhold will utilize chemical data, site-specific data, whole effluent toxicity testing protocols, and ground water models and methodologies acceptable to Ecology.

Task 2. Calculate MTCA Method B ground water cleanup levels. Reichhold will back calculate ground water cleanup levels protective of the calculated surface water cleanup levels. Methodology for calculating protective cleanup levels will include modeling dispersion and natural attenuation.

Task 3. Calculate MTCA soil cleanup levels. Reichhold will calculate soil cleanup levels protective of ground water cleanup levels. Reichhold will evaluate the direct contact pathway (ingestion), evaluate the leaching pathway using the 3-phase model or equivalent method approved by Ecology, and conduct a terrestrial ecological evaluation following the procedures in WAC 173-340-7490 through 7494. Reichhold will select the concentration protective of groundwater cleanup levels as the preliminary cleanup level. If site-specific information was used to calculate the cleanup levels, Reichhold will evaluate the dermal pathway and adjust the cleanup level downward if necessary.

Task 4. Compare existing soil contaminant concentrations with calculated cleanup levels at regulated units and SWMUs. Reichhold will perform a comparison of existing and/or historical contamination levels at regulated units and SWMUs identified in Attachment 1 to this Agreed Order, with calculated soil cleanup levels protective of surface water to identify areas requiring additional soil corrective actions.

Task 5. Define the nature and extent of contamination at specific SWMUs. If existing soil contamination as documented in previous investigations, exceeds the calculated soil cleanup levels from Task 4, Reichhold shall complete additional work to sufficiently define the nature and extent of contamination at specific SWMUs. The SWMUs to be reviewed in this task are 1) Butylphenol Process Area, 2) Catalyst Reclaim Sludge Area, 3) Hydrochloric Acid Pond, 4) Resin Tank Farm and 5) Pentachlorophenol Plant.

Task 6. Define the hydraulic relationship along the northern segment of the SID. There is uncertainty in ground water capture along the northern segment of the SID. To refine the understanding of hydraulic gradients in the area, Reichhold will investigate the relationship between the ditch water levels

and the water levels in the shallow aquifer wells. Information prepared for this task is intended to verify that the SID is effective at preventing offsite migration of contaminated groundwater.

Task 7. Determine if groundwater contamination for site constituents of concern exists above calculated groundwater cleanup levels in the area between MW-13I and MW-5I. Reichhold has previously performed field testing to determine if permeable zones are present in the intermediate aquifer in the potential stagnation zone (the area between the capture zones formed by extraction wells EW-11/EW-12 and EW-6/EW-7). While the data shows that it is unlikely that preferential pathways exist for potential groundwater contamination in that area, Reichhold will confirm this information by installing up to three additional monitoring wells in the area between MW-13I and MW-10I.

Task 8. Sample extraction wells EW-8 and EW-9. Reichhold will collect ground water samples once during the July 2004 annual event from extraction wells EW-8 and EW-9 and analyze the samples for semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs) and metals as provided in Attachment 2 to this Agreed Order.

Draft and Final Focused Remedial Investigation Work Plan

The draft focused RI work plan will provide the framework for the collection and analysis of information required by this Attachment. The work plan will be composed of a concise background section describing the facility, its operational and remedial history, site map, site geology and hydrogeology, an implementation schedule, a field sampling and analysis plan (SAP) that describes in detail the sampling locations, field methods and procedures that will be used during the investigation, a quality assurance project plan, and a health and safety plan.

Within sixty (60) days of receiving Ecology's comments on the draft focused RI work plan, Reichhold will prepare and submit for Ecology's approval a revised RI work plan. Ecology will then approve, approve with conditions, or disapprove the revised work plan as described in Section VI of this Agreed Order.

Field SAP. The field SAP will describe in detail the objectives, field methods, procedures, and sampling locations required to complete all investigations comprising the focused RI. The field SAP will include the following information:

1. Figures showing all new and existing soil sampling locations as related to Attachment 3-Task5;
2. Figures showing the locations and screen elevations of all new and existing monitoring wells that are part of the ongoing groundwater monitoring program;
3. Descriptions and construction diagrams of all monitoring wells installed during the focused RI;
4. Methodologies and procedures for drilling soil borings, and installing monitoring wells;
5. Methodologies and procedures for collecting representative soil and ground water samples;
6. Sampling frequency and data tables for all field and laboratory analyses;
7. Type, frequency, and handling of Quality Assurance /Quality Control (QA/AC) samples;
8. Equipment decontamination procedures;
9. Accumulation, handling and disposition of all investigative derived wastes;
10. Schedule for the implementation of each specific field investigation. Initial field investigations will begin according to the schedule in the approved workplan.

Quality Assurance Project Plan (QAPP). QAPP will include the following:

1. Data quality objectives;
2. Project Organization and responsibilities;
3. Calibration procedures for field equipment and laboratory testing;
4. Sample chain-of-custody procedures
5. Sample handling, labeling, packaging, and shipping procedures;
6. Parameter holding times, treatment and preservation techniques;
7. Analytical methods and detection limits;
8. Data reduction, validation, and reporting methods; and
9. Internal quality control measures.

Health and Safety Plan. The Health & Safety (HSP) Plan must meet all applicable federal Occupational and Safety and Health Administration (OSHA) and Washington Department of Labor and Industries, Division of Industrial Safety and Health (WISHA) worker protection requirements. The existing H&S plan must be revised to ensure potential worker exposure to hazardous materials during remedial actions is mitigated to the maximum extent possible.

Draft and Final Focused Remedial Investigation (RI) Reports

According to the schedule in the approved focused RI work plan, Reichhold will submit for Ecology's review and approval a draft focused remedial investigation report. The draft report will contain: 1) a description of data collection methodologies, 2) environmental sampling data presented in a format approved by Ecology in accordance with WAC 173-340-840(5), 3) data evaluations, and 4) conclusions reached during the focused RI. Supporting documentation including field notes, geologic logs, laboratory analytical and data validation reports will be included with the focused RI report or will be clearly referenced to specific sections of existing reports.

Within sixty (60) days of receiving Ecology's comments on the draft RI report, Reichhold will prepare and submit for Ecology's approval a revised focused remedial investigation report. Ecology will subsequently approve, approve with conditions, or disapprove the revised focused RI report as described in Section VI.3 of this Agreed Order.

ATTACHMENT 4

Focused Feasibility Study Tasks

Summary Requirements and Tasks

Within ninety (90) days of Ecology's written approval of the revised focused RI report, Reichhold will submit to Ecology a draft focused feasibility study (FS) work plan including a schedule for implementing the work plan. The purpose of the focused feasibility study is to develop and evaluate cleanup action alternatives to enable a cleanup action to be selected for the site. The focused feasibility study shall be performed in accordance with WAC 173-340-350 (8) and (9) to achieve the remedial action objectives identified as a result of the focused remedial investigation. This includes cleanup action alternatives for both *in-situ* treatment or source removal and subsequent treatment of any source materials identified as contaminating the ground or surface water. With Ecology's approval, Reichhold may elect to proceed with elements of tasks listed below in advance of schedules provided in the focused FS work plan. The focused FS work plan will address the following tasks:

Task 1. Identify remediation technologies for the treatment of soils impacted above the calculated cleanup levels protective of groundwater. Tentatively identified contaminated areas include tetrachloroethene-contaminated soil in the HCL Pond, PCP and PCB contaminated soil at the former PCP plant, and possible PCP contamination at the former Resin Tank Farm.

Task 2. Shut down off-site extraction wells. Reichhold will evaluate the capability of extraction wells EW-11 and EW-12 to contain the PCP plume that exists downgradient of the site, in the vicinity of off-site extraction wells EW-4 and EW-10. The evaluation will consist of a phased shutdown of the off-site wells and may include the installation of up to two additional monitoring wells that Ecology determines are necessary to define the plume with one or both of the extraction wells shut down.

Task 3. Evaluate options for achieving hydraulic control of contaminated ground water. If the focused Remedial Investigation indicates that groundwater contains site constituents of concern greater than the calculated groundwater cleanup levels, Reichhold will evaluate options for controlling the off-site flow of ground water contaminated with site constituents in the intermediate aquifer in the vicinity of extraction wells EW-11/12 and EW-8/9.This evaluation could include a review of the effectiveness of in-situ treatment of ground water.

Draft and Final Focused Feasibility Study (FS) Work Plan

Within sixty (60) days of receiving Ecology's comments on the draft focused FS work plan, Reichhold will prepare and submit for Ecology's approval a revised focused FS work plan. Ecology will then approve, approve with conditions, or disapprove the revised work plan as described in Section VI of this Agreed Order.

Draft and Final Focused Feasibility Study (FS) Reports

According to the schedule in the approved focused FS work plan, Reichhold will submit to Ecology for its approval a draft focused FS report that documents the following: 1) the identification, screening and evaluation of remedial alternatives, and 2) a recommendation for a remedial action alternative that achieves the remedial action objectives for soil and ground water identified during the completion of the focused RI tasks listed in Attachment 3.

Within sixty (60) days of receiving Ecology's comments on the draft focused FS report, Reichhold will prepare and submit to Ecology a revised focused FS report for Ecology approval. Ecology will then approve, approve with conditions, or disapprove the revised focused FS report as described in Section VI. 5 of this Agreed Order.

ATTACHMENT 5

Legal Description of Parcel A

"EXHIBIT A"

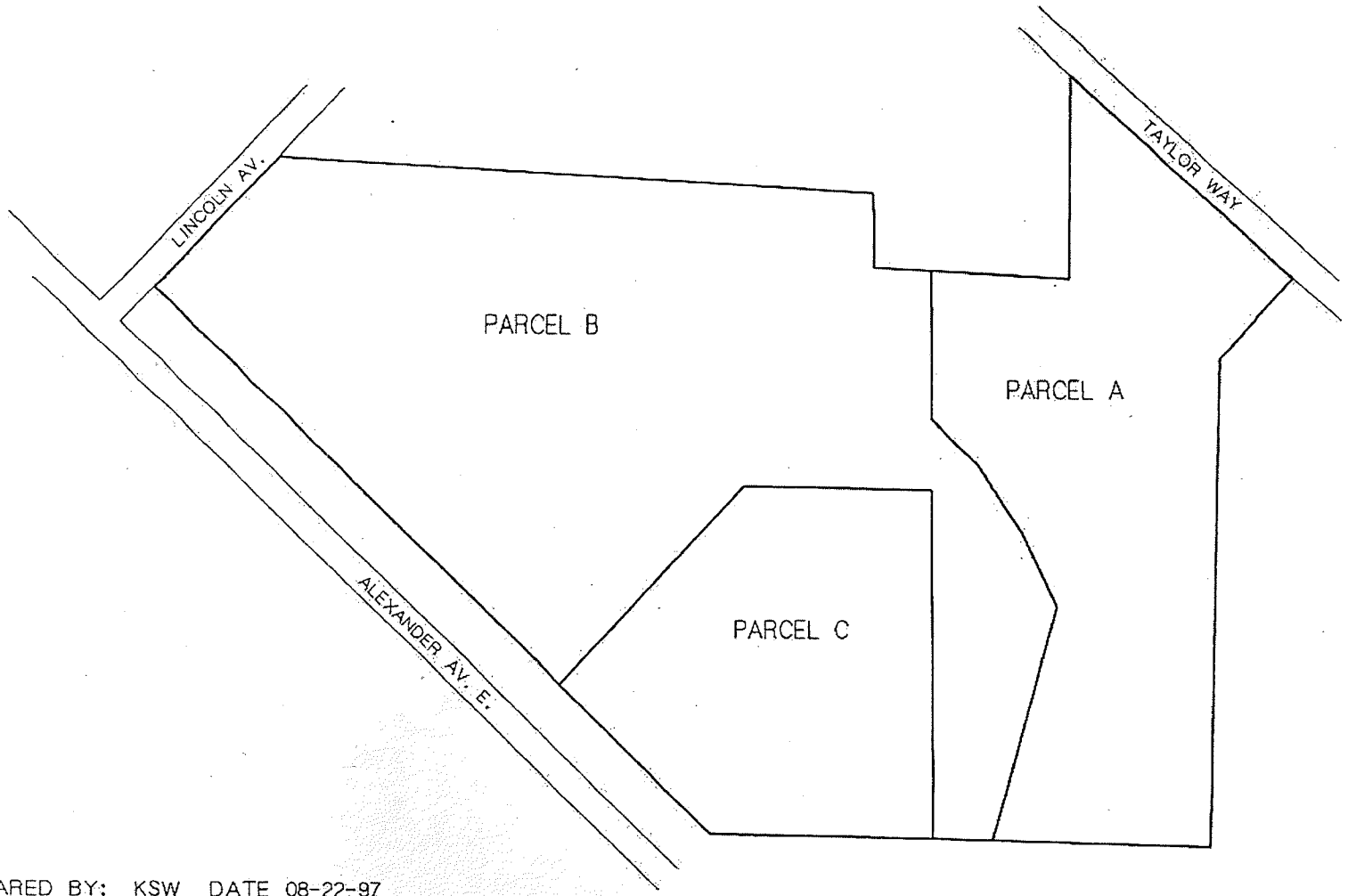
Parcel A

All that portion of real property situated in the Northeast Quarter of Section 35, Township 21 North, Range 3 East of the Willamette Meridian, County of Pierce, State of Washington, and being more particularly described as follows:

Beginning at the southeast corner of Lot 1 of Pierce County Short Plat recorded under Auditor's Fee Number 8308190230; thence along the south line of Lot 1 North 88° 18'59" West 456.24 feet; thence leaving said south line North 15° 51'52" East 497.41 feet; thence North 25° 32'58" West 168.64 feet; thence North 33° 46'29" West 167.53 feet; thence North 46° 46'30" West 130.37 feet to a point on the east margin of 49th Avenue Northeast as vacated by Vacation Ordinance Number 17660; thence along said margin North 00° 04'15" West 309.59 feet to the northerly line of Lot 1; thence along said line South 86° 31'40" East 288.34 feet; thence North 00° 34'02" East 200.26 feet; thence North 00° 28'46" East 215.01 feet to the southerly margin of Taylor Way; thence along said margin South 47° 55'54" East 622.22 feet; thence leaving said margin and along the easterly line of Lot 1 South 42° 04'06" West 225.48 feet; thence South 01° 12'53" East 995.88 feet to the Point of Beginning, containing 647,289 square feet or 14.86 acres, more or less.

8/21/97

SEC. 35, T. 21 N., R. 3 E., W.M.



NTS

PREPARED BY: KSW DATE 08-22-97
CHECKED BY: DATE

REVISED BY: DATE

FOR INFORMATION PURPOSES ONLY
THIS DRAWING IS NOT A RECORD OF
SURVEY NOR MEETS MINIMUM STANDARD
FOR SAID SURVEYS.

CH2MHILL

FILE NAME:

ATTACHMENT 6

Blair Backup Property means a tract of land lying in Section 35 and the west half of Section 36, T. 21 N., R. 3 E., W.M., in Pierce County, Washington, described as follows:

> Commencing at the brass pin at the intersection of the monument lines of Alexander Avenue and Lincoln Avenue; thence S 45°53'50" E along said Alexander Avenue monument line, 80.00 feet to the southeasterly right-of-way line extended of Lincoln Avenue; thence N 44°06'17" E along said extension, 60.00 feet to the northeasterly right-of-way line of Alexander Avenue and the point of beginning; thence continuing N 44°06'17" E, along said right-of-way line 150.00 feet; thence S 45°53'50" E parallel with said Alexander Avenue monument line 1611.89 feet to the north line of the southeast quarter of Section 35; thence S 88°56'05" E along said north line 442.50 feet to the northwest corner of the Northeast quarter of the Southeast quarter of said Section 35; thence S 88°19'49" E along the north line of the Southeast quarter of Section 35, 610.14 feet to the west line of the east half of the Southeast quarter of the Northeast quarter of said Section 35; thence N 1°12'03" E along said west line 995.88 feet; thence N 42°02'33" E 225.58 feet to the southwesterly right-of-way line of Taylor Way; thence S 47°57'27" E along said right-of-way line 1064.87 feet to the east line of the west half of the Southwest quarter of the Southwest quarter of the Northwest quarter of Section 36; thence S 2°33'41" W along said east line, 481.46 feet to the north line of the Southwest quarter of said Section 36; thence S 87°43'56" E, along said north line 580.83 feet to the southwesterly right-of-way line of Taylor Way; thence S 47°57'27" E along said southwesterly right-of-way line, 869.96 feet to the northeasterly corner of a parcel conveyed to Kaiser Aluminum and Chemical Co. by deed recorded under Auditors Fee No. 811026224_____; thence N 88°37'49" W along the north line of said parcel 1319.73 feet; thence S 1°22'11" W along the west line of said parcel 411.54 feet to the southwest corner thereof; thence S 1°22'11" W along the west line of said parcel 411.54 feet to the southwest corner thereof; thence S 2°37'02" W 957.65 feet to the northeasterly right-of-way line of Alexander Avenue; thence N 45°53'50" W along said right-of-way line, 4329.45 feet to the point of beginning.

Blair Waterway Property means a parcel of land in Section 35, T 21 N., R. 3 E., W.M., described as follows:

> Beginning at the intersection of Lincoln Avenue monument line and Alexander Avenue monument line, in the Northwest quarter of said Section 35, thence S 47°15'36" E along the monument line of Alexander Avenue, a distance of 80.0 feet to a point on the southeasterly right-of-way line of Lincoln Avenue extended; thence S 42°48'17" W along said extension, a distance of 60.0 feet to intersect the southerly right-of-way line of Alexander Avenue, and the true point of beginning of this description; thence S 47°15'36" E, a distance of 1439.27 feet to the northwest corner of a lease entered into with the Weyerhaeuser Co. on June 8, 1972; thence S 42°44'24" W along said lease line, a distance of 770.0 feet to the northeasterly pierhead line of Blair Waterway; thence N 47°15'36" W along said northeasterly pierhead line a distance of 1440.15 feet to the easterly right-of-way line of Lincoln Avenue as vacated by City of Tacoma Ordinance

No. 21508; thence continuing N 47°15'36" W, a distance of 1240.47 feet to the southeast corner of a lease agreement entered into with Domtar Gypsum America Inc., on July 26, 1979; thence N 42°44'24" E along said lease line, a distance of 200.00 feet; thence S 89°14'50" E, a distance of 85.06 feet; thence S 84°30'30" E, a distance of 236.27 feet; thence N 45°58'51" E, a distance of 27.67 feet; thence S 89°14'50" E, a distance of 227.85 feet; thence N 42°14'24" E, a distance of 52.97 feet; thence N 66°50'02" E, a distance of 63.00 feet; thence N 18°38'46" E, a distance of 63.0 feet; thence N 42°44'24" E, a distance of 22.03 feet to the southerly right-of-way line of Alexander Avenue; thence S 47°15'36" E along said right-of-way line, a distance of 819.12 feet to the true point of beginning.

INCLUDING that portion acquired for extensions, additions or betterments to the Municipal Belt Line Railway under Petition No. 1336970, dated January 12, 1944, described as follows:

Beginning at a point on the westerly line of Alexander Avenue in the City of Tacoma, Washington, said point being 480 feet northwesterly from point of intersection of said westerly line of Alexander Avenue extended southerly with the northerly line of Lincoln Avenue extended easterly; thence southwesterly on a curve having a radius of 480 feet through an angle of 90° to a point of tangent with the northerly line of Lincoln Avenue; thence easterly to the beginning of curve designating the westerly line of Alexander Avenue; thence alone said westerly line to point of beginning.

Containing 43.5 acres

SUBJECT TO easements of record.