

ATC MAKENA HOLDINGS, LLC
c/o Trinity Investments, LLC
55 Merchant Street, Suite 1560
Honolulu, HI 96813

TRANSMITTAL

April 5, 2013

Land Use Commission
State of Hawaii
235 South Beretania Street, Suite 406
P. O. Box 2359
Honolulu, Hawaii 96804

LAND USE COMMISSION
STATE OF HAWAII
2013 APR -5 P 2:40

SUBJECT: Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

Via: Hand Delivery

Dear Chair and Members of the Commission:

Please find the following enclosed:

1 (one) Original Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

In compliance of Condition No. 19, the enclosed Annual Report is provided for your review.
Condition No. 19 states

"Petitioner shall timely provide without any prior notice, annual reports to the Commission, the Office of Planning, and the County of Maui Planning Department in connection with the status of the subject project and Petitioner's progress in complying with the conditions imposed herein. The annual report shall be submitted in a form prescribed by the Executive Officer of the Commission."

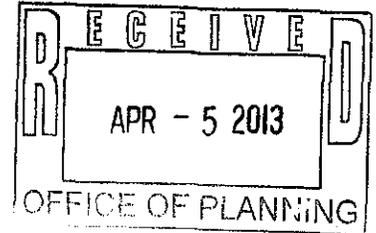
Should you have any questions or require additional information, do not hesitate to contact me at sarah@stanfordcarr.com or on by phone at (808)547-2276.

Sincerely,



Sarah Agnew-Miller
Project Coordinator/Planner

ATC MAKENA HOLDINGS, LLC
c/o Trinity Investments, LLC
55 Merchant Street, Suite 1560
Honolulu, HI 96813



TRANSMITTAL

April 5, 2013

Office of Planning
State of Hawaii
State Office Tower
235 S. Beretania Street, 6th Floor
Honolulu, HI 96813

SUBJECT: Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

Via: Hand Delivery

Dear Jesse K. Souki, Director:

Please find the following enclosed:

1 (one) Original Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

In compliance of Condition No. 19, the enclosed Annual Report is provided for your review.
Condition No. 19 states

"Petitioner shall timely provide without any prior notice, annual reports to the Commission, the Office of Planning, and the County of Maui Planning Department in connection with the status of the subject project and Petitioner's progress in complying with the conditions imposed herein. The annual report shall be submitted in a form prescribed by the Executive Officer of the Commission."

Should you have any questions or require additional information, do not hesitate to contact me at sarah@stanfordcarr.com or on by phone at (808)547-2276.

Sincerely,

A handwritten signature in cursive script that reads "Sarah Agnew-Miller".

Sarah Agnew-Miller
Project Coordinator/Planner

ATC MAKENA HOLDINGS, LLC
c/o Trinity Investments, LLC
55 Merchant Street, Suite 1560
Honolulu, HI 96813

TRANSMITTAL

April 5, 2013

Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

SUBJECT: Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

Via: USPS Mail

Dear Will Spence, Director:

Please find the following enclosed:

1 (one) Original Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

In compliance of Condition No. 19, the enclosed Annual Report is provided for your review.
Condition No. 19 states

"Petitioner shall timely provide without any prior notice, annual reports to the Commission, the Office of Planning, and the County of Maui Planning Department in connection with the status of the subject project and Petitioner's progress in complying with the conditions imposed herein. The annual report shall be submitted in a form prescribed by the Executive Officer of the Commission."

Should you have any questions or require additional information, do not hesitate to contact me at sarah@stanfordcarr.com or on by phone at (808)547-2276.

Sincerely,



Sarah Agnew-Miller
Project Coordinator/Planner

ATC MAKENA HOLDINGS, LLC

c/o Trinity Investments, LLC
55 Merchant Street, Suite 1560
Honolulu, HI 96813

April 4, 2013

Land Use Commission
State of Hawaii
235 South Beretania Street, Suite 406
P. O. Box 2359
Honolulu, Hawaii 96804

SUBJECT: Fifteenth Annual Report for Land Use Commission
Docket No. A97-721 (Makena Resort)

Dear Chair and Members of the Commission:

On behalf of the ATC Makena Entities (identified below), we hereby submit this Fifteenth Annual Report for Docket No. A97-72.

I. INTRODUCTION

On February 19, 1998, the Land Use Commission of the State of Hawaii (the "**Commission**") filed its "Findings of Fact, Conclusions of Law and Decision and Order" (the "**1998 D&O**"), which reclassified 145.943 acres of land in Makena, Maui, Hawaii from the State Land Use Agricultural District into the State Land Use Urban District (hereinafter, the "**LUC Reclassified Property**").

The LUC Reclassified Property is currently owned by multiple owners, including Keaka LLC, ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC. All of the ATC entities listed above are Delaware limited liability companies and are hereinafter collectively referred to as the "ATC Makena Entities." The ATC Makena Entities purchased portions of the LUC Reclassified Property through a foreclosure action on August 27, 2010.

This Fifteenth Annual Report covers those portions of the LUC Reclassified Property that is owned by the ATC Makena Entities, and does not address any properties owned by others, including those owned by Hawaii Development, LLC, e.g., the parcels identified by the following Tax Map Key Nos. 2-1-05:83, 84, and 85.

On August 27, 2012, the Commission filed an Order Granting With Modification Movant's Motion for Sixth Amendment to the Findings of Fact, Conclusions of Law, and Decision and Order, Filed on February 19, 1998, and for Release of Certain Conditions (the "2012 Amendment"). Pursuant to the 2012 Amendment, the Commission released the ATC Makena Entities from Conditions 4, 15 and 21, and amended Conditions 12 and 22, as further described herein.

III. STATUS OF COMPLIANCE WITH LUC CONDITIONS

The following are the conditions set forth in the **1998 D&O, as amended by the 2012 Amendment**, and a description of efforts that are being made to comply with each stated condition:

1. Petitioner shall provide affordable housing opportunities for low, low-moderate, and gap group income residents of the State of Hawai'i in accordance with applicable laws, rules, and regulations of the County of Maui. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as may be mutually agreeable between Petitioner and the County of Maui.

Response: ATC Makena Entities acknowledge that the Petitioner is subject to the provisions of said condition.

2. Petitioner shall coordinate with the County of Maui Board of Water Supply to incorporate the proposed project into the County Water Use and Development Plan for the area. Prior to the granting of the first discretionary permit for the single-family and multi-family residential development described in paragraph 20 of the Decision and Order or the hotel described in paragraph 21 of the Decision and Order and by or before one year from the issuance date of this Decision and Order, Petitioner shall furnish the Commission with a letter from the County of Maui Board of Water Supply confirming that (a) the potable water allocation that will be credited to Petitioner will be available to and sufficient for the proposed project as it is described in the Petition, (b) the availability of potable water will not be an obstacle or impediment to the development of the proposed project as described in the Petition and (c) the proposed project as it is described in the Petition has been incorporated into the County Water Use and Development Plan for the area and that this plan will prevent the continued overpumping of the sustainable yield of the Iao aquifer.

Response: As provided in Petitioner's Second Annual Report, this condition was complied with as set forth in a letter from David

Craddick, Director of the Department of Water Supply, County of Maui, dated February 18, 1999.

Additional letters regarding compliance with this condition, dated October 1, 2003 from Petitioner to the Department of Water Supply and the response from George Tengan, Director of Water Supply, dated October 7, 2003, were attached as Exhibit "A" and Exhibit "B" to the Sixth Annual Report.

ATC Makena Entities understand that this condition has been complied with.

3. Petitioner shall participate in the funding and construction of adequate water source, storage, and transmission facilities and improvements to accommodate the proposed project in accordance with the applicable laws, rules and regulations of the County of Maui, and consistent with the County of Maui water use and development plan.

Response: The ATC Makena Entities acknowledge this condition. Furthermore, the ATC Makena Entities understand that, in 1976, the Petitioner participated in the Central Maui Source Development Joint Venture and also the Central Maui Transmission Joint Venture, which developed water sources in Waiehu, Maui and a transmission line from the newly developed water sources down to the Wailea and Makena regions. Further, in 1985, Makena Resort constructed a 1.5 million gallon water storage tank at the Makena Resort.

4. Petitioner shall participate in the funding and construction of adequate wastewater treatment, transmission and disposal facilities to accommodate the proposed project under such terms as are agreeable between Petitioner and the County of Maui.

Response: Condition 4 was released by the Commission pursuant to the 2012 Amendment. Petitioner's predecessor in interest complied with said Condition 4.

5. Petitioner shall contribute to the development, funding, and/or construction of school facilities, on a pro rata basis for the residential developments in the proposed project, as determined by and to the satisfaction of the State Department of Education ("DOE"). Terms of the contribution shall be agreed upon by Petitioner and DOE prior to Petitioner acquiring county rezoning or

prior to Petitioner applying for building permits if county zoning is not required.

Response: ATC Makena Entities understand that this condition has been complied with. Pursuant to an Educational Contribution Agreement for Makena Resort between Petitioner and the Department of Education (DOE), dated August 17, 2000, the parties have agreed upon a cash contribution by Petitioner which shall represent a fair share payment for the development, funding and/or construction of school facilities by Petitioner

6. Petitioner shall participate in the pro rata funding and construction of adequate civil defense measures as determined by the State of Hawai'i and County of Maui civil defense agencies.

Response:

ATC Makena Entities understand that Petitioner executed agreements with the State for the installation of new Civil Defense Sirens (Siren 157, Makena Resort and Siren 158, Big Beach-Makena). Copies of the agreements were attached as Exhibit "B" and Exhibit "C" to the Eleventh Annual Report.

ATC Makena Entities and the State of Hawaii Department of Accounting and General Services (DAGS) on behalf of the State Civil Defense have executed a construction ROE and non-exclusive license agreement for the proposed new civil defense warning siren at the Makena Resort WWTP Location (Siren Name Designation: Makena Resort WWTP, Siren 157) dated May 23, 2012, a copy of which is enclosed as **Exhibit "A"**.

7. Should any human burials or any historic sites such as artifacts, charcoal deposits, stone platforms, pavings, or walls be found, Petitioner shall stop work in the immediate vicinity and contact SHPD. The significance of these finds shall then be determined and approved by SHPD, and an acceptable mitigation plan shall be approved by SHPD. SHPD must verify that the fieldwork portion of the mitigation plan has been successfully executed prior to work proceeding in the immediate vicinity of the find. Burials must be treated under specific provisions of Chapter 6E, Hawai'i Revised Statutes.

Response: ATC Makena Entities acknowledge that they are subject to provisions of said condition and will comply.

8. Petitioner shall follow the State DLNR recommendations for Petition Areas 1, 2 and 3, for archaeological data recovery and preservation. An archaeological data recovery plan (scope of work) must be approved by SHPD. That plan then must be successfully executed (to be verified in writing by the SHPD), prior to any grading, clearing, grubbing or other land alteration in these areas. In Petition Area 1, three significant historic sites (1969, 2563, 2569) are committed to preservation. A preservation plan must be approved by SHPD. This plan, or minimally its interim protection plan phase, must be successfully executed (to be verified in writing by the SHPD), prior to any grading, clearing, grubbing or other land alteration in these areas.

Response: ATC Makena Entities acknowledge that they are subject to provisions of said condition and will comply.

9. Petitioner shall implement efficient soil erosion and dust control measures during and after the development process to the satisfaction of the State Department of Health and County of Maui.

Response: ATC Makena Entities acknowledge that they are subject to provisions of said condition and will comply at the appropriate time prior to commencement of construction.

10. Petitioner shall initiate and fund a nearshore water quality monitoring program. The monitoring program shall be approved by the State Department of Health in consultation with the U.S. Fish and Wildlife Service, the National Marine Fisheries Services, and the State Division of Aquatic Resources, DLNR. Petitioner shall coordinate this consultation process with the concurrence of the State Department of Health. Mitigation measures shall be implemented by Petitioner if the results of the monitoring program warrant them. Mitigation measures shall be approved by the State Department of Health in consultation with the above mentioned agencies.

Response: ATC Makena Entities understand that since August 1995, Petitioner (under prior ownership) has implemented and funded a nearshore water quality monitoring program. This program initially collected base line water samples and analyzed the same to determine turbidity, chemical compound contents and biota sampling. This monitoring program continues with semi-annual sampling at four separate nearshore sites.

ATC Makena Entities is providing the two most recent reports along with copies of their transmittals to State of Hawaii Department of Health: a.) dated December 2012 for work conducted in April 2012 **See Exhibit "B-1"**, and b.) dated February 2013 for work conducted in December 2012 **See Exhibit "B-2"**. ATC Makena Entities has contracted for this work with Marine Research Consultants, Inc.

ATC Makena Entities acknowledge that they are subject to provisions of said condition and will comply with said provisions.

11. Petitioner shall submit a Traffic Impact Analysis Report (TIAR) for review and approval by the State Department of Transportation and the County of Maui.

Response: As set forth in the Second Annual Report, a TIAR was prepared and submitted for review by the State Department of Transportation (DOT) and the County of Maui as part of the change in zoning application. Following certain comments by DOT, revisions were made to the TIAR which DOT agreed with as set forth in a letter from Kazu Hayashida, Director of Transportation, dated May 2, 2000, a copy of which was attached to the Third Annual Report.

In addition, as set forth in prior Annual Reports, the Petitioner prepared and submitted a Makena Resort Master Traffic Study, dated June 6, 2003 (Revised September 14, 2003), which was submitted to the SDOT and County of Maui, and approved by the County on September 26, 2003. See Sixth Annual Report.

ATC Makena Entities understand that this condition has been complied with.

12. (as amended) Petitioner shall participate in the pro rata funding and construction of local and regional transportation improvements and programs including dedication of rights-of-way as determined by the State Department of Transportation ("DOT") and the County of Maui. Agreement between Petitioner and DOT as to the level of funding and participation shall be obtained within fourteen (14) years from June 1, 2000.

Response: ATC Makena Entities acknowledge that they are subject to provisions of said condition.

ATC Makena Entities met with DOT on March 4, 2011, December 21, 2011, February 1, 2012, and May 8, 2012, regarding its participation in the design and construction of the four-lane widening of Piilani highway from Kilohana Drive to Wailea Ike Drive in order to satisfy Condition 12. ATC Makena Entities are presently formalizing an agreement with DOT that will satisfy Condition 12.

13. Petitioner shall fund the design and construction of drainage improvements required as a result of the development of the Property to the satisfaction of the appropriate State of Hawai'i and County of Maui agencies.

Response: ATC Makena Entities acknowledge that they are subject to provisions of said condition.

As reported in the Fifth Annual Report the Petitioner prepared a Drainage Master Plan, which was submitted to the County Department of Public Works and Environmental Management and Planning Department on July 1, 2003, and approved by the County on August 20, 2003.

14. The Petition Areas will be developed in accordance with the Kihei-Makena Community Plan.

Response: ATC Makena Entities acknowledge that development of the Petition Areas is to be in accordance with the Kihei-Makena Community Plan.

15. Petitioner shall obtain appropriate changes in zoning from the County of Maui for the Petition Areas.

Response: Condition 15 was released by the Commission pursuant to the 2012 Amendment. ATC's predecessor in interest complied with said Condition 15.

16. Petitioner shall fund, design and construct all necessary traffic improvements necessitated by development of the Petition Areas as required by the State Department of Transportation and the County of Maui Department of Public Works and Waste Management.

Response: ATC Makena Entities acknowledge that it is subject to the provisions of this said condition.

17. Petitioner shall develop the Property in substantial compliance with the representations made to the Commission. Failure to so develop the Property may result in a reversion of the Property to its former classification, a change to a more appropriate classification, or other reasonable remedy as determined by the Commission.

Response: ATC Makena Entities acknowledges that it is subject to the provisions of this said condition.

18. Petitioner shall give notice to the Commission of any intent to sell, lease, assign, place in trust, or otherwise voluntarily alter the ownership interests in the Property, prior to development of the Property.

Response: ATC Makena Entities acknowledges that it is subject to the provisions of this said condition.

19. Petitioner shall timely provide without any prior notice, annual reports to the Commission, the Office of Planning, and the County of Maui Planning Department in connection with the status of the subject project and Petitioner's progress in complying with the conditions imposed herein. The annual report shall be submitted in a form prescribed by the Executive Officer of the Commission.

Response: The submittal of this Fifteenth Annual Report by ATC Makena Entities is in compliance with this condition.

20. The commission may fully or partially release or amend the conditions provided herein as to all or any portion of the petition area upon timely motion and upon the provision of adequate assurance of satisfaction of these conditions by Petitioner.

Response: ATC Makena Entities acknowledges that it is subject to the provisions of this said condition. .

21. Within seven (7) days of the issuance of the Commission's Decision and Order for the subject reclassification, Petitioner shall (a) record with the Bureau of Conveyances a statement that the Property is subject to conditions imposed herein by the Land Use Commission in the reclassification of the Property, and (b) shall file a copy of such recorded statement with the Commission.

Response: Condition 21 was released by the Commission pursuant to the 2012 Amendment. ATC's predecessor in interest complied with said Condition 21.

22. (as amended) Petitioner shall record the conditions imposed herein by the Commission and every amendment thereto with the Bureau of Conveyances pursuant to Section 15-15-92, Hawai'i Administrative Rules.

Response: ATC Makena Entities acknowledges that it is subject to the provisions of this said condition.

ATC Makena Entities recorded in said Bureau that certain Amended and Restated Declaration of Conditions Applicable To An Amendment to District Boundary From Agricultural to Urban on September 7, 2012, as Document Number A-46330782, a copy of which is enclosed herein as **Exhibit "C"**.

If you have any questions or require any further information, please contact Richard Riegels at (808)547-2239 or rbr@stanfordcarr.com.

Sincerely,



Sean Hehir
Authorized Signor
ATC Makena Entities

Sincerely,



Stanford S. Carr
Authorized Signor
ATC Makena Entities

SH:bbc

cc: State of Hawaii, Office of Planning
County of Maui, Department of Planning
Munekiyo & Hiraga, Inc.

Encl. **Exhibit "A"** Construction Right-of-Entry (ROE) and Non-Exclusive License Agreements for Proposed New Civil Defense Warning Sirens - Makena Resort WWTP Location (Siren Name Designation: Makena Resort WWTP, Siren 157) and Big Beach Location (Siren Name Designation: Big Beach-Makena, Siren 158) dated May 23, 2012

Exhibit "B-1" Marine Monitoring Report with transmittal to State of Hawaii Department of Health dated December 2012, for work conducted in April 2012.

Exhibit "B-2" Marine Monitoring Report with transmittal to State of Hawaii Department of Health dated February 2013, for work conducted in December 2012.

Exhibit "C" Amended and Restated Declaration of Conditions Applicable to an Amendment of District Boundary from Agriculture to Urban, Docket A-46330782 dated September 7, 2012.

Exhibit A

NEIL ABERCROMBIE
GOVERNOR



DEAN H. SEKI
COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES

P.O. BOX 119, HONOLULU, HAWAII 96810-0119

(P)1117.2

MAY 25 2012

Ms. Sarah Agnew-Miller
Stanford Carr Development, LLC
1100 Alakea Street, 27th Floor
Honolulu, Hawaii 96813

Dear Ms. Agnew-Miller:

Subject: Fully Executed Construction Right-of-Entry (ROE) and
Non-Exclusive License Agreements for Proposed
New Civil Defense Warning Sirens - Makena Resort WWTP
Location (Siren Name Designation: Makena Resort WWTP, Siren 157) and
Big Beach Location (Siren Name Designation: Big Beach-Makena, Siren 158)

Attached for your information is one (1) copy of the fully executed construction ROE and non-exclusive license agreement for the proposed new civil defense warning siren at the Makena Resort WWTP Location (Siren Name Designation: Makena Resort WWTP, Siren 157).

Also, attached for your information is one (1) copy of the fully executed construction ROE and non-exclusive license agreement for the proposed new civil defense warning siren at the Big Beach location (Siren Name Designation: Big Beach-Makena, Siren 158).

If you have any questions, please call Mr. Brian Isa of the Planning Branch at 586-0484 or email him at brian.s.isa@hawaii.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "J. K. Kurata".

JAMES K. KURATA
Public Works Administrator

BI:mo

Attachments

c: Ms. Anna Foust, County of Maui-Civil Defense Agency w/attachments

RIGHT-OF-ENTRY AND NON-EXCLUSIVE LICENSE AGREEMENT

THIS RIGHT-OF-ENTRY AND NON-EXCLUSIVE LICENSE AGREEMENT (“Agreement”) made this 23rd day of May, 2012 (“**Effective Date**”) by and between ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC, all of which are Delaware limited liability companies, as fee owners, and ATC Makena Services LLC, a Delaware limited liability company, as lessee, all of whose mailing address is c/o ATC Makena Holdings, LLC, 1 Aloha Tower Drive, Suite 3100, Honolulu, Hawai‘i 96813 (hereafter collectively called “**Grantor**”) and the STATE OF HAWAII, DEPARTMENT OF DEFENSE (DOD), whose mailing address is 3949 Diamond Head Road, Honolulu, Hawai‘i 96816, AND DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES (DAGS), whose mailing address is 1151 Punchbowl Street, Honolulu, Hawai‘i, 96813 (hereafter collectively called “**Grantee**”).

BACKGROUND

WHEREAS, Grantor is the owner of those certain parcels of land situated in the County of Maui, State of Hawaii, bearing Tax Map Key Numbers (2) 2-1-008: 108, 2-1-008: 090 and 2-1-005: 108 and as more particularly shown on **Exhibit “A”** attached hereto and made a part hereof (the “**Property**”);

WHEREAS, by that certain License Agreement dated December 28, 2011 but effective as of January 1, 2012, by and between Grantor and ATC Makena WWTP Services, Corp., a Delaware corporation, Grantor granted an exclusive license, subject to the terms therein, to ATC Makena WWTP Services, Corp. to enter upon a portion of the Property solely for the purpose of operating and maintaining the wastewater treatment plant that serves Makena Beach & Golf Resort and is located on a portion of TMK (2) 2-1-008: 108 (the “**WWTP Site**”) (ATC Makena WWTP Services, Corp. and any subsequent licensee of the WWTP Site is hereinafter referred to as the “**WWTP Licensee**”);

WHEREAS, the WWTP Licensee may enter into contracts from time to time with independent operators for the operation and maintenance of the wastewater treatment plant (the operator of the wastewater treatment plant is hereinafter referred to as the “**WWTP Operator**”);

WHEREAS, various portions of the Property are encumbered by the easements described and depicted in **Exhibits “B-1”, “B-2”, “C-1”, “C-2”, “D-1”, “D-2”** and “**E**” attached hereto and made a part hereof (collectively referred to herein as the “**Access Easements**”);

WHEREAS, the Department of Defense, acting by and through its Division of State Civil Defense (“**State Civil Defense**”), has identified a suitable civil defense warning siren location, with the siren name designation “**Makena Resort WWTP, Siren 157**”, which is to be located within the WWTP Site and is more specifically identified as the hatched area on **Exhibit “F”** attached hereto and made a part hereof (the “**New Siren Site**”);

WHEREAS, Grantee, who has the responsibility to fund and maintain the civil defense warning siren, seeks a right-of-entry onto the Property together with a non-exclusive license for the purpose of installing and maintaining a new State Civil Defense warning siren in accordance with the specifications set forth on **Exhibit "G"** attached hereto and made a part hereof (the "**New Siren**");

NOW, THEREFORE, in consideration of the promises and covenants contained herein and for other good and valuable consideration, the receipt, adequacy and sufficiency of which is hereby acknowledged by the parties hereto, the parties hereby agree as follows:

AGREEMENT

1. **Right-of-Entry.** Subject to the terms and conditions of this Agreement, Grantor hereby grants to Grantee, its officers, employees, agents, contractors and subcontractors, a right-of-entry (the "**Right-of-Entry**") over the New Siren Site, together with the Access Easements and an access route over the WWTP Site to be determined as set forth in Section 8 below, for the purpose of installing the New Siren at the New Siren Site. The installation of the New Siren shall be at Grantee's sole expense and Grantee shall keep the Property free and clear of any lien, charge, judgment or encumbrance arising from or in connection with such installation.

2. **Term of Right-of-Entry.** The term of the Right-of-Entry shall commence as of the Effective Date and shall expire upon Grantee's installation of the New Siren, unless sooner terminated as provided in Section 6 below.

3. **Non-Exclusive License.** Subject to the terms and conditions of this Agreement, Grantor hereby grants to Grantee, its officers, employees, agents, contractors and subcontractors, a non-exclusive License (the "**License**") to use the New Siren Site, together with the Access Easements and an access route over the WWTP Site to be determined as set forth in Section 8 below, for the purpose of maintaining the New Siren, but for no other purpose.

4. **Term of License.** The term of the License shall commence upon Grantee's lien-free installation of the New Siren and shall thereafter continue on a month-to-month basis, unless sooner terminated as provided in Section 6 below.

5. **Access to New Siren Site.** For all purposes under this Agreement, Grantee's sole access to the New Siren Site shall be from Makena Alanui (a public road) over the Access Easements, or such other access easements as may be designated in writing by Grantor.

6. **Termination.** Grantor or Grantee may terminate this Agreement upon three hundred sixty five (365) days prior written notice to the other party at the respective addresses set forth in Section 15 below. Notwithstanding the foregoing, in the event that Grantee: (i) fails to install the New Siren within three (3) years from the date of this Agreement; or (ii) abandons or fails to operate the New Siren for a period of one (1) year, then Grantor may terminate this Agreement upon sixty (60) days prior written notice to Grantee. Upon any termination of this Agreement, unless otherwise agreed in writing by Grantor and Grantee, Grantee shall remove the New Siren and the mountings, equipment and other appurtenances related thereto.

7. **Approval for Entry.** The New Siren Site is located within the WWTP Site, which is a secured area. Grantor shall have the right of prior approval of Grantee's entry onto the Property for any and all purposes contemplated under this Agreement, which right shall be exercised in Grantor's sole and absolute discretion. Such approval must be obtained from Grantor's representative, Craig Tanaka, by telephone at (808) 875-5813 (days) and confirmed by email at ctanaka@makenaresortmaui.com, or from such other representative as may be communicated by Grantor to Grantee in writing, at least seventy-two (72) hours prior to Grantee's entry. Grantee shall make a good faith effort to minimize any potential interference with Grantor's normal operations.

8. **Safety and Security.** While on the WWTP Site, Grantor shall be accompanied at all times by a representative of the WWTP Operator and shall observe all safety and security rules and regulations applicable to the WWTP Site. The probable access route to the New Siren Site within the WWTP Site is depicted on **Exhibit "F"** but is subject to change at the sole discretion of the WWTP Operator at the time of entry.

9. **Liability and Indemnity.** Grantee shall be responsible to Grantor, the WWTP Licensee, the WWTP Operator, and their respective members, managers, officers, employees, affiliates and invitees for any and all loss, cost, damage, liability or claim thereof, including attorneys' fees, for injury or damage to persons or property arising out of or in connection with the exercise of its rights hereunder by Grantee, its agents, employees, contractors, invitees or representatives or any others claiming by, through or under Grantee. Grantee's responsibility shall not apply to any loss, cost, damage, liability or claim for injury or damage resulting from or in connection with the gross negligence, reckless, wrongful, or intentional acts of Grantor, the WWTP Licensee, the WWTP Operator, their respective employees, agents, contractors, representatives, invitees, or any other claiming by, through, or under them.

10. **Condition of Property.** Grantee acknowledges and agrees that the Property, including, without limitation, the Access Easements and the New Siren Site, are "as-is, where-is and with all faults" and that Grantor has made no representations or warranties with respect to the condition of the Property, the Access Easements or the New Siren Site.

11. **Due Care.** Grantee will use due care and diligence in the exercise of its rights hereunder and, at all times, will exercise its rights in a manner that will occasion the least interference with or interruption of the use of the Property by Grantor, the WWTP Licensee and the WWTP Operator, to the extent reasonably possible and consistent with the purposes of this Agreement.

At all times during installation of the New Siren and during maintenance of the New Siren, Grantee shall clearly and safely mark-off the construction work area and shall maintain and exercise due care to keep the area around Grantee's activity clear and safe for use.

12. **Restoration.** Upon removal of the New Siren, relocation of the New Siren, or permanent removal of the New Siren upon termination of this Agreement, Grantee shall restore the New Siren Site to a condition that is substantially similar to that which existed prior to the commencement of Grantee's activity under this Agreement. In addition, Grantee shall be responsible for the repair and restoration of any damage to the Access Easements arising in connection with Grantee's use.

13. **Maintenance, Repair and Operation.** Grantee shall be responsible for all maintenance, repair and operation of the New Siren, including all utilities it uses to operate the New Siren.

14. **Emergency Contact.** In case of an emergency involving the New Siren, please contact the Grantee's representative from the County of Maui's Civil Defense Agency: Ms. Anna Foust at (808) 270-7285 (work) or (808) 269-7773 (cell), or Ms. Darlene Lai at (808) 270-7280 (work) or (808) 264-8626 (cell).

15. **Notices.** Unless otherwise expressly provided herein, all notices, requests, demands, consents and other communications under this Agreement shall be in writing and: (i) personally delivered; (ii) sent by registered or certified mail, postage prepaid; or (iii) transmitted by facsimile or in pdf or other electronic file format by email, provided that a hard copy is deposited in the mail concurrently with such transmission, addressed as follows:

Grantor: ATC Makena Holdings, LLC
1 Aloha Tower Drive, Suite 3100
Honolulu, Hawai'i 96813
Attn: Becky Collins
Tel.: (808) 537-5220
Fax: (808) 537-1801
Email: bcollins@stanfordcarr.com

With a copy to: Bickerton Lee Dang & Sullivan
745 Fort Street, Suite 801
Honolulu, Hawai'i 96813
Attn: Barry A. Sullivan
Tel.: (808) 599-3811
Fax: (808) 533-2467
Email: sullivan@bsds.com

Grantee: State of Hawaii
Department of Defense
3949 Diamond Head Road
Honolulu, Hawai'i 96816
Attn: George Burnett
Tel.: (808) 733-4301, Ext 530
Fax: (808) 733-4287
Email: gburnett@scd.hawaii.gov

And: State of Hawaii
Department of Accounting and General Services
1151 Punchbowl Street
Honolulu, Hawai'i 96813
Attn: James K. Kurata
Tel.: (808) 586-0526
Fax: (808) 586-0521

Email: James.K.Kurata@hawaii.gov

Such addresses, facsimile numbers and email addresses may be changed from time to time by the addressee by serving notice as herein provided. Copies of all notices to persons other than Grantor and Grantee shall be for courtesy purposes only and shall not constitute delivery or receipt of such notices by Grantor or Grantee, as the case may be.

16. **Compliance with Laws.** Grantee, its officers, employees, agents, contractors, and subcontractors shall comply with and satisfy all applicable statutes, ordinances, rules and regulations of the Federal, State and County governments in doing its work during the term of the Right-of-Entry and term of the License.

17. **No Assignment or Sublicensing.** Grantee shall not assign, sublicense, transfer or otherwise encumber all or any part of Grantee's interest in this Agreement or the rights granted hereunder without the prior written consent of Grantor, which consent may be withheld by Grantor in its sole and absolute discretion.

18. **Counterparts and Facsimile Signatures.** This Agreement may be executed in any number of counterparts, each of which shall be an original, but all of which together shall constitute but one instrument. Duplicate, unexecuted counterpart pages may be discarded and the remaining pages assembled as one document. Signatures transmitted and received by facsimile on this Agreement shall be binding and effective for all purposes.

19. **Governing Law** This Agreement shall be governed under Hawaii law, and be binding on and inure to the benefit of the successors and permitted assignees of the respective parties.

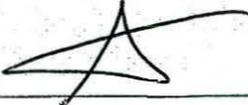
20. **No Party Deemed Drafter.** Grantor and Grantee agree that neither party shall be deemed to be the drafter of this Agreement and that, in the event this Agreement is ever construed by a court of law, such court shall not construe this Agreement or any provision hereof against either party as the drafter.

21. **Entire Agreement** This Agreement constitutes the entire agreement between the parties, and supersedes all understandings, offers, negotiations and other agreements concerning the subject matter contained herein. There are no representations or understandings of any kind not set forth herein. Any amendments, modifications or waivers of any of the terms and conditions of this Agreement must be in writing and executed by both parties.

[No Further Text On This Page.]

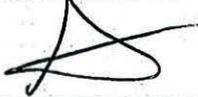
IN WITNESS WHEREOF, the parties hereto have entered into this Agreement as of the date first above written.

ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC

By:  _____

Their Authorized Signatory

ATC Makena Services LLC

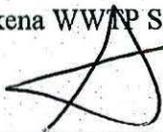
By:  _____

Its Authorized Signatory

“GRANTOR”

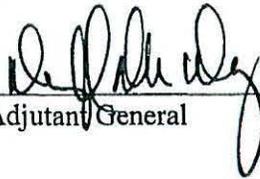
ACKNOWLEDGED AND AGREED TO
THIS 13th DAY OF April, 2012

ATC Makena WWTP Services, Corp.

By:  _____

Its Authorized Signatory

STATE OF HAWAII, DEPARTMENT OF
DEFENSE

By:  _____
Adjutant General

STATE OF HAWAII, DEPARTMENT OF
ACCOUNTING AND GENERAL SERVICES

By:  _____
State Comptroller

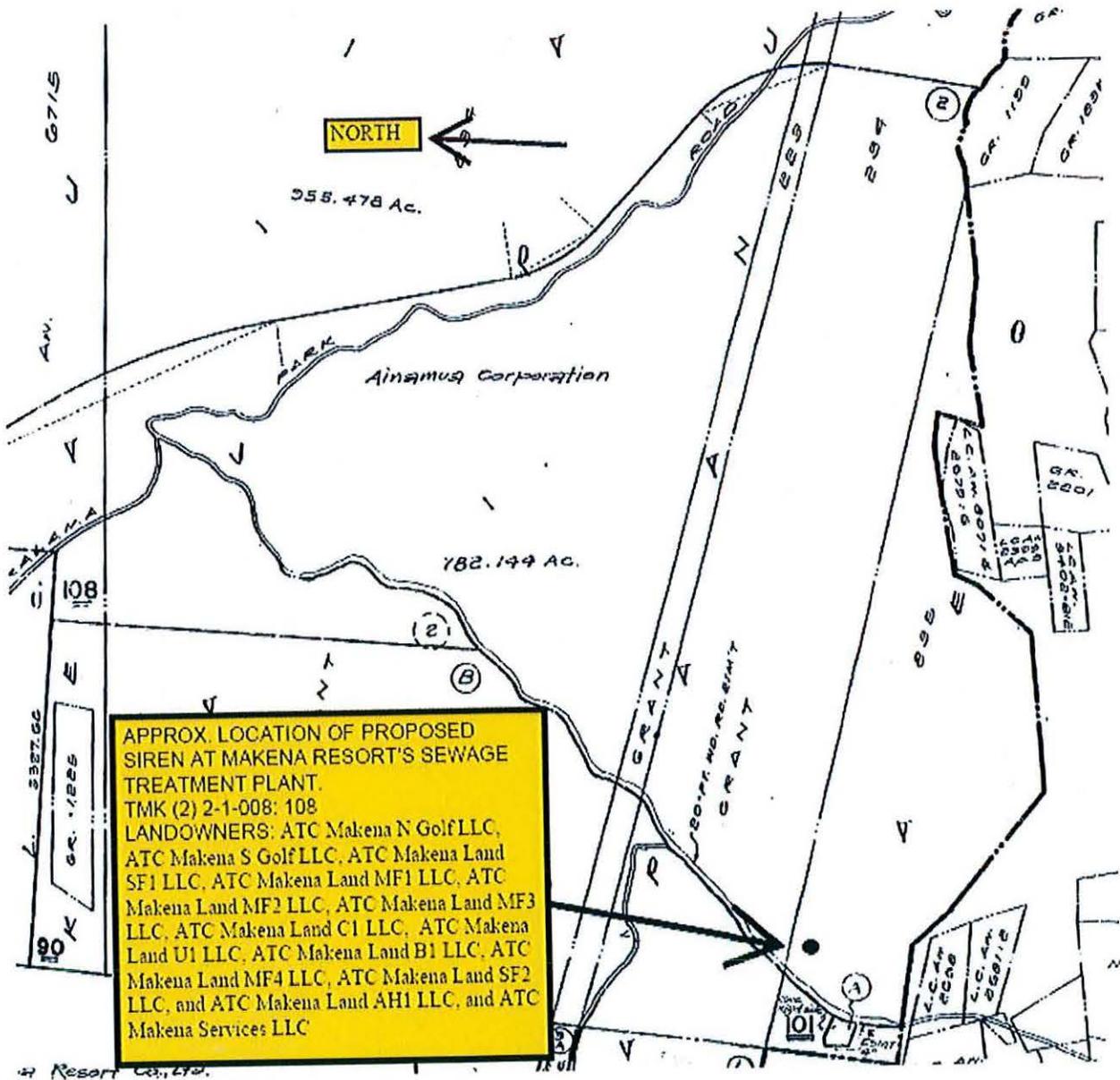
"GRANTEE"

APPROVED AS TO FORM
AND LEGALITY:

By:  _____
State Deputy Attorney General

**EXHIBIT A
THE PROPERTY**

Those certain parcels of land situate at Tax Map Key Nos. (2) 2-1-008: 108, 2-1-008: 090 and 2-1-005: 108 in the County of Maui. The parcels are shown below.



This plan has no scale.

DESCRIPTION
WATERLINE EASEMENT NO. 1
AFFECTING LOT 3-A-1-A OF THE SEIBU MAKENA HOTEL SUBDIVISION

All of that certain parcel of land, being Waterline Easement No. 1 over, under and across a portion of Lot 3-A-1-A of the Seibu Makena Hotel Subdivision (the map thereof not being recorded) in favor of the Board of Water Supply of the County of Maui, being a portion of Grant 835 to Mahoe, situated at Kaco, Honuaula, Makawao, Island and County of Maui, State of Hawaii and being more particularly described as follows:

Beginning at the north corner of this easement, on the easterly boundary of Makena Alanui Road (Lot 4 of said Seibu Makena Hotel Subdivision), the coordinates of said point of beginning referred to Government Survey Triangulation Station "PUU OLAI" being:

4,788.35 feet North
3,626.66 feet East

and running by azimuths measured clockwise from true South:

Thence along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe, on the arc of a curve to the left, concave northeasterly with a radius of 30.00 feet, the chord azimuth and distance being:

1. 325° 04' 48" 42.42 feet;
2. 280° 05' 00" 156.46 feet along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe;

Thence along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe, on the arc of a curve to the right, concave southwesterly with a radius of 680.00 feet, the chord azimuth and distance being:

3. 298° 40' 00" 433.41 feet;
4. 317° 15' 00" 410.95 feet along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe;

Thence along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe, on the arc of a curve to the left, concave northeasterly with a radius of 720.00 feet, the chord azimuth and distance being:

5. 307° 45' 00" 237.67 feet;

Page 1 of 3

EXHIBIT "B-1"

- | | | | |
|----|--------------|--------|--|
| 6. | 298° 15' 00" | 257.87 | feet along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe to a point on the west boundary of Lot B of the Makena Mauka Lots; |
| 7. | 5° 34' 57" | 65.02 | feet along said Lot B of the Makena Mauka Lots and along the remainder of said Grant 835 to Mahoe; |
| 8. | 118° 15' 00" | 282.93 | feet along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe; |

Thence along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe, on the arc of a curve to the right, concave northeasterly with a radius of 780.00 feet, the chord azimuth and distance being:

- | | | | |
|-----|--------------|--------|--|
| 9. | 127° 45' 00" | 257.47 | feet; |
| 10. | 137° 15' 00" | 117.28 | feet along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe; |
| 11. | 89° 20' 00" | 20.21 | feet along same; |
| 12. | 137° 15' 00" | 280.12 | feet along same; |

Thence along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe, on the arc of a curve to the left, concave southwesterly with a radius of 605.00 feet, the chord azimuth and distance being:

- | | | | |
|-----|--------------|--------|--|
| 13. | 118° 40' 00" | 385.61 | feet; |
| 14. | 100° 05' 00" | 7.57 | feet along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe; |
| 15. | 145° 52' 00" | 20.93 | feet along same; |
| 16. | 100° 05' 00" | 134.28 | feet along same; |

Thence along the remainders of said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and said Grant 835 to Mahoe, on the arc of a curve to the left, concave southeasterly with a radius of 30.00 feet, the chord azimuth and distance being:

17. 55° 04' 48" 42.43 feet to a point on the easterly boundary of said Makena Alanui Road (Lot 4 of said Seibu Makena Hotel Subdivision);
18. 190° 04' 36" 120.00 feet along said easterly boundary of Makena Alanui Road (Lot 4 of said Seibu Makena Hotel Subdivision) and along the remainder said Grant 835 to Mahoe to the point of beginning and containing an area of 2.368 Acres, more or less.

Prepared by:

NEWCOMER-LEE
LAND SURVEYORS, INC., a Hawai'i Corporation



This description was prepared from a survey on the ground performed by me or under my supervision.

Bruce R. Lee

BRUCE R. LEE
 Licensed Professional Land
 Surveyor Certificate No. 5983-LS

9/10/01
 SAVALANUI
 File 97-4034
 4034-mro-water ease 1

DESCRIPTION
WATERLINE EASEMENT NO. 2
AFFECTING LOT B OF THE MAKENA MAUKA LOTS

All of that certain parcel of land, being Waterline Easement No. 2 over, under and across a portion of Lot B of the Makena Mauka Lots (the map thereof not being recorded) in favor of the Board of Water Supply of the County of Maui, being a portion of Grant 835 to Mahoe, situated at Kaeo, Honuaula, Makawao, Island and County of Maui, State of Hawaii and being more particularly described as follows:

Beginning at the southwest corner of this easement, on the easterly boundary of Lot 3-A-1-A of the Seibu Makena Hotel Subdivision, the coordinates of said point of beginning referred to Government Survey Triangulation Station "PUU OLAI" being:

3,884.22 feet North
4,872.98 feet East

and running by azimuths measured clockwise from true South:

1. 185° 34' 57" 65.02 feet along said Lot 3-A-1-A of the Seibu Makena Hotel Subdivision and along the remainder of said Grant 835 to Mahoe;
2. 298° 15' 00" 29.59 feet along the remainders of said Lot B of the Makena Mauka Lots and said Grant 835 to Mahoe;

Thence along the remainders of said Lot B of the Makena Mauka Lots and said Grant 835 to Mahoe, on the arc of a curve to the left, concave northwesterly with a radius of 20.00 feet, the chord azimuth and distance being:

3. 243° 41' 39" 32.59 feet to a point of compound curvature;

Thence along the remainders of said Lot B of the Makena Mauka Lots and said Grant 835 to Mahoe, on the arc of a curve to the left, concave westerly with a radius of 355.00 feet, the chord azimuth and distance being:

4. 179° 55' 58" 113.58 feet;
5. 260° 43' 38" 35.00 feet along the remainders of said Lot B of the Makena Mauka Lots and said Grant 835 to Mahoe to a point on the west boundary of Lot A (Tank Lot) of said Makena Mauka Lots;

Page 1 of 2

EXHIBIT "C-1"

Thence along said Lot A (Tank lot) of the Makena Mauka Lots and along the remainders of said Lot B of the Makena Mauka Lots and said Grant 835 to Mahoe, on the arc of a curve to the right, concave westerly with a radius of 390.00 feet; the chord azimuth and distance being:

6. 2° 50' 29" 163.69 feet;
7. 28° 15' 00" 60.00 feet along the remainders of said Lot B of the Makena Mauka Lots and said Grant 835 to Mahoe;
8. 118° 15' 00" 67.54 feet along same to the point of beginning and containing an area of 10,343 Square Feet or 0.237 Acre, more or less.

Prepared by:

NEWCOMER-LEE
LAND SURVEYORS, INC., a Hawaii Corporation

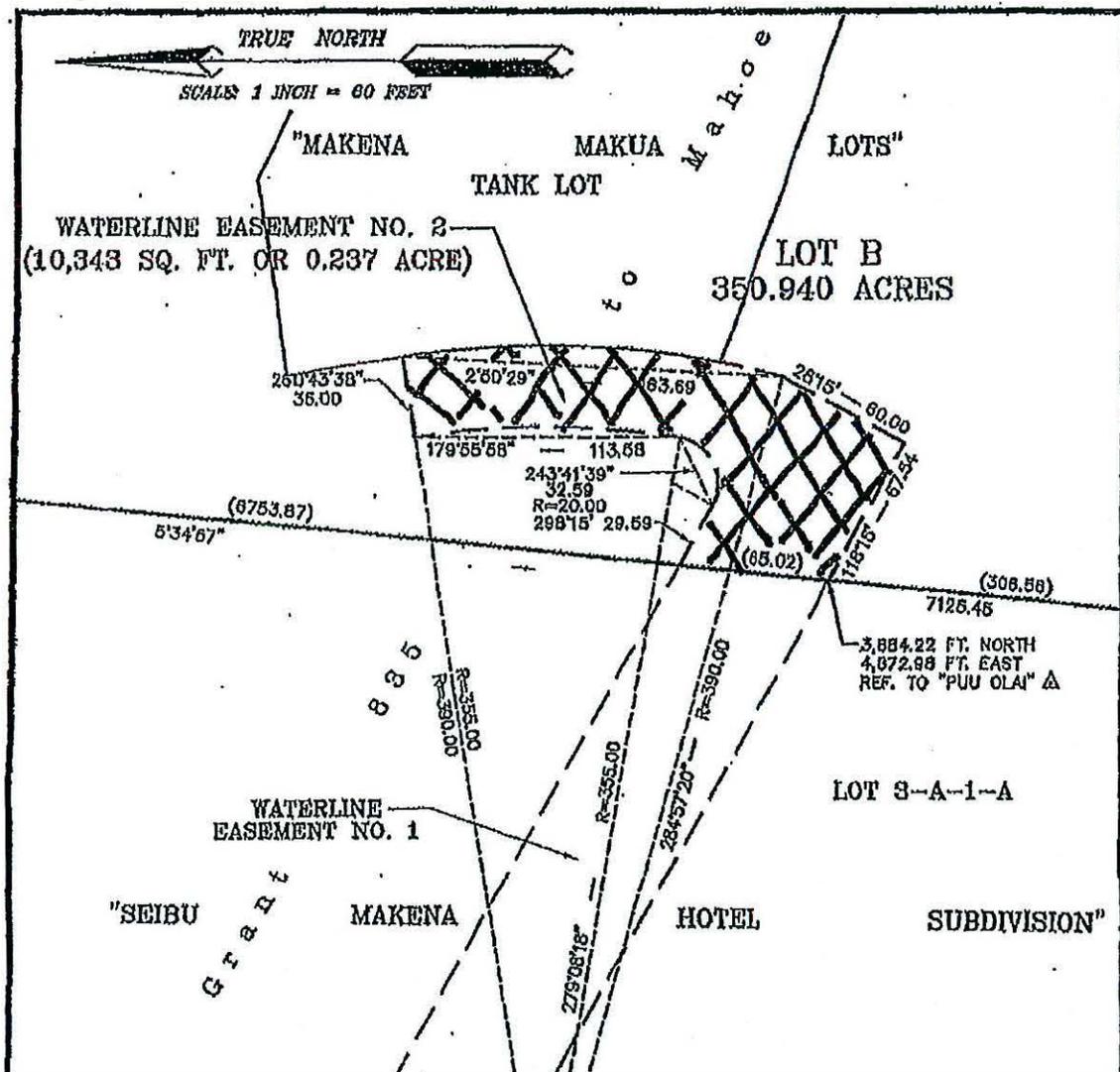


This description was prepared from a survey on the ground performed by me or under my supervision.

A handwritten signature in cursive script that reads "Bruce R. Lee".

BRUCE R. LEE
Licensed Professional Land
Surveyor Certificate No. 5983-LS

9/10/01
SAVALANUI
File 97-4054
4054-mre-water ease 2



 <p>BRUCE R. LEE LICENSED PROFESSIONAL LAND SURVEYOR No. 5883-LS HAWAII, U.S.A.</p> <p><i>Bruce R. Lee</i></p> <p>THIS PLAT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.</p>	<p>PLAT SHOWING WATERLINE EASEMENT NO. 2 AFFECTING LOT B OF THE MAKENA MAKUA LOTS Being a portion of Grant 885 to Mahoe SITUATED AT KAKO, HONUAAULA, MAKAWAO, MAUI, HAWAII</p>	
	<p>PREPARED FOR:</p> <p>SATO & ASSOCIATES, INC. 2115 WELLS STREET WAILUKU, HI 96793</p>	<p>PREPARED BY:</p> <p>NEWCOMER - LEE LAND SURVEYORS, INC. 1488 LOWER MAIN STREET, SUITE D, WAILUKU, MAUI, HAWAII 96793</p>
<p>T.M.K.(2) 2-1-008: 000</p>	<p>SCALE: 1 INCH = 60 FEET</p>	<p>DATE: SEPTEMBER 7, 2001</p>

EXHIBIT "C-2"

EASEMENT A
FOR ACCESS AND UTILITY PURPOSES

AFFECTING LOT B OF "MAKENA MAUKA LOTS"
BEING PORTIONS OF GRANT 835 TO MAHOE,
GRANT 234 TO L.L. TORBERT AND WM. WILCOX,
GRANT 223 TO L.L. TORBERT
AND LAND PATENT 8213, LAND COMMISSION AWARD 6715 TO HOOMANAWANUI

AT KEAUKOU, KALIHI, WAIPAO, PAPAANUI & KAEO, HONUĀULA,
MAKAWAO, ISLAND OF MAUI, HAWAII

Beginning at the northeast corner of this easement, being the southeast corner of Lot A of "Makena Mauka Lots", the coordinates of said point of beginning referred to Government Survey Triangulation Station "PUU OLAI" being 3,859.50 feet North and 5,151.54 feet East, thence running by azimuths measured clockwise from true South:

1. 20° 00' 77.95 feet along Lot 2 of "Ulupalakua-Seibu Subdivision", being portions of Grant 835 to Mahoe, Grant 234 to L.L. Torbert and Wm. Wilcox, Grant 223 to L.L. Torbert and Land Patent 8213, Land Commission Award 6715 to Hoomanawanui;
2. 359° 20' 43.32 feet along Lot 2 of "Ulupalakua-Seibu Subdivision", being portions of Grant 835 to Mahoe, Grant 234 to L.L. Torbert and Wm. Wilcox, Grant 223 to L.L. Torbert and Land Patent 8213, Land Commission Award 6715 to Hoomanawanui;
3. 118° 15' 219.18 feet;
4. 208° 15' 60.00 feet;
5. Thence on a curve to the left with a radius of 390.00 feet, the chord azimuth and distance being:
192° 54' 28.5" 27.87 feet;

- 1 -

420 Waiakemilo Road
Suite 411
Honolulu Hawaii 96817-4941
Telephone 808 842 1133
Fax 808 842 1937
eMail rmtowill@i-one.com



R. M. TOWILL CORPORATION
SINCE 1980

Planning
Engineering
Environmental Services
Photogrammetry
Surveying
Construction Management

EXHIBIT "D-1"

6. 290° 00'

196.45 feet along Lot A of "Makena Mauka Lots", being a portion of Grant 835 to Mahoe to the point of beginning and containing an area of 20,337 Square Feet.

R. M. TOWILL CORPORATION

Description prepared by:



420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
May 14, 2007


Ryan M. Suzuki Exp: 4/30/08
Licensed Professional Land Surveyor
Certificate Number 10059

-2-

420 Waiakamilo Road
Suite 411
Honolulu Hawaii 96817-4941
Telephone 808 842 1133
Fax 808 842 1937
eMail rmtowill@rmtc.com


R. M. TOWILL CORPORATION
SINCE 1950

Planning
Engineering
Environmental Services
Photogrammetry
Surveying
Construction Management

EXHIBIT "D-2"

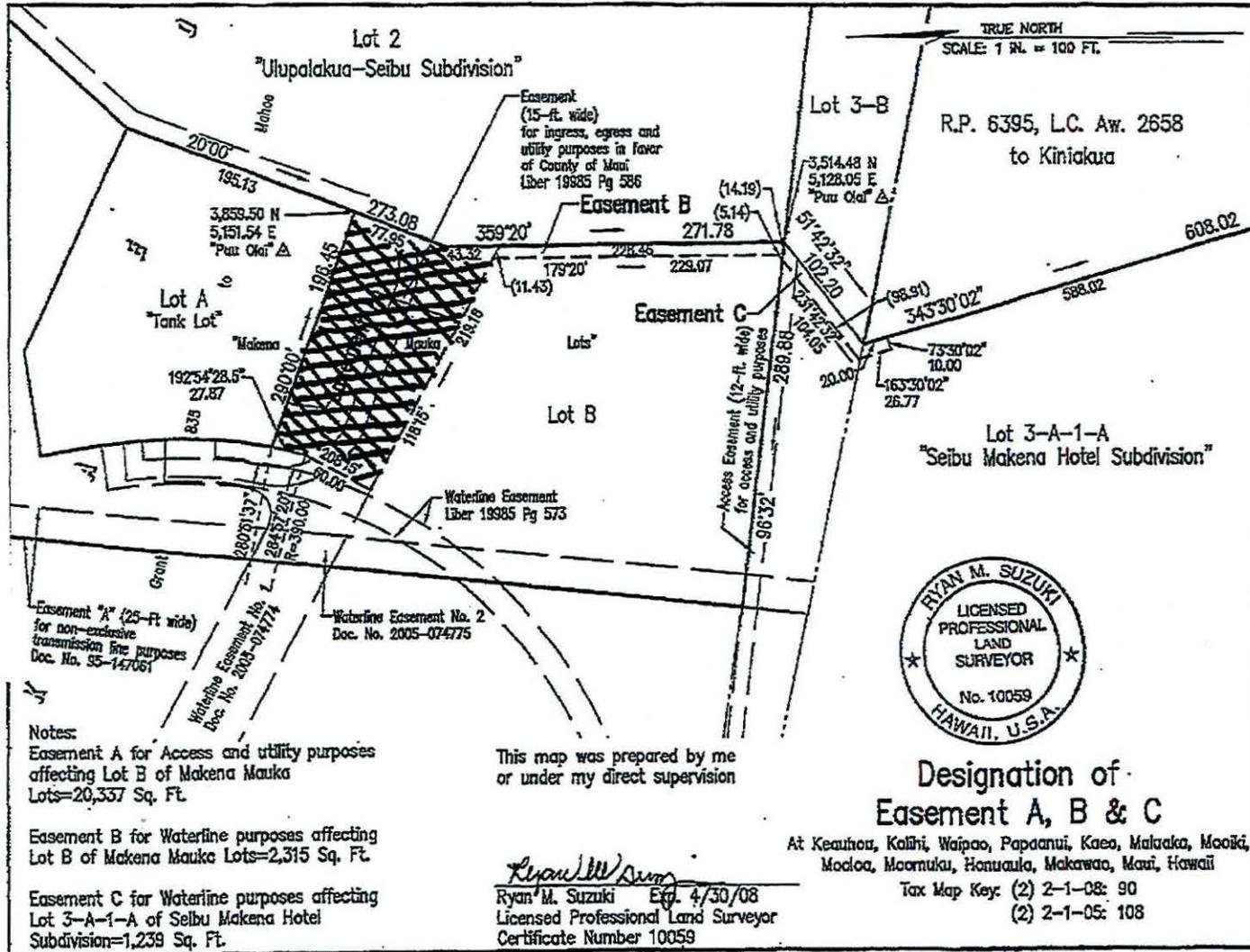


EXHIBIT F
THE NEW SIREN SITE

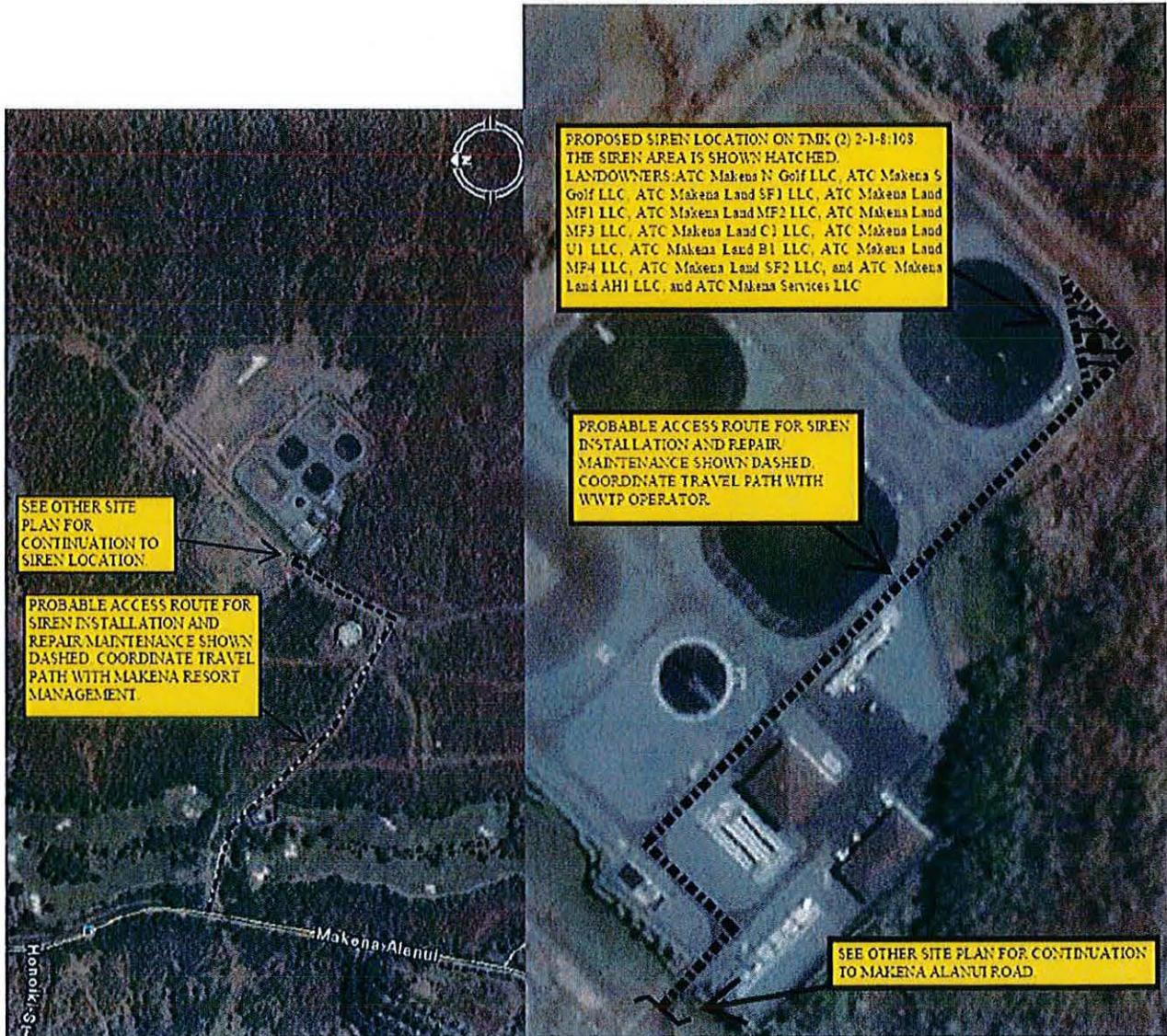
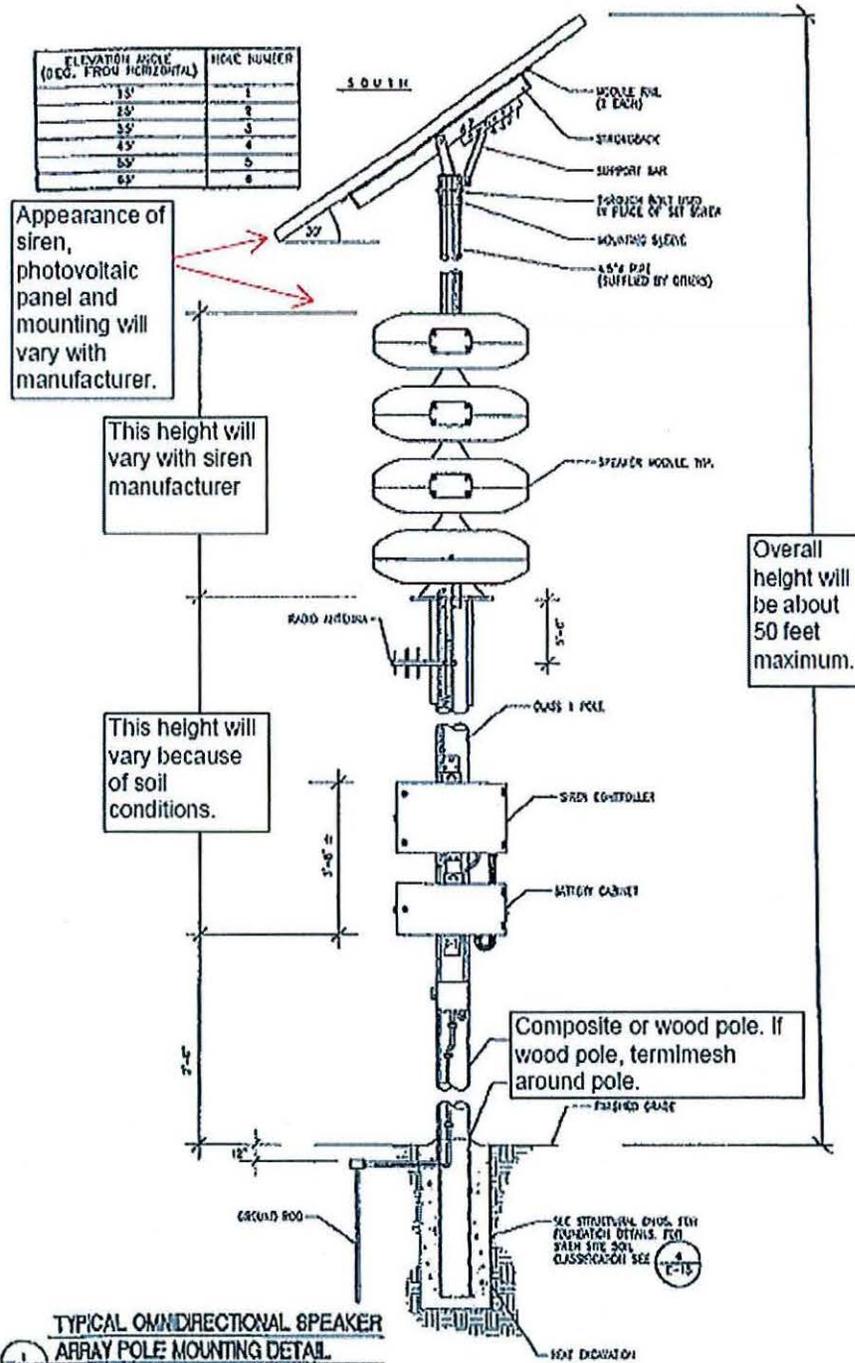


Photo has no scale.

EXHIBIT G THE NEW SIREN



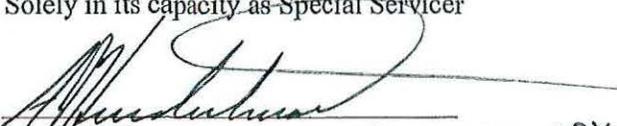
CONSENT AND JOINDER

The undersigned, Wells Fargo Bank, N. A., as Trustee for the Registered Holders of UBS Commercial Mortgage Securities Trust 2007-FL1, Commercial Mortgage Pass-Through Certificates, Series 2007-FL1 ("Lender") by and through CW Capital Asset Management, LLC, a Massachusetts limited liability company, solely in its capacity as Special Servicer, hereby consents to and joins in the execution of the foregoing grant of **Right-Of-Entry And Non-Exclusive License Agreement** dated as of March 16, 2012, by and between ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC, all of which are Delaware limited liability companies, as fee owners, and ATC Makena Services LLC, a Delaware limited liability company, as lessee, and the State of Hawaii, Department of Defense (DOD) and Department of Accounting and General Services (DAGS) (the "Agreement"), by virtue of Lender's rights and interests set forth in that certain Mortgage and Security Agreement dated as of August 27, 2010, recorded in the Bureau of Conveyances of the State of Hawaii as Document Nos. 3993962 and 2010-125630 (the "Mortgage"), and agrees to the granting of the aforesaid Agreement. Notwithstanding the foregoing, Lender does not waive any of its rights under the Mortgage, including the right to review and approve any request pertaining to any amendment to the Agreement.

Executed this 16 day of March, 2012.

Wells Fargo Bank, N. A., as Trustee for the
Registered Holders of UBS Commercial
Mortgage Securities Trust 2007-FL1,
Commercial Mortgage Pass-Through
Certificates, Series 2007-FL1

By: CW Capital Asset Management, LLC,
a Massachusetts limited liability company,
Solely in its capacity as Special Servicer

By: 
Name: ANDREW J. HUNDERTMARK
Title: MANAGING DIRECTOR

RIGHT-OF-ENTRY AND NON-EXCLUSIVE LICENSE AGREEMENT

THIS RIGHT-OF-ENTRY AND NON-EXCLUSIVE LICENSE AGREEMENT (“Agreement”) made this 23rd day of May, 2012 (“**Effective Date**”) by and between ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land UI LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC, all of which are Delaware limited liability companies, as fee owners, and ATC Makena Services LLC, a Delaware limited liability company, as lessee, all of whose mailing address is c/o ATC Makena Holdings, LLC, 1 Aloha Tower Drive, Suite 3100, Honolulu, Hawai‘i 96813 (hereafter collectively called “**Grantor**”) and the STATE OF HAWAII, DEPARTMENT OF DEFENSE (DOD), whose mailing address is 3949 Diamond Head Road, Honolulu, Hawai‘i 96816, AND DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES (DAGS), whose mailing address is 1151 Punchbowl Street, Honolulu, Hawai‘i, 96813 (hereafter collectively called “**Grantee**”).

BACKGROUND

WHEREAS, Grantor is the owner of that certain parcel of land situated in the County of Maui, State of Hawaii, bearing Tax Map Key Number (2) 2-1-005: 108, as more particularly described on **Exhibit “A”** attached hereto and made a part hereof (the “**Property**”);

WHEREAS, the Department of Defense, acting by and through its Division of State Civil Defense (“**State Civil Defense**”), has identified a suitable civil defense warning siren location, with the siren name designation ‘**Big Beach-Makena, Siren 158**’, which is to be located on a portion of the Property and more specifically identified on **Exhibit “B”** attached hereto (the “**New Siren Site**”);

WHEREAS, Grantee, who has the responsibility to fund and maintain the civil defense warning siren, seeks a right-of-entry onto the Property together with a non-exclusive license for the purpose of installing and maintaining a new State Civil Defense warning siren in accordance with the specifications set forth on **Exhibit “C”** attached hereto and made a part hereof (the “**New Siren**”);

NOW, THEREFORE, in consideration of the promises and covenants contained herein and for other good and valuable consideration, the receipt, adequacy and sufficiency of which is hereby acknowledged by the parties hereto, the parties hereby agree as follows:

AGREEMENT

1. **Right-of-Entry**. Subject to the terms and conditions of this Agreement, Grantor hereby grants to Grantee, its officers, employees, agents, contractors and subcontractors, a right-of-entry (the “**Right-of-Entry**”) onto the Property for the purpose of installing the New Siren. The installation of the New Siren shall be at Grantee’s sole expense and Grantee shall keep the Property free and clear of any lien, charge, judgment or encumbrance arising from or in connection with such installation.

2. **Term of Right-of-Entry.** The term of the Right-of-Entry shall commence as of the Effective Date and shall expire upon Grantee's installation of the New Siren, unless sooner terminated as provided in Section 5 below.

3. **Non-Exclusive License.** Subject to the terms and conditions of this Agreement, Grantor hereby grants to Grantee, its officers, employees, agents, contractors and subcontractors, a non-exclusive License (the "**License**") to use a portion of the Property shown roughly as the hatched area on **Exhibit "B"** attached hereto as the "proposed new siren site" (the "**New Siren Site**"), for the purpose of maintaining the New Siren identified on **Exhibit "C"**, but for no other purpose.

4. **Term of License.** The term of the License shall commence upon Grantee's lien-free installation of the New Siren and shall thereafter continue on a month-to-month basis, unless sooner terminated as provided in Section 5 below.

5. **Termination.** Grantor or Grantee may terminate this Agreement upon three hundred sixty five (365) days prior written notice to the other party at the respective addresses set forth in Section 13 below. Notwithstanding the foregoing, in the event that Grantee: (i) fails to install the New Siren within three (3) years from the date of this Agreement; or (ii) abandons or fails to operate the New Siren for a period of one (1) year, then Grantor may terminate this Agreement upon sixty (60) days prior written notice to Grantee. Upon any termination of this Agreement, unless otherwise agreed in writing by Grantor and Grantee, Grantee shall remove the New Siren and the mountings, equipment and other appurtenances related thereto.

6. **Access Approval.** Grantor shall have the right of prior approval of Grantee's entry onto the Property for any and all purposes contemplated under this Agreement, which right shall be exercised in Grantor's sole and absolute discretion. Such approval must be obtained from Grantor's representative, Craig Tanaka, by telephone at (808) 875-5813 (days) or (808) 879-3107 (evenings) and confirmed by email at ctanaka@makenaresortmaui.com, or from such other representative as may be communicated by Grantor to Grantee in writing, at least seventy-two (72) hours prior to Grantee's entry. Grantee shall make a good faith effort to minimize any potential interference with Grantor's normal operations.

7. **Liability and Indemnity.** Grantee shall be responsible to Grantor and its respective members, managers, officers, employees, affiliates and invitees for any and all loss, cost, damage, liability or claim thereof, including attorneys' fees, for injury or damage to persons or property arising out of or in connection with the exercise of its rights hereunder by Grantee, its agents, employees, contractors, invitees or representatives or any others claiming by, through or under Grantee. Grantee's responsibility shall not apply to any loss, cost, damage, liability or claim for injury or damage resulting from or in connection with the gross negligence, reckless, wrongful, or intentional acts of Grantor, its employees, agents, contractors, representatives, invitees, or any other claiming by, through, or under Grantor.

8. **Condition of Property.** Grantee acknowledges and agrees that the Property and the New Siren Site are "as-is, where-is and with all faults" and that Grantor has made no representations or warranties with respect to the condition of the Property or the New Siren Site.

9. **Due Care.** Grantee will use due care and diligence in the exercise of its rights hereunder and, at all times, will exercise its rights in a manner that will occasion the least interference with or interruption of the use of the Property by Grantor, to the extent reasonably possible and consistent with the purposes of this Agreement.

At all times during installation of the New Siren and during maintenance of the New Siren, Grantee shall clearly and safely mark-off the construction work area and shall maintain and exercise due care to keep the area around Grantee's activity clear and safe for public use.

10. **Restoration.** Upon removal of the New Siren, relocation of the New Siren, or permanent removal of the New Siren upon termination of this Agreement, Grantee shall restore the New Siren Site to a condition that is substantially similar to that which existed prior to the commencement of Grantee's activity under this Agreement.

11. **Maintenance, Repair and Operation.** Grantee shall be responsible for all maintenance, repair and operation of the New Siren, including all utilities it uses to operate the New Siren.

12. **Emergency Contact.** In case of an emergency involving the New Siren, please contact the Grantee's representative from the County of Maui's Civil Defense Agency: Ms. Anna Foust at (808) 270-7285 (work) or (808) 269-7773 (cell), or Ms. Darlene Lai at (808) 270-7280 (work) or (808) 264-8626 (cell).

13. **Notices.** Unless otherwise expressly provided herein, all notices, requests, demands, consents and other communications under this Agreement shall be in writing and: (i) personally delivered; (ii) sent by registered or certified mail, postage prepaid; or (iii) transmitted by facsimile or in pdf or other electronic file format by email, provided that a hard copy is deposited in the mail concurrently with such transmission, addressed as follows:

Grantor: ATC Makena Holdings, LLC
1 Aloha Tower Drive, Suite 3100
Honolulu, Hawai'i 96813
Attn: Becky Collins
Tel.: (808) 537-5220
Fax: (808) 537-1801
Email: bcollins@stanfordcarr.com

With a copy to: Bickerton Lee Dang & Sullivan
745 Fort Street, Suite 801
Honolulu, Hawai'i 96813
Attn: Barry A. Sullivan
Tel.: (808) 599-3811
Fax: (808) 533-2467
Email: sullivan@bsds.com

Grantee: State of Hawaii
Department of Defense

3949 Diamond Head Road
Honolulu, Hawai'i 96816
Attn: George Burnett
Tel.: (808) 733-4301, Ext 530
Fax: (808) 733-4287
Email: gburnett@scd.hawaii.gov

And: State of Hawaii
Department of Accounting and General Services
1151 Punchbowl Street
Honolulu, Hawai'i 96813
Attn: James K. Kurata
Tel.: (808) 586-0526
Fax: (808) 586-0521
Email: James.K.Kurata@hawaii.gov

Such addresses, facsimile numbers and email addresses may be changed from time to time by the addressee by serving notice as herein provided. Copies of all notices to persons other than Grantor and Grantee shall be for courtesy purposes only and shall not constitute delivery or receipt of such notices by Grantor or Grantee, as the case may be.

14. **Compliance with Laws.** Grantee, its officers, employees, agents, contractors, and subcontractors shall comply with and satisfy all applicable statutes, ordinances, rules and regulations of the Federal, State and County governments in doing its work during the term of the Right-of-Entry and term of the License.

15. **No Assignment or Sublicensing.** Grantee shall not assign, sublicense, transfer or otherwise encumber all or any part of Grantee's interest in this Agreement or the rights granted hereunder without the prior written consent of Grantor, which consent may be withheld by Grantor in its sole and absolute discretion.

16. **Counterparts and Facsimile Signatures.** This Agreement may be executed in any number of counterparts, each of which shall be an original, but all of which together shall constitute but one instrument. Duplicate, unexecuted counterpart pages may be discarded and the remaining pages assembled as one document. Signatures transmitted and received by facsimile on this Agreement shall be binding and effective for all purposes.

17. **Governing Law not defined.** This Agreement shall be governed under Hawaii law, and be binding on and inure to the benefit of the successors and permitted assignees of the respective parties.

18. **No Party Deemed Drafter.** Grantor and Grantee agree that neither party shall be deemed to be the drafter of this Agreement and that, in the event this Agreement is ever construed by a court of law, such court shall not construe this Agreement or any provision hereof against either party as the drafter.

19. **Entire Agreement** This Agreement constitutes the entire agreement between the parties, and supersedes all understandings, offers, negotiations and other agreements concerning the subject matter contained herein. There are no representations or understandings of any kind not set forth herein. Any amendments, modifications or waivers of any of the terms and conditions of this Agreement must be in writing and executed by both parties.

IN WITNESS WHEREOF, the parties hereto have entered into this Agreement as of the date first above written.

ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC

By: _____

Their Authorized Signatory

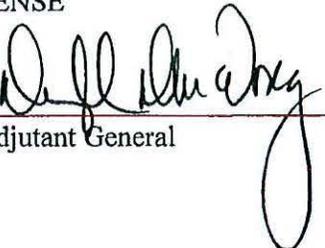
ATC Makena Services LLC

By: _____

Its Authorized Signatory

“GRANTOR”

STATE OF HAWAII, DEPARTMENT OF
DEFENSE

By: 
Adjutant General

STATE OF HAWAII, DEPARTMENT OF
ACCOUNTING AND GENERAL SERVICES

By: 
State Comptroller

"GRANTEE"

APPROVED AS TO FORM
AND LEGALITY:

By: 
State Deputy Attorney General

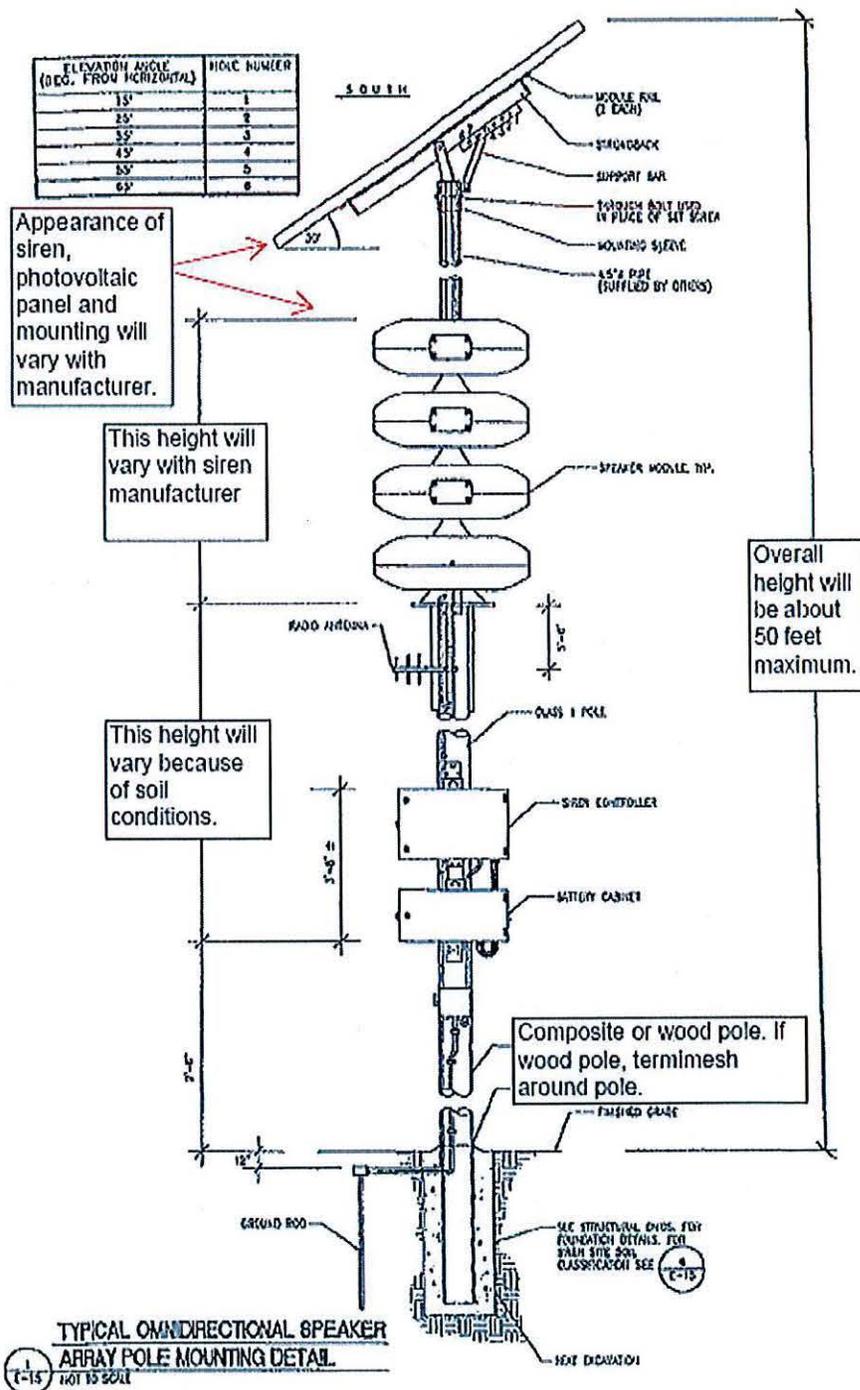
EXHIBIT B
THE NEW SIREN SITE



Photo has no scale.

EXHIBIT C

THE NEW SIREN



CONSENT AND JOINDER

The undersigned, Wells Fargo Bank, N. A., as Trustee for the Registered Holders of UBS Commercial Mortgage Securities Trust 2007-FL1, Commercial Mortgage Pass-Through Certificates, Series 2007-FL1 ("Lender") by and through CW Capital Asset Management, LLC, a Massachusetts limited liability company, solely in its capacity as Special Servicer, hereby consents to and joins in the execution of the foregoing grant of Right-Of-Entry And Non-Exclusive License Agreement dated as of March 16, 2012, by and between ATC Makena N Golf LLC, ATC Makena S Golf LLC, ATC Makena Land SF1 LLC, ATC Makena Land MF1 LLC, ATC Makena Land MF2 LLC, ATC Makena Land MF3 LLC, ATC Makena Land C1 LLC, ATC Makena Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, and ATC Makena Land AH1 LLC, all of which are Delaware limited liability companies, as fee owners, and ATC Makena Services LLC, a Delaware limited liability company, as lessee, and the State of Hawaii, Department of Defense (DOD) and Department of Accounting and General Services (DAGS) (the "Agreement"), by virtue of Lender's rights and interests set forth in that certain Mortgage and Security Agreement dated as of August 27, 2010, recorded in the Bureau of Conveyances of the State of Hawaii as Document Nos. 3993962 and 2010-125630 (the "Mortgage"), and agrees to the granting of the aforesaid Agreement. Notwithstanding the foregoing, Lender does not waive any of its rights under the Mortgage, including the right to review and approve any request pertaining to any amendment to the Agreement.

Executed this 16 day of March, 2012.

Wells Fargo Bank, N. A., as Trustee for the
Registered Holders of UBS Commercial
Mortgage Securities Trust 2007-FL1,
Commercial Mortgage Pass-Through
Certificates, Series 2007-FL1

By: CW Capital Asset Management, LLC,
a Massachusetts limited liability company,
Solely in its capacity as Special Servicer

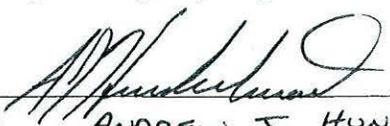
By: 
Name: ANDREW S. HUNDERTMARK
Title: MANAGING DIRECTOR

Exhibit B-1

STANFORD CARR DEVELOPMENT, LLC

January 3, 2013

Mr. Watson Okubo
State of Hawaii, Department of Health
Clean Water Branch
919 Ala Moana Blvd. Room 301
Honolulu, HI 96814

Via PDF only unless hardcopy is requested.

Re: State Land Use District Boundary Amendment Docket A9-721 Condition No. 10,
County of Maui Zoning Ordinance 3613 Condition No. 19, Marine Water Quality
Monitoring.

Dear Mr. Okubo

ATC Makena Holdings, LLC, in compliance with the above referenced conditions, respectfully submits the enclosed Marine Water Quality Monitoring Report prepared by Marine Research Consultants, Inc. dated December, 2012, for tests performed in April, 2012.

Should you have any questions, require a hardcopy, or require additional information please do not hesitate to contact me at (808) 547-2276, or by e-mail at sarah@stanfordcarr.com.

Sincerely,

STANFORD CARR DEVELOPMENT, LLC
For ATC MAKENA HOLDINGS, LLC



Sarah Agnew-Miller
Project Management/Planning

MARINE WATER QUALITY MONITORING
MAKENA RESORT, MAKENA, MAUI
WATER CHEMISTRY
REPORT 1-2012
(April 2012)

Prepared for

ATC Makena Holdings, LLC
c/o Stanford Carr Development, LLC
1100 Alakea St. 27th Floor
Honolulu, HI 96813

By

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, Hawaii 96822

Submitted

December 2012

EXECUTIVE SUMMARY

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments. In the interest of assuring maintenance of the highest possible quality of the marine environment, condition No. 10 of the Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulates the implementation of an ongoing marine monitoring program off the Makena Resort Development. Additionally, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the program are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question that is addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure? The following report fulfills the requirements of these Conditions, and presents the results of water quality monitoring off the Makena Resort conducted on April 22, 2012. The report also incorporates the cumulative data from twenty-six past water chemistry surveys conducted in the area.

Survey methodology includes collection of 62 ocean water samples on four transects spaced along the projects ocean frontage and on one control transect. Site 1 is located at the northern boundary of the project, Site 2 is located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) is located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 is located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Water samples were collected at 7 stations spaced along transects that extended from the shoreline out to the open coastal ocean (about 500 feet). At sampling stations where water depth exceeded about 3 feet, samples were collected at the surface and just above the sea floor. Water samples were analyzed for chemical criteria specified by DOH water quality standards for open coastal waters, as well as several additional criteria. In addition, water samples were collected from nine irrigation wells located on the golf courses.

Results of analysis of water chemistry showed that constituents that occur in high concentration in groundwater (silica, nitrate-nitrogen) were found to be highest in ocean samples collected nearest to the shoreline, with progressively decreasing values moving away from shore into deeper water. While groundwater nutrient input was evident at all four sampling locations, it was highest in magnitude at Site 3A, located directly downslope from the Makena Resort. As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort land usage.

Vertical stratification of the water column was evident on transects with surface water generally having higher nutrient concentrations and lower salinities than samples from near the sea floor.

The observed patterns of distribution with respect to both distance from shore and depth in the water column indicate that physical mixing processes generated by tide, wind, waves and currents mix the water column from top to bottom.

Overall, measurements of turbidity and chlorophyll *a* were low throughout the sampling area, although values were slightly elevated close to the shoreline probably as a result of resuspension of fine-grained marine sediments (turbidity) and fragments of benthic algae washed up to the shoreline (Chl *a*). These results indicate that at the time of sampling, nutrient input from land was not resulting in increases in plankton populations in nearshore waters. Low turbidity in Makena Bay (transect Site 2) suggests mitigation of the effects of a past episode of high runoff of upland soil from a flash flood in October 1999 that resulted in substantial impacts to water clarity within the Bay.

Other organic water chemistry constituents that do not occur in high concentrations in groundwater, such as ammonium nitrogen or organic nitrogen and phosphorus, were consistently low and did not show any distinctive patterns with respect to input from land.

Analyses that scale nutrient concentrations to salinity reveal that there were measurable increases of nitrate nitrogen above what is found in naturally occurring groundwater that enters the nearshore ocean at three survey sites (Sites 1, 3 and 3A). These subsidies, which are likely a result of land uses involving fertilizers, substantially increase the concentration of nitrate over natural groundwater flowing to the ocean. These subsidies were greatest in magnitude at Sites 3 and 3A, followed by Site 1, all of which are located off the Makena Golf Course and adjacent residential areas. No subsidies of nitrate were apparent at Site 2 (Makena Landing) or Site 4 (Ahihi-Kina`u). The lack of distinguishable upward curvature of these data arrays indicates that the nutrients from groundwater that enter the ocean, both from natural and the human sources, are not being taken up by biotic communities in the nearshore zone. Rather, nutrients are mixed to background ocean values by physical processes including wind stirring and wave action.

Statistical tests of nutrient concentration scaled to salinity over time show no significant increases or decreases over the years of monitoring at any of the survey sites. The lack of such increases suggests that there has been no consistent change in nutrient input from land (either as an increase or decrease) to groundwater that enters the ocean over the past years.

Comparing values of water chemistry measured in the monitoring program to State of Hawaii Department of Health (DOH) water quality standards revealed that several measurements of nitrogen, phosphorus, turbidity and Chlorophyll *a* exceeded the DOH standards, particularly for "geometric mean" standards. Such exceedances occurred at all survey sites, including the control site that was removed from influences of the Makena Resort. The consistent exceedance of water quality standards is in large part a consequence of the natural effects of groundwater discharge to the nearshore ocean, as well as physical mixing processes that occur near the shorelines of all coastal areas. Revision of DOH standards to account for such natural input has been implemented for the West Coast of the Island of Hawaii, and will hopefully be extended to the rest of the State in the near future.

As in all past surveys, the results of the most recent increment of monitoring reveal that there is an increase over natural conditions of dissolved inorganic nutrients (e.g., nitrate and sometimes to a lesser extent phosphate) in groundwater that enters the nearshore ocean at sampling sites

downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased significantly over time during the 17-year course of the monitoring program. The regions where the highest elevations over natural inputs occur are restricted to narrow zone that extends from the shoreline to several meters offshore, and as such is restricted to an area that is not suitable for coral communities to occur owing to shallow water depth, wave impact and sand scour. Surveys of coral reef community structure that are also part of the ongoing monitoring program for the Makena Resort, as well as the continued lack of any nuisance algal accumulations in the nearshore area, indicate that the nutrient subsidies are presently not detrimental to marine community structure.

The next scheduled testing for the Makena Resort monitoring program is planned for the fall-winter season of 2012.

I. PURPOSE

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments.

Evaluations of other golf courses and other forms of resort development located near the ocean in the Hawaiian Islands reveal that there is detectable input to the coastal ocean of materials used for fertilization of turfgrass and landscaping (Dollar and Atkinson 1992). However, few, if any, effects that have been documented have been found to be detrimental to the marine ecosystem. Confirmation that the construction and responsible operation of the golf courses and other components of the Makena Resort does not cause any harmful changes to the marine environment requires rigorous and continual monitoring.

In the interest of assuring maintenance of excellent environmental quality in the Makena region, Condition No. 10, Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulated the implementation of an ongoing marine monitoring program off the Makena Resort Development. In addition, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the established monitoring program to satisfy these two requirements are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure?

The rationale of the monitoring program is to conduct repetitive evaluations of water chemistry at the same locations at regular time intervals (twice per year). This strategy allows for determination of variations in effects from the Makena Resort in both space (at different locations along the shoreline) and time. It should be noted that water chemistry monitoring off the Makena area was initiated in 1995 on a voluntary basis, and has continued uninterrupted until the present. With the implementation of the Boundary Amendment and Zoning Conditions, it was determined that the ongoing voluntary monitoring protocol satisfied the stated requirements. Hence, the entire data set from 1995 onward is considered as part of the monitoring program. The following report presents the results of the twenty-seventh increment in the monitoring program, and contains data from water chemistry sampling conducted on April 22, 2012.

II. ANALYTICAL METHODS

Three survey sites directly downslope from the Makena Resort have been selected as sampling locations. A fourth site, located offshore of an area with minimal land-based development,

particularly golf course operations, was selected as a control. During the June 2007 survey, another sampling location was added near the southern boundary of Maluaka Bay. It is anticipated that this station will remain part of the sampling protocol permanently. Figure 1 is a map showing the shoreline and topographical features of the Makena area, and the location of the North and South Golf Courses. All survey sites are depicted as transects perpendicular to the shoreline extending from the shoreline out to what is considered open coastal ocean (i.e., beyond the effects of activities on land). Survey Site 1 is located near the northern boundary of the project site off Nahuna Point; Survey Site 2 bisects Makena Bay near Makena Landing. Site 3 bisects the middle of the South course on the north side of Maluaka Point. Site 3A is on the southern corner of Maluaka Bay. Site 4, which is considered the Control site, is located near the northern boundary of the 'Ahihi-Kina`u natural area reserve north of the 1790 lava flow and approximately 1-2 miles south of the existing Makena Golf courses (Figure 1). The control site was located off a shoreline area with minimal land uses (i.e., residences near the shoreline and upslope ranchlands) rather than off the completely uninhabited 1790 lava flow. This location was selected as the most appropriate control site, as it is the farthest location from the Makena Resort with the same geophysical structural of the land area. The completely different geological structure of the lava flow off the natural reserve likely results in very different groundwater dynamics compared to the land area where the Makena Resort is located, hence making the lava flow an unsuitable control site.

In July of 2002, Site 3 was relocated from a location at the southern boundary of the project offshore of Oneloa Beach to the location directly off the Makena Golf Course, as described above. The relocation of Site 3 was deemed necessary as the original location consistently showed virtually no input of groundwater to the ocean. Such lack of groundwater discharge resulted in little potential for evaluating effects from the project. The new location of Site 3 is directly downslope from both the portion of the golf course nearest to the ocean, several newly constructed private residences, and a 3-acre recently restored wetland area. As a result, the new location represents an area that reflects the maximum influence on nearshore water quality from a variety of land uses and natural habitat.

All fieldwork for the present survey was conducted on April 22, 2012. Environmental conditions during sample collection consisted of mild winds (0-5 knots), sunny skies, and very little swell. Sample collection at the shoreline occurred during a falling tide with a tidal range of 1.0 to +0.7 feet.

Water samples were collected at stations along transects that extend from the highest wash of waves to between 150-200 meters (m) offshore (about 500-650 feet), depending on the site. Such a sampling scheme is designed to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone because this area is most likely to show the effects of land-based activities. With the exception of the two stations closest to the shoreline (0 and 2 m offshore), samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) (~4 inches) of the sea surface, and a bottom sample was collected within one m (3 feet) of the sea floor.

Water samples from the shoreline to a distance of 10 m offshore were collected in triple-rinsed 1-liter polyethylene bottles by swimmers working from the shoreline. A digital refractometer was used to pinpoint the location of maximum groundwater flux to the ocean shoreline origin of each

transect site. Water samples beyond 10 m from the shoreline were collected from a small boat using a 1.8-liter Niskin sampling bottle. This bottle was lowered to the desired depth in an open position where spring-loaded endcaps were triggered to close by a messenger released from the surface. Upon recovery, each sample was placed on ice until further processing in Honolulu. Water samples were also collected from nine golf course irrigation wells (No's 1, 2, 3, 4, 5, 6, 8, 10 and 11) on May 10, 2012.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii Department of Health Water Quality Standards. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen [nitrate + nitrite nitrogen ($\text{NO}_3^- + \text{NO}_2^-$), ammonium (NH_4^+)], plus total organic nitrogen (TON), total phosphorus (TP) which is defined as inorganic phosphorus (PO_4^{3-}) plus total organic phosphorus, chlorophyll *a* (Chl *a*), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{3-}) and silica (Si) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for $\text{NO}_3^- + \text{NO}_2^-$ (hereafter termed NO_3^-), NH_4^+ and PO_4^{3-} , were performed on filtered samples using a SEAL Analytical AA3 autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion on unfiltered samples following digestion. Total organic nitrogen (TON) and Total organic phosphorus (TOP) were calculated as the difference between TN and inorganic N, and TP and inorganic P, respectively. Limits of detection for the dissolved nutrients are $0.01 \mu\text{M}$ ($0.14 \mu\text{g/L}$) for NO_3^- and NH_4^+ , $0.01 \mu\text{M}$ ($0.31 \mu\text{g/L}$) for PO_4^{3-} , $0.1 \mu\text{M}$ ($1.4 \mu\text{g/L}$) for TN and $0.1 \mu\text{M}$ ($3.1 \mu\text{g/L}$) for TP.

Chl *a* was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5°C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection $0.01 \mu\text{g/L}$). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.003‰.

In situ field measurements included water temperature, pH, dissolved oxygen and salinity which were acquired using an RBR Model XR-420 CTD calibrated to factory specifications. The CTD has a readability of 0.001°C , 0.001 pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity. Shoreline salinity was measured in the field using an Atago PAL-06S digital refractometer.

Nutrient, Chl *a* and salinity analyses were conducted by Schar Analytical Specialists located in Honolulu, Hawaii.

III. RESULTS and DISCUSSION

A. General Overview

Table 1 shows results of all marine water chemical analyses for samples collected off Makena on April 22, 2012 with nutrient concentrations reported in micromolar units (μM). Table 2 shows similar results with nutrient concentrations presented in units of micrograms per liter ($\mu\text{g/L}$). Tables 3 and 4 show geometric means of ocean samples at Sites 1, 2 and 4 for 27 surveys, 18 surveys at Site 3, and 9 surveys from Site 3A, with nutrient concentrations shown in μM and $\mu\text{g/L}$, respectively. Table 5 shows water chemistry measurements (in units of μM and $\mu\text{g/L}$) for samples collected from irrigation located on the Makena Resort Golf Courses. Concentrations of twelve chemical constituents in surface and deep-water samples from the April 2012 sampling are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (\pm standard error) of twelve chemical constituents in surface and deep water samples as functions of distance from the shoreline at Sites 1-4 collected since 1995 and from Site 3A collected since 2007 are plotted in Figures 4-18. In addition, data from the most recent sampling in April 2012 are also plotted on Figures 4-18.

During the April 2012 sampling, nearshore concentrations of dissolved Si, NO_3^- and TN on all five transects were elevated up to four orders of magnitude compared to samples collected in the open coastal ocean farthest from shore (Figure 2, Tables 1 and 2). The horizontal gradients of nutrients were steepest on transects 1 and 3A where NO_3^- at the shoreline (103 μM and 187 μM , respectively) was up to about 1,000-fold higher than the surface samples collected at the seaward end of the transects. On transects 2, 3, and 4, peak values of NO_3^- at the shoreline (7, 26 and 50 μM , respectively) were up to 100-fold higher than the concentrations in some of the surface samples collected at the seaward ends of the transects (Figure 2, Table 1).

Salinity displayed mirror images of the horizontal gradients of Si and NO_3^- , with lowest salinities at the shoreline and rapidly increasing values with increasing distance from shore to near oceanic values (35‰) at the seaward ends of all transects (Figure 3, Table 1). The lowest salinities were measured at the shoreline of Sites 1 and 3A with values of 21.7‰ and 17.2‰, respectively. Distinct horizontal gradients of salinity extended to a distance of 50-100 m from the shoreline on transects 1, 3A and 4 (Tables 1 and 2).

Surface concentrations of phosphate phosphorus (PO_4^{3-}) and TP were highest near the shoreline at transect Site 3A (2.16 and 2.17 μM , respectively) while at the other sites maximum concentrations of PO_4^{3-} and TP was 0.77 and 0.99 μM , respectively (Table 1, Figure 2). Strong horizontal gradients were not evident for PO_4^{3-} or TP on transect 2 during the April 2012 survey.

With no streams in the sampling area, nor heavy rainfall and subsequent surface runoff preceding sampling, the pattern of elevated Si, NO_3^- , PO_4^{3-} and TN with corresponding reduced salinity indicates groundwater entering the ocean near the shoreline. Low salinity groundwater, which contains high concentrations of Si, NO_3^- , TN and PO_4^{3-} (see values for well waters in Table 5), percolates to the ocean near the shoreline, resulting in a distinct zone of mixing in the nearshore region. The zone of mixing is discernible by distinct decreasing gradients of nutrients and increasing gradients of salinity with distance from shoreline (Figures 2 and 3). During periods of

low tide when sea conditions are calm, the zone of mixing between groundwater and ocean water is most pronounced. The April 2012 sampling was conducted near low tide (~0.6 ft) with light winds and a slight surface swell, resulting in a zone of mixing extending up to 50 m from the shoreline. Past monitoring surveys at Makena Resort conducted during periods of high tide and strong winds (e.g. December 2005) showed substantially smaller horizontal gradients than the present survey. Comparing the results of surveys conducted during different sea conditions clearly indicates that tidal state, as well as wind and wave energy, greatly effect groundwater mixing in the nearshore zone.

Dissolved nutrient constituents that are not usually associated with groundwater input (NH_4^+ , TON, TOP) did not exhibit distinct horizontal gradients across the sampling transects (Table 1, Figure 2). With the exception of a few shoreline samples, NH_4^+ , TON and TOP were relatively constant along all transect, and were of the same magnitude among the four transect sites (Table 1, Figure 2).

Turbidity was highest near the shoreline on all transects with distinctly higher concentrations at transect 3 and 4 (Tables 1 and 2, Figure 3). In previous surveys, turbidity has generally been highest on Transect 2 compared to the other sites. However, this was not the case in the present survey, nor was it the case in the previous three surveys (July 2010, March and October 2011). Transect 2 bisects Makena Bay, which is semi-enclosed embayment with a silt/sand bottom rather than the predominantly "hard" reef or sand bottoms that occur at the other transect sites. In addition, it has been observed that during flash floods originating in the ranch lands upslope of the Makena Resort, terrigenous sediment may flow to the ocean in Makena Bay. As a result of wave-induced resuspension of the naturally occurring silt/sand substratum, as well as terrigenous runoff which may be partially retained within the embayment, turbidity has often been elevated on transect 2 relative to the other transect sites. It is important to note that in surveys conducted since July 2002, water clarity in Makena Bay has improved greatly compared to preceding surveys in 2001 which reflected conditions following substantial input of terrigenous materials from a flash-flood that occurred in October 1999. Since that time, a large retention basin has been constructed on the upper slopes of Makena Resort in the watershed that flows into Makena Bay.

In April 2012 concentrations of Chl *a* were higher near the shoreline compared to offshore values at all five survey sites. Values of Chl *a* were of the same magnitude at all five survey sites (Table 1 and Figure 3). Surface water temperature ranged between 23.2°C and 27.6°C among the five sites during the April 2012 survey (Figure 3 and Tables 1 and 2).

In many areas of the Hawaiian Islands, input of low salinity groundwater to the nearshore ocean creates a distinct buoyant surface lens that can persist for some distance offshore. Buoyant surface layers are generally found in areas where turbulent processes (primarily wave action) are insufficient to completely mix the water column in the nearshore zone. Figures 2 -18 and Tables 1 and 2 show concentrations of water chemistry constituents with respect to vertical stratification. During the April 2012 survey, vertical stratification was evident for nutrients and salinity on most of the transects with lower concentrations of nutrients and higher salinity in the deep water. A notable exception was with NH_4^+ on transect 1 where the NH_4^+ concentration in the deep water was markedly higher than the surface waters (Figure 4).

B. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (\pm standard error) of water chemistry constituents from surface and deep samples at Transect Sites 1-4 from monitoring surveys conducted since 1995 and from Site 3A for monitoring surveys conducted since 2007. In addition, the results of the most recent survey in April 2012 are also shown on each plot.

Surface concentrations of Si, NO_3^- , TN and PO_4^{3-} at sampling sites within 50 m of the shoreline at Stations 1 and 4 were generally higher than mean values during the April 2012 survey. At these stations, salinity was correspondingly lower than mean values (Figures 4, 7, 10, 13,16). At stations 1, 3 and 3A, most of the gradients of nutrients fell within the range of the mean values of all previous surveys. Turbidity at stations near the shoreline showed a trend of increased values near the shoreline relative to mean values on transect 3A, 3 and 4 (Figures 12, 15 and 18). Measurements of Chl *a* during April 2012 were substantially lower than the mean values on four of the five transects. All of these variations between the values measured in the most recent survey, and the overall survey means are likely a result of sampling during a period of relatively high mixing of groundwater and ocean water in the nearshore zone owing to wind and wave action. None of the comparisons of the most recent sampling results to the mean values calculated for the entire monitoring regime indicates any recent negative effects to nearshore water quality.

C. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993).

Figure 19 shows plots of concentrations of four chemical constituents (Si, NO_3^- , PO_4^{3-} , and NH_4^+) as functions of salinity for samples collected in April 2012. Figures 20 and 21 show the same type of plot with data pooled by transect site for a composite of all past surveys, as well as for the most recent survey. Each graph also shows a conservative mixing line that is constructed by connecting the end member concentrations of open ocean water with irrigation well No. 4 located off the North Course of the Makena Resort (representative of groundwater upslope of the Makena Resort).

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 19 that when

concentrations of Si are plotted as functions of salinity, most of the data points from Sites 1 and 3A fall in a linear array above the conservative mixing line. Data points for Sites 2 and 3 fall near the conservative mixing line, while data points for control Site 4 lie well below the mixing line (Figure 19). While there is substantial variability between the linear arrays from different sampling areas, the linearity of the data points indicates that marine waters at the five transect sites are primarily a mixture of groundwater flowing beneath the project and ocean water. These results indicate that the groundwater from upslope Well No. 4 provides a valid representation of groundwater that enters the ocean following flow through the Makena development. Over the course of monitoring since 1995, the relationship between salinity and Si has remained nearly constant (Figure 20).

NO_3^- is the form of nitrogen most common in fertilizer mixes that are used for enhancing turf growth. When the concentrations of NO_3^- are plotted as functions of salinity, data from each transect prescribe distinctly different patterns (Figure 19). Data points from Transects 2 (Makena Bay) and 4 (Control transect) lie close to the conservative mixing line. The location of these data arrays indicates that the source of NO_3^- entering the ocean at these sites contains little or no subsidies from activities on land. Inspection of the long-term mixing data (Figure 20) indicates that with the exception of two data points, all of the values of NO_3^- from Control Site 4 fall on, or very near, the conservative mixing line. Such a result validates that Site 4 is indeed a good “control” area that is not greatly affected by activities on land.

Conversely, data points from the nearshore samples at Transects 1, 3, and 3A all fall well above the conservative mixing line, indicating various subsidies of NO_3^- to the ocean from sources on land (Figure 19). Data points for Sites 3 and 3A are similar in slope, and are substantially steeper than data points from Site 1 (Figure 19). Such relationships indicate subsidies of NO_3^- at transect Sites 1, 3 and 3A that are likely a result of leaching of golf course fertilizers to the groundwater lens. In addition to the golf courses, however, residences near the shoreline at Site 1 include landscaping and lawns, while residences and a wetland lie directly inshore from Site 3. Sites 3 and 3A lies directly offshore of the golf course and a residential community clubhouse that is currently under construction.

Transect Site 1 has also been used as a monitoring station for a similar evaluation of the effects of the Wailea Golf Courses on water chemistry that commenced in 1989. The lowest concentrations of NO_3^- relative to salinity at Transect site 1 occurred during the initial two years of study, with subsequent higher concentrations increasing since 1992. Hence, there appears to have been an increase of NO_3^- in nearshore waters since 1992 that was not occurring in 1989-1991. Completion of the Wailea Gold Course occurred in December 1993, while completion of the Makena North Course occurred in November 1993. As the southern region of the Wailea Course and the northern part of the Makena Course abut each other in the makai-mauka direction landward of ocean Transect 1, the increased concentrations of NO_3^- evident in Figure 19 may be a result of leaching of fertilizer materials from the combined golf courses to groundwater that enters the ocean in the sampling area.

Mixing analyses also indicate an ongoing input of NO_3^- at the shoreline of Stations 3 and 3A located off the existing Makena Golf Course and several new residences that have been constructed adjacent to the Golf Course (Figures 19 and 20). Such subsidies have been noted in past surveys, as can be seen in Figure 20. When the slopes of the data points for the April 2012

survey (red symbols) are compared to the slopes of combined sets of data points from past surveys (black and green symbols) subsidies of NO_3^- have not increased during the most recent survey (Figure 20). Future monitoring will clarify if the trend of NO_3^- input to the ocean is indeed decreasing

While the data reveal a long-term subsidy to the concentration of NO_3^- in groundwater and the nearshore zone at several of the sampling sites, the concentrations of NO_3^- fall in clearly linear relationship as functions of salinity. The linearity of the data array indicates that there is little or no detectable uptake of this material by the marine environment. Such lack of uptake indicates that the nutrients are not being removed from the water column by metabolic reactions that could change the composition of the marine environment. Rather, the nutrient subsidies are diluted to background oceanic levels by physical processes of wind and wave mixing. As a result, the increased nutrients do not appear to have the potential to cause alteration in biological community composition or function.

Similar situations have also been observed in other locales in the Hawaiian islands where nutrient subsidies from golf course leaching result in excess NO_3^- in the nearshore zone. At Keauhou Bay on the Big Island, it was shown that owing to the distinct vertical stratification in the nearshore zone, the excess nutrients never come into contact with benthic communities, thereby limiting the potential for increased uptake by benthic algae. In addition, the residence time of the high nutrient water was short enough within the embayment to preclude phytoplankton blooms. As a result, while NO_3^- concentrations doubled as a result of golf course leaching for a period of at least several years, there was no detectable negative effect to the marine environment (Dollar and Atkinson 1992). Owing to the unrestricted nature of circulation and mixing off the Makena project (no confined embayments) it is reasonable to assume that the excess NO_3^- subsidies that are apparent in the present study will not result in alteration to biological communities.

Indeed, surveys of the nearshore marine habitats off of Makena reveal a generally healthy coral reef that does not appear to exhibit any negative effects from nutrient loading, particularly in the form of abundant algal biomass (Marine Research Consultants 2006). In addition to the lack of negative impacts to offshore coral communities, inspection of the entire shoreline fronting the Makena Resort revealed that there are no areas where excessive algal growth is presently occurring.

The other form of dissolved inorganic nitrogen, NH_4^+ , does not show a linear pattern of distribution with respect to salinity for either the April 2012 survey (Figure 19) or the entire monitoring program (Figure 21). The lack of a correlation between salinity and concentration of NH_4^+ suggests that this form of nitrogen is not present in the marine environment as a result of mixing from groundwater sources. Rather, NH_4^+ is generated by natural biotic activity in the ocean waters off Makena.

PO_4^{3-} is also a major component of fertilizer, but is usually not found to leach to groundwater to the extent of NO_3^- , owing to a high absorptive affinity of phosphorus in soils. With the exception of data points from transect site 3A, all data points from April 2012 fell close to the mixing line. This result indicates that with the exception of site 3A the source of PO_4^{3-} to the ocean is from naturally occurring groundwater. At site 3A, the elevated PO_4^{3-} is likely a result of golf course and residential landscaping, reflecting similar subsidies of NO_3^- .

D. Time Course Mixing Analyses

While it is possible to evaluate temporal changes from repetitive surveys conducted over time in terms of concentrations of water chemistry constituents (See Section C), a more informative and accurate method of evaluating changes over time is to utilize the results of scaling nutrient concentrations to salinity. As discussed above, the simple hydrographic mixing model consisting of plotting concentrations of nutrient constituents versus salinity eliminates the ambiguity associated with comparing only the concentrations of samples collected during multiple samplings at different stages of tide and weather conditions. Figures 22 and 23 show plots of Si and NO_3^- , respectively, as functions of salinity collected during each year of sampling since 1995. Also shown in Figures 22 and 23 are straight lines that represent the least squares linear regression fitted through concentrations of Si and NO_3^- as functions of salinity at each monitoring site for each year. Tables 6-8 show the numerical values of the Y-intercepts, slopes, and respective upper and lower 95% confidence limits of linear regressions fitted through the data points for Si, NO_3^- , and PO_4^{3-} as functions of salinity for each year of monitoring.

The magnitude of the contribution of nutrients originating from land based activities to groundwater will be reflected in both the steepness of the slope and the magnitude of the Y-intercept of the regression line fitted through the concentrations scaled to salinity (the Y-intercept can be interpreted as the concentration that would occur at a salinity of zero if the distribution of data points is linear). This relationship is valid because with increasing contributions from land, nutrient concentrations in any given parcel of water would increase with no corresponding change in salinity. Hence, if the contribution from land to groundwater nutrient composition is increasing over time, there would be progressive increases in the absolute value of the slopes, as well as the Y-intercepts of the regression lines fitted through each set of annual nutrient concentrations when plotted as functions of salinity. Conversely, if the contributions to groundwater from land are decreasing, there will be decreases in the absolute values of the slopes and Y-intercepts.

Plots of the values of the slopes (Figure 24) and Y-intercepts (Figure 25) of regression lines fitted through concentrations of Si, NO_3^- and PO_4^{3-} scaled to salinity during each survey year provide an indication of the changes that have been occurring over time in the nearshore ocean off the Makena Resort. As stated above, Si provides the best case for evaluating the effectiveness of the method, as Si is present in high concentration in groundwater but is not a component of fertilizers. NO_3^- and PO_4^{3-} are the forms of nitrogen and phosphorus that are found in high concentrations in groundwater relative to ocean water, and are the major nutrient constituents found in fertilizers.

Examination of Figures 24 and 25, as well as Tables 6-8 reveal that none of the slopes or Y-intercepts of Si, NO_3^- and PO_4^{3-} at any of the transect sites exhibit any indication of progressively increasing or decreasing values over the course of monitoring. The term "REGSLOPE" in Tables 6-8 denotes the values of the slopes and 95% confidence limits of linear regressions of the values of the yearly slopes and Y-intercepts as a function of time. For all sites, the span of the upper and lower 95% confidence limits of the REGSLOPE coefficients are not significantly different than zero, indicating that there is no statistically significant increase or decrease in the salinity-scaled concentrations of Si, NO_3^- and PO_4^{3-} over the course of the monitoring program (Tables 6-8).

For all three nutrients, there is little variation in either slopes or Y-intercepts during any single year at Site 1, located off the "5 Graves" area downslope from the juncture of the Wailea and Makena

Resorts (Figures 24 and 25). Such lack of variation indicates relatively consistent concentrations of Si, NO_3^- and PO_4^{3-} in groundwater entering the ocean over the seventeen years of monitoring. Sites 2 (Makena Landing) and 4 ('Ahihi-Kina`u) also show relatively constant trends with time with the exception of 2001 which is marked by large spikes in Si and PO_4^{3-} . Such a fluctuation is not present for NO_3^- in 2001. Sampling in 2001 was conducted during a period of rough winter sea conditions marked by vigorous mixing of the water column. As a result, there was very weak linear relationship between nutrient concentrations and salinity.

At Site 3, located directly downslope for the point of the Makena Golf Course closest to the ocean, there is a trend of decreasing NO_3^- between 2002 and 2004, an increasing trend from 2004 to 2007, followed by another downturn in 2007 – 2009 (Figures 24 and 25). As a result of these reversing trends, there is no significant change over the seven-year period of monitoring. The multiple reversing trends may reflect changes in land use, such as variation in fertilizer application or construction-related activities in 2002-2004 versus 2004-2007. In June of 2008, the golf course fronting the ocean in this area was shut down for re-alignment and re-planting. Underground retention/filtration systems were also constructed to mitigate adverse affects of stormwater runoff. At the time of the April 2012 survey, new turf grass had been applied but the course remained closed and the filtration systems were not yet operational.

E. Compliance with DOH Standards

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. These criteria are applied depending upon whether the area is likely to receive less than (dry) or greater than (wet) 3 million gallons of groundwater and/or surface water input per mile per day. As it is not possible to accurately estimate groundwater and surface water discharge, both wet and dry standards are considered. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. With only one or two samplings collected per year since 1995, comparison of the 10% or 2% of the time criteria for any sample is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 show instances where measurements exceed the DOH standards under dry conditions, while boxed and shaded values show instances where measurements exceed DOH standards under wet conditions.

Results from the April 2012 survey indicated numerous measurements of NO_3^- , NH_4^+ , and TN along all five transect sites exceeded the 10% DOH criteria under wet or dry conditions (Tables 1 and 2). Several measurements of turbidity exceeded the DOH standards under "dry" conditions while only three measurements of TP and no measurements of Chl α exceeded the 10% DOH criteria under dry conditions. It is of interest to note that at Transect Site 4, which is considered the control station beyond the influence of the Makena Resort, exceedance of DOH criteria occurred for NO_3^- , TN and turbidity.

Tables 3 and 4 show geometric means of samples collected at the same locations during the 27 increments of the monitoring program at Sites 1, 2 and 4. Geometric means of samples collected over 18 increments of sampling at Site 3 and nine increments of sampling at Site 3A are also shown. These tables also specify the samples that exceed the DOH geometric mean limits for open coastal waters under "dry" (boxed) and "wet" (boxed and shaded) conditions. For NO_3^- , NH_4^+ , and TN numerous dry and wet standards were exceeded on all transects. Eight samples of TP and 22 samples of turbidity exceeded standards. All but six samples exceed the geometric mean standards for Chl *a*.

Site 4 is considered a control transect, in that it is not located offshore of a resort, golf course or dense residential development. It can be seen in Tables 3 and 4, however, that the number of samples that exceed geometric mean criteria at Site 4 are comparable to the other four sites, all of which are located downslope from the Makena Resort. Hence, Resort activities, including golf courses cannot be attributed as the sole (or even major) factor causing water quality to exceed geometric mean standards.

Several comments can be made regarding the present DOH water quality standards and how they apply to the monitoring program at the Makena Resort. As noted above, the category of water quality standards that are applicable for the Makena Monitoring program are "Open Coastal Waters." As the name implies, these standards apply to "open" waters that can be reasonably defined as "waters beyond the direct influence of land." In order to evaluate the effects of land uses on the nearshore ocean off Makena, the selected sampling regime collects water within a zone that extends from the shoreline to the open coastal ocean. As a result, sampling takes place within the region of ocean that is directly influenced by land. If the monitoring protocol were changed to include only those sampling locations beyond 50-100 m from shore (i.e., open coastal waters), which is completely valid with respect to meeting DOH regulatory compliance, virtually none of the factors discussed above relating to the effects of activities on land to the nearshore ocean would not be observed.

Initial steps have been taken by DOH to rectify this situation. During revision of the Department of Health water quality standards in 2004, a unique set of monitoring criteria was added for the West Coast of the Island of Hawaii (i.e., "Kona standards"). The rationale for these unique standards was the recognition that existing numerical "standards" represent offshore coastal waters that are beyond the natural confluence of land and the nearshore ocean. As a result, the West Hawaii standards recognize that groundwater entering the ocean at the shoreline contains substantially elevated nutrients relative to open coastal waters. As a result, the Kona criteria provide the potential to meet water quality standards with elevated nutrient concentrations resulting from natural sources of groundwater input. As the same processes of groundwater discharge to the coastal ocean have been documented in Maui, it is hopeful that similar new provisions of the water quality standards will soon be applicable to the South Maui area.

IV. SUMMARY

- The twenty-seventh phase of water chemistry monitoring of the nearshore ocean off the Makena Resort was carried out on April 22, 2012. Sixty-two ocean water samples were collected on four transects spaced along the project ocean frontage and on one control

transect. Site 1 was located at the northern boundary of the project, Site 2 was located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) was located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 was located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Sampling transects extended from the shoreline out to the open coastal ocean. Water samples were analyzed for chemical criteria specified by DOH water quality standards, as well as several additional criteria. In addition, water samples were collected from nine irrigation wells located on the golf courses.

- Water chemistry constituents that occur in high concentration in groundwater (Si , NO_3^- and TN) displayed distinct horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward. Groundwater input (based on salinity) was greatest at Sites 1 and 3A, but was also evident at all other sites. As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort or residential land usage.
- Vertical stratification of the water column was evident during April 2012, with most surface samples displaying higher nutrient and lower salinities than the corresponding bottom samples. The consistent vertical patterns of distribution indicate that strong physical mixing processes generated by tidal exchange, wind stirring, and breaking waves were insufficient to mix the water column from surface to bottom throughout the sampling area at the time of the monitoring survey.
- Overall, values of Chl *a* and turbidity were elevated near the shoreline compared to offshore samples, with Control Site 4 having the highest values of turbidity in nearshore samples. The elevated levels of Chl *a* and turbidity in the nearshore zone are likely a result of broken fragments of benthic plants that broken from the bottom by wave action and washed to the shoreline. The low concentrations of Chl *a* through the water column indicates the lack of plankton blooms in the area. Site 2, located at the point where sediment-laden storm water runoff entered the ocean following a flash flood in October 1999 did not display substantially elevated turbidity during the present survey suggesting that the effects of the flood have been fully mitigated.
- Other organic water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+ , TON, TOP) did not show any distinctive patterns with respect to horizontal gradients.
- Scaling nutrient concentrations to salinity indicates that there are measurable subsidies of NO_3^- to groundwater that enters the nearshore ocean at three Transect sites. Results of the April 2012 monitoring indicated that these subsidies were greatest in magnitude at Sites 3 and 3A, followed by Site 1. No subsidies other than the chemical constituents of naturally occurring groundwater (particularly NO_3^-) were apparent at Site 2 (Makena Landing) or Control Site 4 ('Ahihi-Kina`u). These subsidies, which are without doubt a result of land uses involving fertilizers, substantially increase the concentration of NO_3^- with respect to salinity in groundwater flowing to the ocean compared to natural groundwater. The area shoreward of Site 1 includes the juncture of the southern part of the Wailea Gold Course and the northern

part of the Makena North Course, as well as residential development. Sites 3 and 3A are directly downslope from the Makena South Course in an area where the golf course extends to the shoreline. In addition, private residences are near completion upslope of Transect 3, and it is possible that a cesspool remains from a house that was recently torn down. Hence, the subsidies of NO_3^- noted at these sites may result from a combination of sources.

- Linear regression statistics of nutrient concentration plotted as functions of salinity are useful for evaluating changes to water quality over time. When the regression values of nutrient concentrations versus salinity are plotted as a function of time, there are no statistically significant increases or decreases over the 17 years of monitoring at any of the survey sites. The lack of increase in these slopes and intercepts indicate that there has been no consistent change in nutrient input from land to groundwater that enters the ocean since 1995 (since 2002 at Site 2). At Site 3 off the Makena Resort South Golf Course, there was a progressive decrease in NO_3^- input between 2002 and 2004, followed by an increase between 2004 and 2007, and another decrease in 2008-2012. Further monitoring at this site will be of interest to note the future direction of the oscillating trends noted in the last seven years.
- Comparing water chemistry parameters to DOH standards revealed that several measurements of NO_3^- and TN, and a few of NH_4^+ , TP, turbidity and Chl *a* exceeded the DOH "not to exceed more than 10% of the time" criteria for dry and wet conditions of open coastal waters. It is apparent that the concentrations of NO_3^- in nearshore marine waters that contains a mixture of seawater and natural groundwater may exceed DOH criteria with no subsidies from human activities on land. Numerous values of NO_3^- , NH_4^+ , TN, turbidity and Chl *a* exceeded specified limits for geometric means. Such exceedances occurred at all survey sites, including the control site that was far from any golf course influence. The consistent exceedance of water quality standards is in large part a consequence of the present DOH standards not accounting for the natural effects of groundwater discharge to the nearshore ocean.
- As in past surveys, there is a subsidy of dissolved inorganic nutrients (e.g., NO_3^- and sometimes to a lesser extent PO_4^{3-}) to groundwater that enters the nearshore ocean at sampling sites downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased over time. Surveys of coral reef community structure that are part of the ongoing monitoring program for the Makena Resort, as well as the continued lack of any nuisance algal aggregations in the nearshore area indicate that the nutrient subsidies are not detrimental to marine community structure.
- The next scheduled testing for the Makena Resort monitoring program is planned for the fall-winter season of 2012.

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FIGURE 1. Aerial photograph of Makena Resort on southwest coastline of Maui. Also shown are locations of five water sampling transects that extend from the shoreline to 150-200 m from shore. The southern end of the Wailea golf course is visible at right.

TABLE 1. Water chemistry measurements from ocean water samples collected in the vicinity of the Makena Resort on April 22, 2012. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. "bdl" indicates below detection level. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO ₄ ³⁻ (μM)	NO ₃ ⁻ (μM)	NH ₄ ⁺ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL a (μg/L)	TEMP (deg.C)	pH (std.units)	O2 (% Sat)	
MAKENA 1	0 S	0.1	0.77	102.6	0.30	354.0	0.08	10.77	0.85	113.6	0.39	21.772	0.25	26.6	8.20	102.7	
	2 S	0.1	0.65	95.98	0.41	316.8	0.18	9.96	0.82	106.4	0.65	22.672	0.43	25.9	8.21	117.1	
	5 S	0.5	0.46	62.17	0.28	246.0	0.10	9.30	0.55	71.75	0.35	26.884	0.23	23.8	8.32	106.9	
	5 D	1.5	0.28	40.00	0.39	212.3	0.18	8.81	0.45	49.20	0.60	29.328	0.23	24.0	8.32	108.6	
	10 S	0.5	0.26	25.45	0.34	49.66	0.12	5.03	0.38	30.82	0.39	31.623	0.13	24.1	8.16	107.6	
	10 D	2.4	0.19	9.22	0.67	19.56	0.12	4.62	0.31	14.51	0.15	33.580	0.13	24.3	8.16	108.5	
	50 S	0.5	0.18	3.58	0.31	15.59	0.12	4.94	0.30	8.83	0.43	34.384	0.11	24.1	8.17	106.6	
	50 D	4.1	0.19	4.62	0.89	13.80	0.15	5.67	0.34	11.17	0.38	34.239	0.18	24.3	8.17	104.2	
	100 S	0.5	0.16	0.25	0.39	5.11	0.14	4.69	0.30	5.33	0.23	34.927	0.11	24.2	8.19	103.9	
	100 D	5.5	0.18	3.60	0.41	13.38	0.15	5.02	0.32	9.03	0.28	34.410	0.11	24.3	8.16	105.4	
	150 S	0.6	0.16	0.03	0.42	3.88	0.16	4.96	0.31	5.41	0.22	34.942	0.18	24.2	8.23	104.1	
	150 D	10.4	0.14	0.78	0.59	6.44	0.20	4.70	0.34	6.07	0.20	34.866	0.12	24.2	8.20	108.3	
	MAKENA 2	0 S	0.1	0.22	6.89	0.89	21.96	0.27	7.76	0.48	15.54	1.00	33.593	0.19	25.4	8.19	105.6
		2 S	0.1	0.28	6.00	0.29	18.47	0.22	5.19	0.50	11.48	0.87	33.745	0.16	25.5	8.19	105.5
		5 S	0.6	0.16	1.58	0.23	5.79	0.20	5.10	0.36	6.91	0.33	34.623	0.17	24.3	8.19	104.5
5 D		2.2	0.18	1.62	0.19	13.25	0.18	4.95	0.36	6.76	0.27	34.627	0.14	24.4	8.19	101.4	
10 S		0.5	0.19	2.95	0.51	12.42	0.20	4.75	0.40	8.21	0.29	34.393	0.15	24.1	8.18	103.4	
10 D		3.0	0.16	0.17	0.20	4.53	0.19	5.00	0.35	5.37	0.28	34.902	0.12	24.4	8.18	102.2	
50 S		0.6	0.22	4.81	0.28	16.83	0.22	5.20	0.43	10.29	0.25	34.072	0.15	24.1	8.18	103.2	
50 D		4.4	0.14	0.09	0.38	4.25	0.19	4.61	0.32	5.08	0.19	34.938	0.11	24.3	8.20	102.6	
100 S		0.6	0.16	1.30	0.36	8.30	0.17	4.93	0.33	6.59	0.69	34.653	0.12	24.1	8.17	103.0	
100 D		5.6	0.13	BDL	0.21	4.56	0.21	4.87	0.35	5.07	0.30	34.952	0.13	24.3	8.20	104.3	
150 S		0.5	0.15	0.94	0.45	9.74	0.24	4.71	0.39	6.10	0.39	34.740	0.14	24.1	8.17	104.4	
150 D		7.2	0.14	BDL	0.31	6.50	0.27	4.64	0.42	4.92	0.28	34.951	0.12	24.3	8.19	103.9	
200 S		0.6	0.13	0.01	0.44	6.56	0.27	4.71	0.40	5.16	0.15	34.951	0.10	24.2	8.19	101.9	
200 D		12.0	0.13	BDL	0.21	1.58	0.19	4.94	0.33	5.15	0.35	34.935	0.10	24.2	8.19	105.2	
MAKENA 3-A		0 S	0.1	2.16	187.5	0.09	514.0	bdl	10.52	2.17	198.1	0.62	17.169	0.27	24.4	7.90	107.8
	2 S	0.1	1.71	151.0	0.11	406.1	0.07	9.13	1.79	160.3	0.50	20.650	0.31	24.5	7.95	105.9	
	5 S	0.5	0.58	39.80	0.21	67.24	0.19	4.00	0.77	44.01	0.22	31.273	0.14	23.6	8.06	100.6	
	5 D	1.1	0.58	38.60	0.39	70.89	0.22	3.66	0.80	42.65	0.32	31.387	0.15	24.0	8.07	100.7	
	10 S	0.5	0.31	14.37	0.31	29.18	0.18	4.71	0.50	19.39	0.28	33.358	0.13	23.8	8.15	103.0	
	10 D	2.9	0.16	0.90	0.21	3.90	0.16	4.82	0.31	5.93	0.45	34.859	0.10	24.2	8.20	101.6	
	50 S	0.5	0.21	7.39	0.18	19.19	0.20	5.05	0.42	12.62	0.17	34.217	0.09	24.1	8.15	102.1	
	50 D	4.5	0.09	BDL	0.63	4.90	0.25	5.34	0.34	5.93	0.30	34.920	0.12	24.3	8.14	100.4	
	100 S	0.5	0.16	1.88	0.21	10.60	0.21	4.80	0.36	6.90	0.25	34.671	0.15	24.0	8.18	103.4	
	100 D	5.0	0.14	0.15	0.34	7.14	0.19	4.77	0.33	5.25	0.32	34.939	0.11	24.3	8.19	101.7	
	150 S	0.5	0.15	0.10	0.21	6.70	0.32	5.31	0.47	5.62	0.38	34.937	0.09	24.3	8.22	102.4	
	150 D	10.4	0.14	0.01	0.39	6.93	0.16	4.49	0.29	4.89	0.39	34.950	0.08	24.2	8.21	106.4	
	MAKENA 3	0 S	0.1	0.49	25.56	0.35	40.29	0.22	6.03	0.71	31.95	3.85	33.271	0.15	27.6	8.15	100.1
		2 S	0.1	0.38	22.61	0.23	41.39	0.19	5.45	0.56	28.28	0.47	33.416	0.16	25.1	8.15	105.8
		5 S	0.5	0.38	22.14	0.10	35.49	0.16	4.19	0.54	26.43	0.40	33.485	0.12	23.2	8.10	100.5
5 D		1.7	0.42	25.34	0.23	36.87	0.15	3.90	0.57	29.47	0.53	33.283	0.14	24.0	8.09	92.1	
10 S		0.5	0.38	20.36	0.14	32.80	0.21	4.86	0.59	25.35	0.42	33.617	0.14	23.9	8.08	94.7	
10 D		2.8	0.16	0.77	0.18	3.17	0.18	5.35	0.34	6.30	0.31	34.892	0.10	24.0	8.11	87.3	
50 S		0.5	0.16	1.05	0.17	3.45	0.18	5.08	0.34	6.30	0.58	34.893	0.08	24.0	8.18	96.8	
50 D		5.2	0.15	0.30	0.17	7.25	0.19	5.29	0.34	5.76	0.28	34.940	0.09	24.2	8.18	94.1	
100 S		0.5	0.14	0.72	0.23	3.31	0.18	4.75	0.32	5.70	0.21	34.881	0.07	23.9	8.22	101.7	
100 D		7.6	0.15	0.14	0.45	6.95	0.20	4.86	0.35	5.45	0.40	34.941	0.08	24.2	8.21	102.1	
150 S		0.5	0.15	0.06	0.14	6.62	0.15	5.29	0.30	5.49	0.35	34.952	0.07	24.2	8.22	101.1	
150 D		13.7	0.13	0.04	0.14	5.41	0.16	5.13	0.29	5.31	0.45	34.948	0.10	24.2	8.21	107.7	
MAKENA 4		0 S	0.1	0.70	50.46	0.20	96.83	0.26	8.57	0.99	56.32	2.87	24.962	0.38	25.5	8.16	111.2
		2 S	0.1	0.50	35.03	0.21	89.94	0.28	6.59	0.71	43.98	0.60	28.165	0.21	24.7	8.19	107.1
		5 S	0.7	0.14	2.26	0.12	12.86	0.22	5.90	0.30	9.94	0.55	34.304	0.13	23.9	8.13	101.4
	5 D	2.7	0.02	2.58	0.14	19.17	0.21	6.52	0.27	14.13	0.33	34.231	0.13	24.0	8.11	95.2	
	10 S	0.8	0.15	0.83	0.51	9.40	0.28	6.82	0.30	7.30	0.53	34.752	0.12	24.0	8.15	99.2	
	10 D	2.5	0.18	0.30	0.20	8.74	0.26	6.25	0.26	5.32	0.21	34.911	0.05	24.1	8.17	94.5	
	50 S	0.9	0.20	2.49	0.45	19.35	0.24	5.75	0.28	8.19	0.28	34.298	0.08	23.7	8.12	97.8	
	50 D	4.5	0.17	0.24	0.11	7.90	0.24	5.51	0.32	4.93	0.39	34.920	0.03	24.1	8.17	95.4	
	100 S	0.8	0.18	1.37	0.61	13.14	0.27	5.59	0.43	6.89	0.18	34.606	0.08	23.8	8.14	102.9	
	100 D	7.0	0.16	0.30	0.12	7.44	0.27	5.81	0.37	5.24	0.19	34.896	0.08	24.1	8.18	98.8	
	150 S	0.5	0.15	0.18	0.09	1.35	0.26	5.49	0.37	6.25	0.20	34.932	0.04	24.0	8.19	102.0	
	150 D	9.7	0.15	0.05	0.11	8.39	0.27	5.45	0.37	5.32	0.42	34.937	0.12	24.1	8.20	103.6	
	DOH WQS	DRY	10%	0.71	0.36					0.96	12.86	0.50	*	0.50	**	***	****
			2%	1.43	0.64					1.45	17.86	1.00		1.00			
		WET	10%	1.00	0.61					1.29	17.85	1.25	*	0.90	**	***	****
2%			1.78	1.07					1.93	25.00	2.00		1.75				

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 2. Water chemistry measurements from ocean water samples (in µg/L) collected in the vicinity of the Makena Resort on April 22, 2012. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. "bdl" indicates below detection level. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO ₄ ³⁻ (µg/L)	NO ₃ ⁻ (µg/L)	NH ₄ ⁺ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	CHL α (µg/L)	TEMP (deg.C)	pH (std.units)	O ₂ % Sat
MAKENA 1	0 S	0.1	23.87	1436	4.20	9948	2.33	150.8	26.20	1591	0.39	21.772	0.25	26.6	8.20	102.7
	2 S	0.1	20.00	1344	5.74	8901	5.43	139.4	25.42	1489	0.65	22.672	0.43	25.9	8.21	117.1
	5 S	0.5	14.11	870.4	3.92	6912	2.95	130.2	17.05	1005	0.35	26.884	0.23	23.8	8.32	106.9
	5 D	1.5	8.53	559.9	5.46	5966	5.43	123.3	13.95	688.7	0.60	29.328	0.23	24.0	8.32	108.6
	10 S	0.5	8.03	356.3	4.76	1395	3.66	70.46	11.69	431.5	0.39	31.623	0.13	24.1	8.16	107.6
	10 D	2.4	5.98	129.1	9.38	549.6	3.72	64.61	9.70	203.1	0.15	33.580	0.13	24.3	8.16	108.5
	50 S	0.5	5.58	50.12	4.34	438.1	3.69	69.19	9.27	123.6	0.43	34.384	0.11	24.1	8.17	106.6
	50 D	4.1	5.89	64.62	12.47	387.8	4.68	79.32	10.57	156.4	0.38	34.239	0.18	24.3	8.17	104.2
	100 S	0.5	4.99	3.49	5.46	143.6	4.25	65.72	9.24	74.66	0.23	34.927	0.11	24.2	8.19	103.9
	100 D	5.5	5.46	50.37	5.74	376.0	4.59	70.24	10.04	126.4	0.28	34.410	0.11	24.3	8.16	105.4
	150 S	0.6	4.81	0.48	5.88	109.0	4.84	69.44	9.64	75.80	0.22	34.942	0.18	24.2	8.23	104.1
	150 D	10.4	4.34	10.92	8.26	181.0	6.17	65.83	10.51	85.01	0.20	34.866	0.12	24.2	8.20	108.3
MAKENA 2	0 S	0.1	6.70	96.45	12.47	617.1	8.22	108.7	14.91	217.6	1.00	33.593	0.19	25.4	8.19	105.6
	2 S	0.1	8.68	83.96	4.06	519.0	6.88	72.65	15.56	160.7	0.87	33.745	0.16	25.5	8.19	105.5
	5 S	0.6	5.02	22.08	3.22	162.7	6.26	71.40	11.28	96.70	0.33	34.623	0.17	24.3	8.19	104.5
	5 D	2.2	5.61	22.64	2.66	372.3	5.55	69.33	11.16	94.63	0.27	34.627	0.14	24.4	8.19	101.4
	10 S	0.5	5.95	41.31	7.14	349.0	6.29	66.51	12.25	115.0	0.29	34.393	0.15	24.1	8.18	103.4
	10 D	3.0	4.84	2.37	2.80	127.3	5.89	69.96	10.73	75.12	0.28	34.902	0.12	24.4	8.18	102.2
	50 S	0.6	6.67	67.33	3.92	472.9	6.67	72.84	13.33	144.1	0.25	34.072	0.15	24.1	8.18	103.2
	50 D	4.4	4.22	1.26	5.32	119.4	5.80	64.47	10.01	71.05	0.19	34.938	0.11	24.3	8.20	102.6
	100 S	0.6	5.02	18.17	5.04	233.2	5.12	69.05	10.14	92.26	0.69	34.653	0.12	24.1	8.17	103.0
	100 D	5.6	4.15	BDL	2.94	128.1	6.60	68.17	10.76	70.95	0.30	34.952	0.13	24.3	8.20	104.3
	150 S	0.5	4.56	13.12	6.30	273.7	7.47	65.93	12.03	85.34	0.39	34.740	0.14	24.1	8.17	104.4
	150 D	7.2	4.46	BDL	4.34	182.7	8.43	64.93	12.90	68.91	0.28	34.951	0.12	24.3	8.19	103.9
	200 S	0.6	4.06	0.15	6.16	184.3	8.25	65.95	12.31	72.27	0.15	34.951	0.10	24.2	8.19	101.9
	200 D	12.0	4.09	BDL	2.94	44.40	5.98	69.17	10.08	72.07	0.35	34.935	0.10	24.2	8.19	105.2
MAKENA 3-A	0 S	0.1	66.96	2625	1.26	14445	bdl	147.2	67.12	2773	0.62	17.169	0.27	24.4	7.90	107.8
	2 S	0.1	53.01	2114	1.54	11411	2.32	127.9	55.34	2244	0.50	20.650	0.31	24.5	7.95	105.9
	5 S	0.5	17.89	557.2	2.94	1889	5.83	55.99	23.72	616.1	0.22	31.273	0.14	23.6	8.06	100.6
	5 D	1.1	17.92	540.4	5.46	1992	6.73	51.21	24.65	597.1	0.32	31.387	0.15	24.0	8.07	100.7
	10 S	0.5	9.73	201.2	4.34	820.0	5.67	65.95	15.41	271.5	0.28	33.358	0.13	23.8	8.15	103.0
	10 D	2.9	4.87	12.53	2.94	109.6	4.87	67.52	9.73	82.99	0.45	34.859	0.10	24.2	8.20	101.6
	50 S	0.5	6.63	103.4	2.52	539.2	6.29	70.71	12.93	176.6	0.17	34.217	0.09	24.1	8.15	102.1
	50 D	4.5	2.64	BDL	8.82	137.7	7.75	74.72	10.39	82.96	0.30	34.920	0.12	24.3	8.14	100.4
	100 S	0.5	4.87	26.38	2.94	297.9	6.39	67.21	11.25	96.53	0.25	34.671	0.15	24.0	8.18	103.4
	100 D	5.0	4.28	2.03	4.76	200.6	5.92	66.71	10.20	73.50	0.32	34.939	0.11	24.3	8.19	101.7
	150 S	0.5	4.68	1.41	2.94	188.3	10.01	74.31	14.69	78.67	0.38	34.937	0.09	24.3	8.22	102.4
	150 D	10.4	4.22	0.07	5.46	194.7	4.87	62.92	9.08	68.45	0.39	34.950	0.08	24.2	8.21	106.4
MAKENA 3	0 S	0.1	15.10	357.9	4.90	1132	6.76	84.45	21.86	447.2	3.85	33.271	0.15	27.6	8.15	100.1
	2 S	0.1	11.72	316.5	3.22	1163	5.74	76.23	17.45	395.9	0.47	33.416	0.16	25.1	8.15	105.8
	5 S	0.5	11.72	310.0	1.40	997.3	4.96	58.59	16.68	370.0	0.40	33.485	0.12	23.2	8.10	100.5
	5 D	1.7	12.99	354.7	3.22	1036	4.68	54.57	17.67	412.5	0.53	33.283	0.14	24.0	8.09	92.1
	10 S	0.5	11.78	285.0	1.96	921.7	6.57	68.01	18.35	354.9	0.42	33.617	0.14	23.9	8.08	94.7
	10 D	2.8	4.96	10.79	2.52	89.08	5.64	74.86	10.60	88.17	0.31	34.892	0.10	24.0	8.11	87.3
	50 S	0.5	4.84	14.67	2.38	96.95	5.67	71.13	10.51	88.19	0.58	34.893	0.08	24.0	8.18	96.8
	50 D	5.2	4.74	4.20	2.38	203.7	5.77	74.06	10.51	80.64	0.28	34.940	0.09	24.2	8.18	94.1
	100 S	0.5	4.25	10.08	3.22	93.01	5.55	66.49	9.80	79.79	0.21	34.881	0.07	23.9	8.22	101.7
	100 D	7.6	4.53	2.00	6.30	195.3	6.20	68.04	10.73	76.34	0.40	34.941	0.08	24.2	8.21	102.1
	150 S	0.5	4.68	0.81	1.96	186.0	4.71	74.07	9.39	76.85	0.35	34.952	0.07	24.2	8.22	101.1
	150 D	13.7	4.06	0.56	1.96	152.0	4.81	71.75	8.87	74.27	0.45	34.948	0.10	24.2	8.21	107.7
MAKENA 4	0 S	0.1	21.73	706.5	2.80	2721	8.06	120.0	30.60	788.5	2.87	24.962	0.38	25.5	8.16	111.2
	2 S	0.1	15.41	490.4	2.94	2527	8.68	92.26	21.98	615.7	0.60	28.165	0.21	24.7	8.19	107.1
	5 S	0.7	4.40	31.63	1.68	361.4	6.82	82.60	9.18	139.2	0.55	34.304	0.13	23.9	8.13	101.4
	5 D	2.7	0.65	36.11	1.96	538.7	6.51	91.28	8.34	197.8	0.33	34.231	0.13	24.0	8.11	95.2
	10 S	0.8	4.68	11.58	7.14	264.1	8.68	95.48	9.36	102.2	0.53	34.752	0.12	24.0	8.15	99.2
	10 D	2.5	5.49	4.23	2.80	245.6	8.06	87.50	8.15	74.48	0.21	34.911	0.05	24.1	8.17	94.5
	50 S	0.9	6.05	34.82	6.30	543.7	7.44	80.50	8.71	114.6	0.28	34.298	0.08	23.7	8.12	97.8
	50 D	4.5	5.36	3.30	1.54	222.0	7.44	77.14	9.95	68.99	0.39	34.920	0.03	24.1	8.17	95.4
	100 S	0.8	5.67	19.19	8.54	369.2	8.37	78.26	13.33	96.46	0.18	34.606	0.08	23.8	8.14	102.9
	100 D	7.0	4.96	4.16	1.68	209.1	8.37	81.34	11.56	73.39	0.19	34.896	0.08	24.1	8.18	98.8
	150 S	0.5	4.53	2.55	1.26	37.94	8.06	76.86	11.44	87.43	0.20	34.932	0.04	24.0	8.19	102.0
	150 D	9.7	4.71	0.66	1.54	235.8	8.37	76.30	11.56	74.44	0.42	34.937	0.12	24.1	8.20	103.6
DOH WQS	DRY		10%	10.00	5.00				30.00	180.00	0.50	*	0.50	**	***	****
	WET		2%	20.00	9.00				45.00	250.00	1.00	*	1.00	**	***	****
			10%	14.00	8.50				40.00	250.00	1.25	*	0.90	**	***	****
			2%	25.00	15.00				60.00	350.00	2.00	*	1.75	**	***	****

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 3. Geometric mean data from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 from Sites 1, 2, and 4 (N=27); since June 2002 from Site 3 (N=18) and since June 2007 from Site 3-A (N=9). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO ₄ ³⁻ (μM)	NO ₃ ⁻ (μM)	NH ₄ ⁺ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL α ($\mu\text{g/L}$)	TEMP (deg.C)	pH	O ₂	
MAKENA 1	0 S	0.22	41.90	0.35	72.95	0.23	7.79	0.54	56.95	0.35	25.901	0.84	25.6	8.13	102.6	
	2 S	0.17	27.49	0.19	51.10	0.25	8.22	0.47	40.02	0.30	29.653	0.82	25.7	8.16	105.2	
	5 S	0.12	11.88	0.13	26.32	0.25	7.96	0.41	24.32	0.24	32.090	0.53	25.6	8.17	105.2	
	5 D	0.12	9.18	0.20	21.67	0.26	7.51	0.41	20.09	0.21	33.043	0.48	25.6	8.17	105.7	
	10 S	0.10	4.04	0.15	10.88	0.25	7.39	0.37	13.37	0.19	34.030	0.33	25.6	8.15	104.7	
	10 D	0.10	2.31	0.21	7.15	0.27	7.29	0.39	10.92	0.17	34.383	0.33	25.6	8.15	103.8	
	50 S	0.08	2.40	0.20	7.14	0.26	7.17	0.36	10.88	0.16	34.432	0.28	25.6	8.14	100.2	
	50 D	0.08	0.30	0.14	2.58	0.27	7.19	0.37	7.99	0.12	34.790	0.25	25.6	8.14	99.1	
	100 S	0.09	0.86	0.15	4.54	0.26	6.70	0.37	9.25	0.13	34.580	0.22	25.6	8.14	98.2	
	100 D	0.07	0.11	0.09	2.13	0.27	7.22	0.36	7.70	0.10	34.836	0.20	25.6	8.15	97.8	
	150 S	0.08	0.27	0.16	2.95	0.27	7.15	0.36	8.33	0.13	34.749	0.19	25.7	8.14	97.2	
	150 D	0.08	0.07	0.13	1.85	0.27	6.96	0.37	7.33	0.10	34.856	0.16	25.6	8.15	98.0	
	MAKENA 2	0 S	0.19	4.31	0.38	22.54	0.31	8.27	0.54	14.17	0.90	33.379	0.75	25.8	8.14	98.2
		2 S	0.18	3.87	0.25	19.70	0.31	7.85	0.53	13.01	0.65	33.565	0.74	25.8	8.14	100.3
5 S		0.16	3.06	0.26	14.60	0.28	7.14	0.47	11.21	0.45	34.038	0.56	25.7	8.14	100.2	
5 D		0.17	2.86	0.30	14.56	0.30	7.37	0.49	11.51	0.42	34.086	0.69	25.7	8.14	99.4	
10 S		0.12	1.69	0.22	9.40	0.29	5.66	0.44	9.30	0.31	34.385	0.40	25.6	8.14	98.6	
10 D		0.11	0.99	0.25	7.66	0.30	7.11	0.44	9.04	0.28	34.508	0.44	25.7	8.14	97.4	
50 S		0.10	1.16	0.26	7.45	0.31	7.59	0.44	9.69	0.24	34.448	0.31	25.6	8.13	97.3	
50 D		0.11	0.21	0.23	3.18	0.30	7.41	0.43	8.10	0.18	34.802	0.34	25.5	8.14	96.7	
100 S		0.09	0.45	0.20	4.14	0.29	7.19	0.40	8.21	0.17	34.647	0.26	25.7	8.13	97.6	
100 D		0.08	0.12	0.18	2.35	0.28	7.08	0.38	7.60	0.13	34.833	0.25	25.6	8.15	96.8	
150 S		0.09	0.23	0.20	3.12	0.28	7.31	0.39	7.98	0.14	34.778	0.21	25.6	8.14	96.8	
150 D		0.08	0.08	0.15	2.07	0.29	7.38	0.39	7.75	0.11	34.856	0.21	25.6	8.15	97.2	
200 S		0.07	0.10	0.16	2.34	0.29	7.13	0.37	7.65	0.11	34.851	0.22	25.7	8.15	97.7	
200 D		0.08	0.04	0.19	1.69	0.29	7.63	0.38	7.96	0.10	34.881	0.22	25.6	8.16	97.3	
MAKENA 3-A	0 S	1.45	180.0	0.37	344.5	0.19	10.48	1.77	192.8	0.32	14.182	0.27	25.0	7.87	97.4	
	2 S	1.05	119.2	0.36	223.4	0.25	7.95	1.53	142.4	0.22	20.270	0.34	25.1	7.89	97.8	
	5 S	0.37	38.37	0.50	76.10	0.33	8.51	0.80	60.27	0.21	29.009	0.29	25.1	8.00	98.2	
	5 D	0.24	21.22	0.38	46.19	0.29	7.51	0.62	34.73	0.19	31.746	0.30	25.3	8.05	98.7	
	10 S	0.10	6.33	0.24	18.47	0.27	7.48	0.42	18.96	0.14	33.464	0.18	25.3	8.08	98.7	
	10 D	0.07	1.31	0.19	5.60	0.25	6.76	0.36	9.38	0.15	34.656	0.22	25.3	8.10	99.3	
	50 S	0.09	1.88	0.21	8.18	0.26	7.47	0.38	11.85	0.12	34.467	0.13	25.7	8.10	98.9	
	50 D	0.07	0.11	0.31	3.05	0.28	7.87	0.37	8.53	0.12	34.849	0.14	25.5	8.11	98.5	
	100 S	0.09	0.79	0.12	4.88	0.27	6.93	0.38	8.69	0.12	34.754	0.14	25.6	8.11	97.7	
	100 D	0.10	0.04	0.30	2.29	0.27	7.00	0.39	7.47	0.10	34.941	0.12	25.4	8.13	99.2	
	150 S	0.07	0.10	0.14	3.11	0.31	7.67	0.40	8.65	0.13	34.863	0.12	25.5	8.13	98.3	
	150 D	0.06	0.01	0.25	1.99	0.27	7.02	0.35	7.38	0.12	34.946	0.13	25.3	8.13	100.7	
	MAKENA 3	0 S	0.13	9.69	0.33	19.98	0.27	6.27	0.46	24.57	0.33	33.731	0.47	25.9	8.14	101.0
		2 S	0.16	14.73	0.26	25.52	0.26	5.86	0.47	28.32	0.30	33.739	0.51	25.8	8.12	101.8
5 S		0.13	9.67	0.20	17.54	0.28	7.51	0.47	22.26	0.22	34.048	0.32	25.7	8.12	101.9	
5 D		0.14	6.71	0.19	13.33	0.27	6.85	0.45	18.24	0.21	34.270	0.39	25.7	8.12	100.5	
10 S		0.10	4.27	0.24	9.47	0.28	7.24	0.41	15.08	0.18	34.418	0.24	25.6	8.12	98.6	
10 D		0.09	2.07	0.16	6.18	0.29	7.57	0.40	11.89	0.16	34.665	0.26	25.5	8.12	97.9	
50 S		0.08	1.43	0.18	5.17	0.27	7.35	0.37	10.43	0.14	34.686	0.20	25.6	8.11	95.5	
50 D		0.09	0.31	0.17	2.84	0.28	7.57	0.39	8.40	0.10	34.861	0.20	25.5	8.13	93.7	
100 S		0.08	0.43	0.21	2.95	0.28	7.32	0.38	8.40	0.11	34.815	0.15	25.6	8.13	96.1	
100 D		0.07	0.10	0.24	1.99	0.29	6.88	0.38	7.42	0.09	34.866	0.16	25.5	8.14	95.9	
150 S		0.06	0.12	0.14	2.29	0.28	6.84	0.35	7.44	0.11	34.840	0.14	25.6	8.15	96.4	
150 D		0.06	0.06	0.12	1.81	0.28	6.91	0.36	7.24	0.10	34.893	0.16	25.5	8.16	97.7	
MAKENA 4		0 S	0.22	41.90	0.35	72.95	0.23	7.79	0.54	56.95	0.35	25.901	0.84	25.6	8.13	101.3
		2 S	0.17	27.49	0.19	51.10	0.25	8.22	0.47	40.02	0.30	29.653	0.82	25.7	8.16	102.1
	5 S	0.12	11.88	0.13	26.32	0.25	7.96	0.41	24.32	0.24	32.090	0.53	25.6	8.17	103.4	
	5 D	0.12	9.18	0.20	21.67	0.26	7.51	0.41	20.09	0.21	33.043	0.48	25.6	8.17	101.9	
	10 S	0.10	4.04	0.15	10.88	0.25	7.39	0.37	13.37	0.19	34.030	0.33	25.6	8.15	100.6	
	10 D	0.10	2.31	0.21	7.15	0.27	7.29	0.39	10.92	0.17	34.383	0.33	25.6	8.15	101.1	
	50 S	0.08	2.40	0.20	7.14	0.26	7.17	0.36	10.88	0.16	34.432	0.28	25.6	8.14	94.7	
	50 D	0.08	0.30	0.14	2.58	0.27	7.19	0.37	7.99	0.12	34.790	0.25	25.6	8.14	93.8	
	100 S	0.09	0.86	0.15	4.54	0.26	6.70	0.37	9.25	0.13	34.580	0.22	25.6	8.14	94.9	
	100 D	0.07	0.11	0.09	2.13	0.27	7.22	0.36	7.70	0.10	34.836	0.20	25.6	8.15	93.2	
	150 S	0.08	0.27	0.16	2.95	0.27	7.15	0.36	8.33	0.13	34.749	0.19	25.7	8.14	96.5	
	150 D	0.08	0.07	0.13	1.85	0.27	6.96	0.37	7.33	0.10	34.856	0.16	25.6	8.15	95.3	
	DOH WQS		DRY	0.25	0.14				0.52	7.86	0.20	*	0.15	**	***	
	GEOMETRIC MEAN		WET	0.36	0.25				0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 4. Geometric mean data (in $\mu\text{g/L}$) from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 for Sites 1, 2, and 4 (N=27); since June 2002 from Site 3 (N=18) and since June 2007 from Site 3-A (N=9). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO ₄ ³⁻ ($\mu\text{g/L}$)	NO ₃ ⁻ ($\mu\text{g/L}$)	NH ₄ ⁺ ($\mu\text{g/L}$)	Si ($\mu\text{g/L}$)	TOP ($\mu\text{g/L}$)	TON ($\mu\text{g/L}$)	TP ($\mu\text{g/L}$)	TN ($\mu\text{g/L}$)	TURB (NTU)	SALINITY (ppt)	CHL α ($\mu\text{g/L}$)	TEMP (deg.C)	pH	O ₂	
MAKENA 1	0 S	6.80	586.8	4.90	2049	7.10	109.1	16.70	797.6	0.35	25.901	0.84	25.6	8.13	102.6	
	2 S	5.20	385.0	2.60	1435	7.70	115.1	14.50	560.5	0.30	29.653	0.82	25.7	8.16	105.2	
	5 S	3.70	166.3	1.80	739.3	7.70	111.4	12.60	340.6	0.24	32.090	0.53	25.6	8.17	105.2	
	5 D	3.70	128.5	2.80	608.7	8.00	105.1	12.60	281.3	0.21	33.043	0.48	25.6	8.17	105.7	
	10 S	3.00	56.50	2.10	305.6	7.70	103.5	11.40	187.2	0.19	34.030	0.33	25.6	8.15	104.7	
	10 D	3.00	32.30	2.90	200.8	8.30	102.1	12.00	152.9	0.17	34.383	0.33	25.6	8.15	103.8	
	50 S	2.40	33.60	2.80	200.6	8.00	100.4	11.10	152.3	0.16	34.432	0.28	25.6	8.14	100.2	
	50 D	2.40	4.20	1.90	72.47	8.30	100.7	11.40	111.9	0.12	34.790	0.25	25.6	8.14	99.1	
	100 S	2.70	12.00	2.10	127.5	8.00	93.80	11.40	129.5	0.13	34.580	0.22	25.6	8.14	98.2	
	100 D	2.10	1.50	1.20	59.83	8.30	101.1	11.10	107.8	0.10	34.836	0.20	25.6	8.15	97.8	
	150 S	2.40	3.70	2.20	82.87	8.30	100.1	11.10	116.6	0.13	34.749	0.19	25.7	8.14	97.2	
	150 D	2.40	0.90	1.80	51.97	8.30	97.40	11.40	102.6	0.10	34.856	0.16	25.6	8.15	98.0	
	MAKENA 2	0 S	5.80	60.30	5.30	633.1	9.60	115.8	16.70	198.4	0.90	33.379	0.75	25.8	8.14	98.2
		2 S	5.50	54.20	3.50	553.4	9.60	109.9	16.40	182.2	0.65	33.565	0.74	25.8	8.14	100.3
5 S		4.90	42.80	3.60	410.1	8.60	100.0	14.50	157.0	0.45	34.038	0.56	25.7	8.14	100.2	
5 D		5.20	40.00	4.20	409.0	9.20	103.2	15.10	161.2	0.42	34.086	0.69	25.7	8.14	99.4	
10 S		3.70	23.60	3.00	264.0	8.90	79.20	13.60	130.2	0.31	34.385	0.40	25.6	8.14	98.6	
10 D		3.40	13.80	3.50	215.2	9.20	99.50	13.60	126.6	0.28	34.508	0.44	25.7	8.14	97.4	
50 S		3.00	16.20	3.60	209.3	9.60	106.3	13.60	135.7	0.24	34.448	0.31	25.6	8.13	97.3	
50 D		3.40	2.90	3.20	89.33	9.20	103.7	13.30	113.4	0.18	34.802	0.34	25.5	8.14	96.7	
100 S		2.70	6.30	2.80	116.3	8.90	100.7	12.30	114.9	0.17	34.647	0.26	25.7	8.13	97.6	
100 D		2.40	1.60	2.50	66.01	8.60	99.10	11.70	106.4	0.13	34.833	0.25	25.6	8.15	96.8	
150 S		2.70	3.20	2.80	87.64	8.60	102.3	12.00	111.7	0.14	34.778	0.21	25.6	8.14	96.8	
150 D		2.40	1.10	2.10	58.15	8.90	103.3	12.00	108.5	0.11	34.856	0.21	25.6	8.15	97.2	
200 S		2.10	1.40	2.20	65.73	8.90	99.80	11.40	107.1	0.11	34.851	0.22	25.7	8.15	97.7	
200 D		2.40	0.50	2.60	47.47	8.90	106.8	11.70	111.4	0.10	34.881	0.22	25.6	8.16	97.3	
MAKENA 3-A	0 S	44.90	2521	5.10	9678	5.80	146.7	54.80	2701	0.32	14.182	0.27	25.0	7.87	97.4	
	2 S	32.50	1670	5.00	6275	7.70	111.3	47.30	1994	0.22	20.270	0.34	25.1	7.89	97.8	
	5 S	11.40	537.4	7.00	2138	10.20	119.1	24.70	844.1	0.21	29.009	0.29	25.1	8	98.2	
	5 D	7.40	297.2	5.30	1297	8.90	105.1	19.20	486.4	0.19	31.746	0.30	25.3	8.05	98.7	
	10 S	3.00	88.60	3.30	518.8	8.30	104.7	13.00	265.5	0.14	33.464	0.18	25.3	8.08	98.7	
	10 D	2.10	18.30	2.60	157.3	7.70	94.60	11.10	131.3	0.15	34.656	0.22	25.3	8.1	99.3	
	50 S	2.70	26.30	2.90	229.8	8.00	104.6	11.70	165.9	0.12	34.467	0.13	25.7	8.1	98.9	
	50 D	2.10	1.50	4.30	85.67	8.60	110.2	11.40	119.4	0.12	34.849	0.14	25.5	8.11	98.5	
	100 S	2.70	11.00	1.60	137.1	8.30	97.00	11.70	121.7	0.12	34.754	0.14	25.6	8.11	97.7	
	100 D	3.00	0.50	4.20	64.33	8.30	98.00	12.00	104.6	0.10	34.941	0.12	25.4	8.13	99.2	
	150 S	2.10	1.40	1.90	87.36	9.60	107.4	12.30	121.1	0.13	34.863	0.12	25.5	8.13	98.3	
	150 D	1.80	0.10	3.50	55.90	8.30	98.30	10.80	103.3	0.12	34.946	0.13	25.3	8.13	100.7	
	MAKENA 3	0 S	4.00	135.7	4.60	561.2	8.30	87.80	14.20	344.1	0.33	33.731	0.47	25.9	8.14	101.0
		2 S	4.90	206.3	3.60	716.9	8.00	82.00	14.50	396.6	0.30	33.739	0.51	25.8	8.12	101.8
5 S		4.00	135.4	2.80	492.7	8.60	105.1	14.50	311.7	0.22	34.048	0.32	25.7	8.12	101.9	
5 D		4.30	93.90	2.60	374.4	8.30	95.90	13.90	255.4	0.21	34.270	0.39	25.7	8.12	100.5	
10 S		3.00	59.80	3.30	266.0	8.60	101.4	12.60	211.2	0.18	34.418	0.24	25.6	8.12	98.6	
10 D		2.70	28.90	2.20	173.6	8.90	106.0	12.30	166.5	0.16	34.665	0.26	25.5	8.12	97.9	
50 S		2.40	20.00	2.50	145.2	8.30	102.9	11.40	146.0	0.14	34.686	0.20	25.6	8.11	95.5	
50 D		2.70	4.30	2.30	79.78	8.60	106.0	12.00	117.6	0.10	34.861	0.20	25.5	8.13	93.7	
100 S		2.40	6.00	2.90	82.87	8.60	102.5	11.70	117.6	0.11	34.815	0.15	25.6	8.13	96.1	
100 D		2.10	1.40	3.30	55.90	8.90	96.30	11.70	103.9	0.09	34.866	0.16	25.5	8.14	95.9	
150 S		1.80	1.60	1.90	64.33	8.60	95.80	10.80	104.2	0.11	34.840	0.14	25.6	8.15	96.4	
150 D		1.80	0.80	1.60	50.84	8.60	96.70	11.10	101.4	0.10	34.893	0.16	25.5	8.16	97.7	
MAKENA 4		0 S	6.80	586.8	4.90	2049	7.10	109.1	16.70	797.6	0.35	25.901	0.84	25.6	8.13	101.3
		2 S	5.20	385.0	2.60	1435	7.70	115.1	14.50	560.5	0.30	29.653	0.82	25.7	8.16	102.1
	5 S	3.70	166.3	1.80	739.3	7.70	111.4	12.60	340.6	0.24	32.090	0.53	25.6	8.17	103.4	
	5 D	3.70	128.5	2.80	608.7	8.00	105.1	12.60	281.3	0.21	33.043	0.48	25.6	8.17	101.9	
	10 S	3.00	56.50	2.10	305.6	7.70	103.5	11.40	187.2	0.19	34.030	0.33	25.6	8.15	100.6	
	10 D	3.00	32.30	2.90	200.8	8.30	102.1	12.00	152.9	0.17	34.383	0.33	25.6	8.15	101.1	
	50 S	2.40	33.60	2.80	200.6	8.00	100.4	11.10	152.3	0.16	34.432	0.28	25.6	8.14	94.7	
	50 D	2.40	4.20	1.90	72.47	8.30	100.7	11.40	111.9	0.12	34.790	0.25	25.6	8.14	93.8	
	100 S	2.70	12.00	2.10	127.5	8.00	93.80	11.40	129.5	0.13	34.580	0.22	25.6	8.14	94.9	
	100 D	2.10	1.50	1.20	59.83	8.30	101.1	11.10	107.8	0.10	34.836	0.20	25.6	8.15	93.2	
	150 S	2.40	3.70	2.20	82.87	8.30	100.1	11.10	116.6	0.13	34.749	0.19	25.7	8.14	96.5	
	150 D	2.40	0.90	1.80	51.97	8.30	97.40	11.40	102.6	0.10	34.856	0.16	25.6	8.15	95.3	
	DOH WQS		DRY	3.50	2.00				16.00	110.00	0.20	*	0.15	**	***	
	GEOMETRIC MEAN		WET	5.00	3.50				20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

TABLE 5. Water chemistry measurements in μM and $\mu\text{g/L}$ (shaded) from irrigation wells and an irrigation lake collected in the vicinity of the Makena Resort on May 10, 2012. For sampling site locations, see Figure 1.

WELL	PO_4^{3-} (μM)	PO_4^{3-} ($\mu\text{g/L}$)	NO_3^- (μM)	NO_3^- ($\mu\text{g/L}$)	NH_4^+ (μM)	NH_4^+ ($\mu\text{g/L}$)	Si (μM)	Si ($\mu\text{g/L}$)	TOP (μM)	TOP ($\mu\text{g/L}$)	TON (μM)	TON ($\mu\text{g/L}$)	TP (μM)	TP ($\mu\text{g/L}$)	TN (μM)	TN ($\mu\text{g/L}$)	SALINITY (ppt)
1	2.10	65.10	124.6	1744.4	1.00	14.00	483.9	13597.6	0.55	17.05	6.80	95.20	2.65	82.15	132.4	1853.6	1.359
2	2.95	91.45	142.6	1996.4	0.80	11.20	648.4	18220.0	0.10	3.10	7.25	101.50	3.05	94.55	150.7	2109.1	1.827
3	3.10	96.10	137.2	1920.8	0.65	9.10	650.2	18270.6	0.15	4.65	12.95	181.30	3.25	100.75	150.8	2111.2	2.007
4	3.00	93.00	126.1	1765.4	0.60	8.40	612.5	17211.3	0.30	9.30	16.80	235.20	3.30	102.30	143.5	2009.0	1.739
5	2.70	83.70	161.4	2259.6	0.65	9.10	555.9	15620.8	0.60	18.60	10.70	149.80	3.30	102.30	172.8	2418.5	1.528
6	2.45	75.95	166.0	2323.3	0.35	4.90	523.8	14717.4	0.45	13.95	14.15	198.10	2.90	89.90	180.5	2526.3	1.611
8	2.80	86.80	111.3	1557.5	0.25	3.50	564.0	15847.0	0.30	9.30	14.55	203.70	3.10	96.10	126.1	1764.7	2.312
10	2.40	74.40	168.2	2354.8	4.75	66.50	578.2	16246.0	0.35	10.85	21.70	303.80	2.75	85.25	194.7	2725.1	1.829
11	2.45	75.95	117.1	1639.4	1.05	14.70	589.4	16562.1	0.65	20.15	17.80	249.20	3.10	96.10	136.0	1903.3	2.002

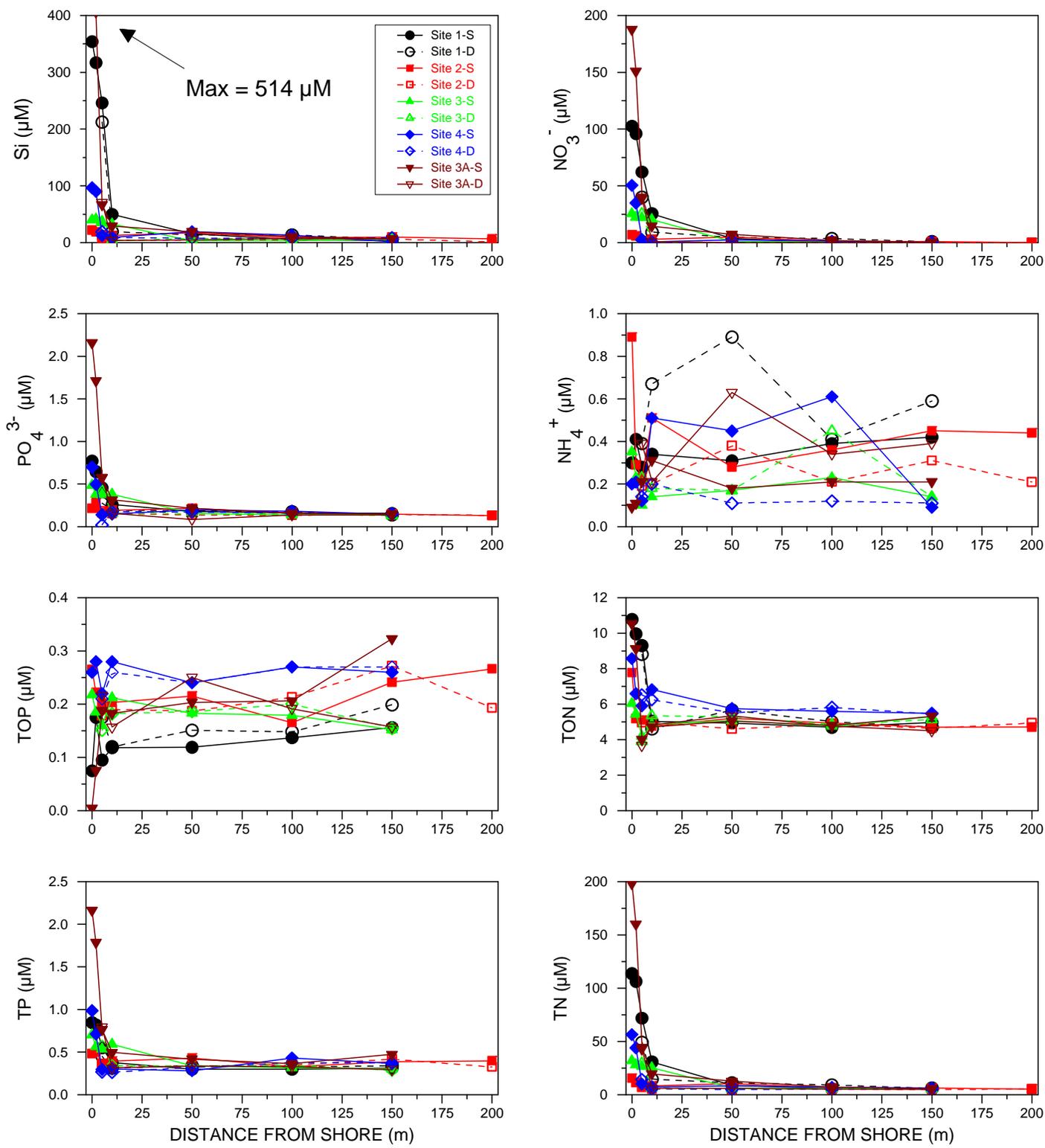


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on April 22, 2012 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

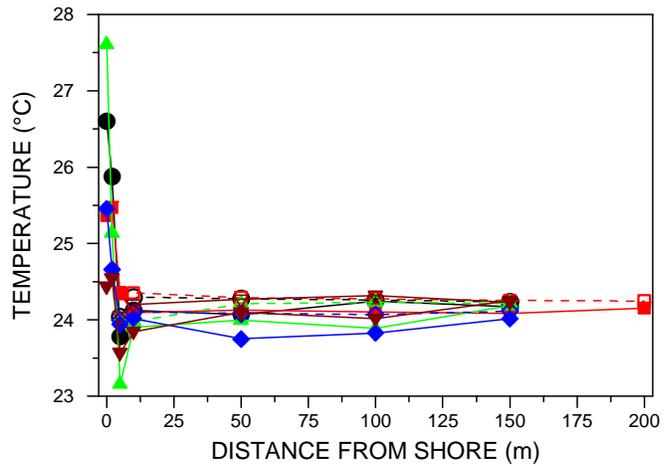
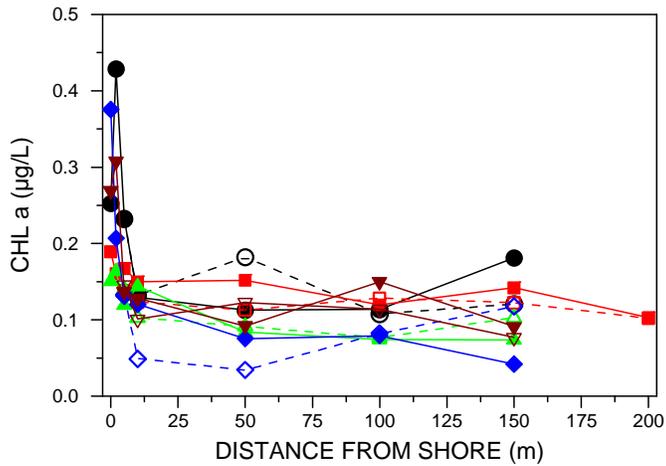
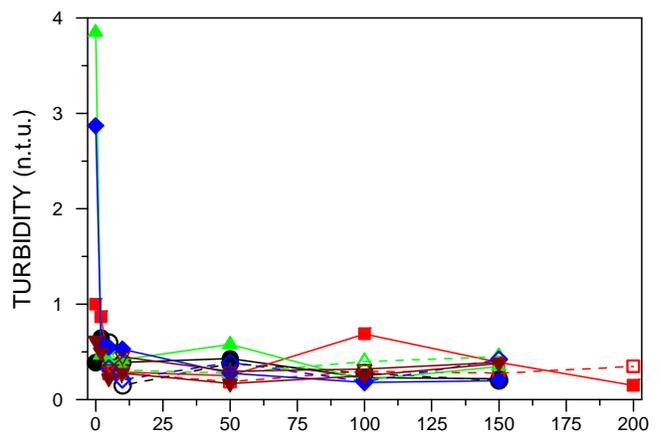
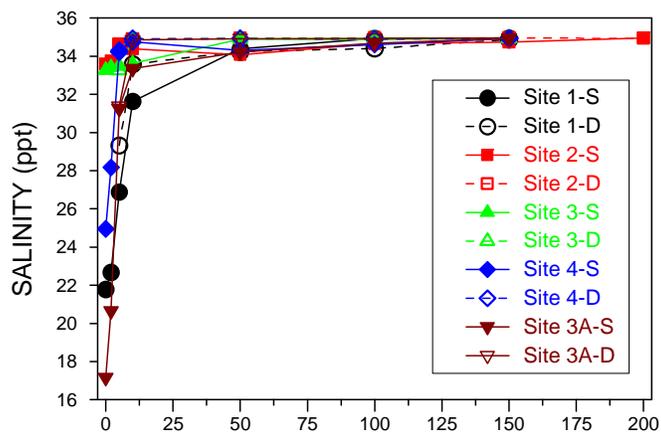


FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on April 22, 2012 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

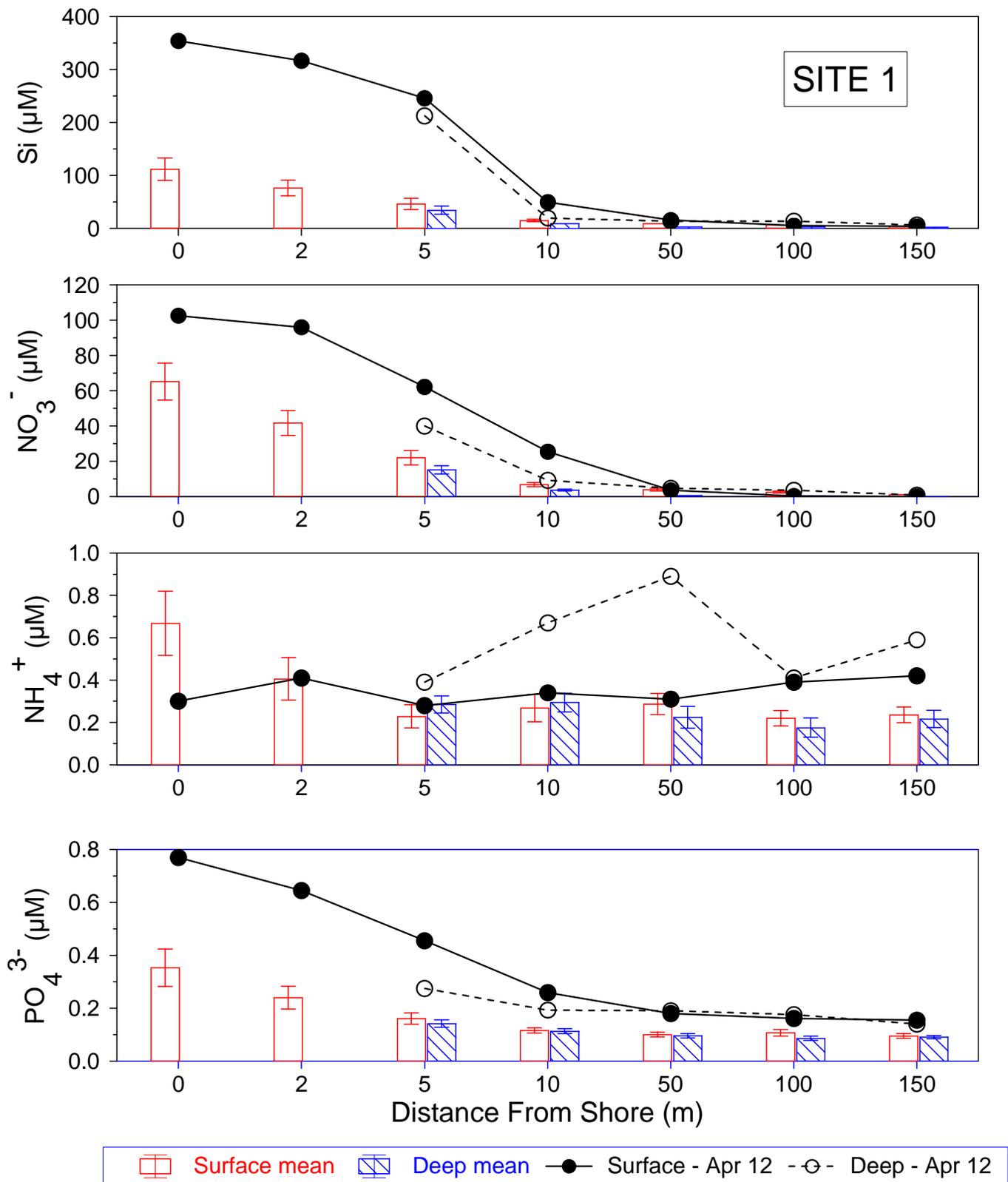


FIGURE 4. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

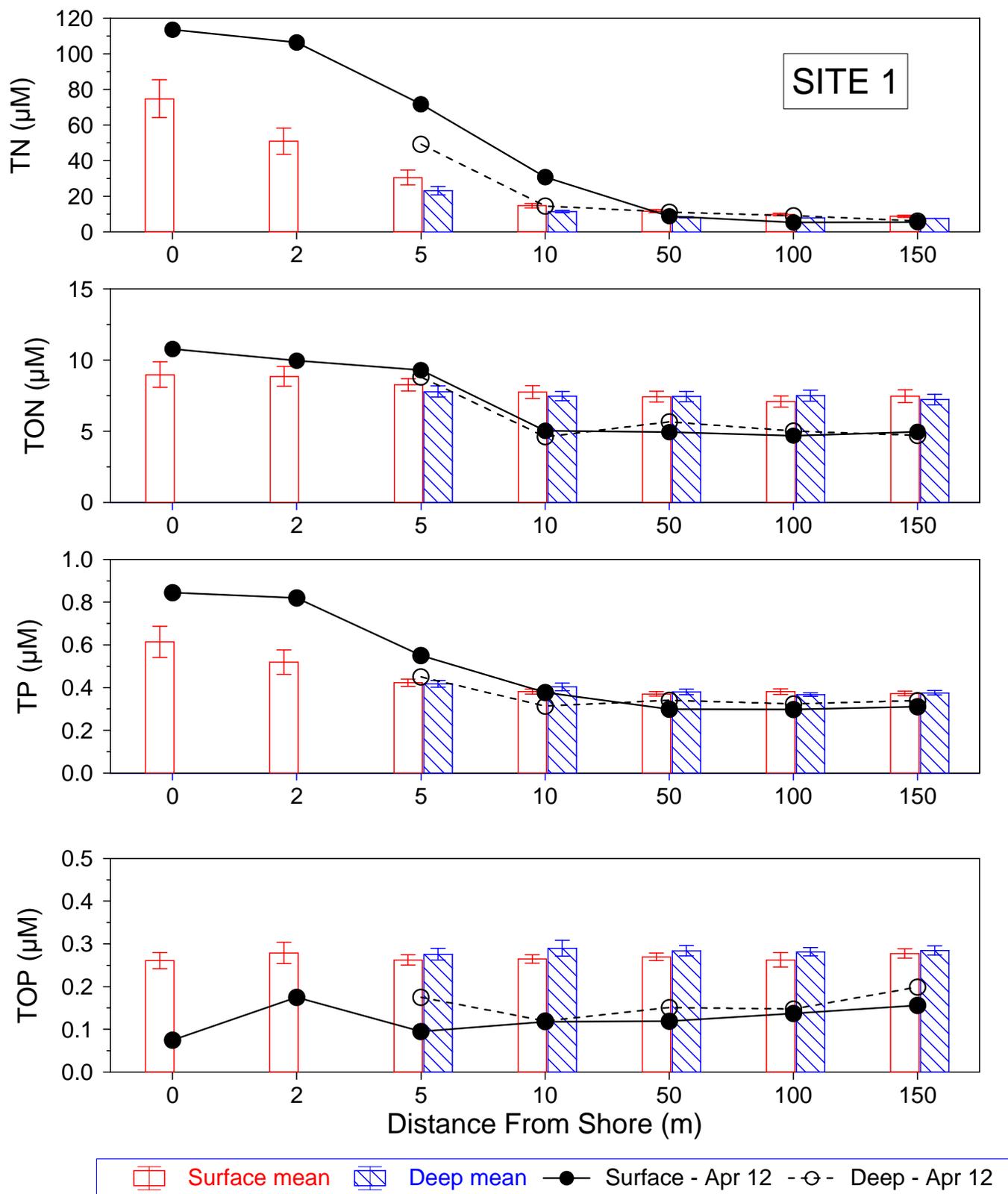


FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

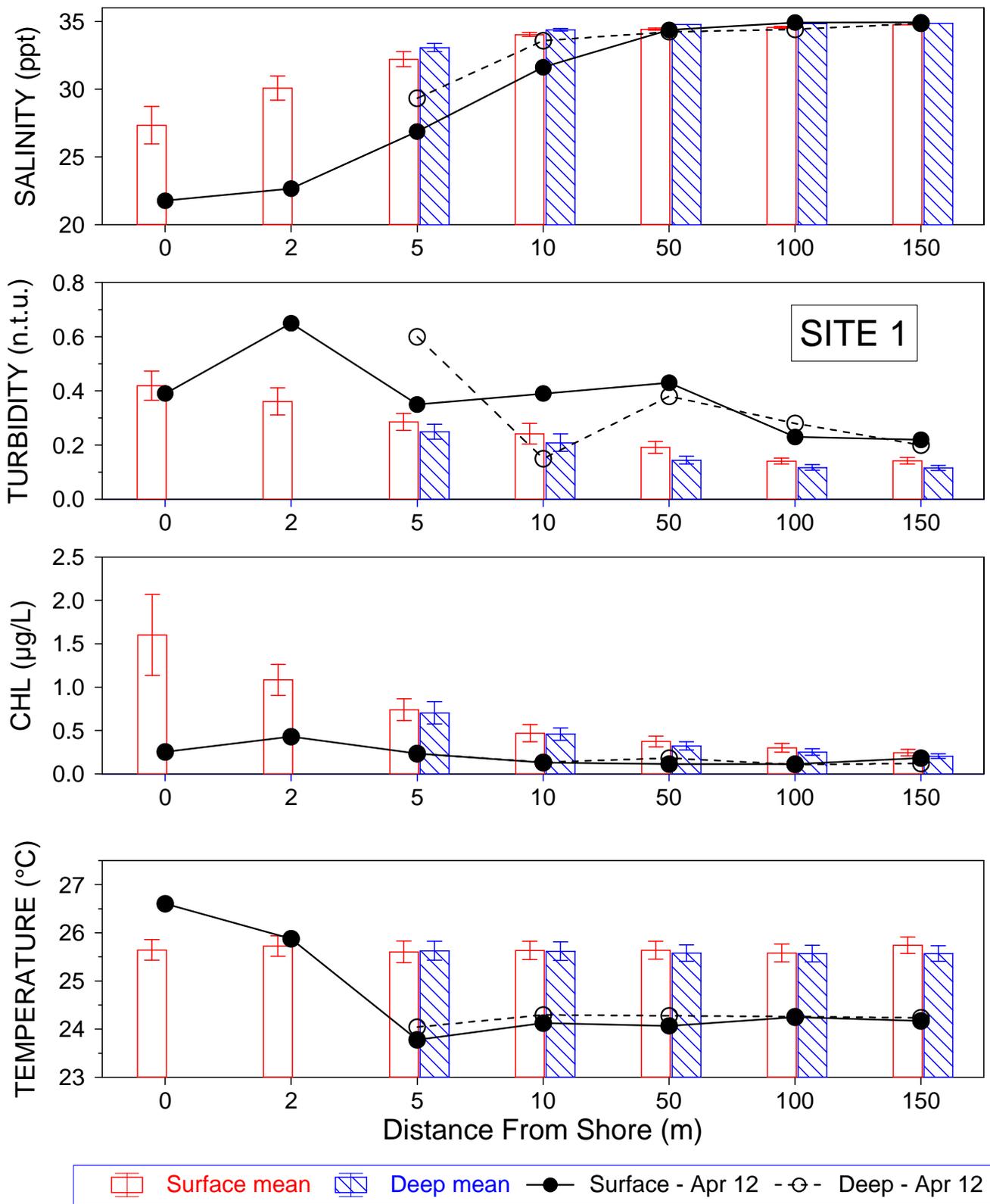


FIGURE 6. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

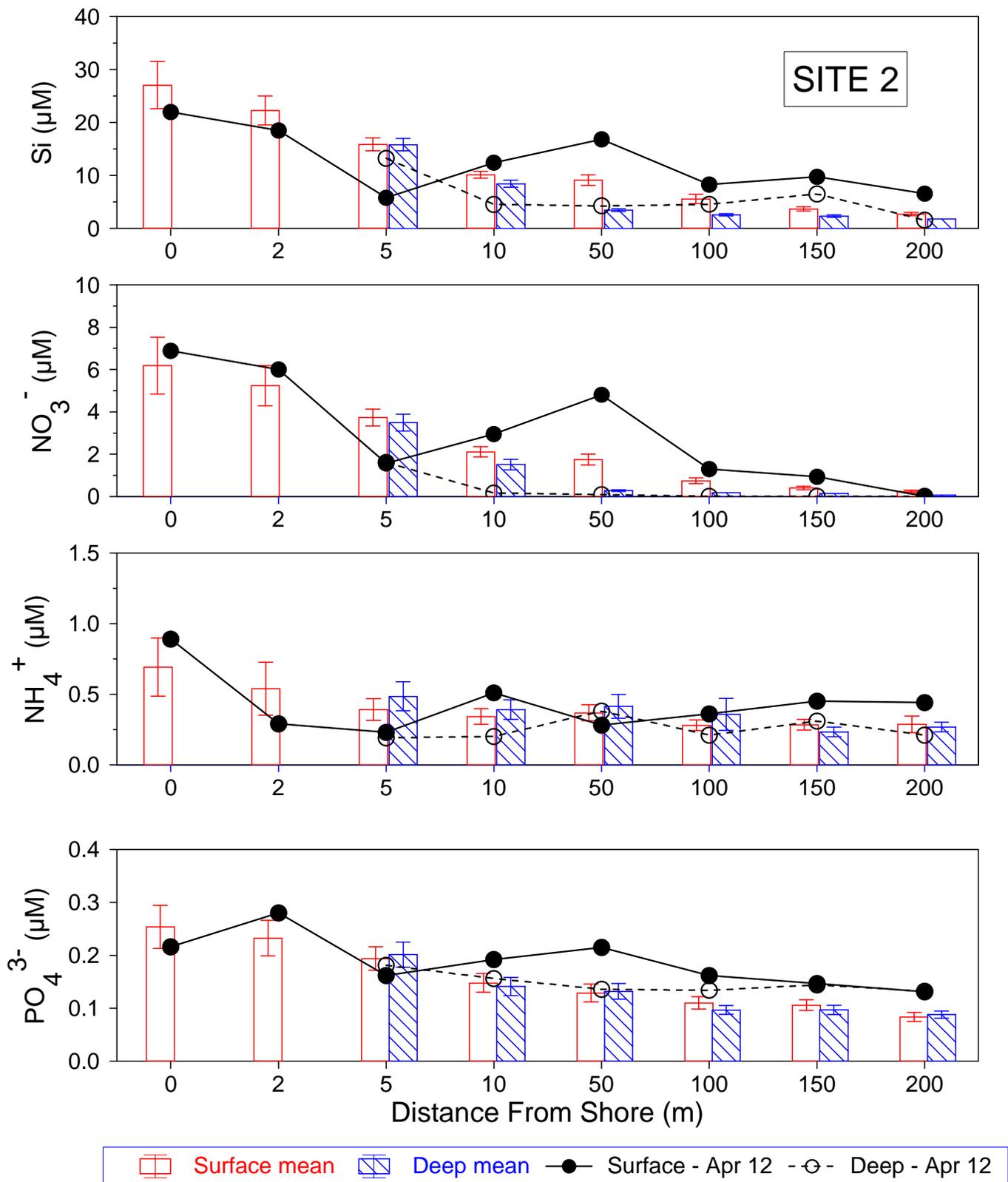


FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

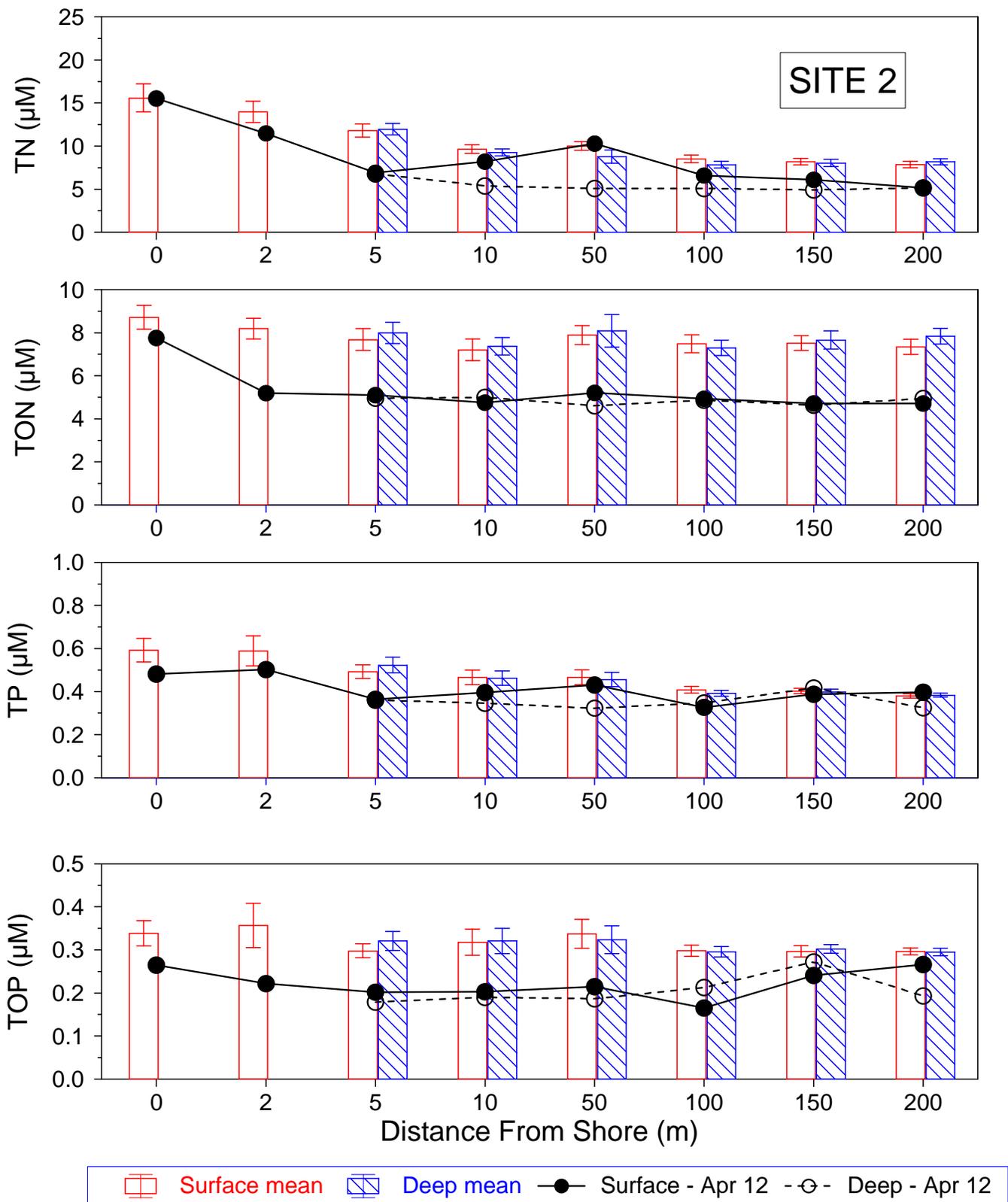


FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

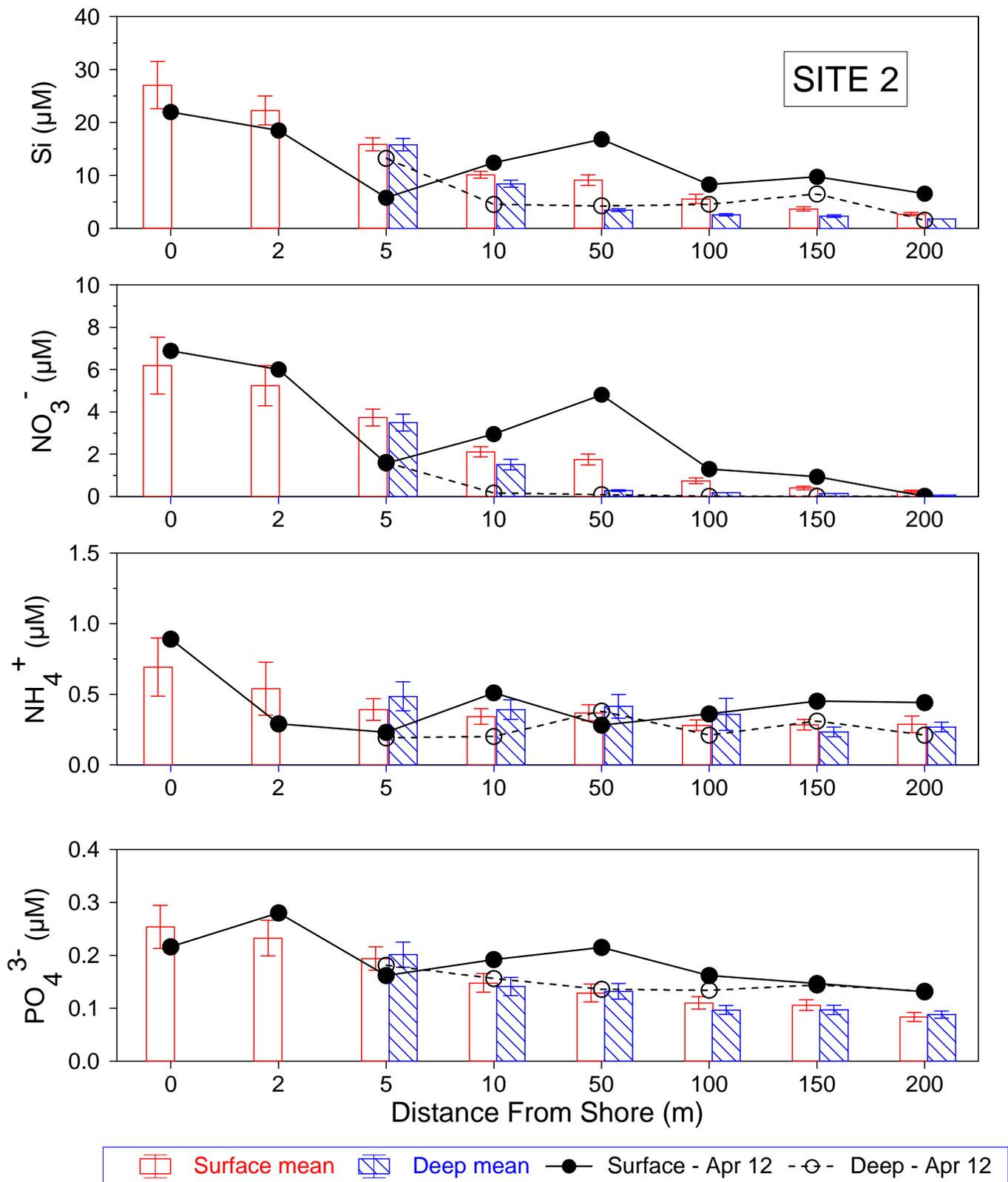


FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

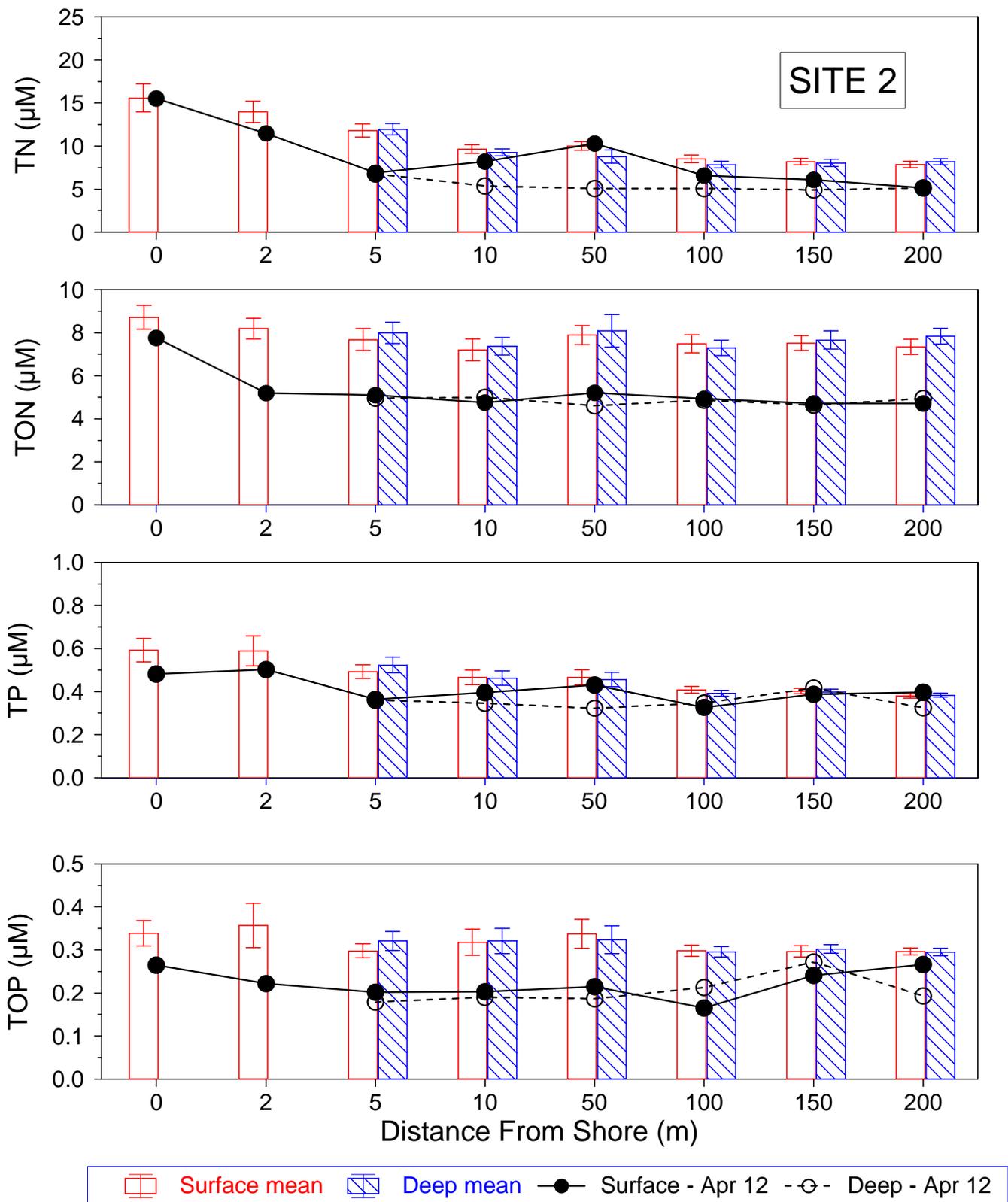


FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

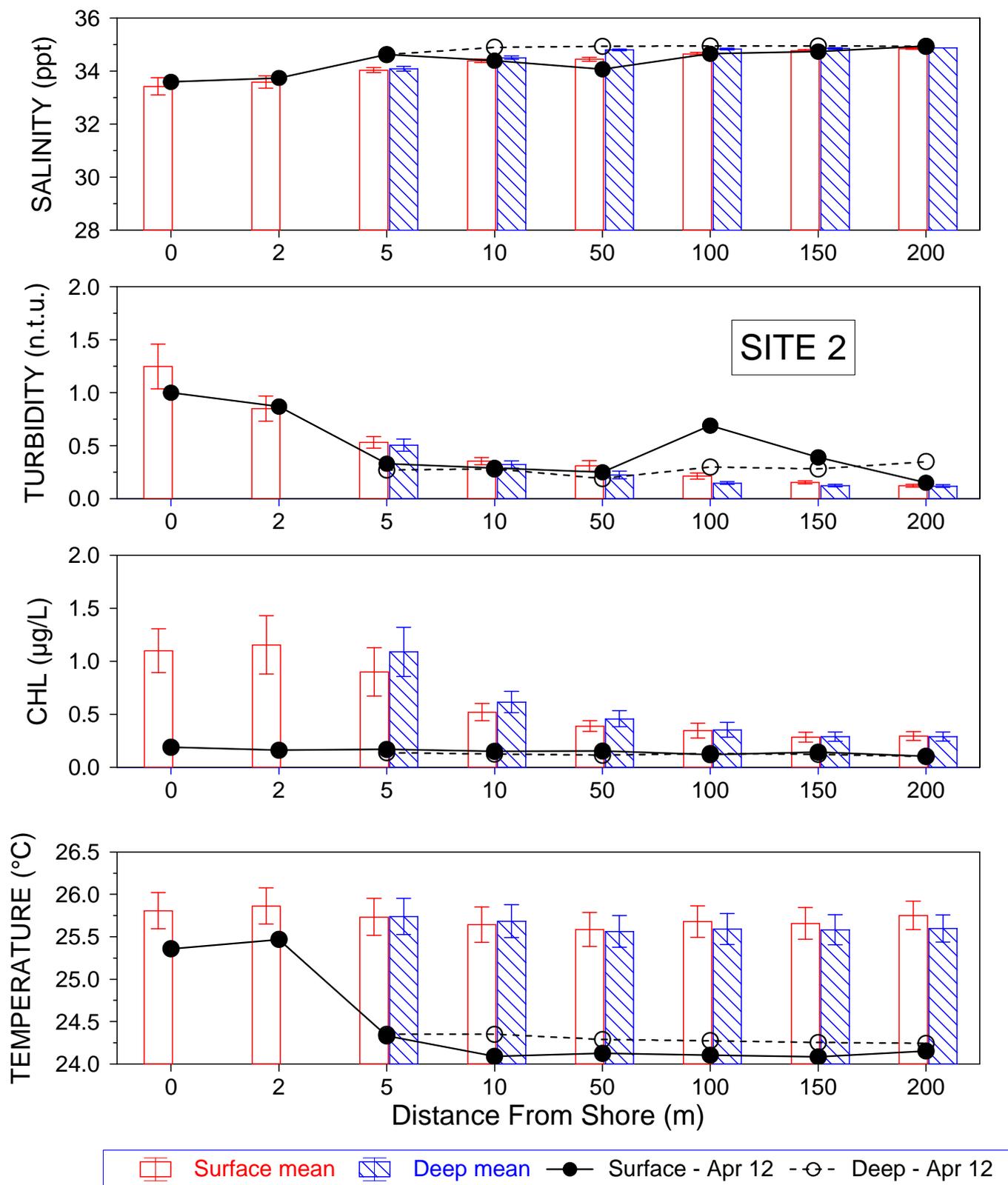


FIGURE 9. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

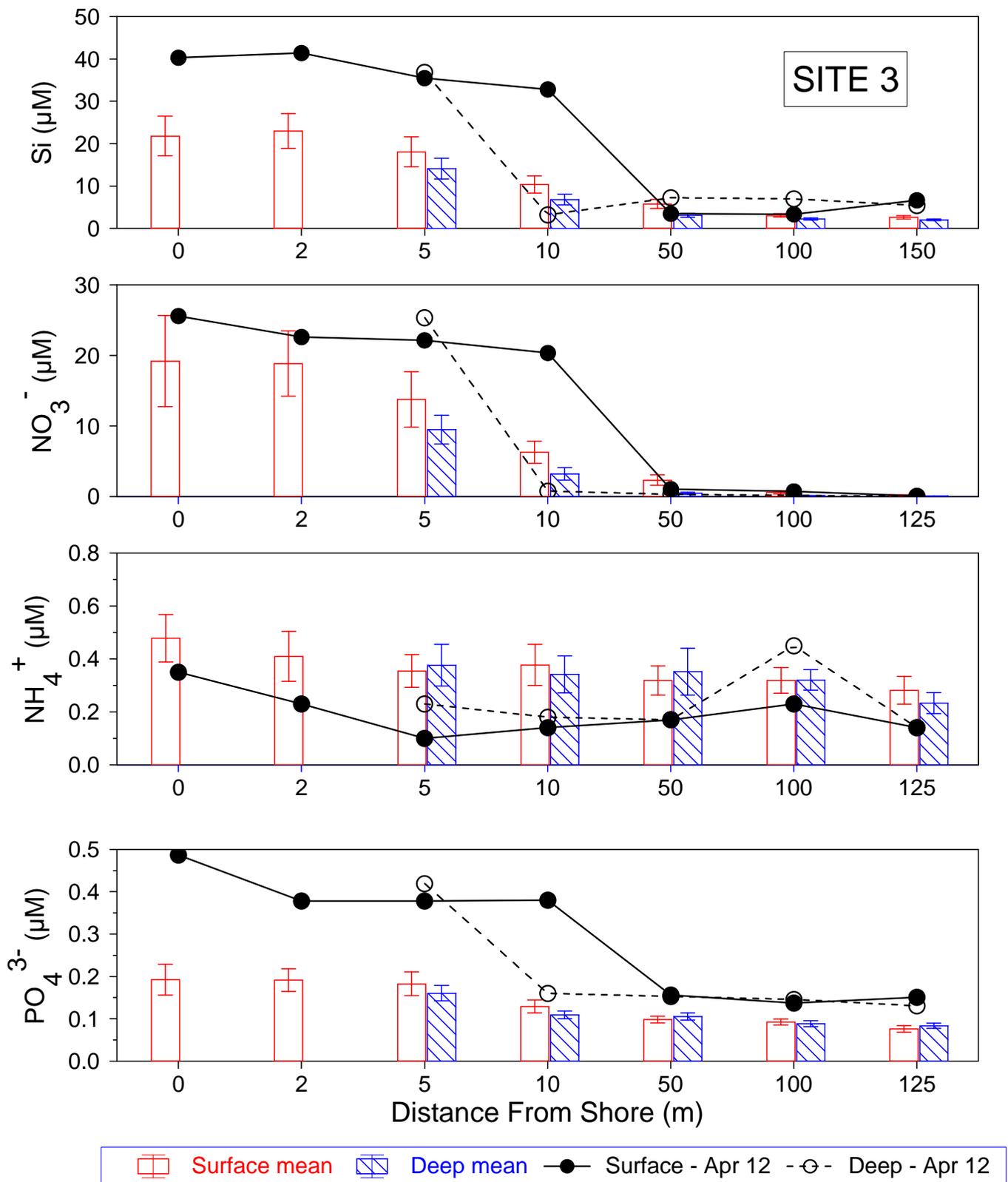


FIGURE 10. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

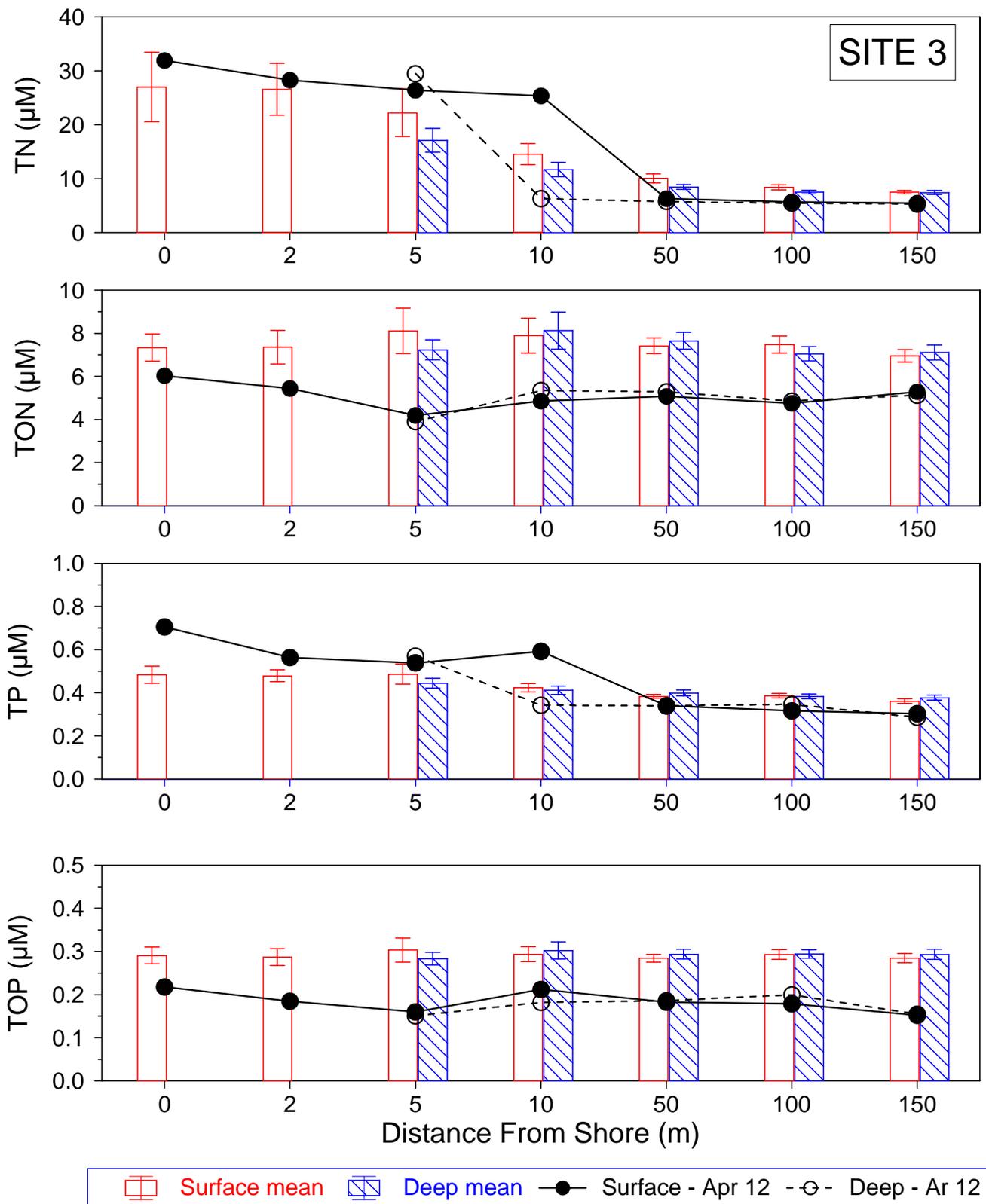


FIGURE 11. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

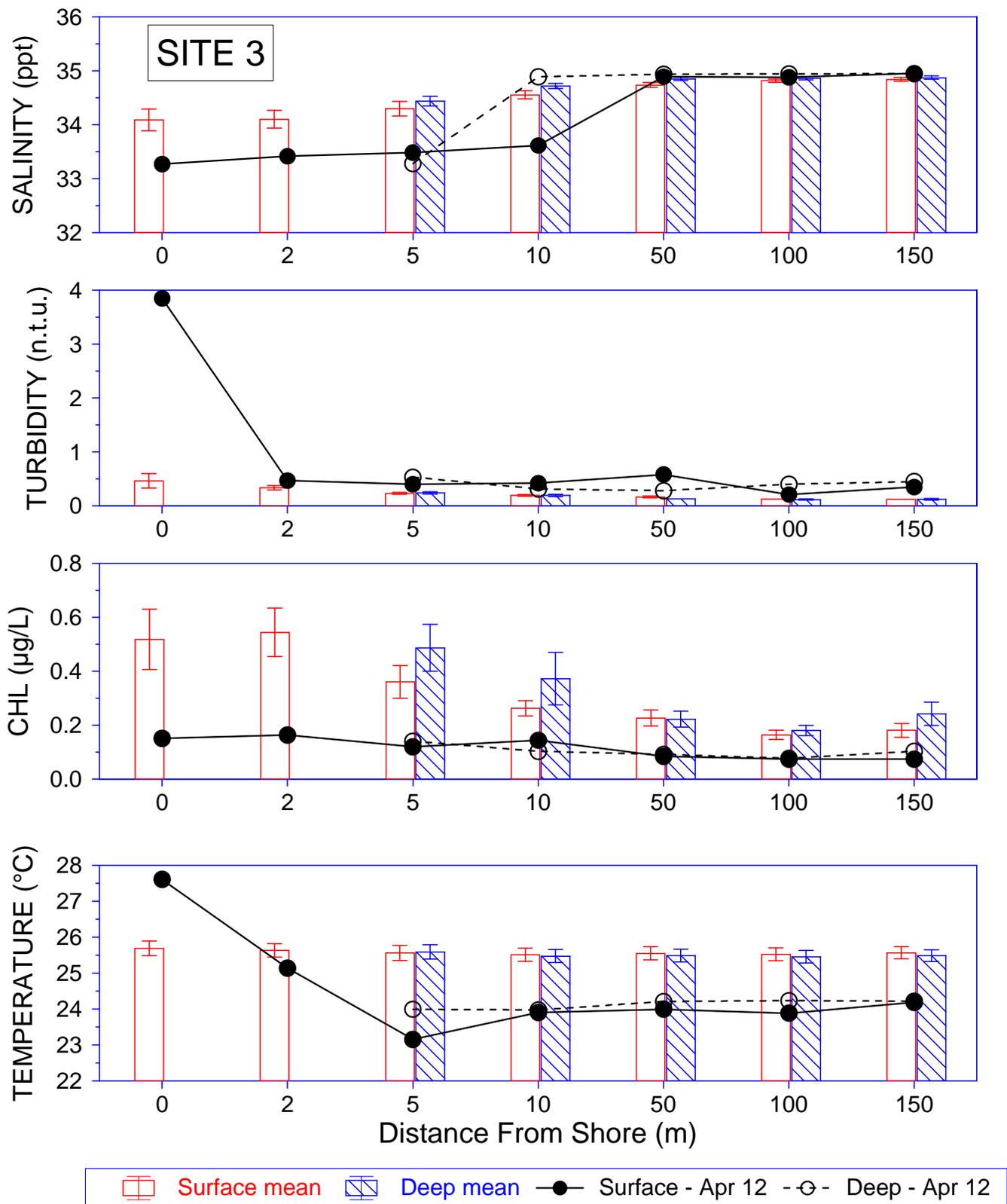


FIGURE 12. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

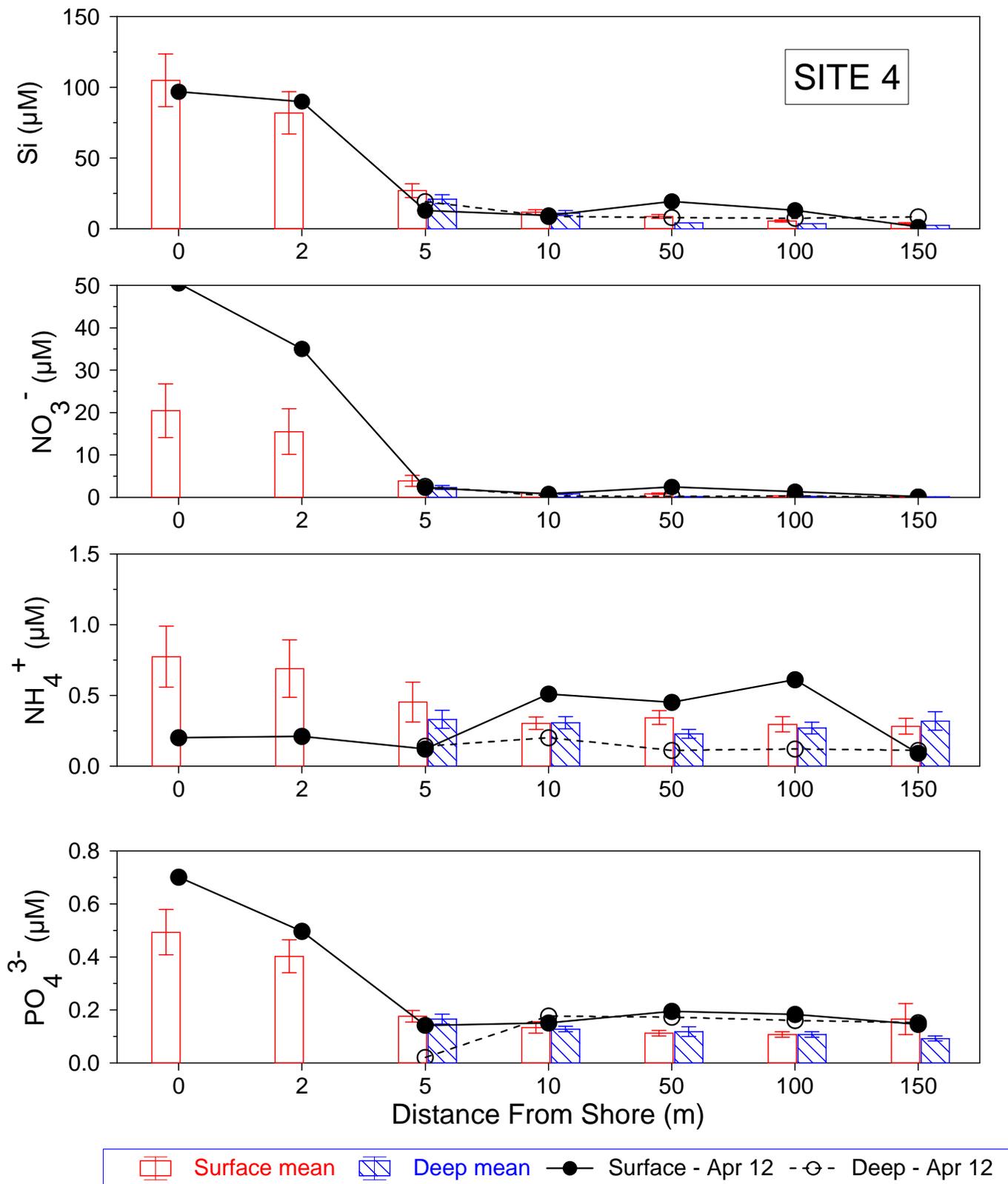


FIGURE 13. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

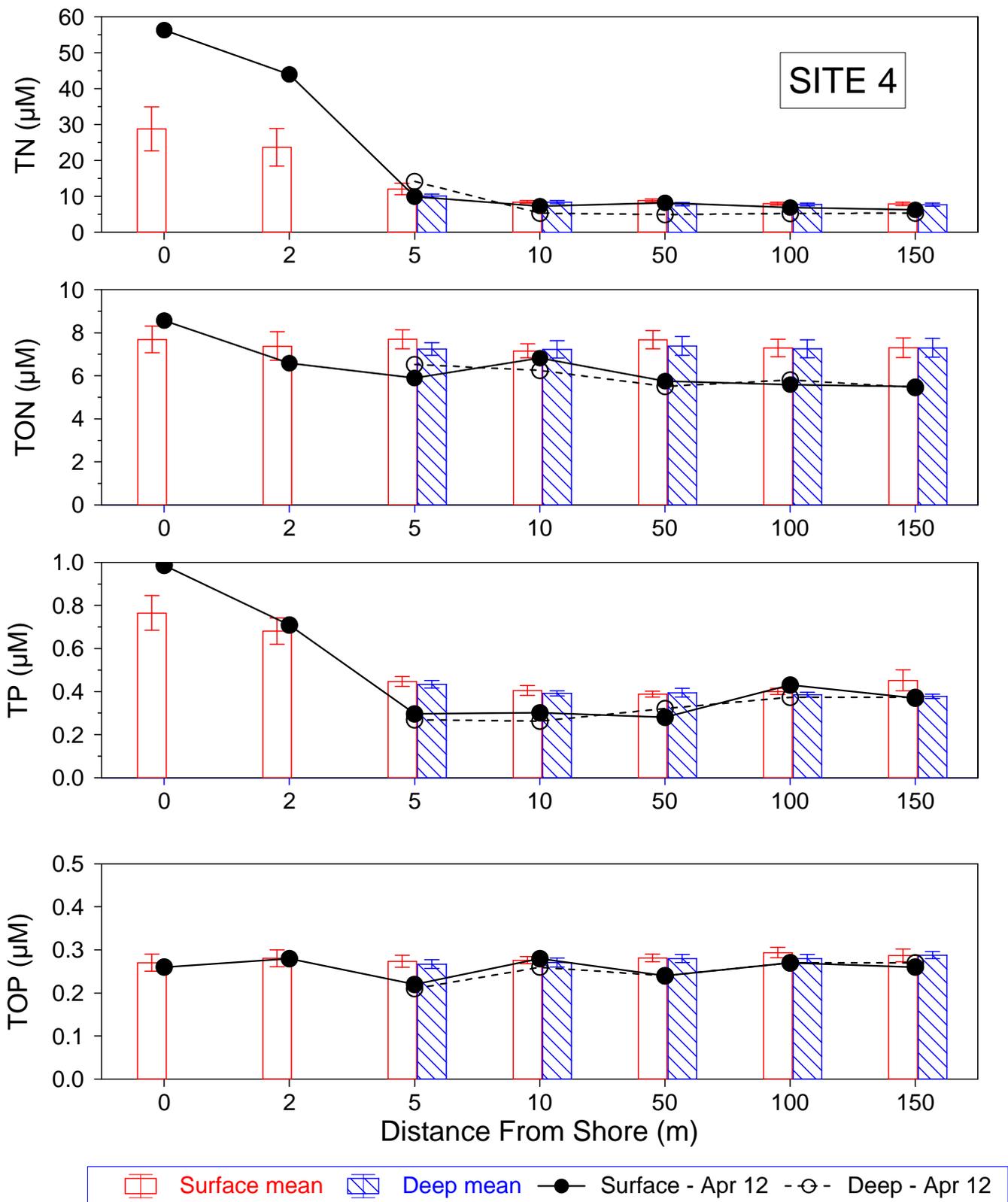


FIGURE 14. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

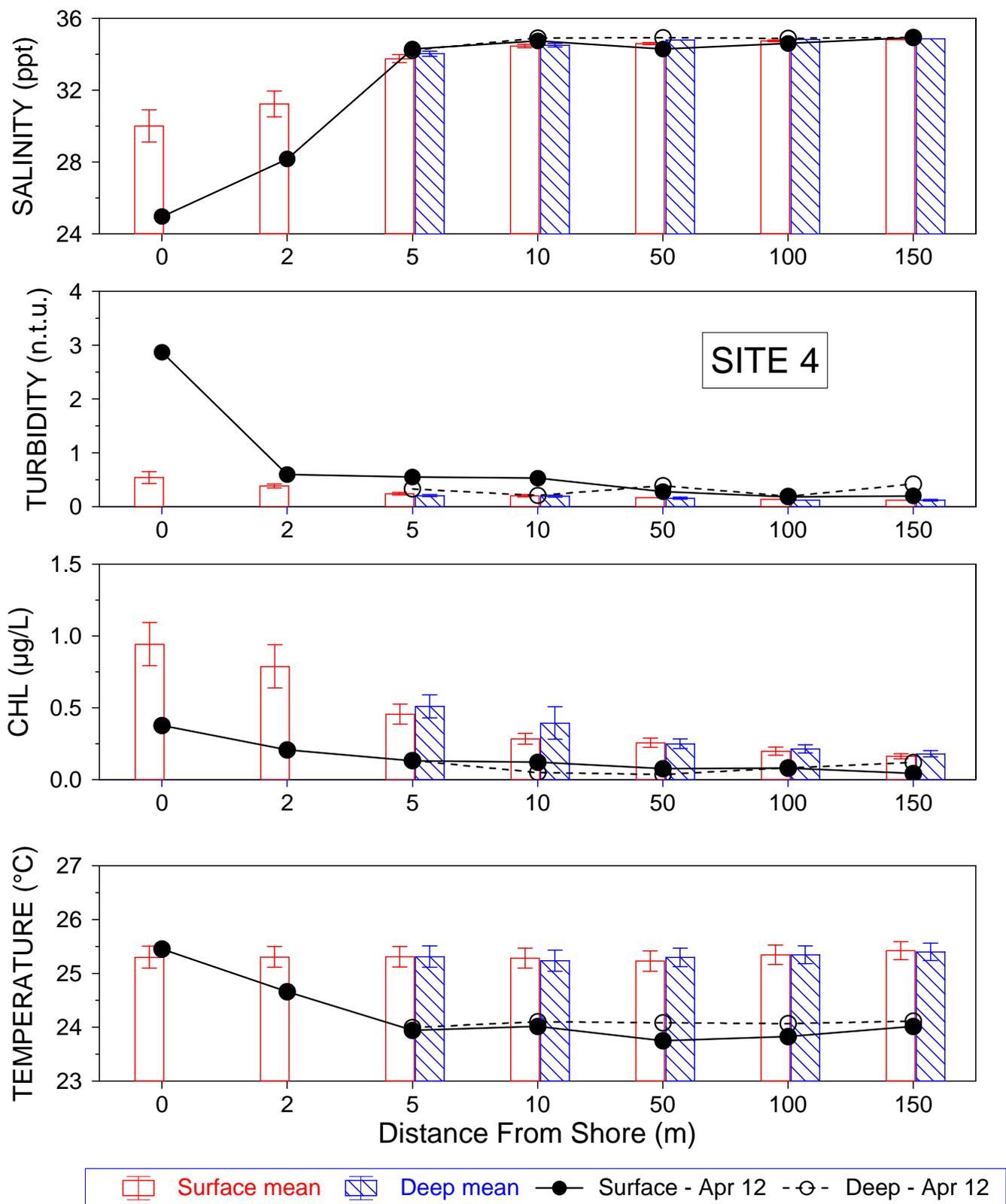


FIGURE 15. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=27). Error bars represent standard error of the mean. For site location, see Figure 1.

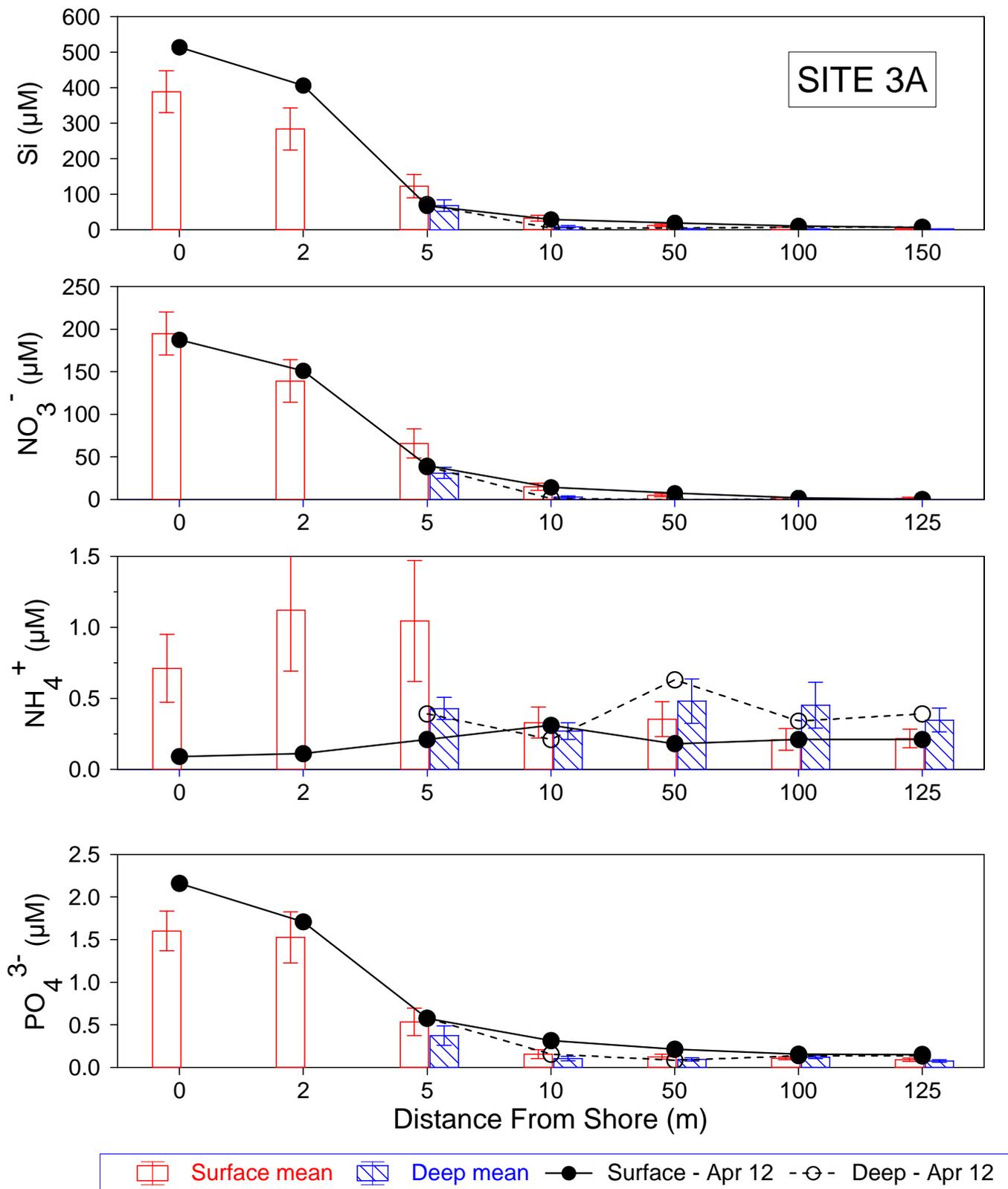


FIGURE 16. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=9). Error bars represent standard error of the mean. For site location, see Figure 1.

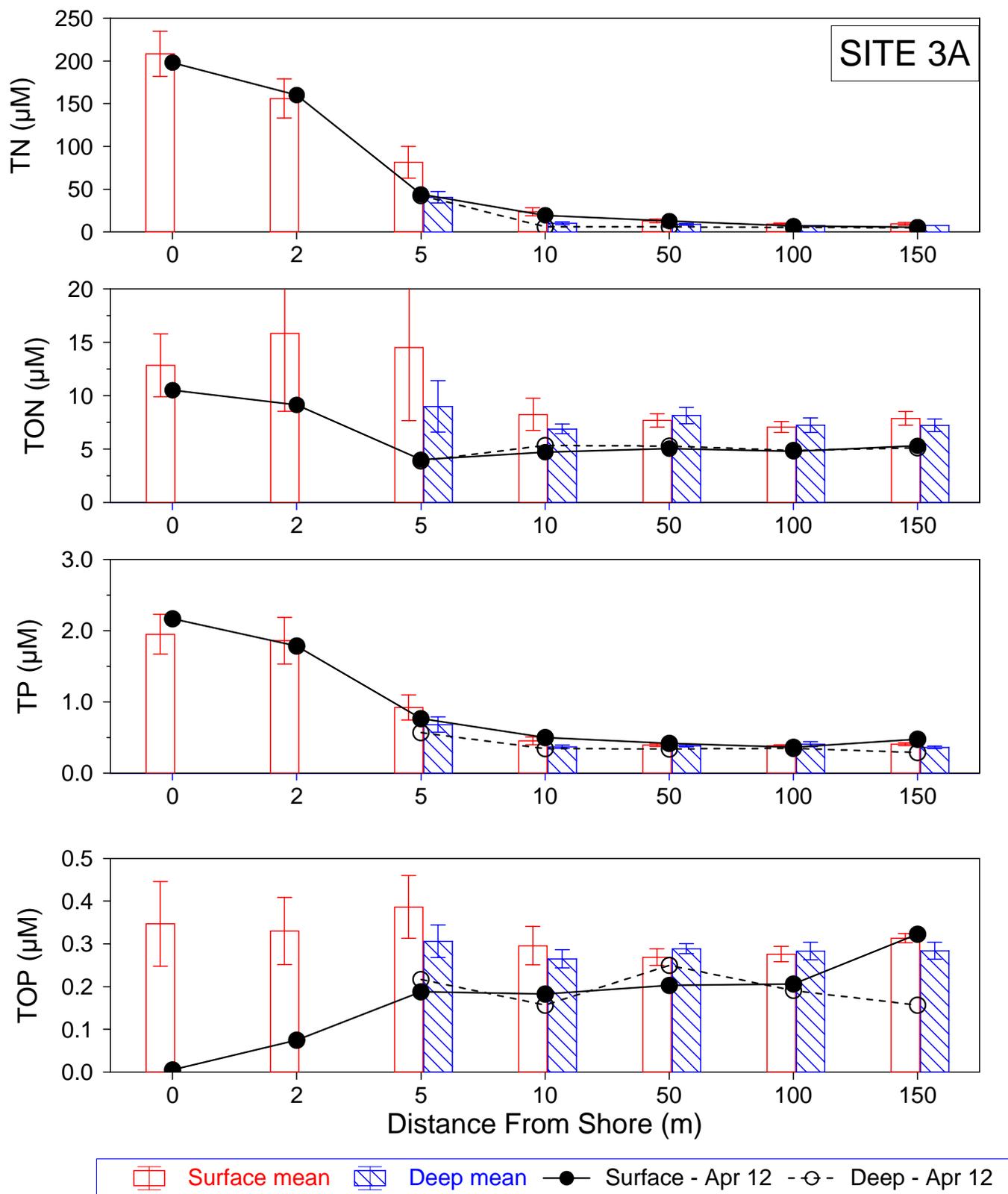


FIGURE 17. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=9). Error bars represent standard error of the mean. For site location, see Figure 1.

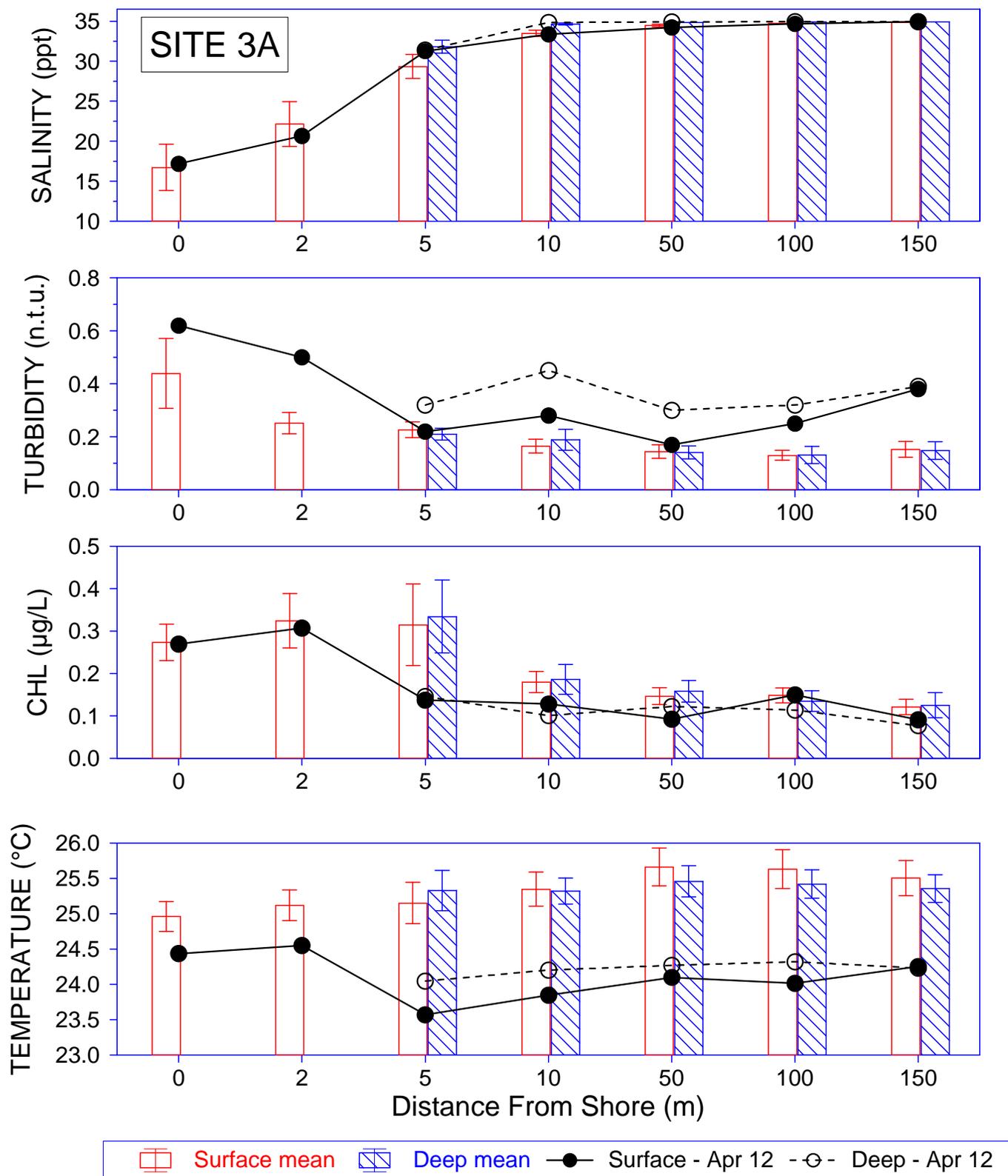


FIGURE 18. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=9). Error bars represent standard error of the mean. For site location, see Figure 1.

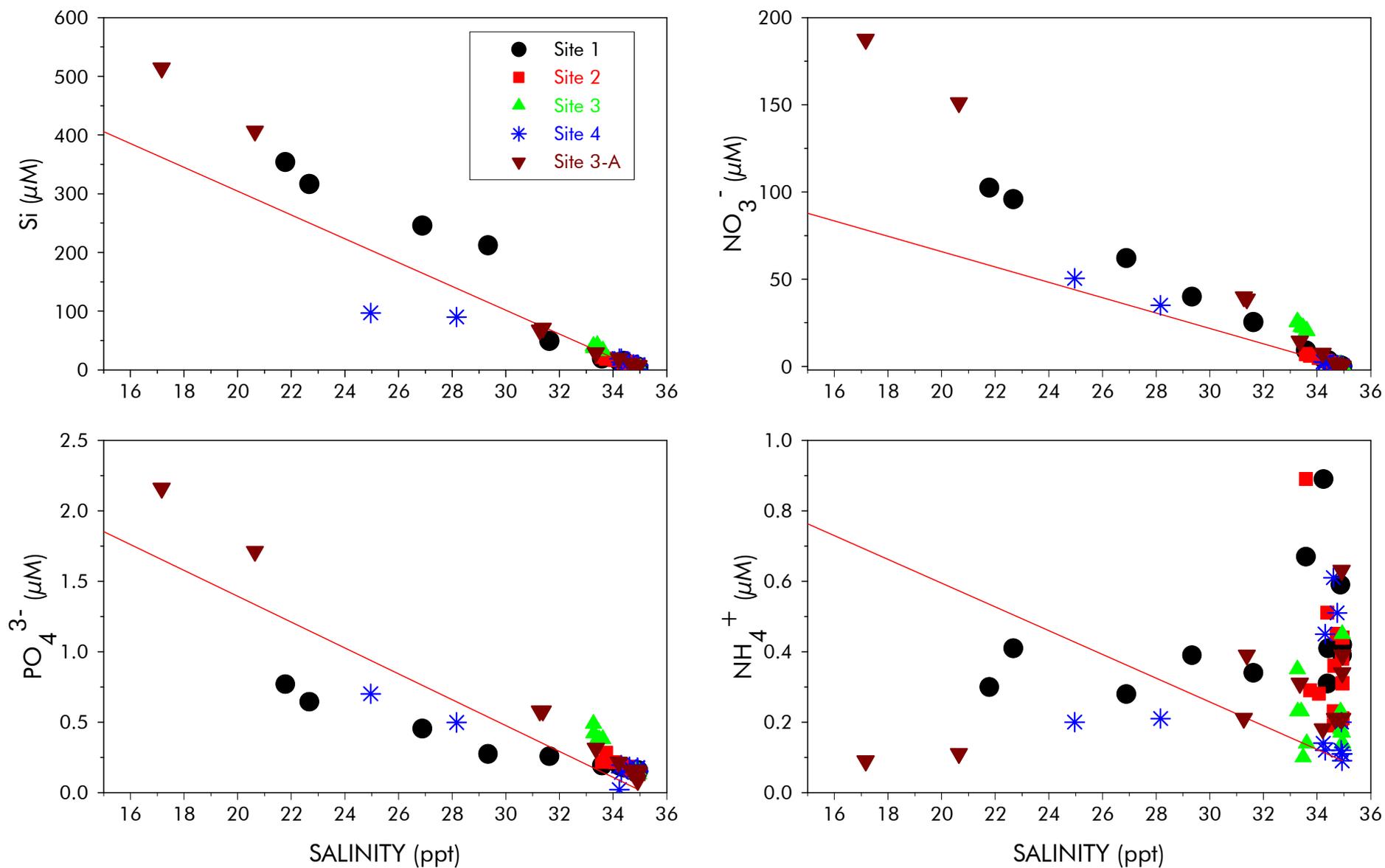


FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Makena Resort on April 12, 2012 as functions of salinity. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from an irrigation well upslope of the Makena Golf Courses. For sampling site locations, see Figure 1.

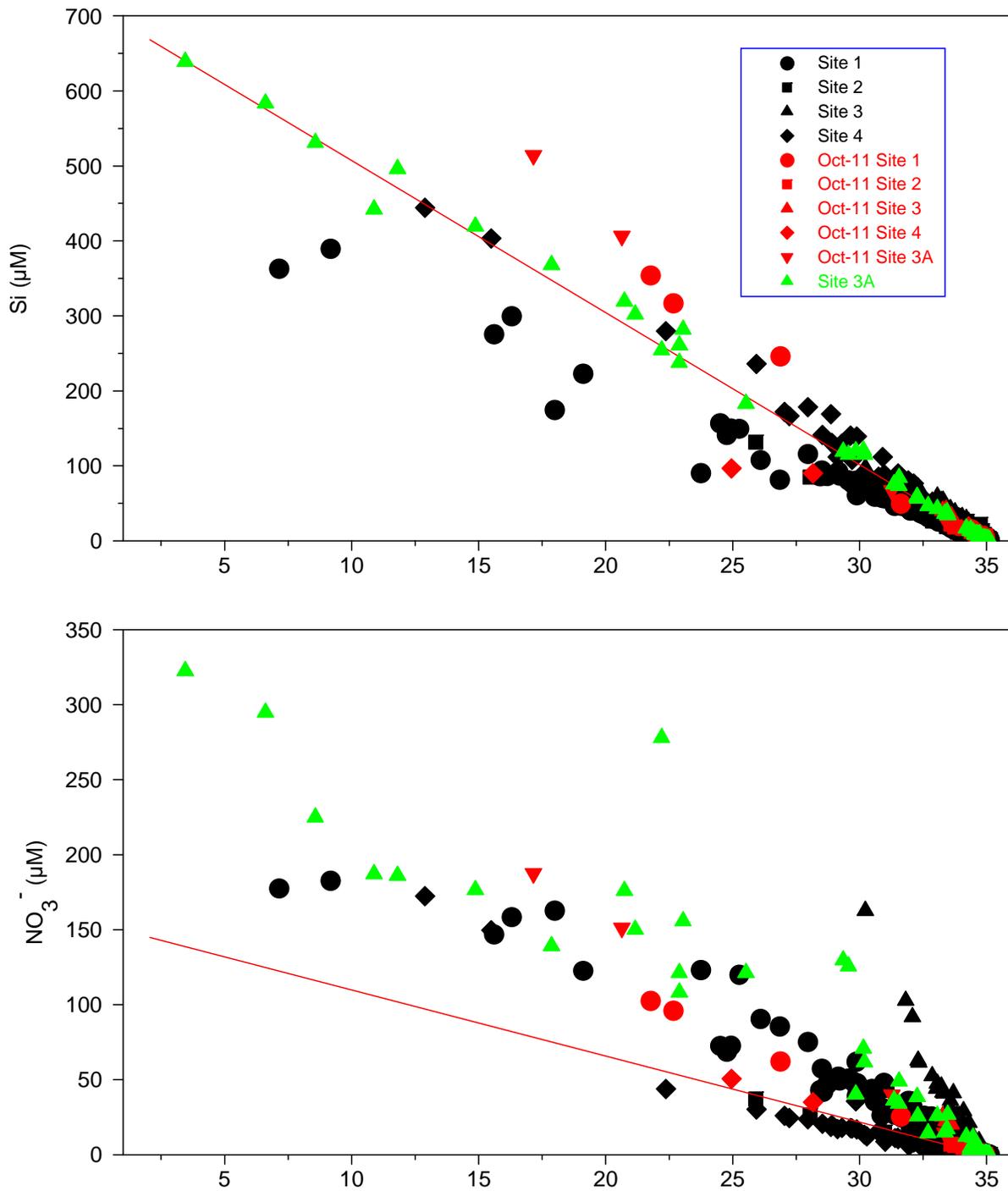


FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and October 2011. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

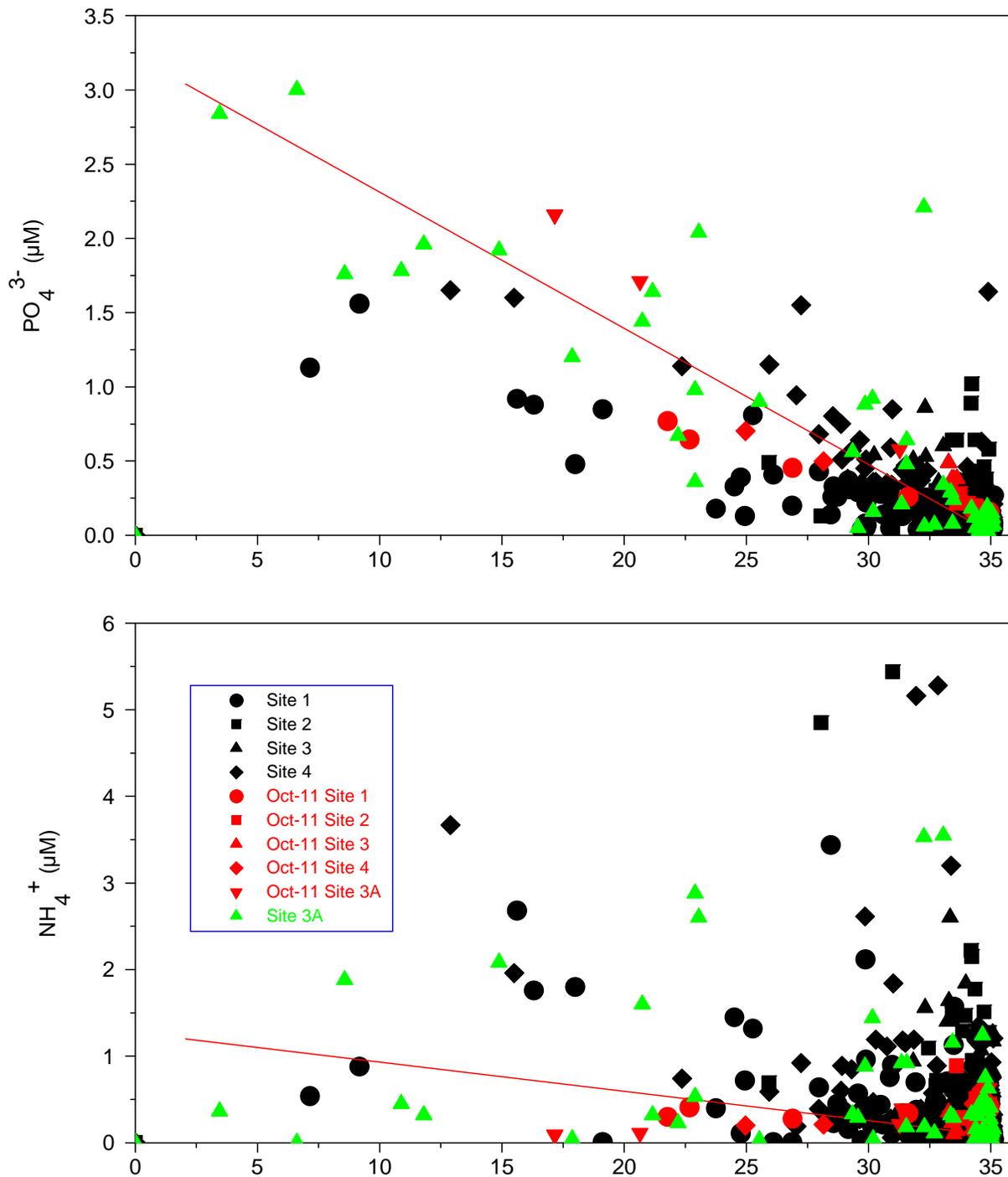


FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and October 2011. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

TABLE 6. Linear regression statistics (y-intercept and slope) of concentrations of silica as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to April 2012 (Transect Site 3 has been monitored since 2002; Transect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

SILICA -Y-INTERCEPT					SILICA - SLOPE				
YEAR	Coefficients	Std Err	Lower 95%	Upper 95%	YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1					SITE 1				
1995	522.34	12.18	491.03	553.66	1995	-15.08	0.38	-16.05	-14.12
1996	629.56	11.05	605.49	653.64	1996	-18.05	0.32	-18.75	-17.34
1997	504.17	2.83	496.89	511.46	1997	-14.43	0.08	-14.65	-14.21
1998	484.14	2.44	477.86	490.41	1998	-13.83	0.07	-14.02	-13.64
1999	479.11	9.89	457.55	500.66	1999	-13.63	0.29	-14.27	-12.99
2000	528.68	5.87	513.58	543.77	2000	-15.08	0.18	-15.54	-14.62
2001	625.85	10.91	597.82	653.88	2001	-17.76	0.32	-18.57	-16.94
2002	502.98	8.68	480.66	525.30	2002	-14.38	0.26	-15.05	-13.72
2003	625.85	10.91	597.82	653.88	2003	-17.76	0.32	-18.57	-16.94
2004	546.00	8.33	527.84	564.16	2004	-15.68	0.25	-16.23	-15.14
2005	466.59	11.09	442.42	490.75	2005	-13.31	0.33	-14.02	-12.61
2006	487.68	24.60	434.08	541.28	2006	-13.88	0.76	-15.53	-12.23
2007	491.19	34.99	414.95	567.42	2007	-14.11	1.14	-16.59	-11.62
2008	371.80	16.96	334.85	408.75	2008	-10.46	0.52	-11.59	-9.33
2009	457.28	10.01	431.54	483.02	2009	-12.98	0.30	-13.76	-12.20
2010	515.27	7.85	495.09	535.45	2010	-14.78	0.28	-15.49	-14.06
2011	464.80	5.70	452.37	477.22	2011	-13.13	0.18	-13.52	-12.74
2012	940.29	48.49	815.64	1064.94	2012	-26.98	1.61	-31.13	-22.84
Regslope	2.45	5.58	-9.39	14.29	Regslope	-0.07	0.16	-0.41	0.28
SITE 2					SITE 2				
1995	468.41	85.54	248.51	688.30	1995	-13.47	2.51	-19.93	-7.00
1996	549.09	177.83	164.91	933.28	1996	-15.62	5.15	-26.75	-4.49
1997	567.57	9.71	543.80	591.33	1997	-16.26	0.29	-16.96	-15.56
1998	563.20	37.23	472.10	654.30	1998	-16.11	1.08	-18.76	-13.45
1999	466.74	95.75	261.37	672.11	1999	-13.21	2.78	-19.18	-7.23
2000	770.15	27.32	703.31	837.00	2000	-22.06	0.80	-24.02	-20.11
2001	1254.31	74.17	1072.82	1435.81	2001	-35.68	2.12	-40.87	-30.49
2002	577.53	29.40	505.60	649.46	2002	-16.54	0.86	-18.64	-14.44
2003	505.05	20.10	461.94	548.15	2003	-14.37	0.59	-15.63	-13.11
2004	565.31	93.71	364.33	766.29	2004	-16.23	2.73	-22.09	-10.38
2005	339.08	33.78	266.64	411.52	2005	-9.61	0.98	-11.70	-7.52
2006	553.48	62.93	418.51	688.45	2006	-15.82	1.83	-19.75	-11.89
2007	443.05	17.15	406.27	479.84	2007	-12.54	0.51	-13.64	-11.45
2008	402.41	73.66	244.42	560.41	2008	-11.41	2.14	-15.99	-6.83
2009	501.76	9.02	479.69	523.82	2009	-14.32	0.27	-14.98	-13.66
2010	490.17	22.77	434.46	545.87	2010	-13.97	0.67	-15.61	-12.33
2011	501.35	17.35	464.13	538.56	2011	-14.24	0.50	-15.31	-13.16
2012	411.67	48.31	293.48	529.87	2012	-11.62	1.41	-15.06	-8.18
Regslope	-10.72	8.88	-29.54	8.10	Regslope	0.31	0.25	-0.22	0.85
SITE 3A					SITE 3A				
2007	714.10	5.58	701.94	726.27	2007	-20.35	0.19	-20.75	-19.94
2008	805.12	9.00	785.52	824.73	2008	-22.96	0.28	-23.57	-22.36
2009	646.37	7.80	626.32	666.43	2009	-18.28	0.26	-18.96	-17.61
2010	750.91	5.70	736.26	765.56	2010	-21.44	0.19	-21.94	-20.94
2011	715.44	5.06	704.42	726.45	2011	-20.35	0.17	-20.72	-19.99
2012	1005.34	28.55	931.95	1078.73	2012	-29.01	0.94	-31.44	-26.59
Regslope	36.90	27.90	-40.56	114.36	Regslope	-1.10	0.83	-3.41	1.20
SITE 3					SITE 3				
2002	931.92	27.54	861.13	1002.71	2002	-26.75	0.81	-28.83	-24.68
2003	984.76	41.58	894.16	1075.35	2003	-28.10	1.21	-30.73	-25.47
2004	632.75	127.62	354.68	910.82	2004	-18.19	3.69	-26.24	-10.14
2005	704.38	52.31	590.40	818.35	2005	-20.11	1.51	-23.40	-16.83
2006	928.22	64.18	788.40	1068.05	2006	-26.56	1.89	-30.67	-22.46
2007	722.80	15.07	689.97	755.63	2007	-20.60	0.44	-21.56	-19.63
2008	1058.06	48.59	952.18	1163.94	2008	-30.22	1.41	-33.29	-27.14
2009	943.91	40.06	840.94	1046.89	2009	-26.90	1.17	-29.90	-23.91
2010	962.57	74.39	771.34	1153.79	2010	-27.56	2.19	-33.18	-21.93
2011	880.51	26.78	822.17	938.85	2011	-25.06	0.77	-26.74	-23.37
2012	792.34	42.16	683.97	900.71	2012	-22.57	1.24	-25.75	-19.39
Regslope	4.40	13.45	-26.03	34.82	Regslope	-0.11	0.38	-0.98	0.76
SITE 4					SITE 4				
1995	710.45	8.83	687.74	733.15	1995	-20.55	0.27	-21.25	-19.85
1996	917.33	13.38	888.18	946.47	1996	-26.23	0.40	-27.10	-25.37
1997	776.74	3.53	767.66	785.82	1997	-22.27	0.11	-22.55	-21.99
1998	841.35	6.75	824.00	858.70	1998	-24.07	0.20	-24.58	-23.56
1999	823.63	24.78	769.63	877.62	1999	-23.50	0.73	-25.10	-21.90
2000	946.97	12.51	914.80	979.14	2000	-27.12	0.37	-28.08	-26.16
2001	1403.91	260.13	735.22	2072.61	2001	-39.92	7.42	-58.99	-20.86
2002	767.85	4.37	756.63	779.08	2002	-21.99	0.13	-22.34	-21.65
2003	854.37	29.88	789.26	919.48	2003	-24.36	0.91	-26.34	-22.39
2004	843.49	37.55	761.67	925.31	2004	-24.27	1.10	-26.66	-21.88
2005	703.97	14.00	673.47	734.46	2005	-20.11	0.41	-21.00	-19.22
2006	735.05	14.01	704.53	765.57	2006	-20.96	0.41	-21.86	-20.06
2007	710.11	7.14	694.56	725.66	2007	-20.27	0.23	-20.77	-19.78
2008	712.32	18.22	672.63	752.01	2008	-20.33	0.53	-21.49	-19.17
2009	715.30	7.99	694.75	735.84	2009	-20.34	0.24	-20.95	-19.73
2010	673.09	6.27	656.98	689.21	2010	-19.14	0.19	-19.62	-18.66
2011	688.21	7.10	672.74	703.68	2011	-19.57	0.21	-20.03	-19.11
2012	353.00	29.28	277.74	428.26	2012	-9.86	0.90	-12.17	-7.54
Regslope	-19.04	8.06	-36.12	-1.97	Regslope	0.56	0.23	0.07	1.04

TABLE 7. Linear regression statistics (y-intercept and slope) of concentrations of nitrate as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to April 2012 (Transect Site 3 has been monitored since 2002; Transect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

NITRATE -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	326.50	7.10	308.25	344.75
1996	336.49	4.62	326.41	346.56
1997	406.96	1.93	402.00	411.93
1998	268.90	1.55	264.91	272.89
1999	225.24	5.32	213.66	236.83
2000	309.77	3.36	301.14	318.41
2001	336.53	9.69	311.61	361.44
2002	278.21	17.43	233.40	323.03
2003	421.29	7.81	404.28	438.30
2004	442.33	4.89	431.68	452.99
2005	296.36	7.44	280.16	312.56
2006	361.76	7.20	346.08	377.45
2007	305.06	15.88	270.45	339.67
2008	330.95	7.18	315.29	346.60
2009	231.91	3.07	224.01	239.81
2010	253.63	4.57	241.88	265.38
2011	235.52	6.82	220.66	250.37
2012	272.66	0.94	270.26	275.07
REGSLOPE	-3.83	2.85	-9.88	2.22

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 2				
1995	119.87	12.03	88.95	150.79
1996	106.36	18.44	66.53	146.19
1997	193.75	5.64	179.95	207.55
1998	166.93	5.33	153.89	179.97
1999	116.21	14.04	86.10	146.32
2000	142.07	2.83	135.13	149.01
2001	154.93	7.65	136.21	173.64
2002	180.82	58.78	36.98	324.66
2003	163.36	6.31	149.82	176.91
2004	145.36	10.55	122.74	167.99
2005	102.66	9.11	83.13	122.19
2006	124.74	4.89	114.26	135.22
2007	134.27	3.25	127.30	141.24
2008	108.01	12.87	80.41	135.61
2009	142.21	9.04	120.08	164.34
2010	135.27	10.49	109.60	160.94
2011	166.23	6.33	152.64	179.81
2012	180.39	4.91	168.38	192.41
REGSLOPE	0.37	1.29	-2.36	3.11

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3A				
2007	354.33	49.92	245.56	463.11
2008	448.07	7.75	431.19	464.95
2009	283.99	14.63	246.38	321.60
2010	283.25	1.86	278.48	288.02
2011	364.51	5.48	352.58	376.45
2012	369.69	1.88	364.84	374.53
REGSLOPE	-4.99	16.30	-50.26	40.28

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3				
2002	847.45	52.35	712.88	982.01
2003	693.24	39.54	607.10	779.38
2004	463.72	90.73	266.04	661.40
2005	535.53	47.19	432.72	638.34
2006	856.96	48.22	751.91	962.02
2007	1233.34	18.23	1193.63	1273.06
2008	899.91	41.92	808.57	991.25
2009	827.18	19.10	778.08	876.29
2010	924.44	35.54	833.09	1015.80
2011	936.86	87.11	747.07	1126.65
2012	527.25	5.85	512.22	542.28
REGSLOPE	12.56	22.23	-37.73	62.86

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 4				
1995	111.38	6.47	94.74	128.02
1996	118.34	1.63	114.79	121.89
1997	122.56	1.29	119.25	125.88
1998	112.77	1.87	107.97	117.57
1999	109.13	3.30	101.94	116.33
2000	118.51	0.75	116.58	120.43
2001	100.93	54.85	-40.08	241.94
2002	118.91	3.25	110.56	127.25
2003	113.78	2.76	107.77	119.79
2004	134.97	4.64	124.86	145.07
2005	114.59	4.47	104.85	124.33
2006	119.85	1.76	116.03	123.68
2007	269.24	10.13	247.16	291.32
2008	62.93	4.05	54.11	71.74
2009	107.17	1.51	103.30	111.04
2010	148.96	16.96	105.35	192.57
2011	126.90	2.74	120.94	132.87
2012	178.94	1.78	174.38	183.51
REGSLOPE	2.37	1.88	-1.60	6.35

NITRATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-9.49	0.22	-10.05	-8.92
1996	-9.67	0.14	-9.97	-9.38
1997	-11.70	0.06	-11.85	-11.55
1998	-7.72	0.05	-7.84	-7.60
1999	-6.44	0.16	-6.79	-6.10
2000	-8.91	0.10	-9.17	-8.65
2001	-9.60	0.28	-10.32	-8.88
2002	-7.99	0.52	-9.31	-6.66
2003	-12.09	0.23	-12.60	-11.58
2004	-12.74	0.15	-13.06	-12.42
2005	-8.48	0.22	-8.96	-8.01
2006	-10.40	0.22	-10.89	-9.92
2007	-8.73	0.52	-9.86	-7.60
2008	-9.52	0.22	-10.00	-9.05
2009	-6.65	0.09	-6.89	-6.41
2010	-7.31	0.16	-7.72	-6.89
2011	-6.66	0.21	-7.12	-6.19
2012	-7.81	0.03	-7.89	-7.73
REGSLOPE	0.11	0.08	-0.06	0.29

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 2				
1995	-3.47	0.35	-4.38	-2.56
1996	-3.05	0.53	-4.20	-1.89
1997	-5.57	0.17	-5.97	-5.16
1998	-4.79	0.16	-5.17	-4.41
1999	-3.31	0.41	-4.19	-2.43
2000	-4.08	0.08	-4.29	-3.88
2001	-4.41	0.22	-4.95	-3.88
2002	-5.19	1.72	-9.40	-0.99
2003	-4.68	0.18	-5.07	-4.28
2004	-4.19	0.31	-4.84	-3.53
2005	-2.94	0.26	-3.50	-2.37
2006	-3.57	0.14	-3.88	-3.27
2007	-3.85	0.10	-4.06	-3.64
2008	-3.09	0.37	-3.89	-2.29
2009	-4.10	0.27	-4.76	-3.43
2010	-3.88	0.31	-4.64	-3.13
2011	-4.74	0.18	-5.14	-4.35
2012	-5.16	0.14	-5.51	-4.81
REGSLOPE	-0.01	0.04	-0.09	0.07

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3A				
2007	-9.57	1.67	-13.20	-5.93
2008	-12.81	0.24	-13.33	-12.29
2009	-7.98	0.49	-9.25	-6.72
2010	-8.15	0.06	-8.32	-7.99
2011	-10.31	0.18	-10.71	-9.92
2012	-10.60	0.06	-10.76	-10.44
REGSLOPE	0.06	0.48	-1.26	1.38

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3				
2002	-24.49	1.53	-28.43	-20.56
2003	-19.86	1.15	-22.36	-17.35
2004	-13.37	2.63	-19.09	-7.64
2005	-15.33	1.36	-18.29	-12.37
2006	-24.61	1.42	-27.70	-21.52
2007	-35.51	0.54	-36.68	-34.34
2008	-25.78	1.22	-28.43	-23.12
2009	-23.65	0.56	-25.08	-22.22
2010	-26.57	1.05	-29.26	-23.88
2011	-26.75	2.51	-32.22	-21.28
2012	-15.09	0.17	-15.53	-14.65
REGSLOPE	-0.34	0.64	-1.80	1.11

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 4				
1995	-3.26	0.20	-3.77	-2.75
1996	-3.40	0.05	-3.50	-3.29
1997	-3.53	0.04	-3.63	-3.43
1998	-3.24	0.05	-3.38	-3.10
1999	-3.13	0.10	-3.34	-2.92
2000	-3.40	0.02	-3.46	-3.34
2001	-2.87	1.56	-6.89	1.15
2002	-3.44	0.10	-3.70	-3.19
2003	-3.28	0.08	-3.46	-3.09
2004	-3.89	0.14	-4.18	-3.59
2005	-3.29	0.13	-3.57	-3.00
2006	-3.43	0.05	-3.54	-3.31
2007	-7.87	0.32	-8.58	-7.17
2008	-1.79	0.12	-2.05	-1.54
2009	-3.07	0.04	-3.18	-2.95
2010	-4.30	0.50	-5.60	-3.00
2011	-3.62	0.08	-3.79	-3.44
2012	-5.13	0.05	-5.27	-4.99
REGSLOPE	-0.07	0.06	-0.19	0.05

TABLE 8. Linear regression statistics (y-intercept and slope) of concentrations of orthophosphate phosphorus as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to April 2012 (Transect site 3 has been monitored since 2002; Traset Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. For location of transect sites, see Figure 1.

PHOSPHATE - Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	1.04	0.14	0.68	1.39
1996	1.78	0.12	1.52	2.03
1997	1.40	0.12	1.10	1.69
1998	1.10	0.06	0.95	1.25
1999	1.07	0.12	0.80	1.34
2000	0.89	0.12	0.59	1.19
2001	2.16	0.76	0.22	4.11
2002	1.12	0.68	-0.64	2.88
2003	0.48	0.19	0.06	0.90
2004	2.71	0.17	2.33	3.08
2005	-0.02	0.14	-0.34	0.29
2006	1.36	0.13	1.08	1.65
2007	1.07	0.20	0.64	1.50
2008	0.89	0.13	0.61	1.16
2009	0.87	0.38	-0.12	1.85
2010	1.86	0.18	1.40	2.31
2011	1.47	0.11	1.24	1.70
2012	1.65	0.08	1.45	1.86
REGSLOPE	0.00	0.03	-0.06	0.07

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 2				
1995	0.15	0.63	-1.46	1.76
1996	2.03	1.59	-1.41	5.48
1997	3.70	0.25	3.10	4.31
1998	3.55	1.44	0.03	7.07
1999	3.68	5.55	-8.22	15.58
2000	12.78	1.18	9.89	15.66
2001	30.73	3.12	23.09	38.37
2002	6.67	1.68	2.57	10.77
2003	3.57	0.31	2.90	4.24
2004	5.76	0.53	4.62	6.91
2005	-0.95	2.96	-7.31	5.40
2006	1.88	0.57	0.67	3.10
2007	0.22	0.26	-0.34	0.78
2008	1.50	1.14	-0.95	3.95
2009	1.54	0.34	0.71	2.38
2010	1.70	1.31	-1.49	4.90
2011	2.46	0.37	1.66	3.26
2012	3.21	0.60	1.74	4.68
REGSLOPE	-0.27	0.33	-0.97	0.43

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3A				
2007	2.39	0.24	1.86	2.93
2008	4.43	0.49	3.36	5.50
2009	2.60	0.15	2.21	2.99
2010	2.75	0.29	2.01	3.48
2011	3.42	0.41	2.53	4.31
2012	4.06	0.04	3.96	4.17
REGSLOPE	0.16	0.21	-0.42	0.74

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3				
2002	4.62	2.31	-1.31	10.55
2003	7.38	0.99	5.24	9.53
2004	7.40	0.78	5.70	9.10
2005	3.17	0.53	2.03	4.32
2006	7.32	1.16	4.80	9.84
2007	4.46	0.46	3.47	5.45
2008	4.01	1.13	1.56	6.47
2009	3.12	2.67	-3.74	9.99
2010	6.25	2.27	0.41	12.09
2011	0.86	0.75	-0.79	2.50
2012	6.37	0.53	5.01	7.73
REGSLOPE	-0.22	0.20	-0.68	0.24

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 4				
1995	2.44	0.15	2.04	2.84
1996	3.08	0.13	2.79	3.37
1997	2.95	0.09	2.71	3.19
1998	3.50	0.46	2.32	4.67
1999	3.26	0.14	2.96	3.55
2000	3.29	0.20	2.77	3.82
2001	-19.16	22.66	-77.41	39.09
2002	3.98	0.15	3.60	4.35
2003	4.13	1.29	1.33	6.93
2004	4.75	0.79	3.04	6.47
2005	2.12	0.38	1.28	2.95
2006	2.15	0.40	1.28	3.02
2007	2.65	0.09	2.46	2.83
2008	2.98	0.67	1.52	4.44
2009	1.51	0.65	-0.16	3.19
2010	0.76	0.47	-0.46	1.97
2011	2.15	0.30	1.51	2.80
2012	2.06	0.07	1.87	2.25
REGSLOPE	0.02	0.25	-0.50	0.55

PHOSPHATE - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-0.03	0.00	-0.04	-0.02
1996	-0.05	0.00	-0.06	-0.04
1997	-0.04	0.00	-0.05	-0.03
1998	-0.03	0.00	-0.03	-0.02
1999	-0.03	0.00	-0.03	-0.02
2000	-0.02	0.00	-0.03	-0.01
2001	-0.06	0.02	-0.12	0.00
2002	-0.03	0.02	-0.08	0.02
2003	-0.01	0.01	-0.02	0.00
2004	-0.08	0.01	-0.09	-0.06
2005	0.00	0.00	-0.01	0.01
2006	-0.04	0.00	-0.04	-0.03
2007	-0.03	0.01	-0.04	-0.02
2008	-0.02	0.00	-0.03	-0.02
2009	-0.02	0.01	-0.05	0.01
2010	-0.05	0.01	-0.07	-0.04
2011	-0.04	0.00	-0.05	-0.03
2012	-0.04	0.00	-0.05	-0.04
REGSLOPE	0.00	0.00	0.00	0.00

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 2				
1995	0.00	0.02	-0.05	0.04
1996	-0.06	0.05	-0.16	0.04
1997	-0.10	0.01	-0.12	-0.09
1998	-0.10	0.04	-0.20	0.00
1999	-0.10	0.16	-0.44	0.25
2000	-0.36	0.03	-0.45	-0.28
2001	-0.87	0.09	-1.09	-0.65
2002	-0.19	0.05	-0.31	-0.07
2003	-0.10	0.01	-0.12	-0.08
2004	-0.16	0.02	-0.20	-0.13
2005	0.03	0.09	-0.15	0.21
2006	-0.05	0.02	-0.09	-0.02
2007	0.00	0.01	-0.02	0.01
2008	-0.04	0.03	-0.11	0.03
2009	-0.04	0.01	-0.07	-0.02
2010	-0.05	0.04	-0.14	0.05
2011	-0.07	0.01	-0.09	-0.04
2012	-0.09	0.02	-0.13	-0.05
REGSLOPE	0.01	0.01	-0.01	0.03

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3A				
2007	-0.07	0.01	-0.09	-0.05
2008	-0.13	0.02	-0.16	-0.09
2009	-0.07	0.01	-0.09	-0.06
2010	-0.07	0.01	-0.10	-0.05
2011	-0.09	0.01	-0.12	-0.06
2012	-0.11	0.00	-0.12	-0.11
REGSLOPE	0.00	0.01	-0.02	0.01

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3				
2002	-0.13	0.07	-0.30	0.04
2003	-0.21	0.03	-0.27	-0.15
2004	-0.21	0.02	-0.26	-0.16
2005	-0.09	0.02	-0.12	-0.06
2006	-0.21	0.03	-0.28	-0.13
2007	-0.13	0.01	-0.16	-0.10
2008	-0.11	0.03	-0.18	-0.04
2009	-0.09	0.08	-0.29	0.11
2010	-0.18	0.07	-0.35	-0.01
2011	-0.02	0.02	-0.07	0.03
2012	-0.18	0.02	-0.22	-0.14
REGSLOPE	0.01	0.01	-0.01	0.02

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 4				
1995	-0.07	0.00	-0.08	-0.06
1996	-0.09	0.00	-0.09	-0.08
1997	-0.08	0.00	-0.09	-0.07
1998	-0.10	0.01	-0.13	-0.06
1999	-0.09	0.00	-0.10	-0.08
2000	-0.09	0.01	-0.10	-0.07
2001	0.55	0.65	-1.11	2.21
2002	-0.11	0.00	-0.12	-0.10
2003	-0.11	0.04	-0.19	-0.02
2004	-0.13	0.02	-0.18	-0.08
2005	-0.06	0.01	-0.08	-0.03
2006	-0.06	0.01	-0.08	-0.03
2007	-0.07	0.00	-0.08	-0.07
2008	-0.08	0.02	-0.13	-0.04
2009	-0.04	0.02	-0.09	0.01
2010	-0.02	0.01	-0.06	0.02
2011	-0.06	0.01	-0.08	-0.04
2012	-0.05	0.00	-0.06	-0.05
REGSLOPE	0.00	0.01	-0.02	0.01

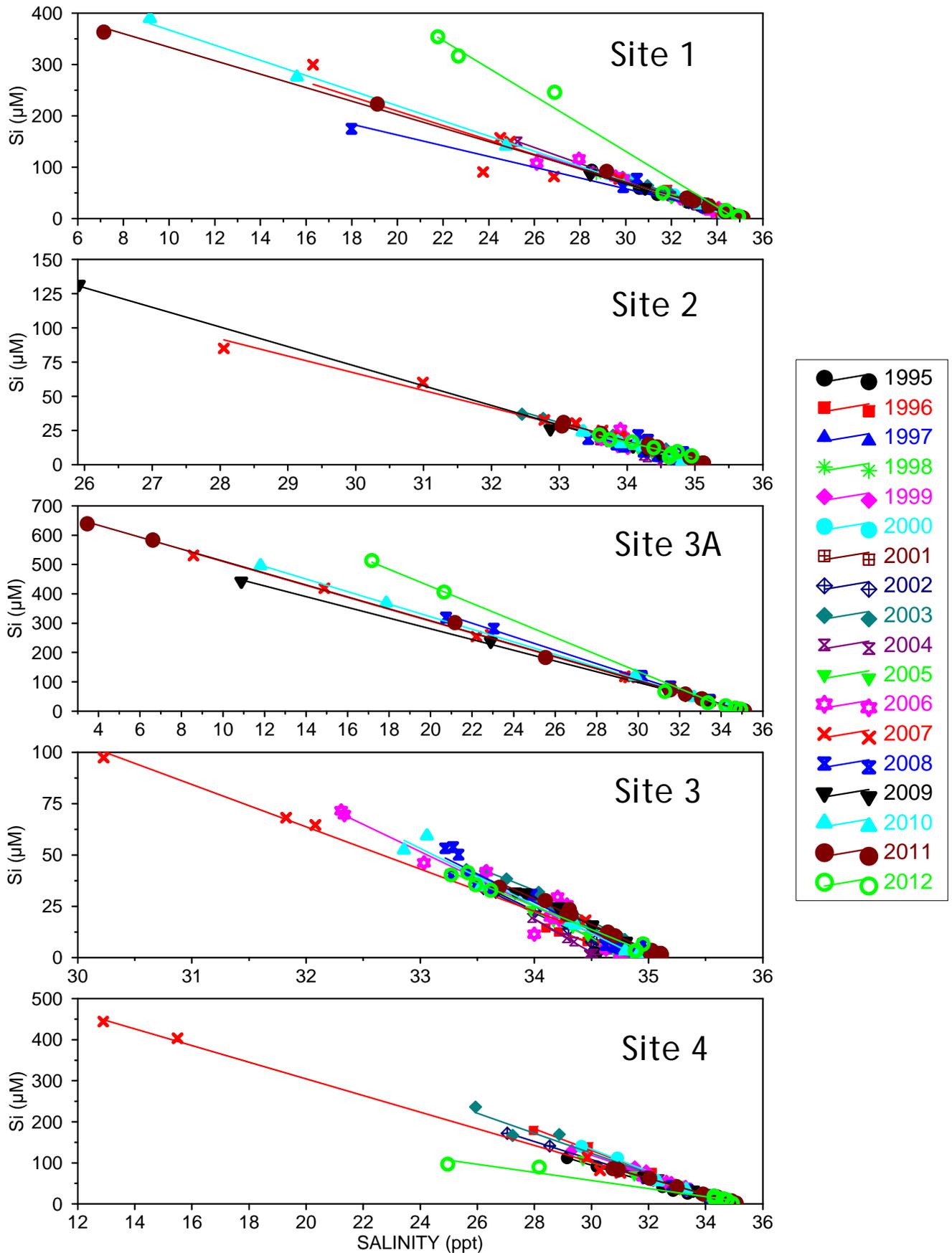


FIGURE 22. Mixing diagram showing yearly concentrations of silicate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

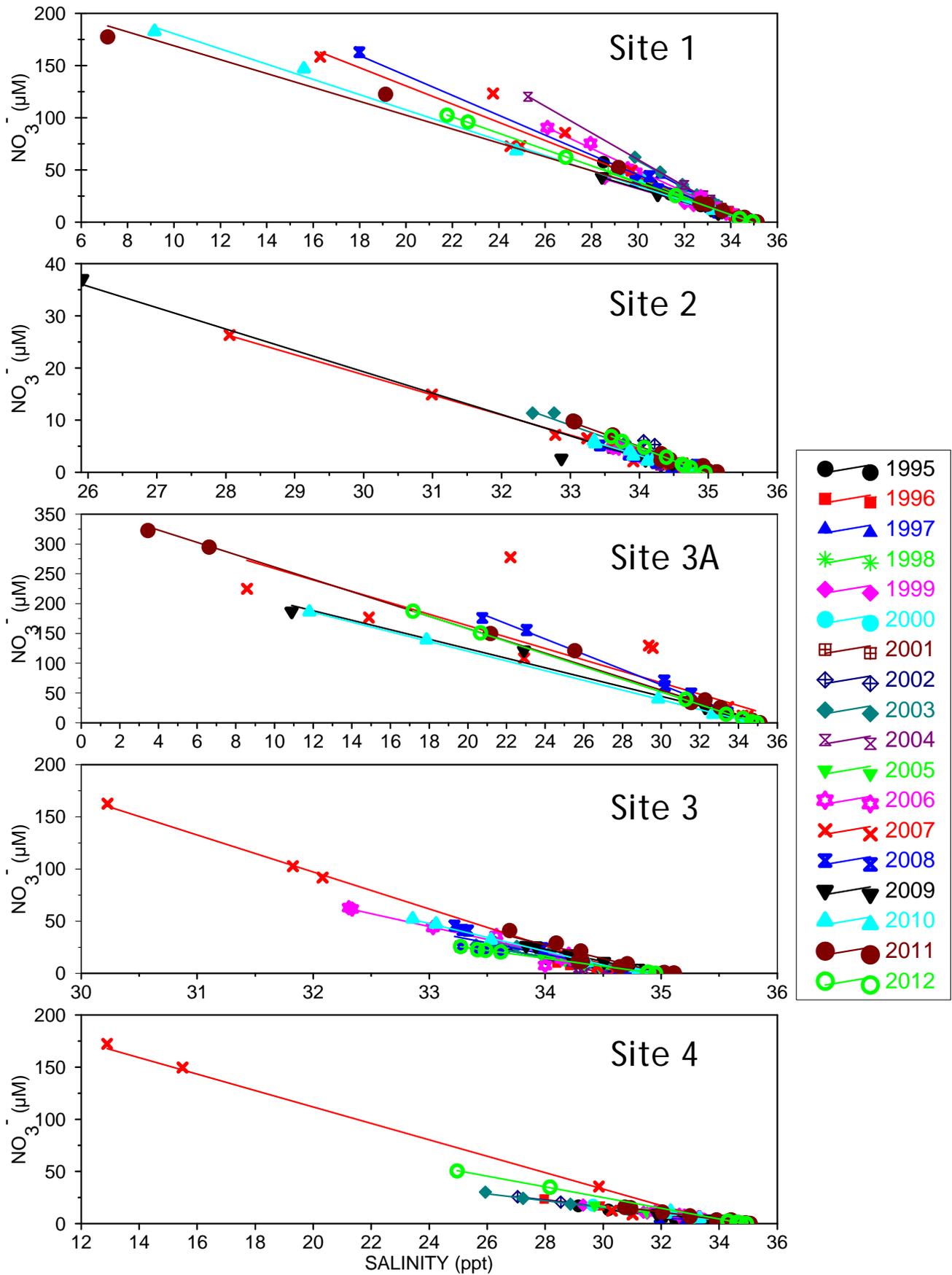


FIGURE 23. Mixing diagram showing yearly concentrations of nitrate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

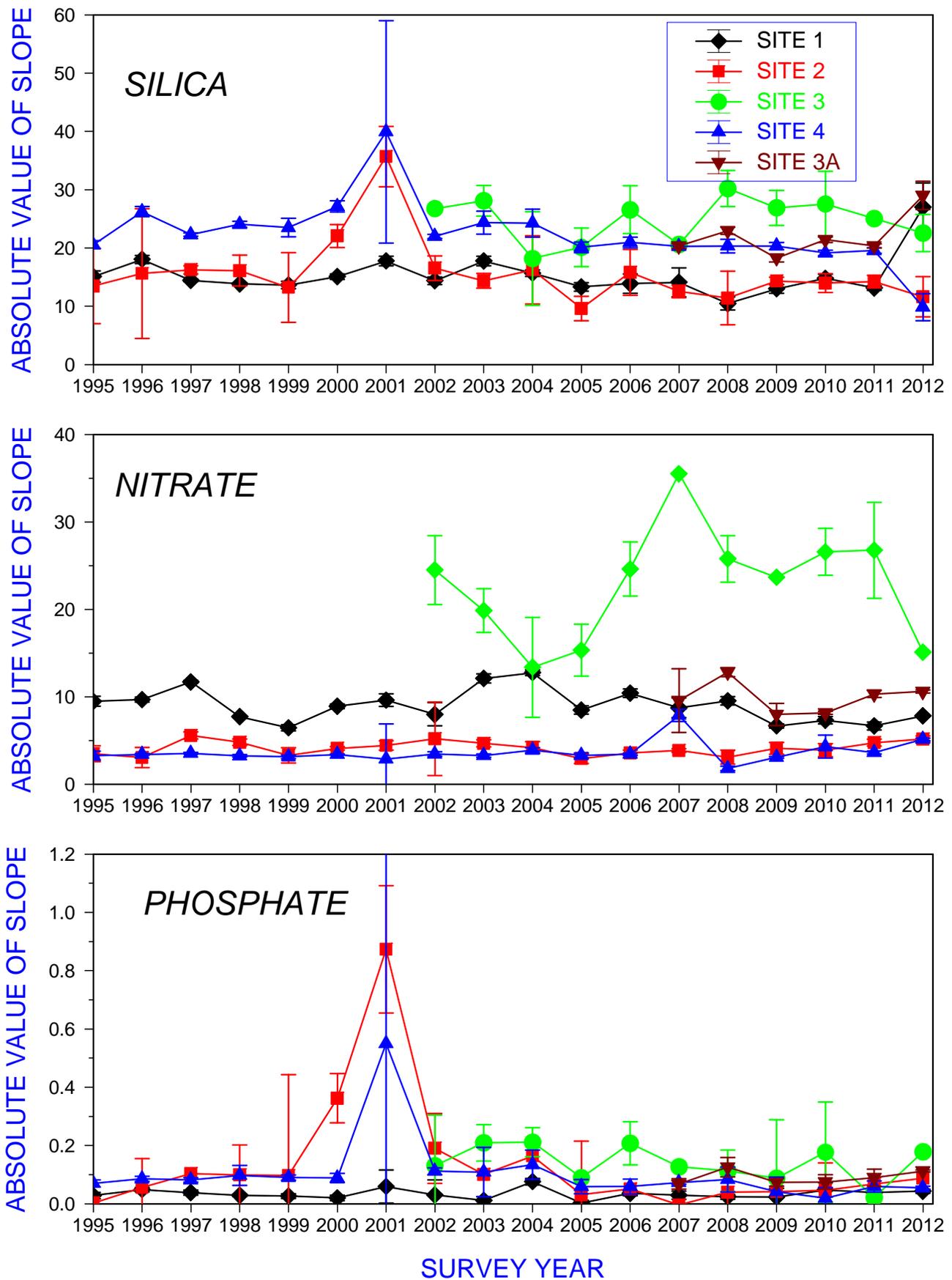


FIGURE 24. Time-course plots of absolute values of slopes of linear regressions of concentrations of silica, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits (Note error bar for Site 4 Phosphate is off scale). For locations of sampling transect sites, see Figure 1.

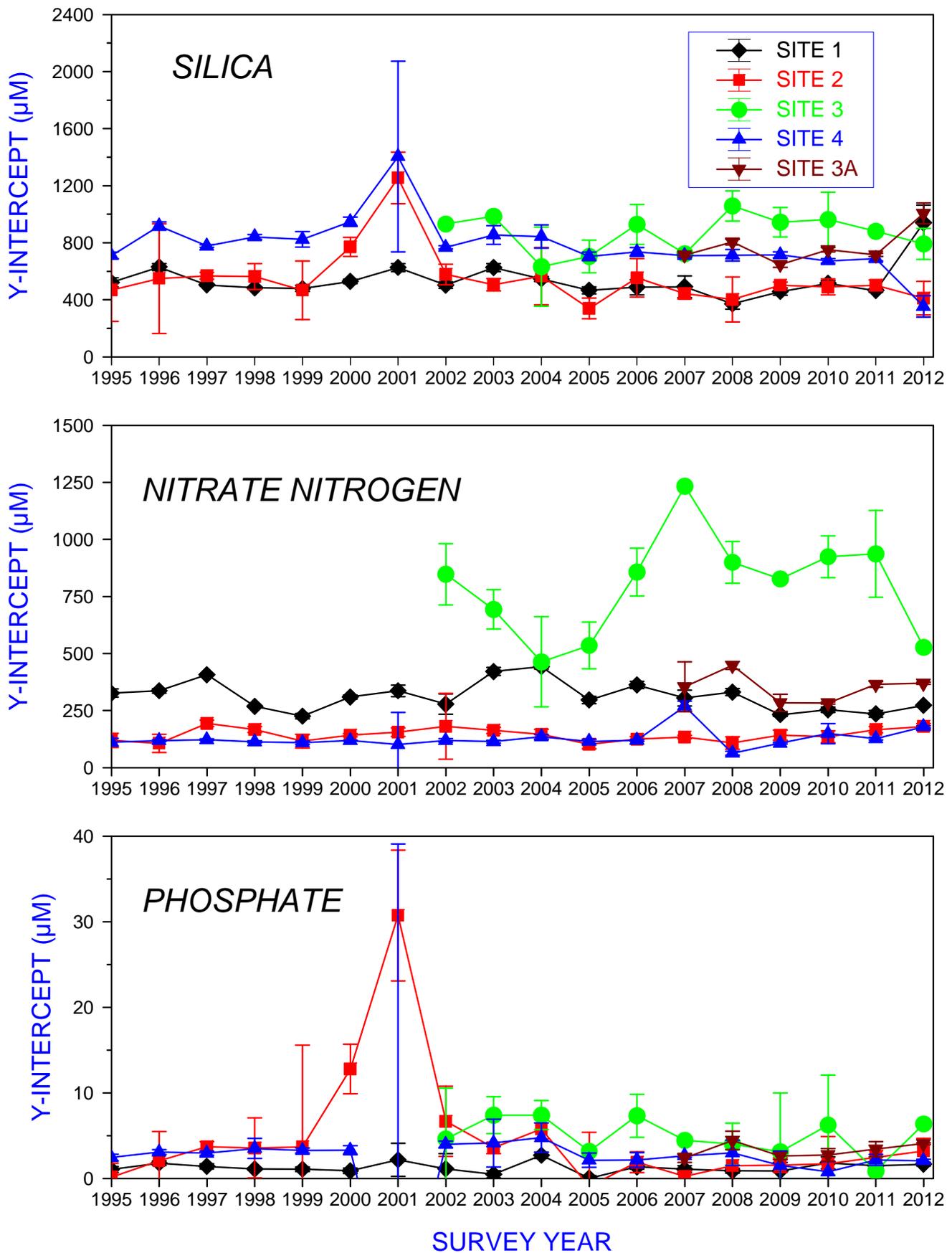


FIGURE 25. Time-course plots of Y-intercepts of linear regressions of concentrations of silica, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

Exhibit B-2

ATC MAKENA HOLDINGS, LLC
c/o Stanford Carr Development, LLC
1100 Alakea St. 27th Floor
Honolulu, HI 96813

February 25, 2013

Mr. Watson Okubo
State of Hawaii, Department of Health
Clean Water Branch
919 Ala Moana Blvd. Room 301
Honolulu, HI 96814

Via PDF Only unless hardcopy is requested.

Re: State Land Use District Boundary Amendment Docket A9-721 Condition No. 10,
County of Maui Zoning Ordinance 3613 Condition No. 19, Marine Water Quality
Monitoring.

Dear Mr. Okubo

ATC Makena Holdings, LLC, in compliance with the above referenced conditions,
respectfully submits the enclosed Marine Water Quality Monitoring Report prepared by
Marine Research Consultants, Inc. dated February, 2013, for tests performed in December,
2012.

Should you have any questions, require a hardcopy, or require additional information
please do not hesitate to contact me at (808) 547-2276, or by e-mail at
sarah@stanfordcarr.com.

Sincerely,

STANFORD CARR DEVELOPMENT, LLC
For ATC MAKENA HOLDINGS, LLC



Sarah Agnew-Miller
Project Management/Planning

MARINE WATER QUALITY MONITORING
MAKENA RESORT, MAKENA, MAUI
WATER CHEMISTRY
REPORT 1-2013
(December 2012)

Prepared for

ATC Makena Holdings, LLC
c/o Stanford Carr Development, LLC
1100 Alakea St. 27th Floor
Honolulu, HI 96813

By

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, Hawaii 96822

Submitted

February 2013

EXECUTIVE SUMMARY

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments. In the interest of assuring maintenance of the highest possible quality of the marine environment, condition No. 10 of the Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulates the implementation of an ongoing marine monitoring program off the Makena Resort Development. Additionally, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the program are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question that is addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure? The following report fulfills the requirements of these Conditions, and presents the results of water quality monitoring off the Makena Resort conducted on December 4, 2012. The report also incorporates the cumulative data from twenty-seven past water chemistry surveys conducted in the area.

Survey methodology includes collection of 62 ocean water samples on four transects spaced along the projects ocean frontage and on one control transect. Site 1 is located at the northern boundary of the project, Site 2 is located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) is located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 is located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Water samples were collected at 7 stations spaced along transects that extended from the shoreline out to the open coastal ocean (about 500 feet). At sampling stations where water depth exceeded about 3 feet, samples were collected at the surface and just above the sea floor. Water samples were analyzed for chemical criteria specified by DOH water quality standards for open coastal waters, as well as several additional criteria. In addition, water samples were collected from nine irrigation wells located on the golf courses.

Results of analysis of water chemistry showed that constituents that occur in high concentration in groundwater (silica, nitrate-nitrogen) were found to be highest in ocean samples collected nearest to the shoreline, with progressively decreasing values moving away from shore into deeper water. While groundwater nutrient input was evident at all four sampling locations, it was highest in magnitude at Site 3A, located directly downslope from the Makena Resort. As Site 4 served as a control, and was not located in the vicinity of the Makena Resort, it is apparent that groundwater input is not solely a function of Resort land usage.

Vertical stratification of the water column was evident on transects with surface water generally having higher nutrient concentrations and lower salinities than samples from near the sea floor.

The observed patterns of distribution with respect to both distance from shore and depth in the water column indicate that physical mixing processes generated by tide, wind, waves and currents mix the water column from top to bottom.

Overall, measurements of turbidity and chlorophyll *a* were low throughout the sampling area, although values were slightly elevated close to the shoreline probably as a result of resuspension of fine-grained marine sediments (turbidity) and fragments of benthic algae washed up to the shoreline (Chl *a*). These results indicate that at the time of sampling, nutrient input from land was not resulting in increases in plankton populations in nearshore waters. Low turbidity in Makena Bay (transect Site 2) suggests mitigation of the effects of a past episode of high runoff of upland soil from a flash flood in October 1999 that resulted in substantial impacts to water clarity within the Bay.

Other organic water chemistry constituents that do not occur in high concentrations in groundwater, such as ammonium nitrogen or organic nitrogen and phosphorus, were consistently low and did not show any distinctive patterns with respect to input from land.

Analyses that scale nutrient concentrations to salinity reveal that there were measurable increases of nitrate nitrogen above what is found in naturally occurring groundwater that enters the nearshore ocean at three survey sites (Sites 1, 3 and 3A). These subsidies, which are likely a result of land uses involving fertilizers, substantially increase the concentration of nitrate over natural groundwater flowing to the ocean. These subsidies were greatest in magnitude at Sites 3 and 3A, followed by Site 1, all of which are located off the Makena Golf Course and adjacent residential areas. No subsidies of nitrate were apparent at Site 2 (Makena Landing) or Site 4 (Ahihi-Kina`u). The lack of distinguishable upward curvature of these data arrays indicates that the nutrients from groundwater that enter the ocean, both from natural and the human sources, are not being taken up by biotic communities in the nearshore zone. Rather, nutrients are mixed to background ocean values by physical processes including wind stirring and wave action.

Statistical tests of nutrient concentration scaled to salinity over time show no significant increases or decreases over the years of monitoring at any of the survey sites. The lack of such increases suggests that there has been no consistent change in nutrient input from land (either as an increase or decrease) to groundwater that enters the ocean over the past years.

Comparing values of water chemistry measured in the monitoring program to State of Hawaii Department of Health (DOH) water quality standards revealed that several measurements of nitrogen, phosphorus, turbidity and Chlorophyll *a* exceeded the DOH standards, particularly for "geometric mean" standards. Such exceedances occurred at all survey sites, including the control site that was removed from influences of the Makena Resort. The consistent exceedance of water quality standards is in large part a consequence of the natural effects of groundwater discharge to the nearshore ocean, as well as physical mixing processes that occur near the shorelines of all coastal areas. Revision of DOH standards to account for such natural input has been implemented for the West Coast of the Island of Hawaii, and will hopefully be extended to the rest of the State in the near future.

As in all past surveys, the results of the most recent increment of monitoring reveal that there is an increase over natural conditions of dissolved inorganic nutrients (e.g., nitrate and sometimes to a lesser extent phosphate) in groundwater that enters the nearshore ocean at sampling sites

downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased significantly over time during the 17-year course of the monitoring program. The regions where the highest elevations over natural inputs occur are restricted to narrow zone that extends from the shoreline to several meters offshore, and as such is restricted to an area that is not suitable for coral communities to occur owing to shallow water depth, wave impact and sand scour. Surveys of coral reef community structure that are also part of the ongoing monitoring program for the Makena Resort, as well as the continued lack of any nuisance algal accumulations in the nearshore area, indicate that the nutrient subsidies are presently not detrimental to marine community structure.

The next scheduled testing for the Makena Resort monitoring program is planned for the spring-summer season of 2013.

I. PURPOSE

The Makena Resort fronts approximately 5.4 miles of coastline of southeastern Maui, extending from Papanui Stream (Nahuna Point) on the north and Pu`u Olai (Ahihi Bay) on the south. However, only 0.58 miles of the Resort reaches to the actual shoreline. Within the Resort are two 18-hole golf courses (North and South Courses), as well as a hotel, sewage treatment plant and private residences. No part of the project involves direct alteration of the shoreline or nearshore marine environments.

Evaluations of other golf courses and other forms of resort development located near the ocean in the Hawaiian Islands reveal that there is detectable input to the coastal ocean of materials used for fertilization of turfgrass and landscaping (Dollar and Atkinson 1992). However, few, if any, effects that have been documented have been found to be detrimental to the marine ecosystem. Confirmation that the construction and responsible operation of the golf courses and other components of the Makena Resort does not cause any harmful changes to the marine environment requires rigorous and continual monitoring.

In the interest of assuring maintenance of excellent environmental quality in the Makena region, Condition No. 10, Declaration of Conditions pertaining to the Amendment of the District Boundary, as required by the Land Use Commission, dated April 17, 1998 stipulated the implementation of an ongoing marine monitoring program off the Makena Resort Development. In addition, County of Maui Zoning Ordinance 3613 Condition 19 included requirements for similar monitoring. The primary goals of the established monitoring program to satisfy these two requirements are twofold: 1) to assess the degree that materials used on land to enhance turf growth and landscaping, as well as other nutrient subsidies, leach to groundwater and subsequently reach the ocean, and 2) to determine the fate of these materials within the nearshore zone. In terms of determining fate, the question addressed is if the materials that originate from Resort activities disperse with little or no effect, or do they cause changes in water quality sufficient to alter marine biological community structure?

The rationale of the monitoring program is to conduct repetitive evaluations of water chemistry at the same locations at regular time intervals (twice per year). This strategy allows for determination of variations in effects from the Makena Resort in both space (at different locations along the shoreline) and time. It should be noted that water chemistry monitoring off the Makena area was initiated in 1995 on a voluntary basis, and has continued uninterrupted until the present. With the implementation of the Boundary Amendment and Zoning Conditions, it was determined that the ongoing voluntary monitoring protocol satisfied the stated requirements. Hence, the entire data set from 1995 onward is considered as part of the monitoring program. The following report presents the results of the twenty-eighth increment in the monitoring program, and contains data from water chemistry sampling conducted on December 4, 2012.

II. ANALYTICAL METHODS

Three survey sites directly downslope from the Makena Resort have been selected as sampling locations. A fourth site, located offshore of an area with minimal land-based development,

particularly golf course operations, was selected as a control. During the June 2007 survey, another sampling location was added near the southern boundary of Maluaka Bay. It is anticipated that this station will remain part of the sampling protocol permanently. Figure 1 is a map showing the shoreline and topographical features of the Makena area, and the location of the North and South Golf Courses. All survey sites are depicted as transects perpendicular to the shoreline extending from the shoreline out to what is considered open coastal ocean (i.e., beyond the effects of activities on land). Survey Site 1 is located near the northern boundary of the project site off Nahuna Point; Survey Site 2 bisects Makena Bay near Makena Landing. Site 3 bisects the middle of the South course on the north side of Maluaka Point. Site 3A is on the southern corner of Maluaka Bay. Site 4, which is considered the Control site, is located near the northern boundary of the 'Ahihi-Kina`u natural area reserve north of the 1790 lava flow and approximately 1-2 miles south of the existing Makena Golf courses (Figure 1). The control site was located off a shoreline area with minimal land uses (i.e., residences near the shoreline and upslope ranchlands) rather than off the completely uninhabited 1790 lava flow. This location was selected as the most appropriate control site, as it is the farthest location from the Makena Resort with the same geophysical structural of the land area. The completely different geological structure of the lava flow off the natural reserve likely results in very different groundwater dynamics compared to the land area where the Makena Resort is located, hence making the lava flow an unsuitable control site.

In July of 2002, Site 3 was relocated from a location at the southern boundary of the project offshore of Oneloa Beach to the location directly off the Makena Golf Course, as described above. The relocation of Site 3 was deemed necessary as the original location consistently showed virtually no input of groundwater to the ocean. Such lack of groundwater discharge resulted in little potential for evaluating effects from the project. The new location of Site 3 is directly downslope from both the portion of the golf course nearest to the ocean, several newly constructed private residences, and a 3-acre recently restored wetland area. As a result, the new location represents an area that reflects the maximum influence on nearshore water quality from a variety of land uses and natural habitat.

All fieldwork for the present survey was conducted on December 4, 2012. Environmental conditions during sample collection consisted of mild on-shore winds (0-5 knots), sunny skies, and choppy shoreline swell. Sample collection at the shoreline occurred during a falling tide with a tidal range of 1.41 to +1.3 feet.

Water samples were collected at stations along transects that extend from the highest wash of waves to between 150-200 meters (m) offshore (about 500-650 feet), depending on the site. Such a sampling scheme is designed to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone because this area is most likely to show the effects of land-based activities. With the exception of the two stations closest to the shoreline (0 and 2 m offshore), samples were collected at two depths; a surface sample was collected within approximately 10 centimeters (cm) (~4 inches) of the sea surface, and a bottom sample was collected within one m (3 feet) of the sea floor.

Water samples from the shoreline to a distance of 10 m offshore were collected in triple-rinsed 1-liter polyethylene bottles by swimmers working from the shoreline. Water samples beyond 10 m from the shoreline were collected from a small boat using a 1.8-liter Niskin sampling bottle. This

bottle was lowered to the desired depth in an open position where spring-loaded endcaps were triggered to close by a messenger released from the surface. Upon recovery, each sample was placed on ice until further processing in Honolulu. Water samples were also collected from nine golf course irrigation wells (No's 1, 2, 3, 4, 5, 6, 8, 10 and 11) on May 10, 2012.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii Department of Health Water Quality Standards. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen [nitrate + nitrite nitrogen ($\text{NO}_3^- + \text{NO}_2^-$), ammonium (NH_4^+)], plus total organic nitrogen (TON), total phosphorus (TP) which is defined as inorganic phosphorus (PO_4^{3-}) plus total organic phosphorus, chlorophyll a (Chl a), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{3-}) and silica (Si) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for $\text{NO}_3^- + \text{NO}_2^-$ (hereafter termed NO_3^-), NH_4^+ and PO_4^{3-} , were performed on filtered samples using a SEAL Analytical AA3 autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion on unfiltered samples following digestion. Total organic nitrogen (TON) and Total organic phosphorus (TOP) were calculated as the difference between TN and inorganic N, and TP and inorganic P, respectively. Limits of detection for the dissolved nutrients are $0.01 \mu\text{M}$ ($0.14 \mu\text{g/L}$) for NO_3^- and NH_4^+ , $0.01 \mu\text{M}$ ($0.31 \mu\text{g/L}$) for PO_4^{3-} , $0.1 \mu\text{M}$ ($1.4 \mu\text{g/L}$) for TN and $0.1 \mu\text{M}$ ($3.1 \mu\text{g/L}$) for TP.

Chl a was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5°C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection $0.01 \mu\text{g/L}$). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.003‰.

In situ field measurements included water temperature, pH, dissolved oxygen and salinity which were acquired using an RBR Model XR-420 CTD calibrated to factory specifications. The CTD has a readability of 0.001°C , 0.001 pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity. Shoreline salinity was measured in the field using an Atago PAL-06S digital refractometer.

Nutrient, turbidity, Chl a and salinity analyses were conducted by Marine Analytical Specialists located in Honolulu, Hawaii. This laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

III. RESULTS and DISCUSSION

A. General Overview

Table 1 shows results of all marine water chemical analyses for samples collected off Makena on December 4, 2012 with nutrient concentrations reported in micromolar units (μM). Table 2 shows similar results with nutrient concentrations presented in units of micrograms per liter ($\mu\text{g/L}$). Tables 3 and 4 show geometric means of ocean samples at Sites 1, 2 and 4 for 28 surveys, 19 surveys at Site 3, and 10 surveys from Site 3A, with nutrient concentrations shown in μM and $\mu\text{g/L}$, respectively. Table 5 shows water chemistry measurements (in units of μM and $\mu\text{g/L}$) for samples collected from irrigation located on the Makena Resort Golf Courses. Concentrations of twelve chemical constituents in surface and deep-water samples from the December 2012 sampling are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (\pm standard error) of twelve chemical constituents in surface and deep water samples as functions of distance from the shoreline at Sites 1-4 collected since 1995 and from Site 3A collected since 2007 are plotted in Figures 4-18. In addition, data from the most recent sampling in December 2012 are also plotted on Figures 4-18.

During the December 2012 sampling, nearshore concentrations of dissolved Si and NO_3^- on three of the five transects (1, 2, and 3-A) were elevated up to an order of magnitude compared to samples collected in the open coastal ocean farthest from shore (Figure 2, Tables 1 and 2). The horizontal gradient of Si was steeper on transect 2 than on transects 1 and 3-A, and was maintained for the entire length of the transect, out to a distance of 150 m from the shoreline. No horizontal gradients in Si or NO_3^- were evident at transects 3 and 4 during the December 2012 survey. Concentration of TN showed no distinct variation with distance offshore at any of the five transects (Figure 2, Tables 1 and 2).

At transects 1, 2 and 3-A, salinity was slightly lower in samples collected within 5 m of the shoreline compared to the samples collected farther from shore. The variation was not substantial with salinity values ranging between 34.88‰ and 35.22‰ for all transects in the December 2012 survey. The maximum change between the shoreline and offshore samples of 0.29‰ occurred at transect 1 (Figure 3 and Tables 1 and 2). Similar to the findings for dissolved nutrients, salinity was nearly constant along the entire transect as sites 3 and 4.

Surface concentrations of phosphate phosphorus (PO_4^{3-}) and TP were nearly constant along all five transects and horizontal gradients were not evident the December 2012 survey.

With no streams in the sampling area, nor heavy rainfall and subsequent surface runoff preceding sampling, patterns of elevated Si, NO_3^- , and TN with corresponding reduced salinity generally indicates groundwater entering the ocean near the shoreline. Low salinity groundwater, which contains high concentrations of Si, NO_3^- , TN and PO_4^{3-} (see values for well waters in Table 5), percolates to the ocean near the shoreline, resulting in a distinct zone of mixing in the nearshore region. The zone of mixing is discernible by distinct decreasing gradients of nutrients and increasing gradients of salinity with distance from shoreline. During periods of low tide when sea conditions are calm, the zone of mixing between groundwater and ocean water is most pronounced. The December 2012 sampling shows substantially smaller horizontal gradients than

past surveys. These results are most likely a result of sampling during a higher tidal stand than normal, along with increased mixing near the shoreline caused by onshore winds and waves which diluted the groundwater signal. Comparing the results of surveys conducted during different sea conditions clearly indicates that tidal state, as well as wind and wave energy, greatly effect groundwater mixing in the nearshore zone.

Dissolved nutrient constituents that are not usually associated with groundwater input (NH_4^+ , TON, TOP) did not exhibit distinct horizontal gradients across the sampling transects (Table 1, Figure 2). With the exception of a few shoreline samples at Site 4, NH_4^+ , TON and TOP were relatively constant along all transect, and were of the same magnitude among the four transect sites (Table 1, Figure 2).

Turbidity was highest near the shoreline on all transects with distinctly higher concentrations at transects 2 and 3-A (Tables 1 and 2, Figure 3). Transect 2 bisects Makena Bay, which is semi-enclosed embayment with a silt/sand bottom rather than the predominantly "hard" reef or sand bottoms that occur at the other transect sites. In addition, it has been observed that during flash floods originating in the ranch lands upslope of the Makena Resort, terrigenous sediment may flow to the ocean in Makena Bay. As a result of wave-induced resuspension of the naturally occurring silt/sand substratum, as well as terrigenous runoff which may be partially retained within the embayment, turbidity has often been elevated on transect 2 relative to the other transect sites. It is important to note that in surveys conducted since July 2002, water clarity in Makena Bay has improved greatly compared to preceding surveys in 2001 which reflected conditions following substantial input of terrigenous materials from a flash-flood that occurred in October 1999. Since that time, a large retention basin has been constructed on the upper slopes of Makena Resort in the watershed that flows into Makena Bay.

In December 2012 concentrations of Chl a were higher near the shoreline compared to offshore values at all five survey sites. Values of Chl a within 50 m of the shoreline were distinctly higher at transect 2 compared to the other 4 transects (Figure 3). Surface water temperature was cool ranging between 23.5°C and 24.4°C among the five sites during the December 2012 survey (Figure 3 and Tables 1 and 2).

In many areas of the Hawaiian Islands, input of low salinity groundwater to the nearshore ocean creates a distinct buoyant surface lens that can persist for some distance offshore. Buoyant surface layers are generally found in areas where turbulent processes (primarily wave action) are insufficient to completely mix the water column in the nearshore zone. Figures 2 -18 and Tables 1 and 2 show concentrations of water chemistry constituents with respect to vertical stratification. During the December 2012 survey, there was no vertical stratification on any of the transects.

B. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (\pm standard error) of water chemistry constituents from surface and deep samples at Transect Sites 1-4 from monitoring surveys conducted since 1995 and from Site 3A for monitoring surveys conducted since 2007. In addition, the results of the most recent survey in December 2012 are also shown on each plot.

Overall, means of surface concentrations of Si, NO_3^- , TN and PO_4^{3-} at sampling sites within 50 m of the shoreline were higher than values measured during the most recent survey in December 2012 (Figures 4, 7, 10, 13 and 16). The opposite pattern is evident for TOP and salinity where the December 2012 measurements were higher compared to the mean values along all five transects (Figures 5, 6, 8, 9, 11, 12, 14 and 15). The patterns comparing the concentrations measured in the most recent survey and the overall survey means are likely a result of conducting the recent sampling during a period of high tide and relatively high physical mixing of groundwater and ocean water in the nearshore zone. None of the comparisons of the most recent sampling results to the mean values calculated for the entire monitoring regime indicates any recent negative effects to nearshore water quality.

C. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993).

Figure 19 shows plots of concentrations of four chemical constituents (Si, NO_3^- , PO_4^{3-} , and NH_4^+) as functions of salinity for samples collected in December 2012. Figures 20 and 21 show the same type of plot with data pooled by transect site for a composite of all past surveys, as well as for the most recent survey. Each graph also shows a conservative mixing line that is constructed by connecting the end member concentrations of open ocean water with irrigation well No. 4 located off the North Course of the Makena Resort (representative of groundwater upslope of the Makena Resort).

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 19 that when concentrations of Si are plotted as functions of salinity, most of the data points at salinities greater than 35‰ from all five sites fall in a linear array on the conservative mixing line. At salinities below 35‰, data points for transect site 1 fall in a linear array slightly below the mixing line, while data points for transect site 2 lie above the mixing line. While there is some variation in the clustering of data points from different transect, the overall linearity of the data points indicates that marine waters at the five transect sites are primarily a mixture of groundwater flowing beneath the project and ocean water. These results indicate that the groundwater from upslope Well No. 4 provides a valid representation of groundwater that enters the ocean following flow through the

Makena development. Over the course of monitoring since 1995, the relationship between salinity and Si has remained nearly constant (Figure 20).

NO_3^- is the form of nitrogen most common in fertilizer mixes that are used for enhancing turf growth. When the concentrations of NO_3^- are plotted as functions of salinity, data from each transect prescribe similar patterns as that seen with Si (Figure 19). Most data points from each transect lies in a straight line. Data points from transects 2 and 4A fall on the mixing line. The location of these data arrays indicates that the source of NO_3^- entering the ocean at these transect sites contains no subsidies from activities on land, and all NO_3^- can be attributed to natural inputs from groundwater. Inspection of the long-term mixing data (Figure 20) indicates that essentially all of the values of NO_3^- from Control Site 4 fall on, or very near, the conservative mixing line. Such a result validates that Site 4 is indeed a good “control” area that is not greatly affected by activities on land.

Conversely, data points from the nearshore samples at Transects 1, 3 and 3A all fall above the conservative mixing line, indicating various subsidies of NO_3^- to the ocean from sources on land (Figure 19). Data points for Sites 3 and 3A are similar in slope, and are substantially steeper than data points from Site 1 (Figure 19). Such relationships indicate subsidies of NO_3^- at transect Sites 1, 3 and 3A that are likely a result of leaching of golf course fertilizers to the groundwater lens. In addition to the golf courses, however, residences near the shoreline at Site 1 include landscaping and lawns, while residences and a wetland lie directly inshore from Site 3. Sites 3 and 3A lies directly offshore of the golf course and a residential community clubhouse that is currently under construction.

Transect Site 1 has also been used as a monitoring station for a similar evaluation of the effects of the Wailea Golf Courses on water chemistry that commenced in 1989. The lowest concentrations of NO_3^- relative to salinity at Transect site 1 occurred during the initial two years of study, with subsequent higher concentrations increasing since 1992. Hence, there appears to have been an increase of NO_3^- in nearshore waters since 1992 that was not occurring in 1989-1991. Completion of the Wailea Gold Course occurred in December 1993, while completion of the Makena North Course occurred in November 1993. As the southern region of the Wailea Course and the northern part of the Makena Course abut each other in the makai-mauka direction landward of ocean Transect 1, the increased concentrations of NO_3^- evident in Figure 19 may be a result of leaching of fertilizer materials from the combined golf courses to groundwater that enters the ocean in the sampling area.

Mixing analyses also indicate an ongoing input of NO_3^- at the shoreline of Stations 3 and 3A located off the existing Makena Golf Course and several new residences that have been constructed adjacent to the Golf Course (Figures 19 and 20). Such subsidies have been noted in past surveys, as can be seen in Figure 20. When the slopes of the data points for the December 2012 survey (red symbols) are compared to the slopes of combined sets of data points from past surveys (black and maroon symbols) subsidies of NO_3^- have not increased during the most recent survey (Figure 20). Future monitoring will clarify if the trend of NO_3^- input to the ocean is indeed decreasing.

While the data reveal a long-term subsidy to the concentration of NO_3^- in groundwater and the nearshore zone at several of the sampling sites, the concentrations of NO_3^- fall in clearly linear

relationship as functions of salinity. The linearity of the data array indicates that there is little or no detectable uptake of this material by the marine environment. Such lack of uptake indicates that the nutrients are not being removed from the water column by metabolic reactions that could change the composition of the marine environment. Rather, the nutrient subsidies are diluted to background oceanic levels by physical processes of wind and wave mixing. As a result, the increased nutrients do not appear to have the potential to cause alteration in biological community composition or function.

Similar situations have also been observed in other locales in the Hawaiian islands where nutrient subsidies from golf course leaching result in excess NO_3^- in the nearshore zone. At Keauhou Bay on the Big Island, it was shown that owing to the distinct vertical stratification in the nearshore zone, the excess nutrients never come into contact with benthic communities, thereby limiting the potential for increased uptake by benthic algae. In addition, the residence time of the high nutrient water was short enough within the embayment to preclude phytoplankton blooms. As a result, while NO_3^- concentrations doubled as a result of golf course leaching for a period of at least several years, there was no detectable negative effect to the marine environment (Dollar and Atkinson 1992). Owing to the unrestricted nature of circulation and mixing off the Makena project (no confined embayments) it is reasonable to assume that the excess NO_3^- subsidies that are apparent in the present study will not result in alteration to biological communities.

Indeed, surveys of the nearshore marine habitats off of Makena reveal a generally healthy coral reef that does not appear to exhibit any negative effects from nutrient loading, particularly in the form of abundant algal biomass (Marine Research Consultants 2006). In addition to the lack of negative impacts to offshore coral communities, inspection of the entire shoreline fronting the Makena Resort revealed that there are no areas where excessive algal growth is presently occurring.

The other form of dissolved inorganic nitrogen, NH_4^+ , does not show a linear pattern of distribution with respect to salinity for either the December 2012 survey (Figure 19) or the entire monitoring program (Figure 21). The lack of a correlation between salinity and concentration of NH_4^+ suggests that this form of nitrogen is not present in the marine environment as a result of mixing from groundwater sources. Rather, NH_4^+ is generated by natural biotic activity in the ocean waters off Makena.

PO_4^{3-} is also a major component of fertilizer, but is usually not found to leach to groundwater to the extent of NO_3^- , owing to a high absorptive affinity of phosphorus in soils. With the exception of data points from transect site 3A, all data points from December 2012 fell close to the mixing line. This result indicates that with the exception of site 3A the source of PO_4^{3-} to the ocean is from naturally occurring groundwater. At site 3A, the elevated PO_4^{3-} is likely a result of golf course and residential landscaping, reflecting similar subsidies of NO_3^- .

D. Time Course Mixing Analyses

While it is possible to evaluate temporal changes from repetitive surveys conducted over time in terms of concentrations of water chemistry constituents (See Section C), a more informative and accurate method of evaluating changes over time is to utilize the results of scaling nutrient

concentrations to salinity. As discussed above, the simple hydrographic mixing model consisting of plotting concentrations of nutrient constituents versus salinity eliminates the ambiguity associated with comparing only the concentrations of samples collected during multiple samplings at different stages of tide and weather conditions. Figures 22 and 23 show plots of Si and NO_3^- , respectively, as functions of salinity collected during each year of sampling since 1995. Also shown in Figures 22 and 23 are straight lines that represent the least squares linear regression fitted through concentrations of Si and NO_3^- as functions of salinity at each monitoring site for each year. Tables 6-8 show the numerical values of the Y-intercepts, slopes, and respective upper and lower 95% confidence limits of linear regressions fitted through the data points for Si, NO_3^- , and PO_4^{3-} as functions of salinity for each year of monitoring.

The magnitude of the contribution of nutrients originating from land-based activities to groundwater will be reflected in both the steepness of the slope and the magnitude of the Y-intercept of the regression line fitted through the concentrations scaled to salinity (the Y-intercept can be interpreted as the concentration that would occur at a salinity of zero if the distribution of data points is linear). This relationship is valid because with increasing contributions from land, nutrient concentrations in any given parcel of water would increase with no corresponding change in salinity. Hence, if the contribution from land to groundwater nutrient composition is increasing over time, there would be progressive increases in the absolute value of the slopes, as well as the Y-intercepts of the regression lines fitted through each set of annual nutrient concentrations when plotted as functions of salinity. Conversely, if the contributions to groundwater from land are decreasing, there will be decreases in the absolute values of the slopes and Y-intercepts.

Plots of the values of the slopes (Figure 24) and Y-intercepts (Figure 25) of regression lines fitted through concentrations of Si, NO_3^- and PO_4^{3-} scaled to salinity during each survey year provide an indication of the changes that have been occurring over time in the nearshore ocean off the Makena Resort. As stated above, Si provides the best case for evaluating the effectiveness of the method, as Si is present in high concentration in groundwater but is not a component of fertilizers. NO_3^- and PO_4^{3-} are the forms of nitrogen and phosphorus that are found in high concentrations in groundwater relative to ocean water, and are the major nutrient constituents found in fertilizers.

Examination of Figures 24 and 25, as well as Tables 6-8 reveal that none of the slopes or Y-intercepts of Si, NO_3^- and PO_4^{3-} at any of the transect sites exhibit any indication of progressively increasing or decreasing values over the course of monitoring. The term "REGSLOPE" in Tables 6-8 denotes the values of the slopes and 95% confidence limits of linear regressions of the values of the yearly slopes and Y-intercepts as a function of time. For all sites, the span of the upper and lower 95% confidence limits of the REGSLOPE coefficients are not significantly different than zero, indicating that there is no statistically significant increase or decrease in the salinity-scaled concentrations of Si, NO_3^- and PO_4^{3-} over the course of the monitoring program (Tables 6-8).

For all three nutrients, there is little variation in either slopes or Y-intercepts during any single year at Site 1, located off the "5 Graves" area downslope from the juncture of the Wailea and Makena Resorts (Figures 24 and 25). Such lack of variation indicates relatively consistent concentrations of Si, NO_3^- and PO_4^{3-} in groundwater entering the ocean over the seventeen years of monitoring. Sites 2 (Makena Landing) and 4 (Ahihi-Kina`u) also show relatively constant trends with time with the exception of 2001 which is marked by large spikes in Si and PO_4^{3-} . Such a fluctuation is not present for NO_3^- in 2001. Sampling in 2001 was conducted during a period of rough winter sea

conditions marked by vigorous mixing of the water column. As a result, there was very weak linear relationship between nutrient concentrations and salinity.

At Site 3, located directly downslope for the point of the Makena Golf Course closest to the ocean, there is a trend of decreasing NO_3^- between 2002 and 2004, an increasing trend from 2004 to 2007, followed by another downturn in 2007 – 2009 (Figures 24 and 25). As a result of these reversing trends, there is no significant change over the seven-year period of monitoring. The multiple reversing trends may reflect changes in land use, such as variation in fertilizer application or construction-related activities in 2002-2004 versus 2004-2007. In June of 2008, the golf course fronting the ocean in this area was shut down for re-alignment and re-planting. Underground retention/filtration systems were also constructed to mitigate adverse affects of stormwater runoff. At the time of the December 2012 survey, new turf grass had been applied but the course remained closed. Construction has begun on the filtration systems but they were not yet operational.

E. Compliance with DOH Standards

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. These criteria are applied depending upon whether the area is likely to receive less than (dry) or greater than (wet) 3 million gallons of groundwater and/or surface water input per mile per day. As it is not possible to accurately estimate groundwater and surface water discharge, both wet and dry standards are considered. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. With only one or two samplings collected per year since 1995, comparison of the 10% or 2% of the time criteria for any sample is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 show instances where measurements exceed the DOH standards under dry conditions, while boxed and shaded values show instances where measurements exceed DOH standards under wet conditions.

Results from the December 2012 survey indicated numerous measurements of NO_3^- , two measurements of NH_4^+ , and six measurements of turbidity exceeded the 10% DOH criteria under wet or dry conditions (Tables 1 and 2). No measurements of TP, TN or Chl *a* exceeded the 10% DOH criteria under dry conditions. It is of interest to note that at Transect Site 4, which is considered the control station beyond the influence of the Makena Resort, exceedance of DOH criteria occurred only for two instances of NH_4^+ .

Tables 3 and 4 show geometric means of samples collected at the same locations during the 28 increments of the monitoring program at Sites 1, 2 and 4. Geometric means of samples collected over 19 increments of sampling at Site 3 and nine increments of sampling at Site 3A are also shown. These tables also specify the samples that exceed the DOH geometric mean limits for open coastal waters under "dry" (boxed) and "wet" (boxed and shaded) conditions. For NO_3^- , NH_4^+ , and TN numerous dry and wet standards were exceeded on all transects. Eight samples of

TP and 21 samples of turbidity exceeded standards. All but seven samples exceed the geometric mean standards for Chl *a*.

Site 4 is considered a control transect, in that it is not located offshore of a resort, golf course or dense residential development. It can be seen in Tables 3 and 4, however, that the number of samples that exceed geometric mean criteria at Site 4 are comparable to the other four sites, all of which are located downslope from the Makena Resort. Hence, Resort activities, including golf courses cannot be attributed as the sole (or even major) factor causing water quality to exceed geometric mean standards.

Several comments can be made regarding the present DOH water quality standards and how they apply to the monitoring program at the Makena Resort. As noted above, the category of water quality standards that are applicable for the Makena Monitoring program are "Open Coastal Waters." As the name implies, these standards apply to "open" waters that can be reasonably defined as "waters beyond the direct influence of land." In order to evaluate the effects of land uses on the nearshore ocean off Makena, the selected sampling regime collects water within a zone that extends from the shoreline to the open coastal ocean. As a result, sampling takes place within the region of ocean that is directly influenced by land. If the monitoring protocol were changed to include only those sampling locations beyond 50-100 m from shore (i.e., open coastal waters), which is completely valid with respect to meeting DOH regulatory compliance, virtually none of the factors discussed above relating to the effects of activities on land to the nearshore ocean would not be observed.

Initial steps have been taken by DOH to rectify this situation. During revision of the Department of Health water quality standards in 2004, a unique set of monitoring criteria was added for the West Coast of the Island of Hawaii (i.e., "Kona standards"). The rationale for these unique criteria was the recognition that existing numerical "standards" represent offshore coastal waters that are beyond the natural confluence of land and the nearshore ocean. As a result, the West Hawaii standards recognize that groundwater entering the ocean at the shoreline contains substantially elevated nutrients relative to open coastal waters. As a result, the Kona criteria provide the potential to meet water quality standards with elevated nutrient concentrations resulting from natural sources of groundwater input. As the same processes of groundwater discharge to the coastal ocean have been documented in Maui, it is hopeful that similar new provisions of the water quality standards with soon be applicable to the South Maui area.

IV. SUMMARY

- The twenty-eighth phase of water chemistry monitoring of the nearshore ocean off the Makena Resort was carried out on December 4, 2012. Sixty-two ocean water samples were collected on four transects spaced along the project ocean frontage and on one control transect. Site 1 was located at the northern boundary of the project, Site 2 was located near the central part of the Makena North Golf Course in the center of Makena Bay, Site 3A (initiated during the June 2007 survey) was located near the southern boundary of Maluaka Bay, Site 3 was downslope from the part of Makena South Golf Course that comes closest to the shoreline, and Control Site 4 was located to the south of Makena Resort near the northern boundary of the 'Ahihi-Kina`u Natural Area Reserve. Sampling transects extended from the shoreline out to

the open coastal ocean. Water samples were analyzed for chemical criteria specified by DOH water quality standards, as well as several additional criteria.

- Water chemistry constituents that occur in high concentration in groundwater (Si and NO_3^-) displayed horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward at three of the five sites. Groundwater input (based on salinity) was greatest at Site 2, followed by Site 3-A and 1. Horizontal gradients were not evident at Sites 3 and 4 during December 2012.
- Vertical stratification of the water column was not evident during December 2012, indicating that strong physical mixing processes generated by tidal exchange, wind stirring, and breaking waves were sufficient to mix the water column from surface to bottom throughout the sampling area at the time of the monitoring survey.
- Overall, values of Chl *a* and turbidity were elevated near the shoreline compared to offshore samples, with Site 2 having the highest values in nearshore samples. The elevated levels of Chl *a* and turbidity in the nearshore zone are likely a result of broken fragments of benthic plants that broken from the bottom by wave action and washed to the shoreline. The low concentrations of Chl *a* through the water column indicates the lack of plankton blooms in the area.
- Other organic water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+ , TON, TOP) did not show any distinctive patterns with respect to horizontal gradients.
- Scaling nutrient concentrations to salinity indicates that there are measurable subsidies of NO_3^- to groundwater that enters the nearshore ocean at three Transect sites. No subsidies other than the chemical constituents of naturally occurring groundwater (particularly NO_3^-) were apparent at Site 2 (Makena Landing) or Control Site 4 ('Ahihi-Kina`u). These subsidies, which are without doubt a result of land uses involving fertilizers, substantially increase the concentration of NO_3^- with respect to salinity in groundwater flowing to the ocean compared to natural groundwater. The area shoreward of Site 1 includes the juncture of the southern part of the Wailea Gold Course and the northern part of the Makena North Course, as well as residential development. Sites 3 and 3A are directly downslope from the Makena South Course in an area where the golf course extends to the shoreline. In addition, private residences are near completion upslope of Transect 3, and it is possible that a cesspool remains from a house that was recently torn down. Hence, the subsidies of NO_3^- noted at these sites may result from a combination of sources.
- Linear regression statistics of nutrient concentration plotted as functions of salinity are useful for evaluating changes to water quality over time. When the regression values of nutrient concentrations versus salinity are plotted as a function of time, there are no statistically significant increases or decreases over the 18 years of monitoring at any of the survey sites. The lack of increase in these slopes and intercepts indicate that there has been no consistent change in nutrient input from land to groundwater that enters the ocean since 1995 (since 2002 at Site 2). At Site 3 off the Makena Resort South Golf Course, there was a progressive decrease in NO_3^- input between 2002 and 2004, followed by an increase between 2004 and

2007, and another decrease in 2008-2012. Further monitoring at this site will be of interest to note the future direction of the oscillating trends noted in the last seven years.

- Comparing water chemistry parameters to DOH standards revealed that several measurements of NO_3^- , two of NH_4^+ , and a few of turbidity exceeded the DOH "not to exceed more than 10% of the time" criteria for dry and wet conditions of open coastal waters. It is apparent that the concentrations of NO_3^- in nearshore marine waters that contains a mixture of seawater and natural groundwater may exceed DOH criteria with no subsidies from human activities on land. Numerous values of NO_3^- , NH_4^+ , TN, turbidity and Chl *a* exceeded specified limits for geometric means. Such exceedances occurred at all survey sites, including the control site that was far from any golf course influence. The consistent exceedance of water quality standards is in large part a consequence of the present DOH standards not accounting for the natural effects of groundwater discharge to the nearshore ocean.
- As in past surveys, there is a subsidy of dissolved inorganic nutrients (e.g., NO_3^- and sometimes to a lesser extent PO_4^{3-}) to groundwater that enters the nearshore ocean at sampling sites downslope from parts of the Makena Resort. Without question, such input is a consequence of various land use activities. However, none of these inputs have increased over time. Surveys of coral reef community structure that are part of the ongoing monitoring program for the Makena Resort, as well as the continued lack of any nuisance algal aggregations in the nearshore area indicate that the nutrient subsidies are not detrimental to marine community structure.
- The next scheduled testing for the Makena Resort monitoring program is planned for the spring-summer season of 2013.

V. REFERENCES CITED

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FIGURE 1. Aerial photograph of Makena Resort on southwest coastline of Maui. Also shown are locations of five water sampling transects that extend from the shoreline to 150-200 m from shore. The southern end of the Wailea golf course is visible at right.

TABLE 1. Water chemistry measurements from ocean water samples collected in the vicinity of the Makena Resort on December 4, 2012. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO ₄ ³⁻ (μM)	NO ₃ ⁻ (μM)	NH ₄ ⁺ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL α (μg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat	
MAKENA 1	0 S	0.1	0.02	0.66	0.06	3.44	0.39	7.44	0.41	8.16	0.19	35.129	0.13	24.2	8.08	102.6	
	2 S	0.1	0.07	0.99	0.08	3.49	0.51	6.42	0.58	7.49	0.23	35.119	0.15	24.3	8.09	102.5	
	5 S	0.5	0.12	2.66	0.11	7.18	0.44	6.42	0.56	9.19	0.61	34.875	0.17	24.3	8.08	103.1	
	5 D	1.5	0.09	1.78	0.13	5.36	0.43	6.56	0.52	8.47	0.49	35.012	0.15	24.3	8.08	103.0	
	10 S	0.5	0.10	0.56	0.14	2.34	0.44	6.35	0.54	7.05	0.17	35.182	0.12	24.3	8.08	101.8	
	10 D	2.4	0.08	0.83	0.15	3.06	0.47	6.72	0.55	7.70	0.22	35.149	0.10	24.3	8.09	102.6	
	50 S	0.5	0.08	1.91	0.18	4.80	0.44	7.00	0.52	9.09	0.14	35.028	0.13	24.2	8.07	101.6	
	50 D	4.1	0.07	0.44	0.20	2.53	0.45	6.63	0.52	7.27	0.12	35.174	0.17	24.5	8.08	101.5	
	100 S	0.5	0.07	1.44	0.20	4.47	0.44	6.00	0.51	7.64	0.16	35.044	0.08	24.3	8.07	102.1	
	100 D	5.5	0.07	0.15	0.16	1.70	0.43	6.76	0.50	7.07	0.08	35.222	0.07	24.5	8.10	102.0	
	150 S	0.6	0.09	0.56	0.14	2.38	0.45	7.31	0.54	8.01	0.09	35.170	0.09	24.3	8.10	100.8	
	150 D	10.4	0.09	0.11	0.16	1.77	0.45	9.03	0.54	9.30	0.05	35.204	0.10	24.5	8.10	101.6	
	MAKENA 2	0 S	0.1	0.20	1.18	0.23	8.80	0.43	5.56	0.63	6.97	0.63	34.988	0.42	24.0	8.09	99.3
		2 S	0.1	0.17	1.10	0.18	8.63	0.43	6.07	0.60	7.35	0.65	34.995	0.40	24.0	8.09	99.7
5 S		0.6	0.17	1.16	0.19	8.01	0.45	6.07	0.62	7.42	0.52	34.964	0.48	24.0	8.09	97.5	
5 D		2.2	0.17	1.18	0.15	8.03	0.47	6.16	0.64	7.49	0.55	34.979	0.42	24.0	8.09	98.3	
10 S		0.5	0.15	1.02	0.06	6.30	0.44	6.29	0.59	7.37	0.29	35.018	0.37	24.0	8.09	99.7	
10 D		3.0	0.14	0.77	0.19	5.10	0.43	5.74	0.57	6.70	0.19	35.069	0.28	24.0	8.09	97.3	
50 S		0.6	0.11	0.59	0.22	3.73	0.45	7.22	0.56	8.03	0.12	35.124	0.10	24.3	8.09	100.3	
50 D		4.4	0.11	0.22	0.20	2.22	0.46	7.23	0.57	7.65	0.05	35.194	0.12	24.5	8.10	100.7	
100 S		0.6	0.09	0.40	0.06	2.88	0.46	6.11	0.55	6.57	0.08	35.154	0.10	24.3	8.09	98.5	
100 D		5.6	0.07	0.32	0.16	2.79	0.47	6.64	0.54	7.12	0.10	35.161	0.09	24.4	8.10	99.3	
150 S		0.5	0.06	0.27	0.22	2.80	0.46	6.48	0.52	6.97	0.11	35.166	0.07	24.2	8.09	100.7	
150 D		7.2	0.09	0.15	0.20	2.27	0.45	5.86	0.54	6.21	0.08	35.194	0.08	24.4	8.09	98.3	
200 S		0.6	0.05	0.19	0.09	2.48	0.48	6.51	0.53	6.79	0.13	35.182	0.06	24.3	8.10	101.3	
200 D		12.0	0.09	0.15	0.03	2.21	0.46	6.32	0.55	6.50	0.04	35.198	0.06	24.4	8.10	101.7	
MAKENA 3-A	0 S	0.1	0.13	1.32	0.17	6.55	0.51	7.33	0.64	8.82	0.59	35.041	0.28	24.1	8.05	94.5	
	2 S	0.1	0.13	1.26	0.22	5.75	0.51	9.39	0.64	10.87	0.30	35.052	0.20	24.1	8.04	94.7	
	5 S	0.5	0.04	0.85	0.04	4.68	0.49	9.07	0.53	9.96	0.18	35.072	0.31	24.0	8.05	96.6	
	5 D	1.1	0.06	0.86	BDL	4.51	0.51	7.83	0.57	8.69	0.18	35.091	0.23	24.0	8.05	96.0	
	10 S	0.5	0.14	1.00	0.11	4.20	0.43	9.06	0.57	10.17	0.15	35.106	0.17	24.0	8.05	97.9	
	10 D	2.9	0.13	0.96	0.15	4.33	0.43	8.60	0.56	9.71	0.12	35.080	0.30	23.5	8.05	102.2	
	50 S	0.5	0.14	0.94	0.13	4.37	0.42	8.86	0.56	9.93	0.12	35.083	0.21	24.2	8.06	97.5	
	50 D	4.5	0.12	0.65	0.18	3.54	0.42	8.71	0.54	9.54	0.09	35.137	0.22	24.3	8.07	97.7	
	100 S	0.5	0.15	0.85	0.30	4.07	0.41	7.79	0.56	8.94	0.13	35.109	0.14	24.2	8.07	99.6	
	100 D	5.0	0.13	0.81	0.23	3.21	0.44	9.01	0.57	10.05	0.14	35.153	0.17	24.3	8.04	99.0	
	150 S	0.5	0.13	0.95	0.25	4.02	0.49	9.15	0.62	10.35	0.12	35.106	0.16	24.2	8.06	100.9	
	150 D	10.4	0.14	0.56	0.23	3.13	0.43	9.43	0.57	10.22	0.10	35.170	0.13	24.3	8.07	103.2	
	MAKENA 3	0 S	0.1	0.13	0.60	0.25	3.41	0.47	9.35	0.60	10.20	0.21	35.179	0.16	24.1	8.03	97.0
		2 S	0.1	0.06	0.50	0.22	3.26	0.47	10.19	0.53	10.91	0.15	35.179	0.17	23.9	8.02	100.0
5 S		0.5	0.10	0.55	0.20	3.12	0.45	9.02	0.55	9.77	0.12	35.163	0.12	23.9	8.03	96.7	
5 D		1.7	0.06	0.58	0.11	3.15	0.44	9.40	0.50	10.09	0.13	35.188	0.21	23.9	8.03	97.1	
10 S		0.5	0.07	0.64	0.24	3.34	0.44	7.76	0.51	8.64	0.12	35.174	0.12	23.8	8.03	97.6	
10 D		2.8	0.15	0.69	0.22	3.36	0.40	8.42	0.55	9.33	0.11	35.167	0.15	23.8	8.02	98.8	
50 S		0.5	0.07	0.79	0.16	3.40	0.47	7.90	0.54	8.85	0.11	35.166	0.09	24.1	8.03	98.0	
50 D		5.2	0.15	0.73	0.18	3.74	0.43	8.55	0.58	9.46	0.10	35.142	0.09	24.2	8.03	101.0	
100 S		0.5	0.14	0.64	0.19	3.14	0.44	9.31	0.58	10.14	0.10	35.176	0.09	24.1	8.05	97.7	
100 D		7.6	0.18	0.56	0.18	3.20	0.40	7.75	0.58	8.49	0.06	35.177	0.08	24.2	8.07	98.1	
150 S		0.5	0.11	0.16	0.12	2.19	0.44	8.11	0.55	8.39	0.03	35.216	0.06	24.3	8.10	98.6	
150 D		13.7	0.12	BDL	0.12	2.25	0.45	9.41	0.57	9.53	0.02	35.246	0.09	24.3	8.11	99.8	
MAKENA 4		0 S	0.1	0.27	0.38	0.43	2.97	0.53	10.85	0.80	11.66	0.12	35.187	0.19	23.9	8.01	95.0
		2 S	0.1	0.09	0.40	0.53	2.91	0.45	9.61	0.54	10.54	0.17	35.195	0.17	23.9	8.00	97.2
	5 S	0.7	0.59	0.30	0.32	3.03	0.32	7.94	0.91	8.56	0.05	35.191	0.20	24.0	8.02	92.6	
	5 D	2.7	0.14	0.28	BDL	2.54	0.44	7.35	0.58	7.63	0.14	35.194	0.24	23.9	8.02	98.9	
	10 S	0.8	0.05	0.37	0.24	2.58	0.45	7.85	0.50	8.46	0.09	35.195	0.16	24.0	8.01	93.9	
	10 D	2.5	0.13	0.32	0.15	2.52	0.43	8.16	0.56	8.63	0.11	35.182	0.19	23.9	8.01	96.2	
	50 S	0.9	0.06	0.31	0.12	2.98	0.50	7.48	0.56	7.91	0.07	35.192	0.08	24.1	8.03	97.0	
	50 D	4.5	0.06	0.30	0.06	3.32	0.50	6.50	0.56	6.86	0.07	35.156	0.16	24.1	8.03	99.2	
	100 S	0.8	0.05	0.34	0.09	2.60	0.51	9.59	0.56	10.02	0.03	35.191	0.07	24.1	8.06	94.6	
	100 D	7.0	0.25	0.26	0.28	2.51	0.46	8.84	0.71	9.38	0.04	35.184	0.12	24.2	8.06	100.9	
	150 S	0.5	0.11	0.23	0.09	2.35	0.45	7.78	0.56	8.10	0.02	35.213	0.09	24.2	8.10	95.9	
	150 D	9.7	0.08	0.12	0.06	2.76	0.47	6.62	0.55	6.80	0.02	35.181	0.07	24.2	8.10	98.2	
	DOH WQS	DRY		10% 2%	0.71 1.43	0.36 0.64				0.96 1.45	12.86 17.86	0.50 1.00	* 1.00		**	***	****
		WET		10% 2%	1.00 1.78	0.61 1.07				1.29 1.93	17.85 25.00	1.25 2.00	* 1.75		**	***	****

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 2. Water chemistry measurements from ocean water samples (in $\mu\text{g/L}$) collected in the vicinity of the Makena Resort on January 4, 2013. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH 10% "dry" standards; boxed and shaded values exceed DOH 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	DEPTH (m)	PO ₄ ³⁻ ($\mu\text{g/L}$)	NO ₃ ⁻ ($\mu\text{g/L}$)	NH ₄ ⁺ ($\mu\text{g/L}$)	Si ($\mu\text{g/L}$)	TOP ($\mu\text{g/L}$)	TON ($\mu\text{g/L}$)	TP ($\mu\text{g/L}$)	TN ($\mu\text{g/L}$)	TURB (NTU)	SALINITY (ppt)	CHL α ($\mu\text{g/L}$)	TEMP (deg.C)	pH (std.units)	O ₂ (% Sat)	
MAKENA 1	0 S	0.1	0.62	9.24	0.84	96.66	12.09	104.2	12.71	114.2	0.19	35.129	0.13	24.2	8.08	102.6	
	2 S	0.1	2.17	13.86	1.12	98.07	15.81	89.88	17.98	104.9	0.23	35.119	0.15	24.3	8.09	102.5	
	5 S	0.5	3.72	37.24	1.54	201.8	13.64	89.88	17.36	128.7	0.61	34.875	0.17	24.3	8.08	103.1	
	5 D	1.5	2.79	24.92	1.82	150.6	13.33	91.84	16.12	118.6	0.49	35.012	0.15	24.3	8.08	103.0	
	10 S	0.5	3.10	7.84	1.96	65.75	13.64	88.90	16.74	98.70	0.17	35.182	0.12	24.3	8.08	101.8	
	10 D	2.4	2.48	11.62	2.10	85.99	14.57	94.08	17.05	107.8	0.22	35.149	0.10	24.3	8.09	102.6	
	50 S	0.5	2.48	26.74	2.52	134.9	13.64	98.00	16.12	127.3	0.14	35.028	0.13	24.2	8.07	101.6	
	50 D	4.1	2.17	6.16	2.80	71.09	13.95	92.82	16.12	101.8	0.12	35.174	0.17	24.5	8.08	101.5	
	100 S	0.5	2.17	20.16	2.80	125.6	13.64	84.00	15.81	107.0	0.16	35.044	0.08	24.3	8.07	102.1	
	100 D	5.5	2.17	2.10	2.24	47.77	13.33	94.64	15.50	98.98	0.08	35.222	0.07	24.5	8.10	102.0	
	150 S	0.6	2.79	7.84	1.96	66.88	13.95	102.3	16.74	112.1	0.09	35.170	0.09	24.3	8.10	100.8	
	150 D	10.4	2.79	1.54	2.24	49.74	13.95	126.4	16.74	130.2	0.05	35.204	0.10	24.5	8.10	101.6	
	MAKENA 2	0 S	0.1	6.20	16.52	3.22	247.3	13.33	77.84	19.53	97.58	0.63	34.988	0.42	24.0	8.09	99.3
		2 S	0.1	5.27	15.40	2.52	242.5	13.33	84.98	18.60	102.9	0.65	34.995	0.40	24.0	8.09	99.7
5 S		0.6	5.27	16.24	2.66	225.1	13.95	84.98	19.22	103.9	0.52	34.964	0.48	24.0	8.09	97.5	
5 D		2.2	5.27	16.52	2.10	225.6	14.57	86.24	19.84	104.9	0.55	34.979	0.42	24.0	8.09	98.3	
10 S		0.5	4.65	14.28	0.84	177.0	13.64	88.06	18.29	103.2	0.29	35.018	0.37	24.0	8.09	99.7	
10 D		3.0	4.34	10.78	2.66	143.3	13.33	80.36	17.67	93.80	0.19	35.069	0.28	24.0	8.09	97.3	
50 S		0.6	3.41	8.26	3.08	104.8	13.95	101.1	17.36	112.4	0.12	35.124	0.10	24.3	8.09	100.3	
50 D		4.4	3.41	3.08	2.80	62.38	14.26	101.2	17.67	107.1	0.05	35.194	0.12	24.5	8.10	100.7	
100 S		0.6	2.79	5.60	0.84	80.93	14.26	85.54	17.05	91.98	0.08	35.154	0.10	24.3	8.09	98.5	
100 D		5.6	2.17	4.48	2.24	78.40	14.57	92.96	16.74	99.68	0.10	35.161	0.09	24.4	8.10	99.3	
150 S		0.5	1.86	3.78	3.08	78.68	14.26	90.72	16.12	97.58	0.11	35.166	0.07	24.2	8.09	100.7	
150 D		7.2	2.79	2.10	2.80	63.79	13.95	82.04	16.74	86.94	0.08	35.194	0.08	24.4	8.09	98.3	
200 S		0.6	1.55	2.66	1.26	69.69	14.88	91.14	16.43	95.06	0.13	35.182	0.06	24.3	8.10	101.3	
200 D		12.0	2.79	2.10	0.42	62.10	14.26	88.48	17.05	91.00	0.04	35.198	0.06	24.4	8.10	101.7	
MAKENA 3-A	0 S	0.1	4.03	18.48	2.38	184.1	15.81	102.6	19.84	123.5	0.59	35.041	0.28	24.1	8.05	94.5	
	2 S	0.1	4.03	17.64	3.08	161.6	15.81	131.5	19.84	152.2	0.30	35.052	0.20	24.1	8.04	94.7	
	5 S	0.5	1.24	11.90	0.56	131.5	15.19	127.0	16.43	139.4	0.18	35.072	0.31	24.0	8.05	96.6	
	5 D	1.1	1.86	12.04	BDL	126.7	15.81	109.6	17.67	121.7	0.18	35.091	0.23	24.0	8.05	96.0	
	10 S	0.5	4.34	14.00	1.54	118.0	13.33	126.8	17.67	142.4	0.15	35.106	0.17	24.0	8.05	97.9	
	10 D	2.9	4.03	13.44	2.10	121.7	13.33	120.4	17.36	135.9	0.12	35.080	0.30	23.5	8.05	102.2	
	50 S	0.5	4.34	13.16	1.82	122.8	13.02	124.0	17.36	139.0	0.12	35.083	0.21	24.2	8.06	97.5	
	50 D	4.5	3.72	9.10	2.52	99.47	13.02	121.9	16.74	133.6	0.09	35.137	0.22	24.3	8.07	97.7	
	100 S	0.5	4.65	11.90	4.20	114.4	12.71	109.1	17.36	125.2	0.13	35.109	0.14	24.2	8.07	99.6	
	100 D	5.0	4.03	11.34	3.22	90.20	13.64	126.1	17.67	140.7	0.14	35.153	0.17	24.3	8.04	99.0	
	150 S	0.5	4.03	13.30	3.50	113.0	15.19	128.1	19.22	144.9	0.12	35.106	0.16	24.2	8.06	100.9	
	150 D	10.4	4.34	7.84	3.22	87.95	13.33	132.0	17.67	143.1	0.10	35.170	0.13	24.3	8.07	103.2	
	MAKENA 3	0 S	0.1	4.03	8.40	3.50	95.82	14.57	130.9	18.60	142.8	0.21	35.179	0.16	24.1	8.03	97.0
		2 S	0.1	1.86	7.00	3.08	91.61	14.57	142.7	16.43	152.7	0.15	35.179	0.17	23.9	8.02	100.0
5 S		0.5	3.10	7.70	2.80	87.67	13.95	126.3	17.05	136.8	0.12	35.163	0.12	23.9	8.03	96.7	
5 D		1.7	1.86	8.12	1.54	88.52	13.64	131.6	15.50	141.3	0.13	35.188	0.21	23.9	8.03	97.1	
10 S		0.5	2.17	8.96	3.36	93.85	13.64	108.6	15.81	121.0	0.12	35.174	0.12	23.8	8.03	97.6	
10 D		2.8	4.65	9.66	3.08	94.42	12.40	117.9	17.05	130.6	0.11	35.167	0.15	23.8	8.02	98.8	
50 S		0.5	2.17	11.06	2.24	95.54	14.57	110.6	16.74	123.9	0.11	35.166	0.09	24.1	8.03	98.0	
50 D		5.2	4.65	10.22	2.52	105.1	13.33	119.7	17.98	132.4	0.10	35.142	0.09	24.2	8.03	101.0	
100 S		0.5	4.34	8.96	2.66	88.23	13.64	130.3	17.98	142.0	0.10	35.176	0.09	24.1	8.05	97.7	
100 D		7.6	5.58	7.84	2.52	89.92	12.40	108.5	17.98	118.9	0.06	35.177	0.08	24.2	8.07	98.1	
150 S		0.5	3.41	2.24	1.68	61.54	13.64	113.5	17.05	117.5	0.03	35.216	0.06	24.3	8.10	98.6	
150 D		13.7	3.72	BDL	1.68	63.23	13.95	131.7	17.67	133.4	0.02	35.246	0.09	24.3	8.11	99.8	
MAKENA 4		0 S	0.1	8.37	5.32	6.02	83.46	16.43	151.9	24.80	163.2	0.12	35.187	0.19	23.9	8.01	95.0
		2 S	0.1	2.79	5.60	7.42	81.77	13.95	134.5	16.74	147.6	0.17	35.195	0.17	23.9	8.00	97.2
	5 S	0.7	18.29	4.20	4.48	85.14	9.92	111.2	28.21	119.8	0.05	35.191	0.20	24.0	8.02	92.6	
	5 D	2.7	4.34	3.92	BDL	71.37	13.64	102.9	17.98	106.8	0.14	35.194	0.24	23.9	8.02	98.9	
	10 S	0.8	1.55	5.18	3.36	72.50	13.95	109.9	15.50	118.4	0.09	35.195	0.16	24.0	8.01	93.9	
	10 D	2.5	4.03	4.48	2.10	70.81	13.33	114.2	17.36	120.8	0.11	35.182	0.19	23.9	8.01	96.2	
	50 S	0.9	1.86	4.34	1.68	83.74	15.50	104.7	17.36	110.7	0.07	35.192	0.08	24.1	8.03	97.0	
	50 D	4.5	1.86	4.20	0.84	93.29	15.50	91.00	17.36	96.04	0.07	35.156	0.16	24.1	8.03	99.2	
	100 S	0.8	1.55	4.76	1.26	73.06	15.81	134.3	17.36	140.3	0.03	35.191	0.07	24.1	8.06	94.6	
	100 D	7.0	7.75	3.64	3.92	70.53	14.26	123.8	22.01	131.3	0.04	35.184	0.12	24.2	8.06	100.9	
	150 S	0.5	3.41	3.22	1.26	66.04	13.95	108.9	17.36	113.4	0.02	35.213	0.09	24.2	8.10	95.9	
	150 D	9.7	2.48	1.68	0.84	77.56	14.57	92.68	17.05	95.20	0.02	35.181	0.07	24.2	8.10	98.2	
	DOH WQS		DRY	10%	10.00	5.00				30.00	180.00	0.50	*	0.50	**	***	****
				2%	20.00	9.00				45.00	250.00	1.00	*	1.00	**	***	****
		WET	10%	14.00	8.50				40.00	250.00	1.25	*	0.90	**	***	****	
			2%	25.00	15.00				60.00	350.00	2.00	*	1.75	**	***	****	

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 3. Geometric mean data from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 from Sites 1, 2, and 4 (N=28); since June 2002 from Site 3 (N=19) and since June 2007 from Site 3-A (N=10). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO ₄ ³⁻ (μM)	NO ₃ ⁻ (μM)	NH ₄ ⁺ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (NTU)	SALINITY (ppt)	CHL α ($\mu\text{g/L}$)	TEMP (deg.C)	pH	O2	
MAKENA 1	0 S	0.20	36.13	0.33	65.41	0.24	7.78	0.54	53.14	0.34	26.185	0.79	25.6	8.13	102.6	
	2 S	0.16	24.41	0.19	46.43	0.26	8.15	0.47	37.69	0.29	29.832	0.77	25.6	8.16	105.0	
	5 S	0.12	11.26	0.13	25.12	0.25	7.90	0.41	23.49	0.25	32.185	0.51	25.5	8.16	105.1	
	5 D	0.12	8.66	0.19	20.61	0.27	7.48	0.41	19.48	0.21	33.111	0.46	25.6	8.17	105.5	
	10 S	0.10	3.77	0.15	10.30	0.26	7.35	0.38	13.07	0.19	34.071	0.32	25.6	8.15	104.5	
	10 D	0.10	2.23	0.20	6.94	0.28	7.27	0.39	10.78	0.17	34.410	0.32	25.5	8.15	103.7	
	50 S	0.08	2.38	0.20	7.04	0.26	7.17	0.37	10.81	0.16	34.453	0.27	25.6	8.14	100.3	
	50 D	0.08	0.30	0.14	2.58	0.28	7.17	0.37	7.96	0.12	34.804	0.25	25.5	8.14	99.3	
	100 S	0.09	0.88	0.16	4.54	0.27	6.67	0.37	9.19	0.13	34.596	0.22	25.5	8.14	98.4	
	100 D	0.07	0.11	0.09	2.11	0.28	7.20	0.36	7.68	0.10	34.850	0.19	25.5	8.15	98.1	
	150 S	0.08	0.27	0.16	2.93	0.27	7.16	0.37	8.32	0.12	34.764	0.18	25.7	8.14	97.4	
	150 D	0.08	0.07	0.13	1.85	0.28	7.03	0.37	7.39	0.10	34.868	0.16	25.5	8.15	98.2	
	MAKENA 2	0 S	0.19	4.12	0.37	21.80	0.32	8.16	0.55	13.82	0.89	33.435	0.73	25.7	8.14	98.2
		2 S	0.18	3.70	0.25	19.12	0.32	7.78	0.53	12.75	0.65	33.615	0.72	25.8	8.14	100.3
		5 S	0.16	2.96	0.25	14.29	0.29	7.10	0.47	11.04	0.45	34.070	0.56	25.6	8.14	100.0
5 D		0.17	2.77	0.29	14.25	0.31	7.33	0.50	11.34	0.42	34.117	0.68	25.6	8.14	99.3	
10 S		0.12	1.66	0.21	9.26	0.30	5.68	0.44	9.23	0.31	34.407	0.40	25.6	8.14	98.6	
10 D		0.11	0.98	0.25	7.54	0.30	7.05	0.44	8.94	0.27	34.528	0.43	25.6	8.14	97.4	
50 S		0.10	1.13	0.26	7.26	0.32	7.57	0.44	9.63	0.23	34.472	0.30	25.5	8.13	97.4	
50 D		0.11	0.21	0.23	3.14	0.30	7.40	0.43	8.09	0.17	34.816	0.33	25.5	8.14	96.9	
100 S		0.09	0.45	0.19	4.08	0.29	7.15	0.40	8.14	0.16	34.665	0.25	25.6	8.13	97.6	
100 D		0.08	0.13	0.18	2.37	0.29	7.06	0.39	7.58	0.13	34.845	0.24	25.5	8.14	97.0	
150 S		0.09	0.23	0.20	3.11	0.29	7.28	0.40	7.94	0.14	34.792	0.20	25.6	8.14	97.1	
150 D		0.08	0.08	0.15	2.08	0.30	7.32	0.39	7.69	0.10	34.868	0.20	25.5	8.15	97.3	
200 S		0.07	0.10	0.16	2.35	0.29	7.11	0.38	7.61	0.11	34.864	0.21	25.7	8.15	97.9	
200 D		0.08	0.04	0.18	1.71	0.29	7.58	0.38	7.90	0.10	34.893	0.21	25.5	8.16	97.6	
MAKENA 3-A		0 S	1.14	110.1	0.34	231.8	0.21	10.11	1.60	141.7	0.34	15.525	0.27	24.9	7.89	97.1
	2 S	0.85	75.65	0.34	154.9	0.27	8.08	1.40	110.1	0.23	21.411	0.32	25.0	7.91	97.5	
	5 S	0.30	26.21	0.38	57.58	0.34	8.56	0.77	50.34	0.20	29.565	0.29	25.0	8.00	98.1	
	5 D	0.20	15.40	0.34	36.60	0.30	7.54	0.61	30.23	0.19	32.066	0.30	25.2	8.05	98.4	
	10 S	0.10	5.26	0.22	15.93	0.28	7.63	0.44	17.81	0.14	33.625	0.18	25.2	8.08	98.7	
	10 D	0.07	1.27	0.19	5.46	0.27	6.93	0.37	9.41	0.15	34.698	0.22	25.1	8.10	99.6	
	50 S	0.09	1.75	0.20	7.68	0.27	7.60	0.40	11.64	0.12	34.528	0.14	25.5	8.10	98.8	
	50 D	0.07	0.13	0.30	3.10	0.29	7.95	0.39	8.62	0.12	34.878	0.15	25.3	8.11	98.4	
	100 S	0.09	0.79	0.13	4.79	0.28	7.01	0.39	8.71	0.12	34.790	0.14	25.5	8.10	97.9	
	100 D	0.11	0.05	0.29	2.36	0.29	7.18	0.41	7.69	0.11	34.962	0.12	25.3	8.12	99.2	
	150 S	0.07	0.12	0.14	3.19	0.32	7.80	0.41	8.81	0.13	34.887	0.12	25.4	8.12	98.5	
	150 D	0.07	0.02	0.24	2.08	0.28	7.23	0.37	7.62	0.12	34.968	0.13	25.2	8.13	101.0	
	MAKENA 3	0 S	0.13	8.37	0.33	18.20	0.27	6.41	0.46	23.45	0.32	33.806	0.45	25.8	8.14	100.7
		2 S	0.15	12.33	0.26	22.90	0.27	6.04	0.47	26.93	0.29	33.813	0.49	25.7	8.12	101.6
		5 S	0.13	8.32	0.20	16.02	0.29	7.58	0.48	21.32	0.21	34.105	0.31	25.6	8.11	101.5
5 D		0.13	5.90	0.18	12.36	0.28	6.97	0.45	17.68	0.21	34.318	0.38	25.6	8.11	100.2	
10 S		0.10	3.86	0.24	8.96	0.28	7.27	0.42	14.64	0.17	34.458	0.24	25.5	8.11	98.5	
10 D		0.09	1.95	0.16	5.98	0.29	7.61	0.40	11.74	0.15	34.691	0.25	25.4	8.11	97.9	
50 S		0.08	1.39	0.18	5.06	0.28	7.38	0.38	10.34	0.14	34.711	0.19	25.5	8.11	95.6	
50 D		0.09	0.32	0.17	2.88	0.29	7.61	0.39	8.45	0.10	34.876	0.19	25.4	8.12	94.1	
100 S		0.08	0.44	0.21	2.96	0.29	7.42	0.39	8.48	0.11	34.834	0.15	25.5	8.12	96.2	
100 D		0.07	0.11	0.23	2.04	0.29	6.92	0.38	7.47	0.09	34.882	0.16	25.5	8.13	96.0	
150 S		0.06	0.12	0.14	2.28	0.28	6.90	0.36	7.49	0.10	34.860	0.13	25.5	8.15	96.6	
150 D		0.07	0.06	0.12	1.83	0.28	7.03	0.37	7.35	0.09	34.911	0.16	25.5	8.16	97.9	
MAKENA 4		0 S	0.20	36.13	0.33	65.41	0.24	7.78	0.54	53.14	0.34	26.185	0.79	25.6	8.13	100.8
		2 S	0.16	24.41	0.19	46.43	0.26	8.15	0.47	37.69	0.29	29.832	0.77	25.6	8.16	101.8
		5 S	0.12	11.26	0.13	25.12	0.25	7.90	0.41	23.49	0.25	32.185	0.51	25.5	8.16	102.5
	5 D	0.12	8.66	0.19	20.61	0.27	7.48	0.41	19.48	0.21	33.111	0.46	25.6	8.17	101.7	
	10 S	0.10	3.77	0.15	10.30	0.26	7.35	0.38	13.07	0.19	34.071	0.32	25.6	8.15	100.1	
	10 D	0.10	2.23	0.20	6.94	0.28	7.27	0.39	10.78	0.17	34.410	0.32	25.5	8.15	100.8	
	50 S	0.08	2.38	0.20	7.04	0.26	7.17	0.37	10.81	0.16	34.453	0.27	25.6	8.14	94.8	
	50 D	0.08	0.30	0.14	2.58	0.28	7.17	0.37	7.96	0.12	34.804	0.25	25.5	8.14	94.1	
	100 S	0.09	0.88	0.16	4.54	0.27	6.67	0.37	9.19	0.13	34.596	0.22	25.5	8.14	94.9	
	100 D	0.07	0.11	0.09	2.11	0.28	7.20	0.36	7.68	0.10	34.850	0.19	25.5	8.15	93.7	
	150 S	0.08	0.27	0.16	2.93	0.27	7.16	0.37	8.32	0.12	34.764	0.18	25.7	8.14	96.4	
	150 D	0.08	0.07	0.13	1.85	0.28	7.03	0.37	7.39	0.10	34.868	0.16	25.5	8.15	95.4	
	DOH WQS		DRY	0.25	0.14				0.52	7.86	0.20	*	0.15	**	***	
	GEOMETRIC MEAN		WET	0.36	0.25				0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 4. Geometric mean data (in $\mu\text{g/L}$) from water chemistry measurements (in μM) off the Makena Resort collected since August 1995 for Sites 1, 2, and 4 (N=28); since June 2002 from Site 3 (N=19) and since June 2007 from Site 3-A (N=10). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep. Also shown are State of Hawaii, Department of Health (DOH) geometric mean water quality standards for open coastal waters under "dry" and "wet" conditions. Boxed values exceed DOH GM 10% "dry" standards; boxed and shaded values exceed DOH GM 10% "wet" standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO ₄ ³⁻ ($\mu\text{g/L}$)	NO ₃ ⁻ ($\mu\text{g/L}$)	NH ₄ ⁺ ($\mu\text{g/L}$)	Si ($\mu\text{g/L}$)	TOP ($\mu\text{g/L}$)	TON ($\mu\text{g/L}$)	TP ($\mu\text{g/L}$)	TN ($\mu\text{g/L}$)	TURB (NTU)	SALINITY (ppt)	CHL a ($\mu\text{g/L}$)	TEMP (deg.C)	pH	O2	
MAKENA 1	0 S	6.10	506.0	4.60	1837	7.40	108.9	16.70	744.2	0.34	26.185	0.79	25.6	8.13	102.6	
	2 S	4.90	341.8	2.60	1304	8.00	114.1	14.50	527.8	0.29	29.832	0.77	25.6	8.16	105.0	
	5 S	3.70	157.7	1.80	705.6	7.70	110.6	12.60	329.0	0.25	32.185	0.51	25.5	8.16	105.1	
	5 D	3.70	121.2	2.60	578.9	8.30	104.7	12.60	272.8	0.21	33.111	0.46	25.6	8.17	105.5	
	10 S	3.00	52.80	2.10	289.3	8.00	102.9	11.70	183.0	0.19	34.071	0.32	25.6	8.15	104.5	
	10 D	3.00	31.20	2.80	194.9	8.60	101.8	12.00	150.9	0.17	34.410	0.32	25.5	8.15	103.7	
	50 S	2.40	33.30	2.80	197.8	8.00	100.4	11.40	151.4	0.16	34.453	0.27	25.6	8.14	100.3	
	50 D	2.40	4.20	1.90	72.47	8.60	100.4	11.40	111.4	0.12	34.804	0.25	25.5	8.14	99.3	
	100 S	2.70	12.30	2.20	127.5	8.30	93.40	11.40	128.7	0.13	34.596	0.22	25.5	8.14	98.4	
	100 D	2.10	1.50	1.20	59.27	8.60	100.8	11.10	107.5	0.10	34.850	0.19	25.5	8.15	98.1	
	150 S	2.40	3.70	2.20	82.30	8.30	100.2	11.40	116.5	0.12	34.764	0.18	25.7	8.14	97.4	
	150 D	2.40	0.90	1.80	51.97	8.60	98.40	11.40	103.5	0.10	34.868	0.16	25.5	8.15	98.2	
	MAKENA 2	0 S	5.80	57.70	5.10	612.4	9.90	114.2	17.00	193.5	0.89	33.435	0.73	25.7	8.14	98.2
		2 S	5.50	51.80	3.50	537.1	9.90	108.9	16.40	178.5	0.65	33.615	0.72	25.8	8.14	100.3
		5 S	4.90	41.40	3.50	401.4	8.90	99.40	14.50	154.6	0.45	34.070	0.56	25.6	8.14	100.0
5 D		5.20	38.70	4.00	400.3	9.60	102.6	15.40	158.8	0.42	34.117	0.68	25.6	8.14	99.3	
10 S		3.70	23.20	2.90	260.1	9.20	79.50	13.60	129.2	0.31	34.407	0.40	25.6	8.14	98.6	
10 D		3.40	13.70	3.50	211.8	9.20	98.70	13.60	125.2	0.27	34.528	0.43	25.6	8.14	97.4	
50 S		3.00	15.80	3.60	203.9	9.90	106.0	13.60	134.8	0.23	34.472	0.30	25.5	8.13	97.4	
50 D		3.40	2.90	3.20	88.20	9.20	103.6	13.30	113.3	0.17	34.816	0.33	25.5	8.14	96.9	
100 S		2.70	6.30	2.60	114.6	8.90	100.1	12.30	114.0	0.16	34.665	0.25	25.6	8.13	97.6	
100 D		2.40	1.80	2.50	66.57	8.90	98.80	12.00	106.1	0.13	34.845	0.24	25.5	8.14	97.0	
150 S		2.70	3.20	2.80	87.36	8.90	101.9	12.30	111.2	0.14	34.792	0.20	25.6	8.14	97.1	
150 D		2.40	1.10	2.10	58.43	9.20	102.5	12.00	107.7	0.10	34.868	0.20	25.5	8.15	97.3	
200 S		2.10	1.40	2.20	66.01	8.90	99.50	11.70	106.5	0.11	34.864	0.21	25.7	8.15	97.9	
200 D		2.40	0.50	2.50	48.03	8.90	106.1	11.70	110.6	0.10	34.893	0.21	25.5	8.16	97.6	
MAKENA 3-A		0 S	35.30	1542	4.70	6512	6.50	141.6	49.50	1984	0.34	15.525	0.27	24.9	7.89	97.1
	2 S	26.30	1060	4.70	4352	8.30	113.1	43.30	1542	0.23	21.411	0.32	25.0	7.91	97.5	
	5 S	9.20	367.0	5.30	1617	10.50	119.8	23.80	705.0	0.20	29.565	0.29	25.0	8	98.1	
	5 D	6.10	215.6	4.70	1028	9.20	105.6	18.80	423.4	0.19	32.066	0.30	25.2	8.05	98.4	
	10 S	3.00	73.60	3.00	447.5	8.60	106.8	13.60	249.4	0.14	33.625	0.18	25.2	8.08	98.7	
	10 D	2.10	17.70	2.60	153.4	8.30	97.00	11.40	131.7	0.15	34.698	0.22	25.1	8.1	99.6	
	50 S	2.70	24.50	2.80	215.7	8.30	106.4	12.30	163.0	0.12	34.528	0.14	25.5	8.1	98.8	
	50 D	2.10	1.80	4.20	87.08	8.90	111.3	12.00	120.7	0.12	34.878	0.15	25.3	8.11	98.4	
	100 S	2.70	11.00	1.80	134.6	8.60	98.10	12.00	121.9	0.12	34.790	0.14	25.5	8.1	97.9	
	100 D	3.40	0.70	4.00	66.29	8.90	100.5	12.60	107.7	0.11	34.962	0.12	25.3	8.12	99.2	
	150 S	2.10	1.60	1.90	89.61	9.90	109.2	12.60	123.3	0.13	34.887	0.12	25.4	8.12	98.5	
	150 D	2.10	0.20	3.30	58.43	8.60	101.2	11.40	106.7	0.12	34.968	0.13	25.2	8.13	101.0	
	MAKENA 3	0 S	4.00	117.2	4.60	511.2	8.30	89.70	14.20	328.4	0.32	33.806	0.45	25.8	8.14	100.7
		2 S	4.60	172.6	3.60	643.3	8.30	84.50	14.50	377.1	0.29	33.813	0.49	25.7	8.12	101.6
		5 S	4.00	116.5	2.80	450.0	8.90	106.1	14.80	298.6	0.21	34.105	0.31	25.6	8.11	101.5
5 D		4.00	82.60	2.50	347.2	8.60	97.60	13.90	247.6	0.21	34.318	0.38	25.6	8.11	100.2	
10 S		3.00	54.00	3.30	251.7	8.60	101.8	13.00	205.0	0.17	34.458	0.24	25.5	8.11	98.5	
10 D		2.70	27.30	2.20	168.0	8.90	106.5	12.30	164.4	0.15	34.691	0.25	25.4	8.11	97.9	
50 S		2.40	19.40	2.50	142.1	8.60	103.3	11.70	144.8	0.14	34.711	0.19	25.5	8.11	95.6	
50 D		2.70	4.40	2.30	80.90	8.90	106.5	12.00	118.3	0.10	34.876	0.19	25.4	8.12	94.1	
100 S		2.40	6.10	2.90	83.15	8.90	103.9	12.00	118.7	0.11	34.834	0.15	25.5	8.12	96.2	
100 D		2.10	1.50	3.20	57.30	8.90	96.90	11.70	104.6	0.09	34.882	0.16	25.5	8.13	96.0	
150 S		1.80	1.60	1.90	64.05	8.60	96.60	11.10	104.9	0.10	34.860	0.13	25.5	8.15	96.6	
150 D		2.10	0.80	1.60	51.40	8.60	98.40	11.40	102.9	0.09	34.911	0.16	25.5	8.16	97.9	
MAKENA 4		0 S	6.10	506.0	4.60	1837	7.40	108.9	16.70	744.2	0.34	26.185	0.79	25.6	8.13	100.8
		2 S	4.90	341.8	2.60	1304	8.00	114.1	14.50	527.8	0.29	29.832	0.77	25.6	8.16	101.8
		5 S	3.70	157.7	1.80	705.6	7.70	110.6	12.60	329.0	0.25	32.185	0.51	25.5	8.16	102.5
	5 D	3.70	121.2	2.60	578.9	8.30	104.7	12.60	272.8	0.21	33.111	0.46	25.6	8.17	101.7	
	10 S	3.00	52.80	2.10	289.3	8.00	102.9	11.70	183.0	0.19	34.071	0.32	25.6	8.15	100.1	
	10 D	3.00	31.20	2.80	194.9	8.60	101.8	12.00	150.9	0.17	34.410	0.32	25.5	8.15	100.8	
	50 S	2.40	33.30	2.80	197.8	8.00	100.4	11.40	151.4	0.16	34.453	0.27	25.6	8.14	94.8	
	50 D	2.40	4.20	1.90	72.47	8.60	100.4	11.40	111.4	0.12	34.804	0.25	25.5	8.14	94.1	
	100 S	2.70	12.30	2.20	127.5	8.30	93.40	11.40	128.7	0.13	34.596	0.22	25.5	8.14	94.9	
	100 D	2.10	1.50	1.20	59.27	8.60	100.8	11.10	107.5	0.10	34.850	0.19	25.5	8.15	93.7	
	150 S	2.40	3.70	2.20	82.30	8.30	100.2	11.40	116.5	0.12	34.764	0.18	25.7	8.14	96.4	
	150 D	2.40	0.90	1.80	51.97	8.60	98.40	11.40	103.5	0.10	34.868	0.16	25.5	8.15	95.4	
	DOH WQS		DRY	3.50	2.00				16.00	110.00	0.20	*	0.15	**	***	
	GEOMETRIC MEAN		WET	5.00	3.50				20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.

** Temperature shall not vary by more than one degree C. from ambient conditions.

***pH shall not deviate more than 0.5 units from a value of 8.1.

****Dissolved Oxygen not to be below 75% saturation.

TABLE 5. Water chemistry measurements in μM and $\mu\text{g/L}$ (shaded) from irrigation wells and an irrigation lake collected in the vicinity of the Makena Resort on May 10, 2012. For sampling site locations, see Figure 1.

WELL	PO_4^{3-} (μM)	PO_4^{3-} ($\mu\text{g/L}$)	NO_3^- (μM)	NO_3^- ($\mu\text{g/L}$)	NH_4^+ (μM)	NH_4^+ ($\mu\text{g/L}$)	Si (μM)	Si ($\mu\text{g/L}$)	TOP (μM)	TOP ($\mu\text{g/L}$)	TON (μM)	TON ($\mu\text{g/L}$)	TP (μM)	TP ($\mu\text{g/L}$)	TN (μM)	TN ($\mu\text{g/L}$)	SALINITY (ppt)
1	2.10	65.10	124.6	1744.4	1.00	14.00	483.9	13597.6	0.55	17.05	6.80	95.20	2.65	82.15	132.4	1853.6	1.359
2	2.95	91.45	142.6	1996.4	0.80	11.20	648.4	18220.0	0.10	3.10	7.25	101.50	3.05	94.55	150.7	2109.1	1.827
3	3.10	96.10	137.2	1920.8	0.65	9.10	650.2	18270.6	0.15	4.65	12.95	181.30	3.25	100.75	150.8	2111.2	2.007
4	3.00	93.00	126.1	1765.4	0.60	8.40	612.5	17211.3	0.30	9.30	16.80	235.20	3.30	102.30	143.5	2009.0	1.739
5	2.70	83.70	161.4	2259.6	0.65	9.10	555.9	15620.8	0.60	18.60	10.70	149.80	3.30	102.30	172.8	2418.5	1.528
6	2.45	75.95	166.0	2323.3	0.35	4.90	523.8	14717.4	0.45	13.95	14.15	198.10	2.90	89.90	180.5	2526.3	1.611
8	2.80	86.80	111.3	1557.5	0.25	3.50	564.0	15847.0	0.30	9.30	14.55	203.70	3.10	96.10	126.1	1764.7	2.312
10	2.40	74.40	168.2	2354.8	4.75	66.50	578.2	16246.0	0.35	10.85	21.70	303.80	2.75	85.25	194.7	2725.1	1.829
11	2.45	75.95	117.1	1639.4	1.05	14.70	589.4	16562.1	0.65	20.15	17.80	249.20	3.10	96.10	136.0	1903.3	2.002

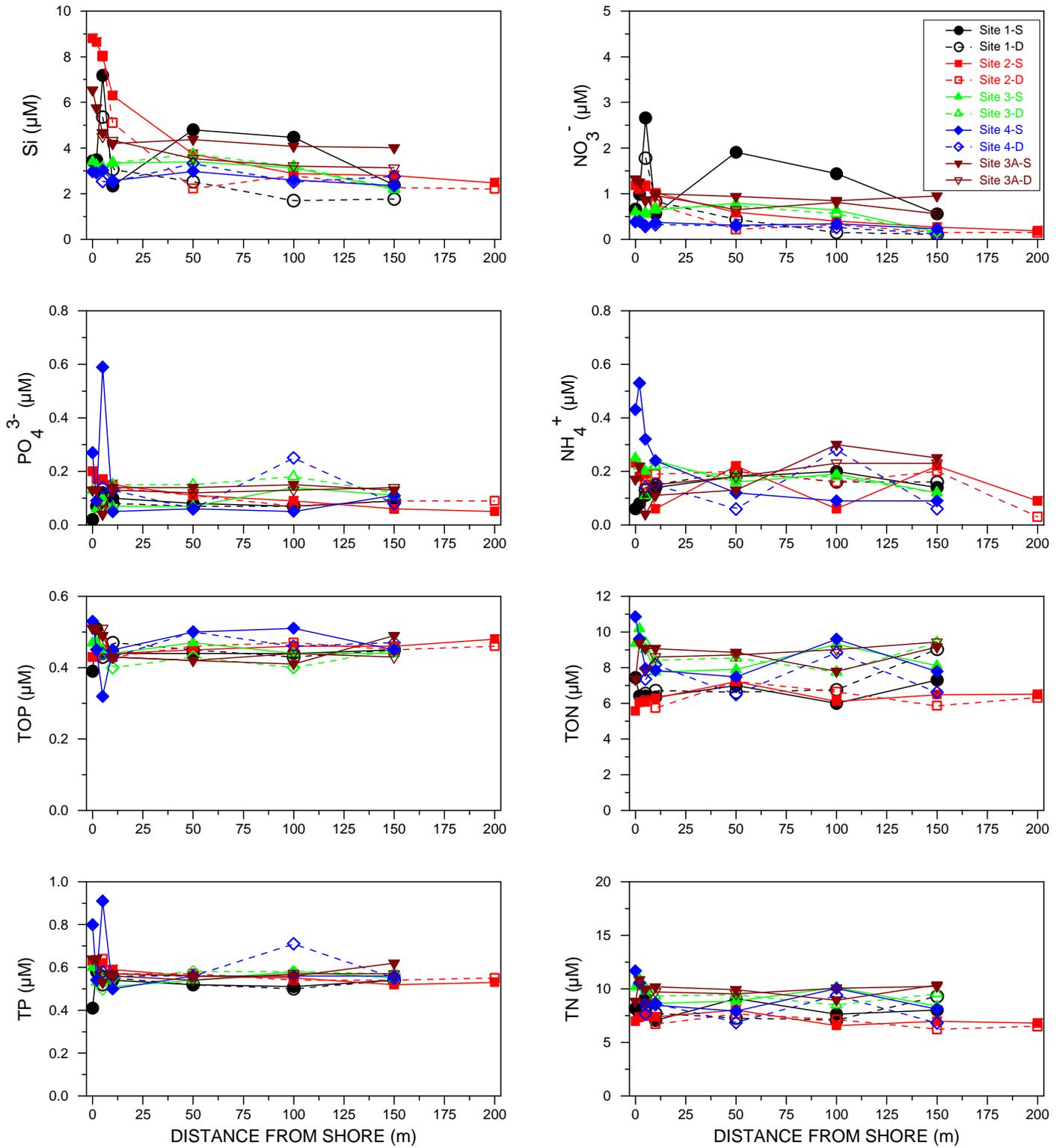


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on December 4, 2012 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

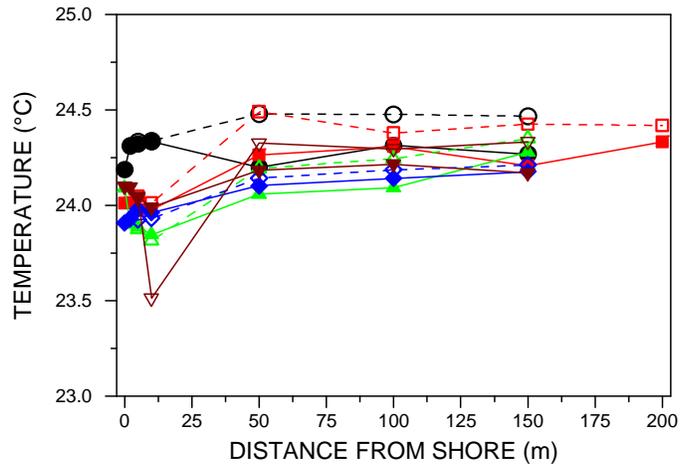
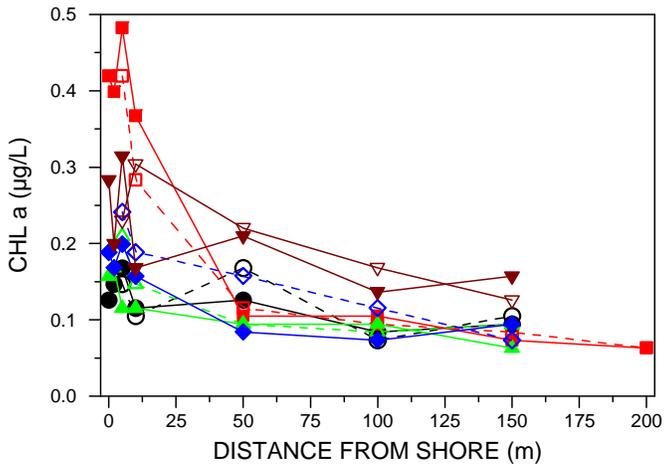
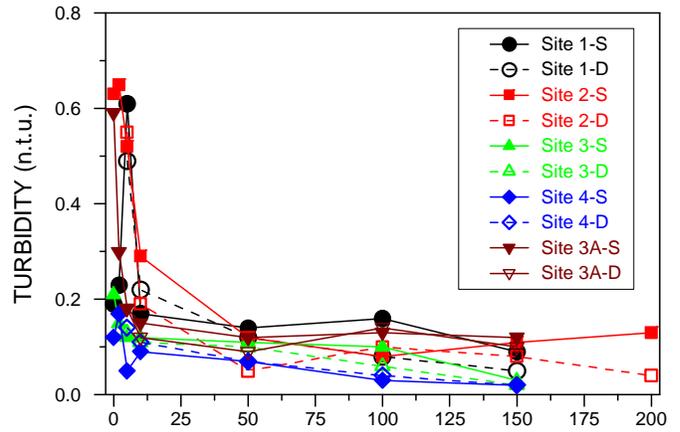
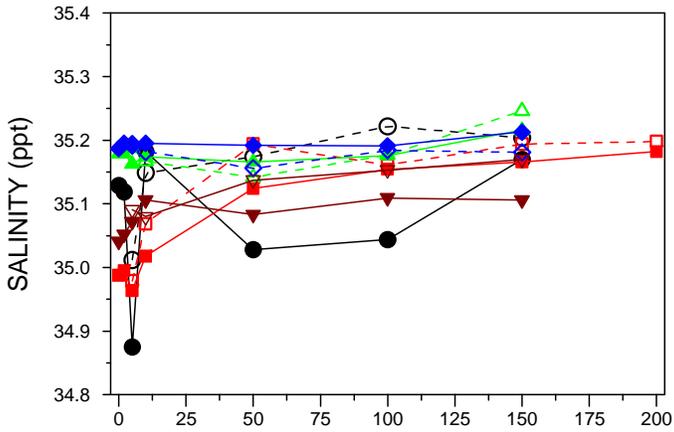


FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on December 4, 2012 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

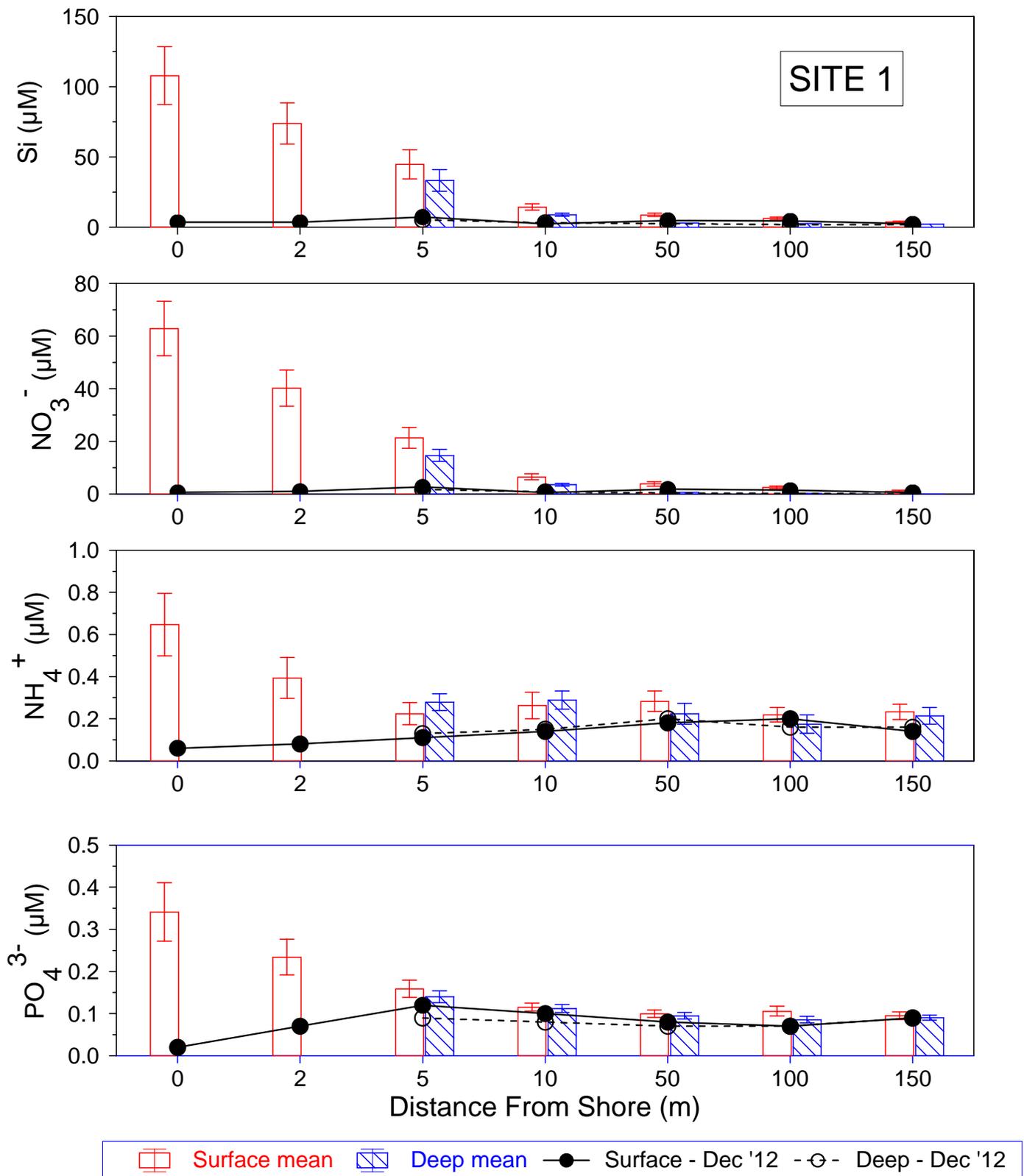


FIGURE 4. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

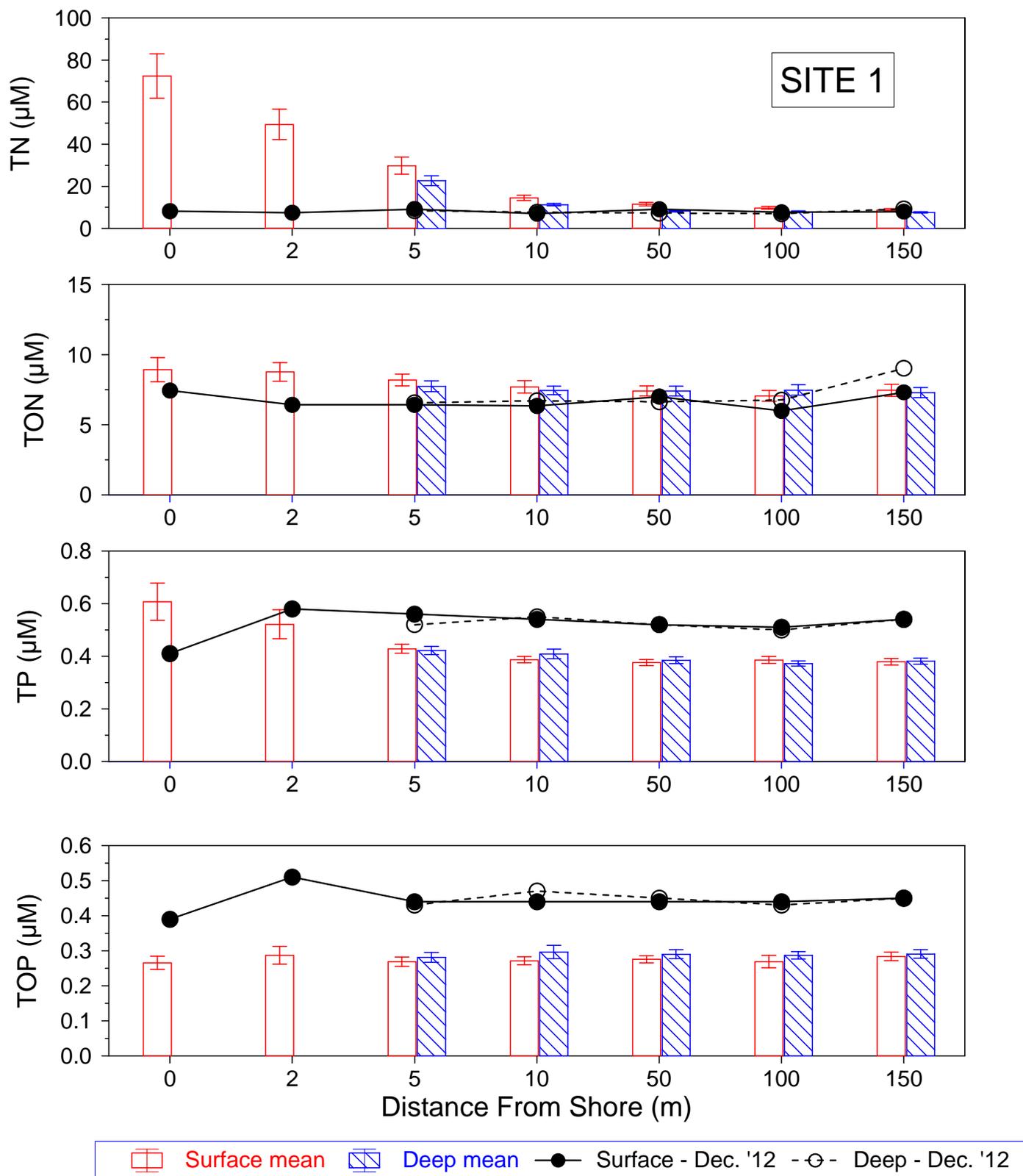


FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

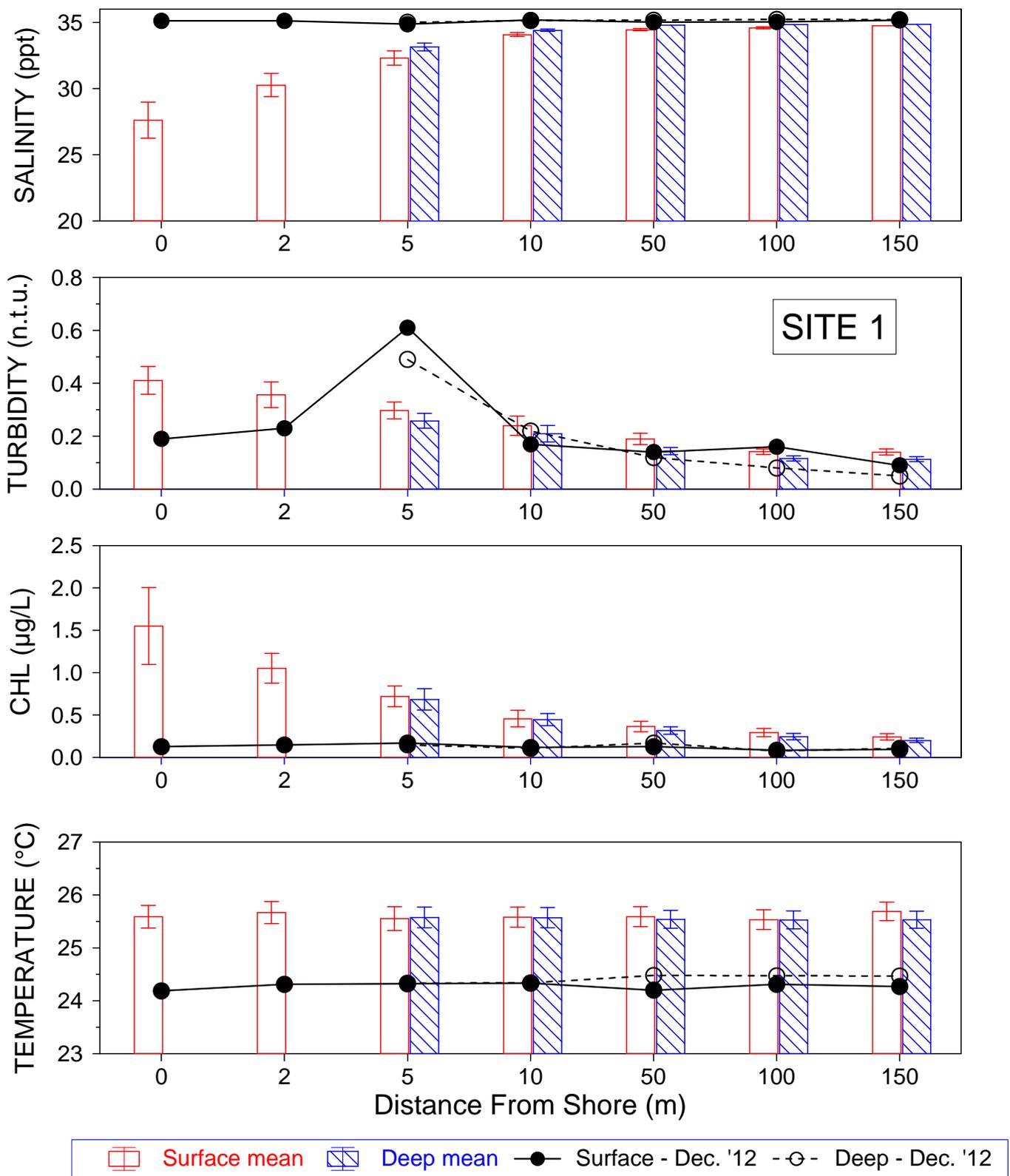


FIGURE 6. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

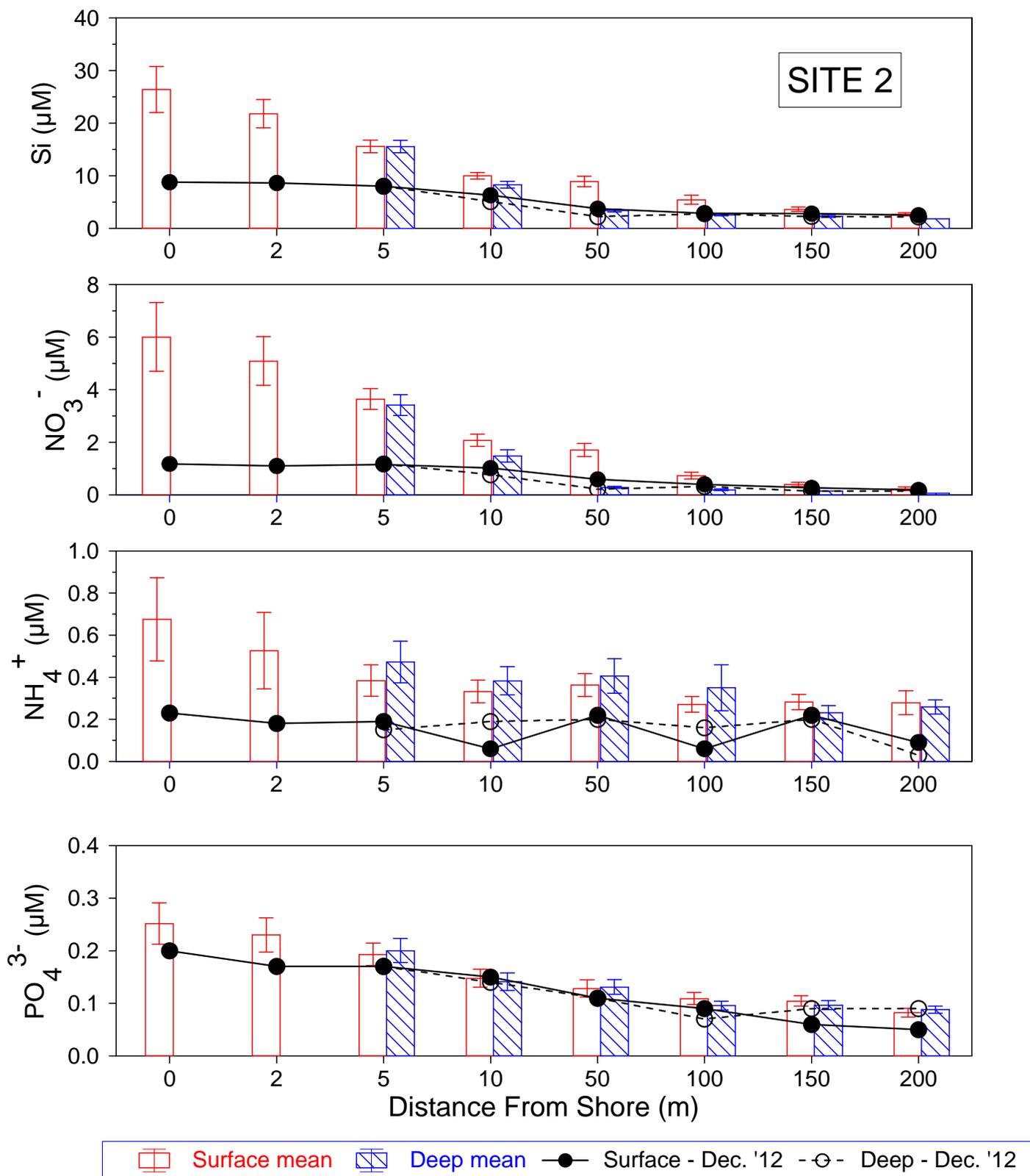


FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

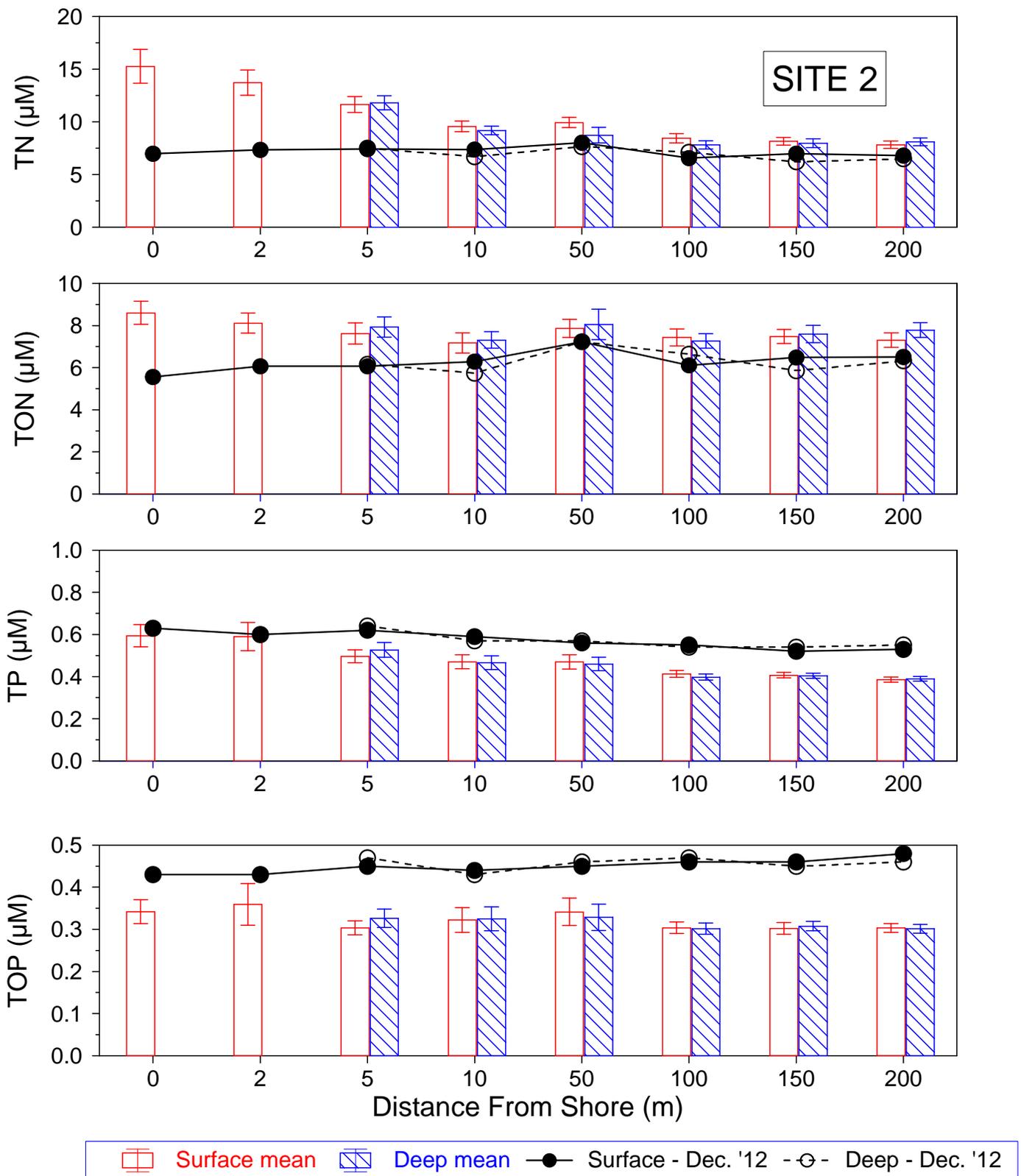


FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

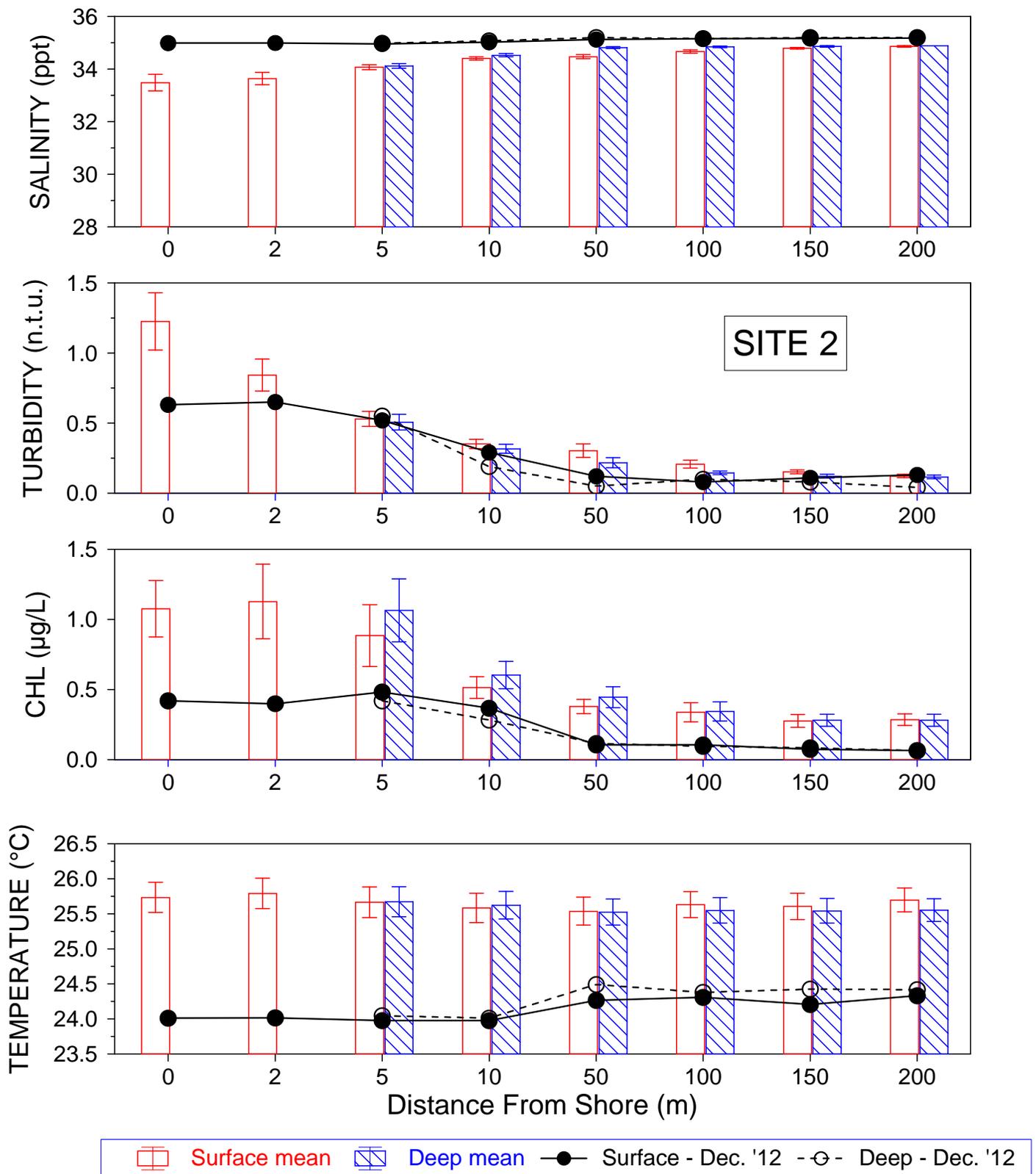


FIGURE 9. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

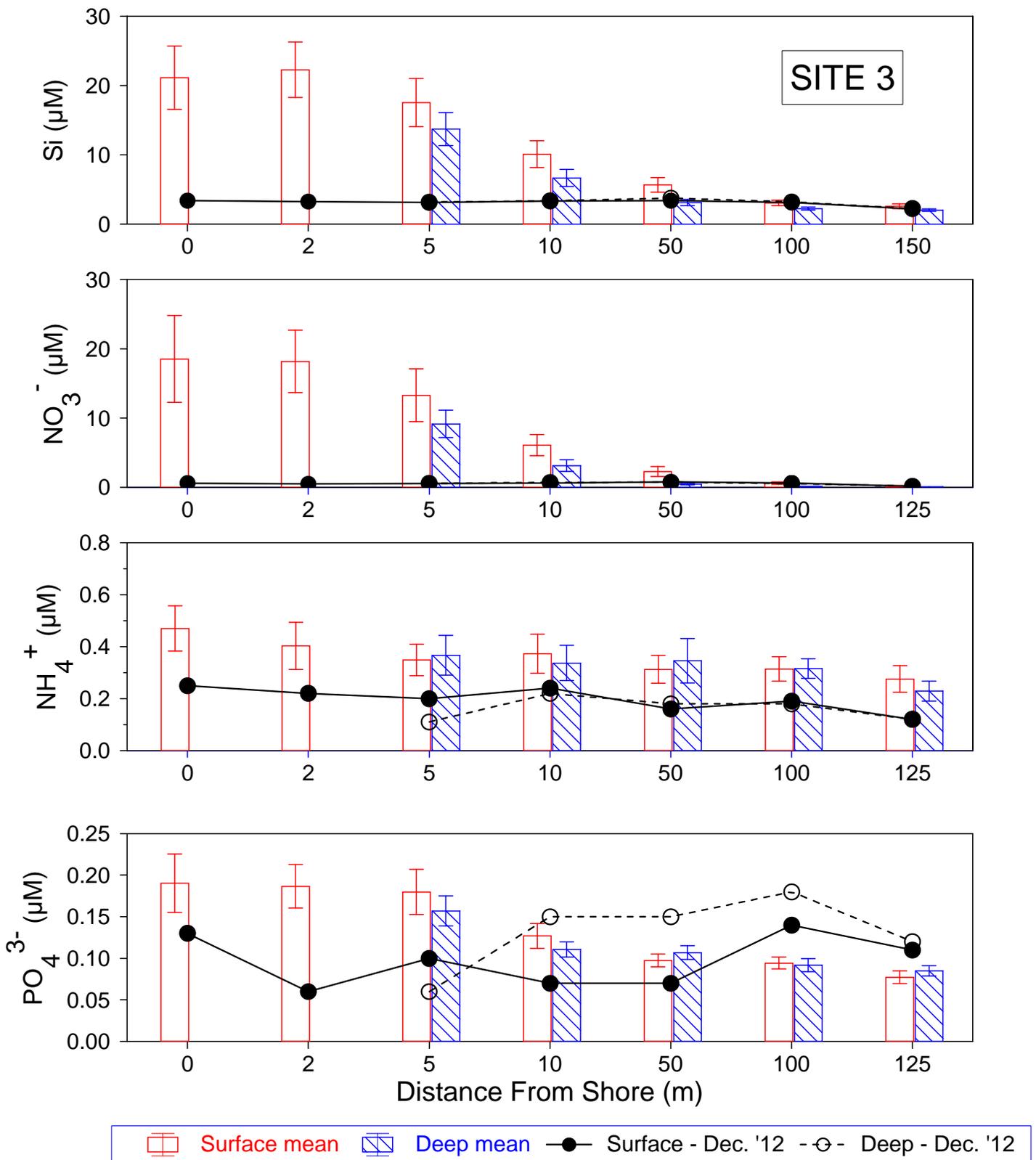


FIGURE 10. Plots of dissolved nutrient constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

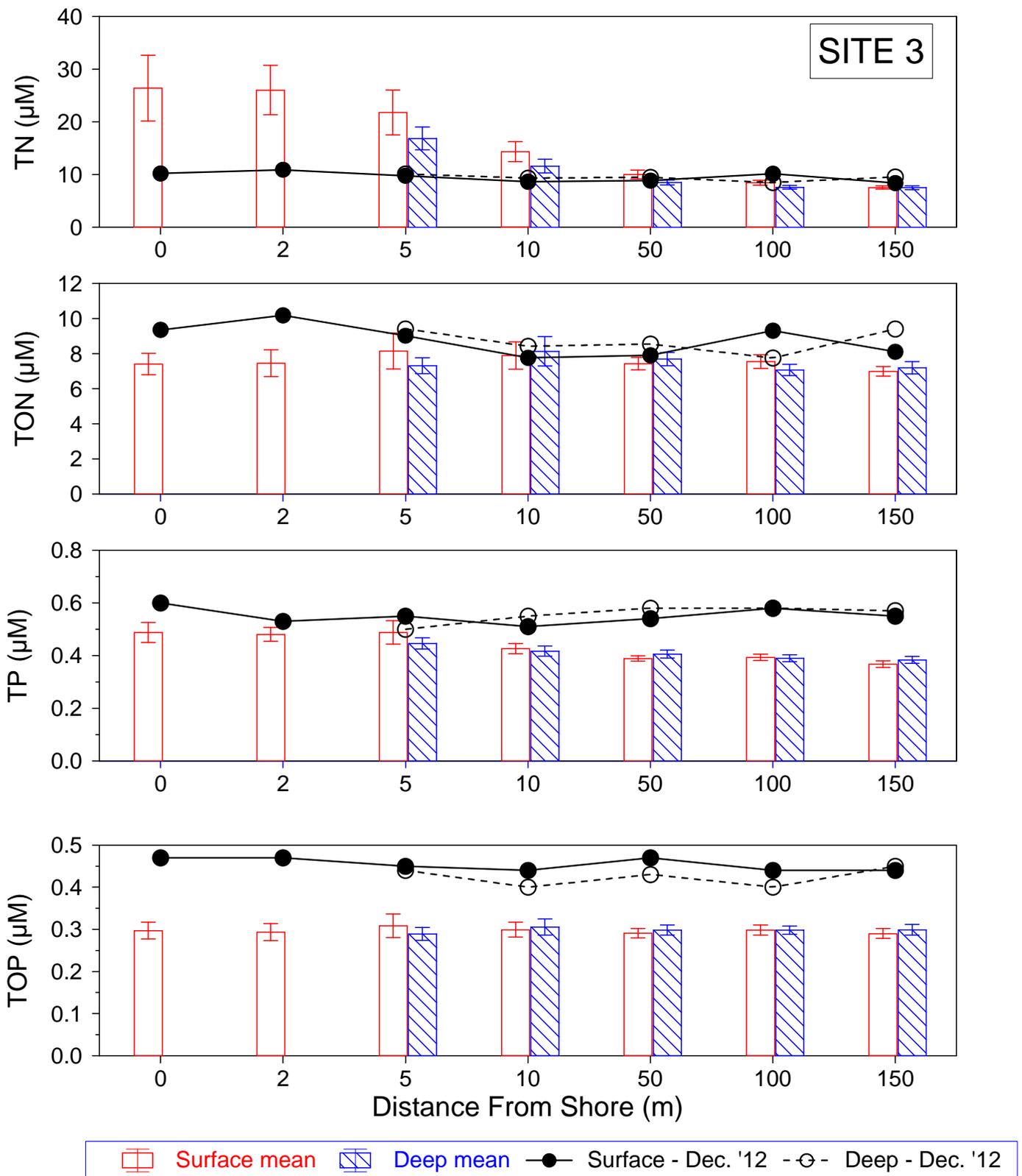


FIGURE 11. Plots of dissolved nutrient constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

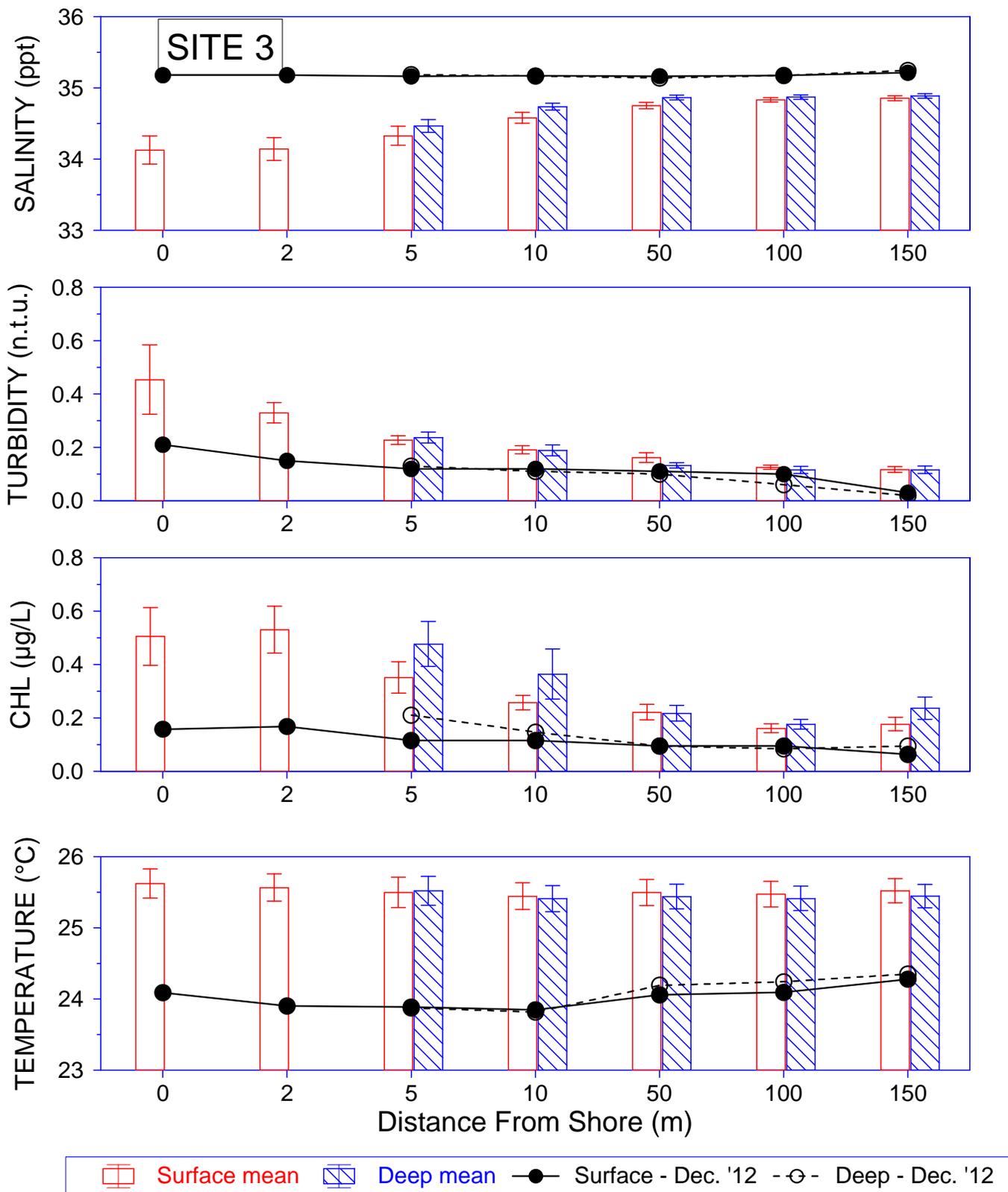


FIGURE 12. Plots of water chemistry constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

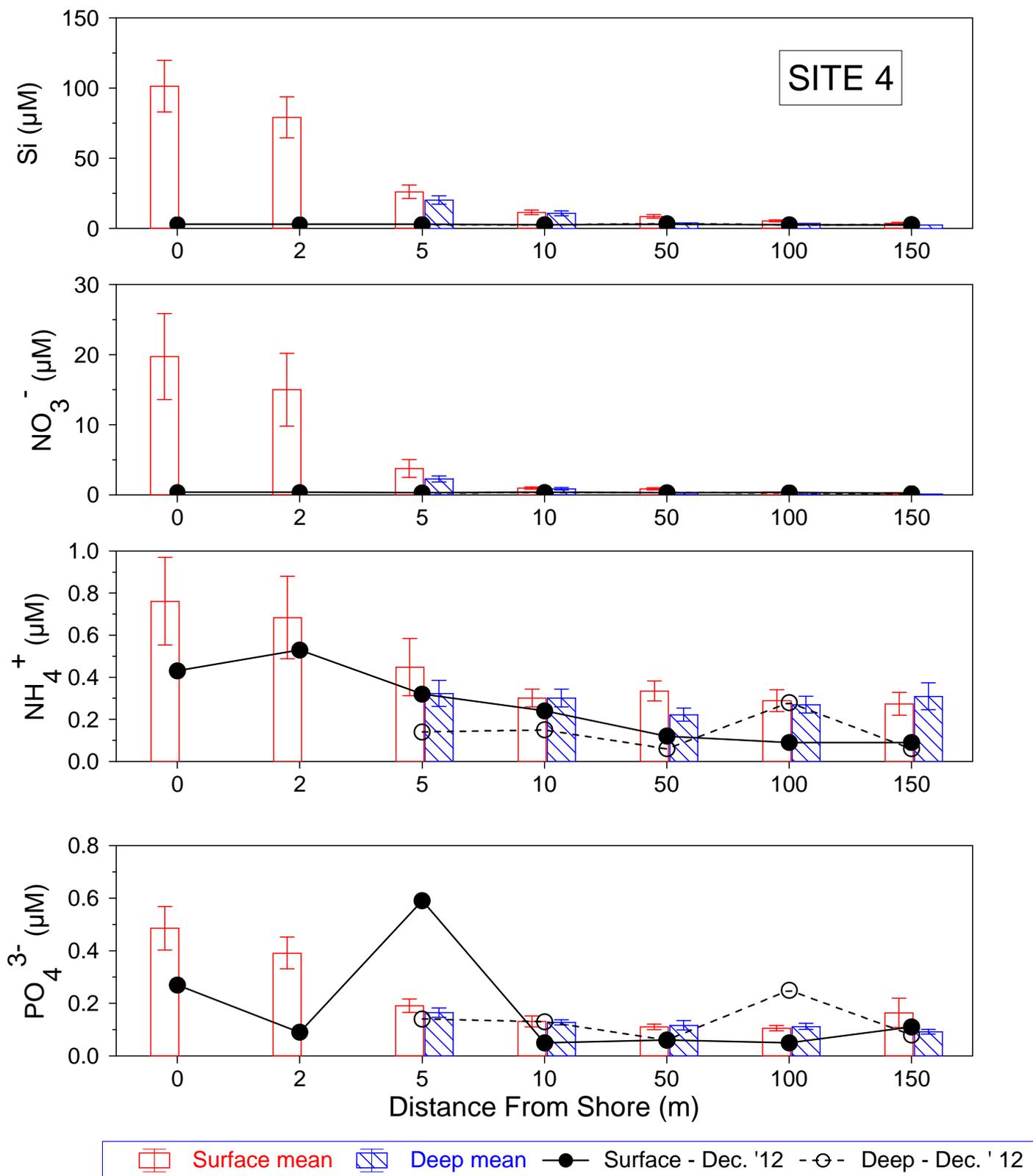


FIGURE 13. Plots of dissolved nutrient constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

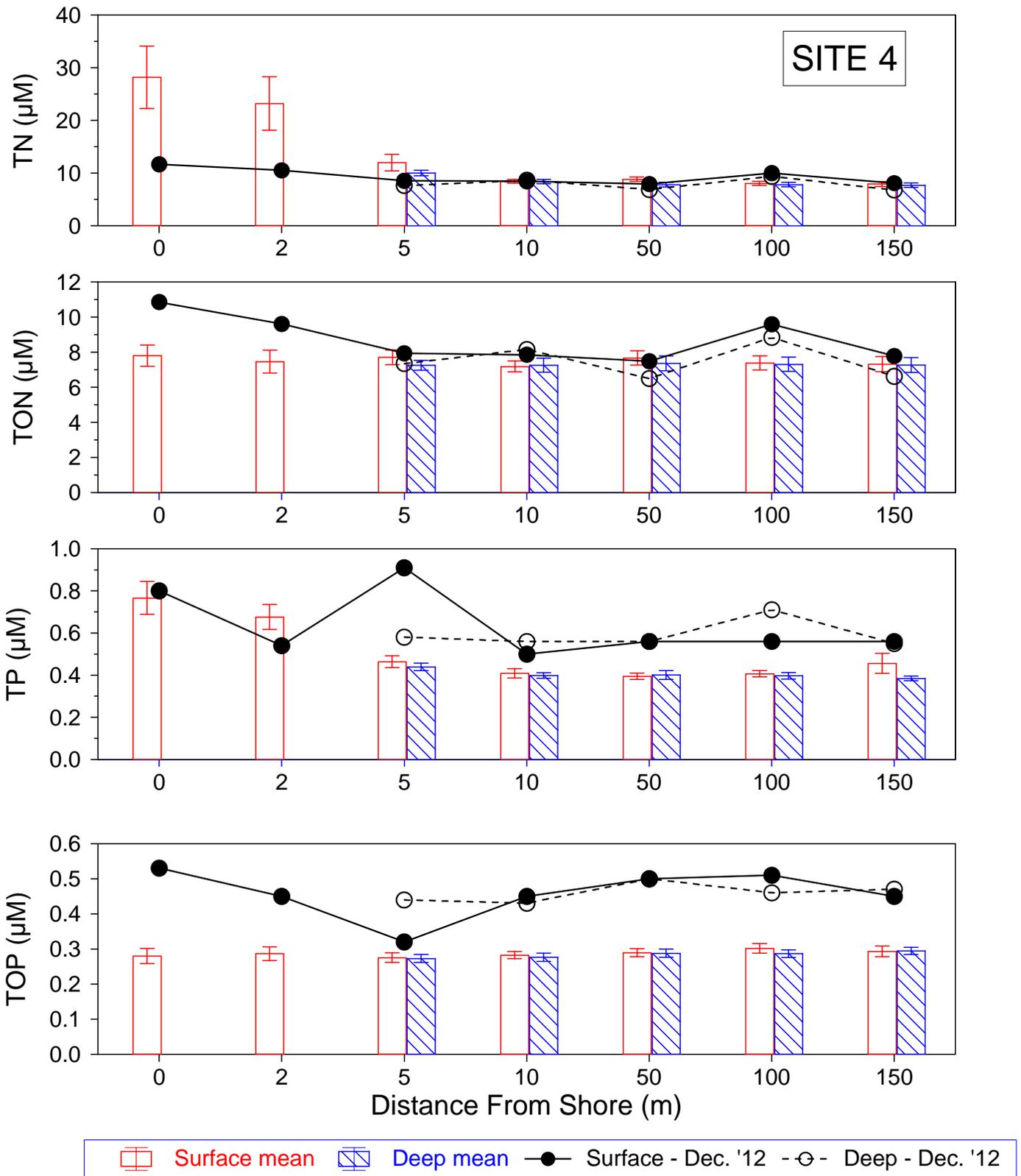


FIGURE 14. Plots of dissolved nutrient constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

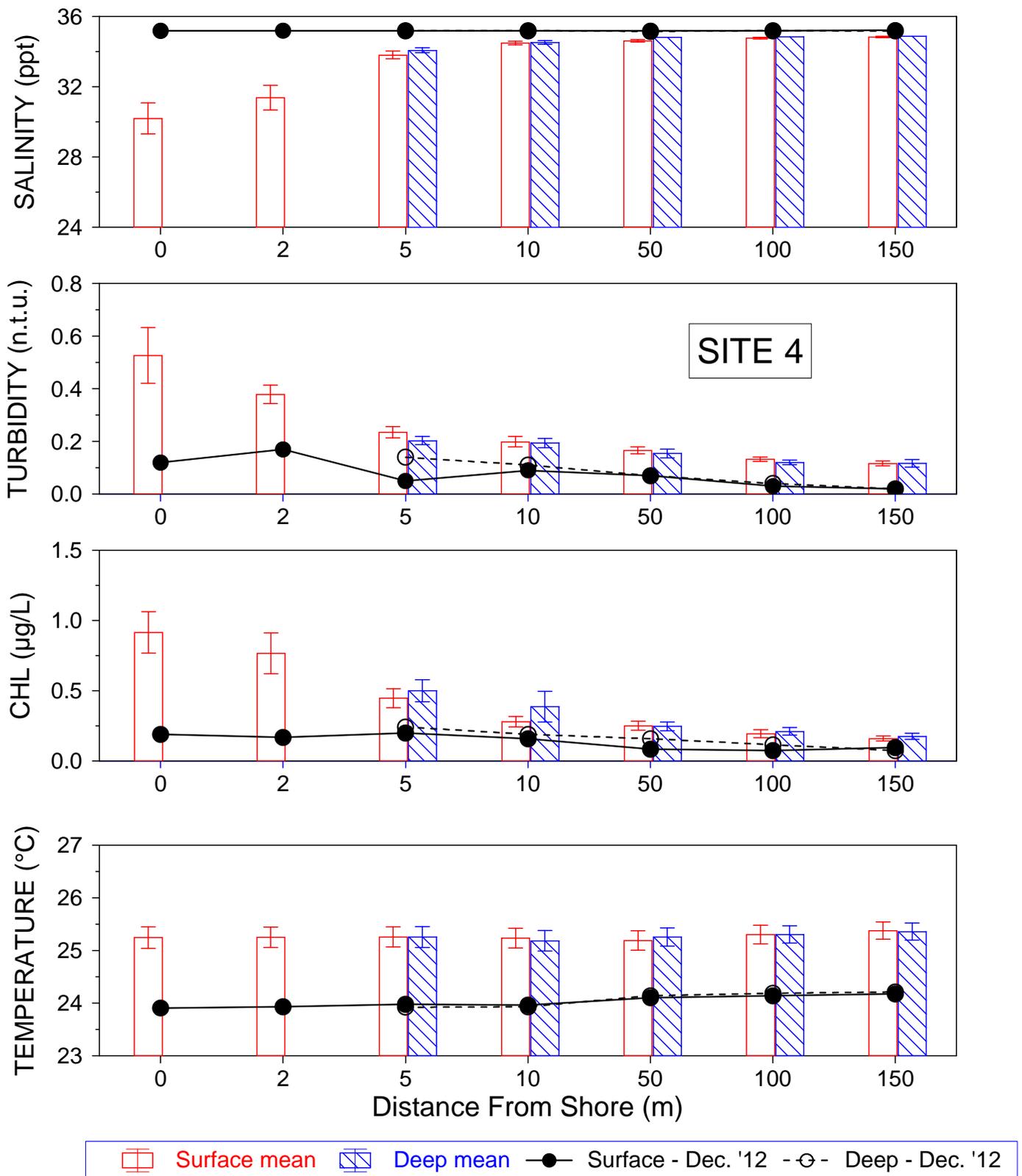


FIGURE 15. Plots of water chemistry constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=28). Error bars represent standard error of the mean. For site location, see Figure 1.

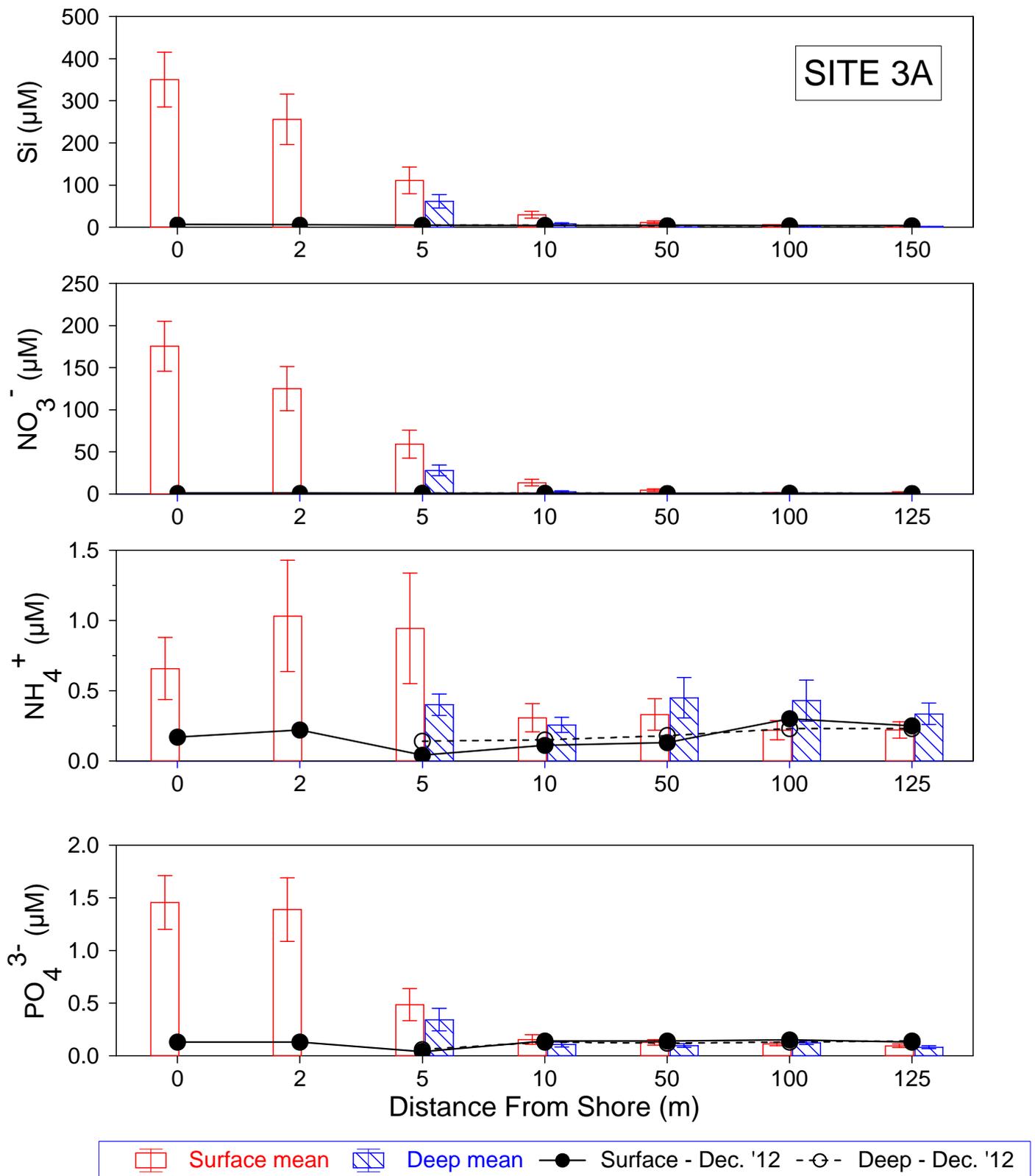


FIGURE 16. Plots of dissolved nutrient constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=10). Error bars represent standard error of the mean. For site location, see Figure 1.

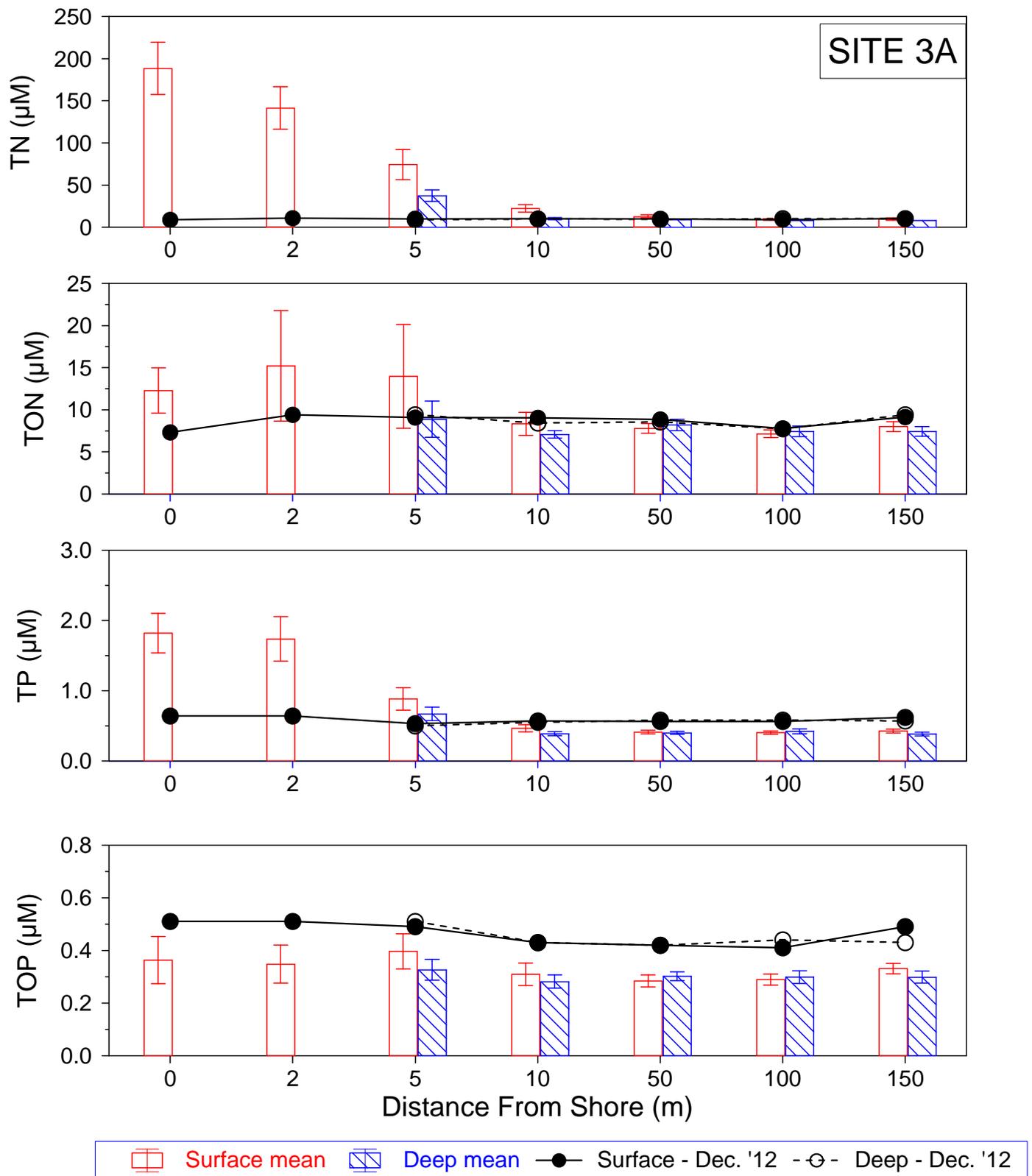


FIGURE 17. Plots of dissolved nutrient constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=10). Error bars represent standard error of the mean. For site location, see Figure 1.

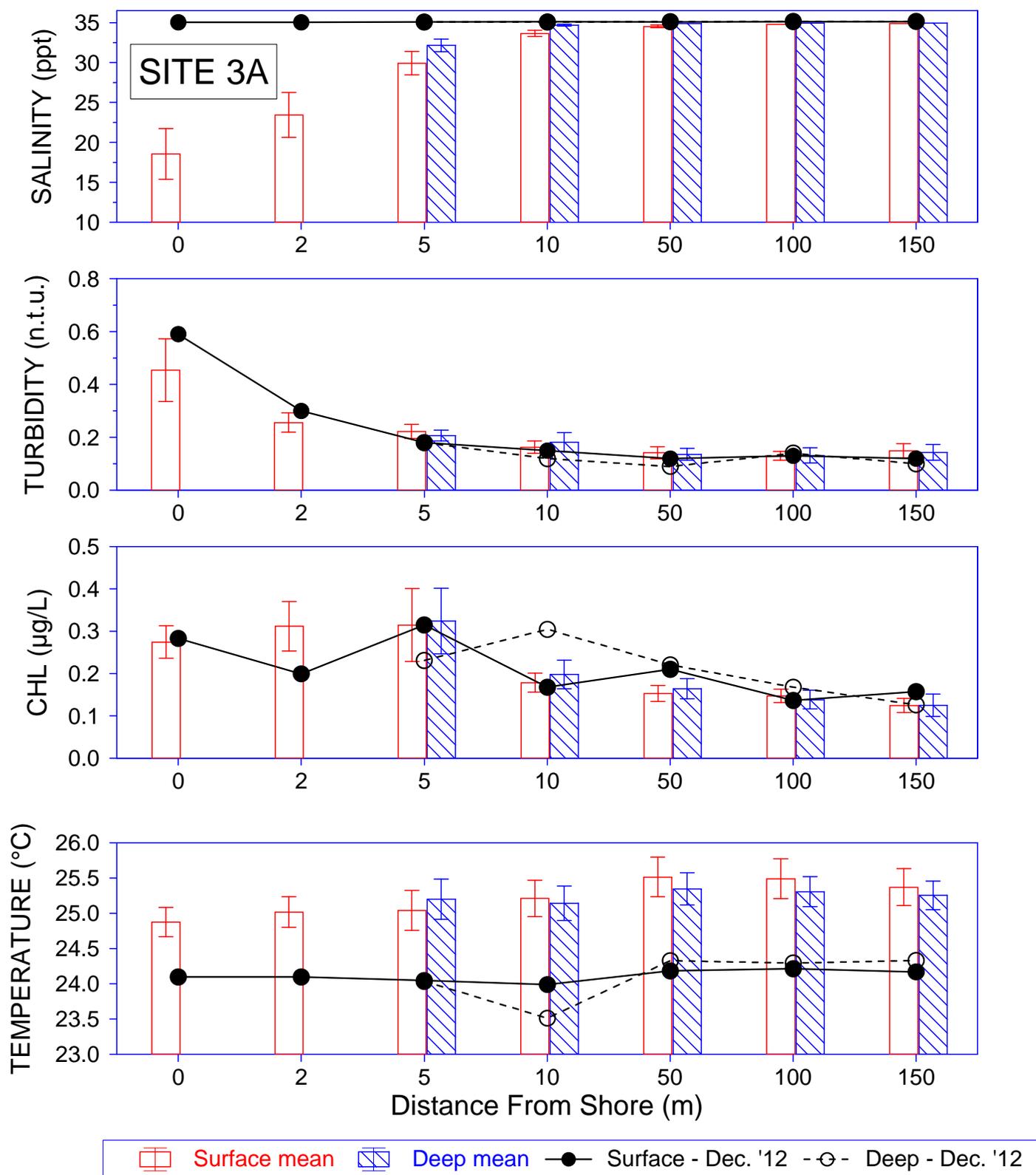


FIGURE 18. Plots of water chemistry constituents measured in surface and deep water samples as functions of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=10). Error bars represent standard error of the mean. For site location, see Figure 1.

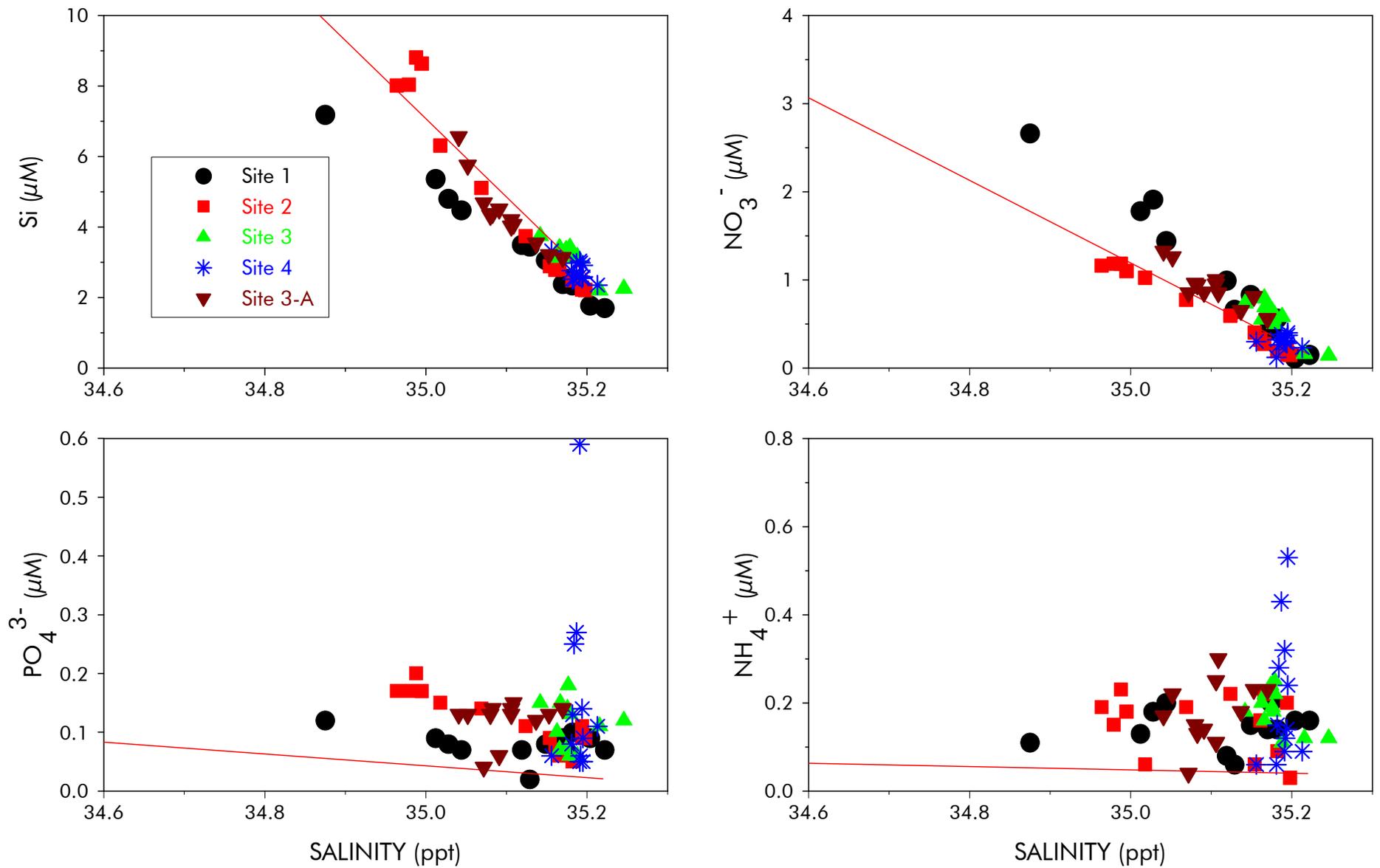


FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Makena Resort on December 4, 2012 as functions of salinity. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from an irrigation well upslope of the Makena Golf Courses. For sampling site locations, see Figure 1.

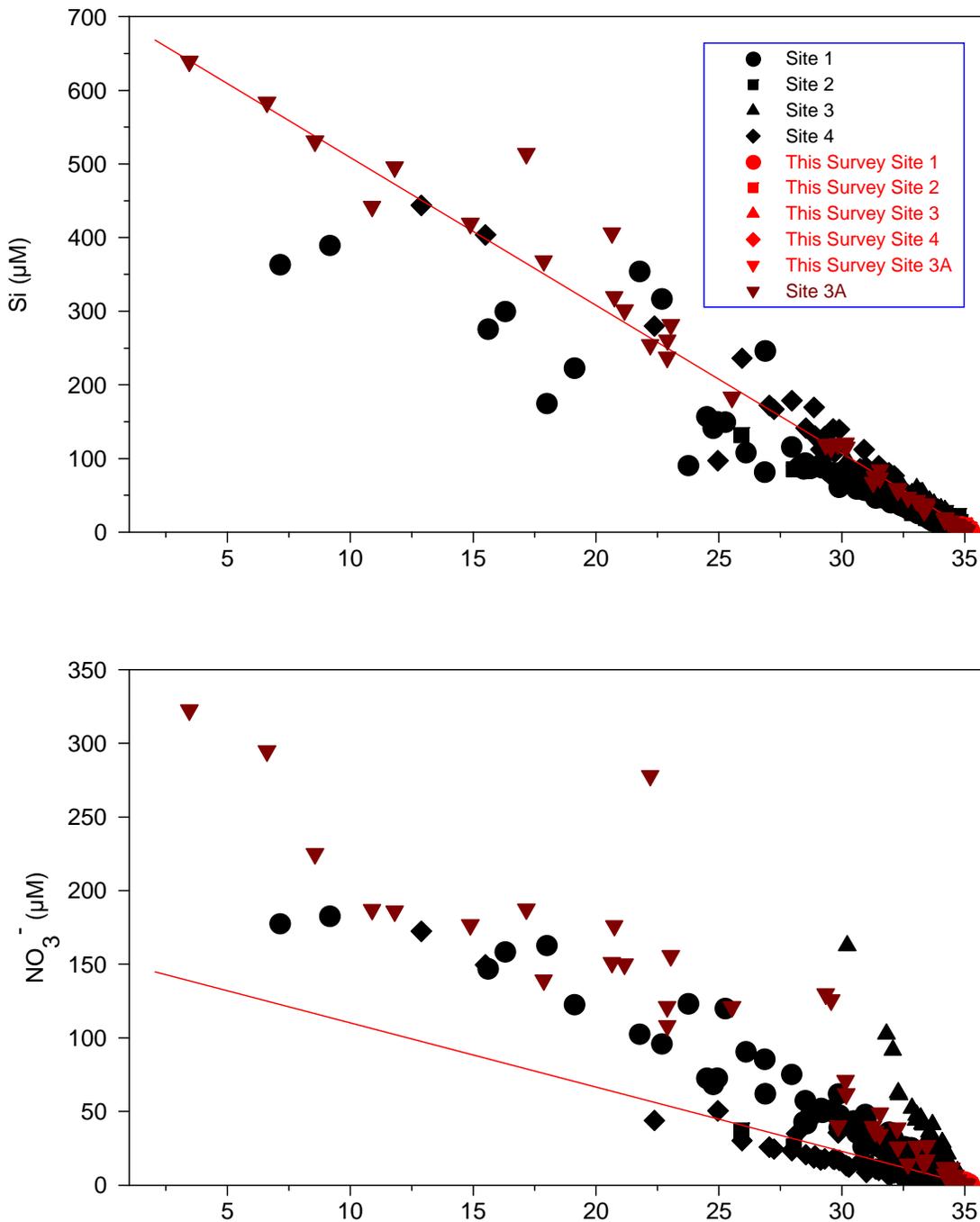


FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and April 2012. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

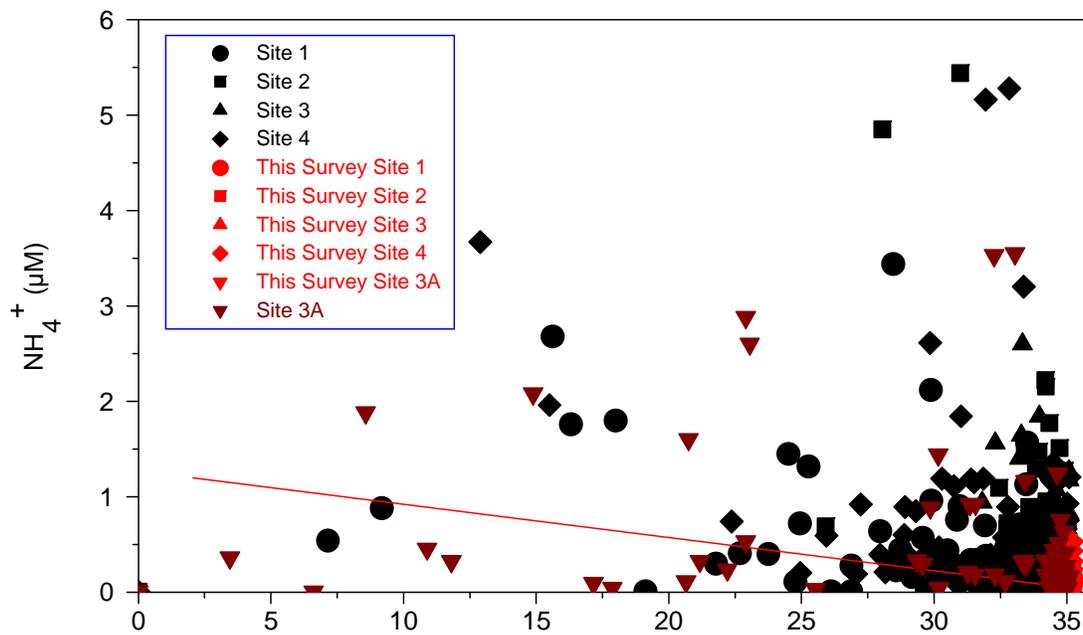
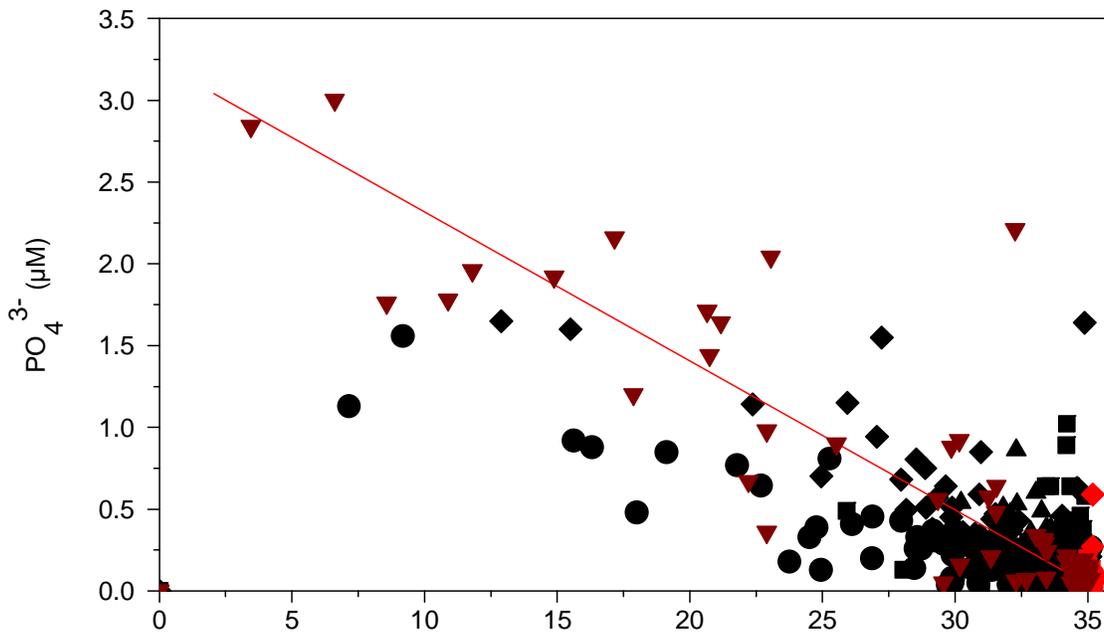


FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and April 2012. Green symbols represent data from surveys at Site 3A commencing in June 2007. Red symbols are data from the most recent survey. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from golf course irrigation well #4. For sampling site locations, see Figure 1.

TABLE 6. Linear regression statistics (y-intercept and slope) of concentrations of silica as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to December 2012 (Transect Site 3 has been monitored since 2002; Transect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

SILICA - Y-INTERCEPT					SILICA - SLOPE				
YEAR	Coefficients	Std Err	Lower 95%	Upper 95%	YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1					SITE 1				
1995	522.34	12.18	491.03	553.66	1995	-15.08	0.38	-16.05	-14.12
1996	629.56	11.05	605.49	653.64	1996	-18.05	0.32	-18.75	-17.34
1997	504.17	2.83	496.89	511.46	1997	-14.43	0.08	-14.65	-14.21
1998	484.14	2.44	477.86	490.41	1998	-13.83	0.07	-14.02	-13.64
1999	479.11	9.89	457.55	500.66	1999	-13.63	0.29	-14.27	-12.99
2000	528.68	5.87	513.58	543.77	2000	-15.08	0.18	-15.54	-14.62
2001	625.85	10.91	597.82	653.88	2001	-17.76	0.32	-18.57	-16.94
2002	502.98	8.68	480.66	525.30	2002	-14.38	0.26	-15.05	-13.72
2003	625.85	10.91	597.82	653.88	2003	-17.76	0.32	-18.57	-16.94
2004	546.00	8.33	527.84	564.16	2004	-15.68	0.25	-16.23	-15.14
2005	466.59	11.09	442.42	490.75	2005	-13.31	0.33	-14.02	-12.61
2006	487.68	24.60	434.08	541.28	2006	-13.88	0.76	-15.53	-12.23
2007	491.19	34.99	414.95	567.42	2007	-14.11	1.14	-16.59	-11.62
2008	371.80	16.96	334.85	408.75	2008	-10.46	0.52	-11.59	-9.33
2009	457.28	10.01	431.54	483.02	2009	-12.98	0.30	-13.76	-12.20
2010	515.27	7.85	495.09	535.45	2010	-14.78	0.28	-15.49	-14.06
2011	464.80	5.70	452.37	477.22	2011	-13.13	0.18	-13.52	-12.74
2012	940.29	48.49	815.64	1064.94	2012	-26.98	1.61	-31.13	-22.84
2013	553.91	19.87	502.83	604.99	2013	-15.68	0.57	-17.13	-14.22
Regslope	2.37	4.99	-8.17	12.91	Regslope	-0.06	0.14	-0.37	0.24
SITE 2					SITE 2				
1995	468.41	85.54	248.51	688.30	1995	-13.47	2.51	-19.93	-7.00
1996	549.09	177.83	164.91	933.28	1996	-15.62	5.15	-26.75	-4.49
1997	567.57	9.71	543.80	591.33	1997	-16.26	0.29	-16.96	-15.56
1998	563.20	37.23	472.10	654.30	1998	-16.11	1.08	-18.76	-13.45
1999	466.74	95.75	261.37	672.11	1999	-13.21	2.78	-19.18	-7.23
2000	770.15	27.32	703.31	837.00	2000	-22.06	0.80	-24.02	-20.11
2001	1254.31	74.17	1072.82	1435.81	2001	-35.68	2.12	-40.87	-30.49
2002	577.53	29.40	505.60	649.46	2002	-16.54	0.86	-18.64	-14.44
2003	505.05	20.10	461.94	548.15	2003	-14.37	0.59	-15.63	-13.11
2004	565.31	93.71	364.33	766.29	2004	-16.23	2.73	-22.09	-10.38
2005	339.08	33.78	266.64	411.52	2005	-9.61	0.98	-11.70	-7.52
2006	553.48	62.93	418.51	688.45	2006	-15.82	1.83	-19.75	-11.89
2007	443.05	17.15	406.27	479.84	2007	-12.54	0.51	-13.64	-11.45
2008	402.41	73.66	244.42	560.41	2008	-11.41	2.14	-15.99	-6.83
2009	501.76	9.02	479.69	523.82	2009	-14.32	0.27	-14.98	-13.66
2010	490.17	22.77	434.46	545.87	2010	-13.97	0.67	-15.61	-12.33
2011	501.35	17.35	464.13	538.56	2011	-14.24	0.50	-15.31	-13.16
2012	411.67	48.31	293.48	529.87	2012	-11.62	1.41	-15.06	-8.18
2013	1050.19	96.78	813.37	1287.01	2013	-29.79	2.76	-36.54	-23.03
Regslope	-1.24	9.64	-21.59	19.10	Regslope	0.04	0.27	-0.54	0.62
SITE 3A					SITE 3A				
2007	714.10	5.58	701.94	726.27	2007	-20.35	0.19	-20.75	-19.94
2008	805.12	9.00	785.52	824.73	2008	-22.96	0.28	-23.57	-22.36
2009	646.37	7.80	626.32	666.43	2009	-18.28	0.26	-18.96	-17.61
2010	750.91	5.70	736.26	765.56	2010	-21.44	0.19	-21.94	-20.94
2011	715.44	5.06	704.42	726.45	2011	-20.35	0.17	-20.72	-19.99
2012	1005.34	28.55	931.95	1078.73	2012	-29.01	0.94	-31.44	-26.59
2013	1176.49	176.84	721.91	1631.08	2013	-33.40	5.04	-46.36	-20.44
Regslope	66.31	26.03	-0.59	133.21	Regslope	-1.90	0.75	-3.83	0.02
SITE 3					SITE 3				
2002	931.92	27.54	861.13	1002.71	2002	-26.75	0.81	-28.83	-24.68
2003	984.76	41.58	894.16	1075.35	2003	-28.10	1.21	-30.73	-25.47
2004	632.75	127.62	354.68	910.82	2004	-18.19	3.69	-26.24	-10.14
2005	704.38	52.31	590.40	818.35	2005	-20.11	1.51	-23.40	-16.83
2006	928.22	64.18	788.40	1068.05	2006	-26.56	1.89	-30.67	-22.46
2007	722.80	15.07	689.97	755.63	2007	-20.60	0.44	-21.56	-19.63
2008	1058.06	48.59	952.18	1163.94	2008	-30.22	1.41	-33.29	-27.14
2009	943.91	40.06	840.94	1046.89	2009	-26.90	1.17	-29.90	-23.91
2010	962.57	74.39	771.34	1153.79	2010	-27.56	2.19	-33.18	-21.93
2011	880.51	26.78	822.17	938.85	2011	-25.06	0.77	-26.74	-23.37
2012	792.34	42.16	683.97	900.71	2012	-22.57	1.24	-25.75	-19.39
2013	757.70	185.71	280.33	1235.07	2013	-21.45	5.28	-35.02	-7.88
Regslope	-0.84	11.59	-26.67	24.99	Regslope	0.04	0.33	-0.70	0.78
SITE 4					SITE 4				
1995	710.45	8.83	687.74	733.15	1995	-20.55	0.27	-21.25	-19.85
1996	917.33	13.38	888.18	946.47	1996	-26.23	0.40	-27.10	-25.37
1997	776.74	3.53	767.66	785.82	1997	-22.27	0.11	-22.55	-21.99
1998	841.35	6.75	824.00	858.70	1998	-24.07	0.20	-24.58	-23.56
1999	823.63	24.78	769.63	877.62	1999	-23.50	0.73	-25.10	-21.90
2000	946.97	12.51	914.80	979.14	2000	-27.12	0.37	-28.08	-26.16
2001	1403.91	260.13	735.22	2072.61	2001	-39.92	7.42	-58.99	-20.86
2002	767.85	4.37	756.63	779.08	2002	-21.99	0.13	-22.34	-21.65
2003	854.37	29.88	789.26	919.48	2003	-24.36	0.91	-26.34	-22.39
2004	843.49	37.55	761.67	925.31	2004	-24.27	1.10	-26.66	-21.88
2005	703.97	14.00	673.47	734.46	2005	-20.11	0.41	-21.00	-19.22
2006	735.05	14.01	704.53	765.57	2006	-20.96	0.41	-21.86	-20.06
2007	710.11	7.14	694.56	725.66	2007	-20.27	0.23	-20.77	-19.78
2008	712.32	18.22	672.63	752.01	2008	-20.33	0.53	-21.49	-19.17
2009	715.30	7.99	694.75	735.84	2009	-20.34	0.24	-20.95	-19.73
2010	673.09	6.27	656.98	689.21	2010	-19.14	0.19	-19.62	-18.66
2011	688.21	7.10	672.74	703.68	2011	-19.57	0.21	-20.03	-19.11
2012	353.00	29.28	277.74	428.26	2012	-9.86	0.90	-12.17	-7.54
2013	835.40	315.71	23.83	1646.97	2013	-23.66	8.97	-46.72	-0.60
Regslope	-15.43	7.50	-31.26	0.39	Regslope	0.46	0.21	0.01	0.90

TABLE 7. Linear regression statistics (y-intercept and slope) of concentrations of nitrate as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to December 2012 (Transect Site 3 has been monitored since 2002; Transect Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. "REGSLOPE" indicates regression statistics for slope of yearly coefficients as a function of time. For location of transect sites, see Figure 1.

NITRATE -Y-INTERCEPT					NITRATE - SLOPE				
YEAR	Coefficients	Std Err	Lower 95%	Upper 95%	YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1					SITE 1				
1995	326.50	7.10	308.25	344.75	1995	-9.49	0.22	-10.05	-8.92
1996	336.49	4.62	326.41	346.56	1996	-9.67	0.14	-9.97	-9.38
1997	406.96	1.93	402.00	411.93	1997	-11.70	0.06	-11.85	-11.55
1998	268.90	1.55	264.91	272.89	1998	-7.72	0.05	-7.84	-7.60
1999	225.24	5.32	213.66	236.83	1999	-6.44	0.16	-6.79	-6.10
2000	309.77	3.36	301.14	318.41	2000	-8.91	0.10	-9.17	-8.65
2001	336.53	9.69	311.61	361.44	2001	-9.60	0.28	-10.32	-8.88
2002	278.21	17.43	233.40	323.03	2002	-7.99	0.52	-9.31	-6.66
2003	421.29	7.81	404.28	438.30	2003	-12.09	0.23	-12.60	-11.58
2004	442.33	4.89	431.68	452.99	2004	-12.74	0.15	-13.06	-12.42
2005	296.36	7.44	280.16	312.56	2005	-8.48	0.22	-8.96	-8.01
2006	361.76	7.20	346.08	377.45	2006	-10.40	0.22	-10.89	-9.92
2007	305.06	15.88	270.45	339.67	2007	-8.73	0.52	-9.86	-7.60
2008	330.95	7.18	315.29	346.60	2008	-9.52	0.22	-10.00	-9.05
2009	231.91	3.07	224.01	239.81	2009	-6.65	0.09	-6.89	-6.41
2010	253.63	4.57	241.88	265.38	2010	-7.31	0.16	-7.72	-6.89
2011	235.52	6.82	220.66	250.37	2011	-6.66	0.21	-7.12	-6.19
2012	272.66	0.94	270.26	275.07	2012	-7.81	0.03	-7.89	-7.73
2013	258.44	23.18	198.85	318.02	2013	-7.33	0.66	-9.03	-5.63
REGSLOPE	-4.12	2.56	-9.52	1.27	REGSLOPE	0.12	0.07	-0.03	0.28
SITE 2					SITE 2				
1995	119.87	12.03	88.95	150.79	1995	-3.47	0.35	-4.38	-2.56
1996	106.36	18.44	66.53	146.19	1996	-3.05	0.53	-4.20	-1.89
1997	193.75	5.64	179.95	207.55	1997	-5.57	0.17	-5.97	-5.16
1998	166.93	5.33	153.89	179.97	1998	-4.79	0.16	-5.17	-4.41
1999	116.21	14.04	86.10	146.32	1999	-3.31	0.41	-4.19	-2.43
2000	142.07	2.83	135.13	149.01	2000	-4.08	0.08	-4.29	-3.88
2001	154.93	7.65	136.21	173.64	2001	-4.41	0.22	-4.95	-3.88
2002	180.82	58.78	36.98	324.66	2002	-5.19	1.72	-9.40	-0.99
2003	163.36	6.31	149.82	176.91	2003	-4.68	0.18	-5.07	-4.28
2004	145.36	10.55	122.74	167.99	2004	-4.19	0.31	-4.84	-3.53
2005	102.66	9.11	83.13	122.19	2005	-2.94	0.26	-3.50	-2.37
2006	124.74	4.89	114.26	135.22	2006	-3.57	0.14	-3.88	-3.27
2007	134.27	3.25	127.30	141.24	2007	-3.85	0.10	-4.06	-3.64
2008	108.01	12.87	80.41	135.61	2008	-3.09	0.37	-3.89	-2.29
2009	142.21	9.04	120.08	164.34	2009	-4.10	0.27	-4.76	-3.43
2010	135.27	10.49	109.60	160.94	2010	-3.88	0.31	-4.64	-3.13
2011	166.23	6.33	152.64	179.81	2011	-4.74	0.18	-5.14	-4.35
2012	180.39	4.91	168.38	192.41	2012	-5.16	0.14	-5.51	-4.81
2013	161.57	8.84	139.95	183.19	2013	-4.59	0.25	-5.20	-3.97
REGSLOPE	0.60	1.16	-1.85	3.06	REGSLOPE	-0.02	0.03	-0.09	0.05
SITE 3A					SITE 3A				
2007	354.33	49.92	245.56	463.11	2007	-9.57	1.67	-13.20	-5.93
2008	448.07	7.75	431.19	464.95	2008	-12.81	0.24	-13.33	-12.29
2009	283.99	14.63	246.38	321.60	2009	-7.98	0.49	-9.25	-6.72
2010	283.25	1.86	278.48	288.02	2010	-8.15	0.06	-8.32	-7.99
2011	364.51	5.48	352.58	376.45	2011	-10.31	0.18	-10.71	-9.92
2012	369.69	1.88	364.84	374.53	2012	-10.60	0.06	-10.76	-10.44
2013	190.37	67.40	17.11	363.63	2013	-5.40	1.92	-10.34	-0.46
REGSLOPE	-20.29	14.52	-57.63	17.05	REGSLOPE	0.52	0.43	-0.58	1.62
SITE 3					SITE 3				
2002	847.45	52.35	712.88	982.01	2002	-24.49	1.53	-28.43	-20.56
2003	693.24	39.54	607.10	779.38	2003	-19.86	1.15	-22.36	-17.35
2004	463.72	90.73	266.04	661.40	2004	-13.37	2.63	-19.09	-7.64
2005	535.53	47.19	432.72	638.34	2005	-15.33	1.36	-18.29	-12.37
2006	856.96	48.22	751.91	962.02	2006	-24.61	1.42	-27.70	-21.52
2007	1233.34	18.23	1193.63	1273.06	2007	-35.51	0.54	-36.68	-34.34
2008	899.91	41.92	808.57	991.25	2008	-25.78	1.22	-28.43	-23.12
2009	827.18	19.10	778.08	876.29	2009	-23.65	0.56	-25.08	-22.22
2010	924.44	35.54	833.09	1015.80	2010	-26.57	1.05	-29.26	-23.88
2011	936.86	87.11	747.07	1126.65	2011	-26.75	2.51	-32.22	-21.28
2012	527.25	5.85	512.22	542.28	2012	-15.09	0.17	-15.53	-14.65
2013	352.15	80.76	144.55	559.76	2013	-9.99	2.30	-15.90	-4.09
REGSLOPE	-7.37	21.79	-55.92	41.17	REGSLOPE	0.23	0.63	-1.17	1.63
SITE 4					SITE 4				
1995	111.38	6.47	94.74	128.02	1995	-3.26	0.20	-3.77	-2.75
1996	118.34	1.63	114.79	121.89	1996	-3.40	0.05	-3.50	-3.29
1997	122.56	1.29	119.25	125.88	1997	-3.53	0.04	-3.63	-3.43
1998	112.77	1.87	107.97	117.57	1998	-3.24	0.05	-3.38	-3.10
1999	109.13	3.30	101.94	116.33	1999	-3.13	0.10	-3.34	-2.92
2000	118.51	0.75	116.58	120.43	2000	-3.40	0.02	-3.46	-3.34
2001	100.93	54.85	-40.08	241.94	2001	-2.87	1.56	-6.89	1.15
2002	118.91	3.25	110.56	127.25	2002	-3.44	0.10	-3.70	-3.19
2003	113.78	2.76	107.77	119.79	2003	-3.28	0.08	-3.46	-3.09
2004	134.97	4.64	124.86	145.07	2004	-3.89	0.14	-4.18	-3.59
2005	114.59	4.47	104.85	124.33	2005	-3.29	0.13	-3.57	-3.00
2006	119.85	1.76	116.03	123.68	2006	-3.43	0.05	-3.54	-3.31
2007	269.24	10.13	247.16	291.32	2007	-7.87	0.32	-8.58	-7.17
2008	62.93	4.05	54.11	71.74	2008	-1.79	0.12	-2.05	-1.54
2009	107.17	1.51	103.30	111.04	2009	-3.07	0.04	-3.18	-2.95
2010	148.96	16.96	105.35	192.57	2010	-4.30	0.50	-5.60	-3.00
2011	126.90	2.74	120.94	132.87	2011	-3.62	0.08	-3.79	-3.44
2012	178.94	1.78	174.38	183.51	2012	-5.13	0.05	-5.27	-4.99
2013	169.16	77.79	-30.81	369.12	2013	-4.80	2.21	-10.48	0.88
REGSLOPE	2.68	1.69	-0.88	6.24	REGSLOPE	-0.08	0.05	-0.18	0.03

TABLE 8. Linear regression statistics (y-intercept and slope) of concentrations of orthophosphate phosphorus as functions of salinity from four ocean transect sites off of the Makena Resort collected during monitoring surveys from 1995 to December 2012 (Transect site 3 has been monitored since 2002; Traset Site 3A since 2007). Also shown are standard errors and upper and lower 95% confidence limits around the y-intercepts and slopes. For location of transect sites, see Figure 1.

PHOSPHATE - Y-INTERCEPT					PHOSPHATE - SLOPE				
YEAR	Coefficients	Std Err	Lower 95%	Upper 95%	YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1					SITE 1				
1995	1.04	0.14	0.68	1.39	1995	-0.03	0.00	-0.04	-0.02
1996	1.78	0.12	1.52	2.03	1996	-0.05	0.00	-0.06	-0.04
1997	1.40	0.12	1.10	1.69	1997	-0.04	0.00	-0.05	-0.03
1998	1.10	0.06	0.95	1.25	1998	-0.03	0.00	-0.03	-0.02
1999	1.07	0.12	0.80	1.34	1999	-0.03	0.00	-0.03	-0.02
2000	0.89	0.12	0.59	1.19	2000	-0.02	0.00	-0.03	-0.01
2001	2.16	0.76	0.22	4.11	2001	-0.06	0.02	-0.12	0.00
2002	1.12	0.68	-0.64	2.88	2002	-0.03	0.02	-0.08	0.02
2003	0.48	0.19	0.06	0.90	2003	-0.01	0.01	-0.02	0.00
2004	2.71	0.17	2.33	3.08	2004	-0.08	0.01	-0.09	-0.06
2005	-0.02	0.14	-0.34	0.29	2005	0.00	0.00	-0.01	0.01
2006	1.36	0.13	1.08	1.65	2006	-0.04	0.00	-0.04	-0.03
2007	1.07	0.20	0.64	1.50	2007	-0.03	0.01	-0.04	-0.02
2008	0.89	0.13	0.61	1.16	2008	-0.02	0.00	-0.03	-0.02
2009	0.87	0.38	-0.12	1.85	2009	-0.02	0.01	-0.05	0.01
2010	1.86	0.18	1.40	2.31	2010	-0.05	0.01	-0.07	-0.04
2011	1.47	0.11	1.24	1.70	2011	-0.04	0.00	-0.05	-0.03
2012	1.65	0.08	1.45	1.86	2012	-0.04	0.00	-0.05	-0.04
2013	4.31	4.19	-6.47	15.09	2013	-0.12	0.12	-0.43	0.19
REGSLOPE	0.05	0.04	-0.03	0.13	REGSLOPE	0.00	0.00	0.00	0.00
SITE 2					SITE 2				
1995	0.15	0.63	-1.46	1.76	1995	0.00	0.02	-0.05	0.04
1996	2.03	1.59	-1.41	5.48	1996	-0.06	0.05	-0.16	0.04
1997	3.70	0.25	3.10	4.31	1997	-0.10	0.01	-0.12	-0.09
1998	3.55	1.44	0.03	7.07	1998	-0.10	0.04	-0.20	0.00
1999	3.68	5.55	-8.22	15.58	1999	-0.10	0.16	-0.44	0.25
2000	12.78	1.18	9.89	15.66	2000	-0.36	0.03	-0.45	-0.28
2001	30.73	3.12	23.09	38.37	2001	-0.87	0.09	-1.09	-0.65
2002	6.67	1.68	2.57	10.77	2002	-0.19	0.05	-0.31	-0.07
2003	3.57	0.31	2.90	4.24	2003	-0.10	0.01	-0.12	-0.08
2004	5.76	0.53	4.62	6.91	2004	-0.16	0.02	-0.20	-0.13
2005	-0.95	2.96	-7.31	5.40	2005	0.03	0.09	-0.15	0.21
2006	1.88	0.57	0.67	3.10	2006	-0.05	0.02	-0.09	-0.02
2007	0.22	0.26	-0.34	0.78	2007	0.00	0.01	-0.02	0.01
2008	1.50	1.14	-0.95	3.95	2008	-0.04	0.03	-0.11	0.03
2009	1.54	0.34	0.71	2.38	2009	-0.04	0.01	-0.07	-0.02
2010	1.70	1.31	-1.49	4.90	2010	-0.05	0.04	-0.14	0.05
2011	2.46	0.37	1.66	3.26	2011	-0.07	0.01	-0.09	-0.04
2012	3.21	0.60	1.74	4.68	2012	-0.09	0.02	-0.13	-0.05
2013	20.71	2.42	14.79	26.63	2013	-0.59	0.07	-0.76	-0.42
REGSLOPE	0.02	0.34	-0.69	0.74	REGSLOPE	0.00	0.01	-0.02	0.02
SITE 3A					SITE 3A				
2007	2.39	0.24	1.86	2.93	2007	-0.07	0.01	-0.09	-0.05
2008	4.43	0.49	3.36	5.50	2008	-0.13	0.02	-0.16	-0.09
2009	2.60	0.15	2.21	2.99	2009	-0.07	0.01	-0.09	-0.06
2010	2.75	0.29	2.01	3.48	2010	-0.07	0.01	-0.10	-0.05
2011	3.42	0.41	2.53	4.31	2011	-0.09	0.01	-0.12	-0.06
2012	4.06	0.04	3.96	4.17	2012	-0.11	0.00	-0.12	-0.11
2013	-12.61	20.44	-65.16	39.95	2013	0.36	0.58	-1.14	1.86
REGSLOPE	-1.60	1.03	-4.24	1.04	REGSLOPE	0.05	0.03	-0.03	0.12
SITE 3					SITE 3				
2002	4.62	2.31	-1.31	10.55	2002	-0.13	0.07	-0.30	0.04
2003	7.38	0.99	5.24	9.53	2003	-0.21	0.03	-0.27	-0.15
2004	7.40	0.78	5.70	9.10	2004	-0.21	0.02	-0.26	-0.16
2005	3.17	0.53	2.03	4.32	2005	-0.09	0.02	-0.12	-0.06
2006	7.32	1.16	4.80	9.84	2006	-0.21	0.03	-0.28	-0.13
2007	4.46	0.46	3.47	5.45	2007	-0.13	0.01	-0.16	-0.10
2008	4.01	1.13	1.56	6.47	2008	-0.11	0.03	-0.18	-0.04
2009	3.12	2.67	-3.74	9.99	2009	-0.09	0.08	-0.29	0.11
2010	6.25	2.27	0.41	12.09	2010	-0.18	0.07	-0.35	-0.01
2011	0.86	0.75	-0.79	2.50	2011	-0.02	0.02	-0.07	0.03
2012	6.37	0.53	5.01	7.73	2012	-0.18	0.02	-0.22	-0.14
2013	-15.11	27.54	-85.90	55.69	2013	0.43	0.78	-1.58	2.44
REGSLOPE	-0.94	0.45	-1.94	0.06	REGSLOPE	0.03	0.01	0.00	0.06
SITE 4					SITE 4				
1995	2.44	0.15	2.04	2.84	1995	-0.07	0.00	-0.08	-0.06
1996	3.08	0.13	2.79	3.37	1996	-0.09	0.00	-0.09	-0.08
1997	2.95	0.09	2.71	3.19	1997	-0.08	0.00	-0.09	-0.07
1998	3.50	0.46	2.32	4.67	1998	-0.10	0.01	-0.13	-0.06
1999	3.26	0.14	2.96	3.55	1999	-0.09	0.00	-0.10	-0.08
2000	3.29	0.20	2.77	3.82	2000	-0.09	0.01	-0.10	-0.07
2001	-19.16	22.66	-77.41	39.09	2001	0.55	0.65	-1.11	2.21
2002	3.98	0.15	3.60	4.35	2002	-0.11	0.00	-0.12	-0.10
2003	4.13	1.29	1.33	6.93	2003	-0.11	0.04	-0.19	-0.02
2004	4.75	0.79	3.04	6.47	2004	-0.13	0.02	-0.18	-0.08
2005	2.12	0.38	1.28	2.95	2005	-0.06	0.01	-0.08	-0.03
2006	2.15	0.40	1.28	3.02	2006	-0.06	0.01	-0.08	-0.03
2007	2.65	0.09	2.46	2.83	2007	-0.07	0.00	-0.08	-0.07
2008	2.98	0.67	1.52	4.44	2008	-0.08	0.02	-0.13	-0.04
2009	1.51	0.65	-0.16	3.19	2009	-0.04	0.02	-0.09	0.01
2010	0.76	0.47	-0.46	1.97	2010	-0.02	0.01	-0.06	0.02
2011	2.15	0.30	1.51	2.80	2011	-0.06	0.01	-0.08	-0.04
2012	2.06	0.07	1.87	2.25	2012	-0.05	0.00	-0.06	-0.05
2013	225.51	356.16	-690.04	1141.05	2013	-6.40	10.12	-32.42	19.61
REGSLOPE	3.56	2.05	-0.77	7.88	REGSLOPE	-0.10	0.06	-0.22	0.02

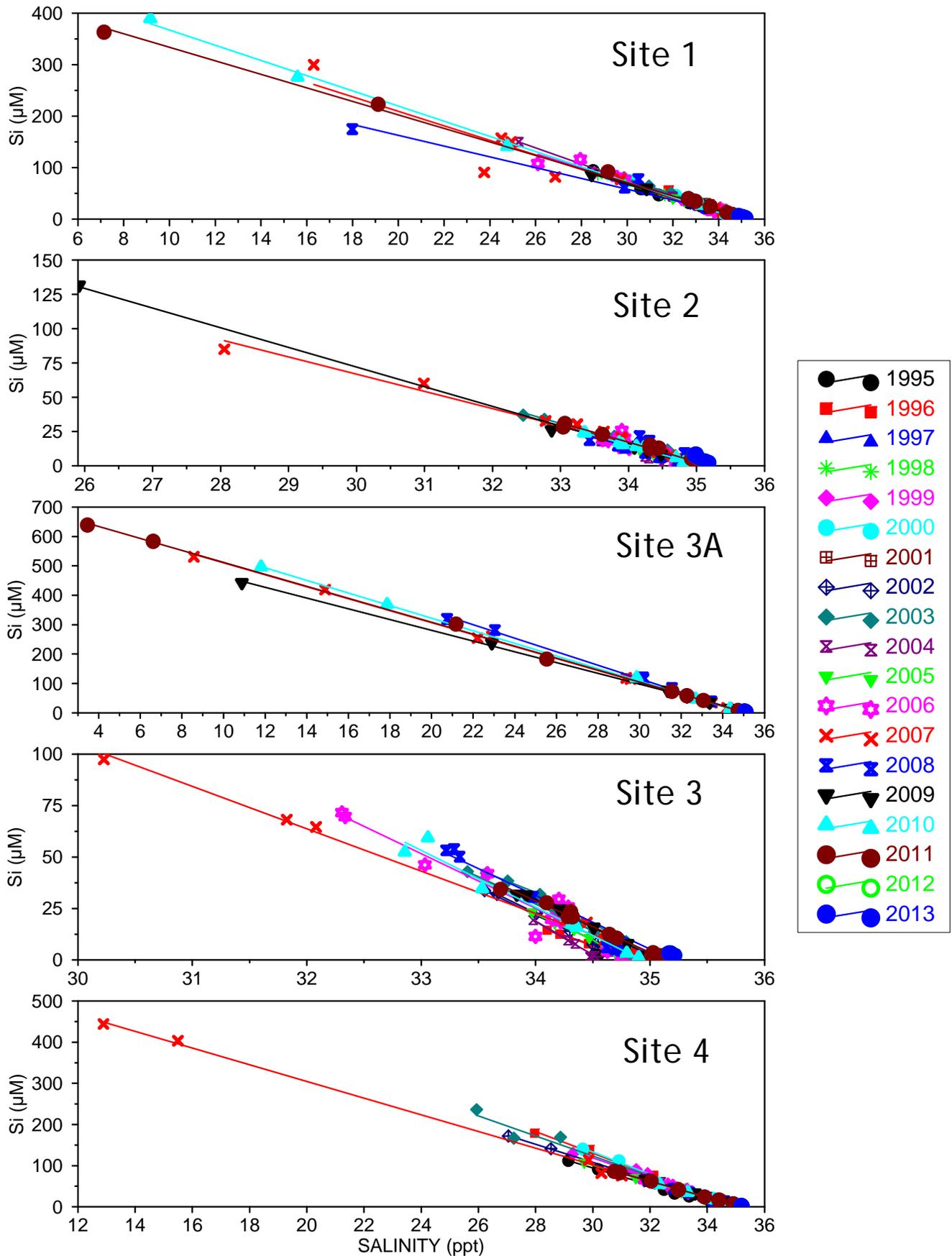


FIGURE 22. Mixing diagram showing yearly concentrations of silicate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

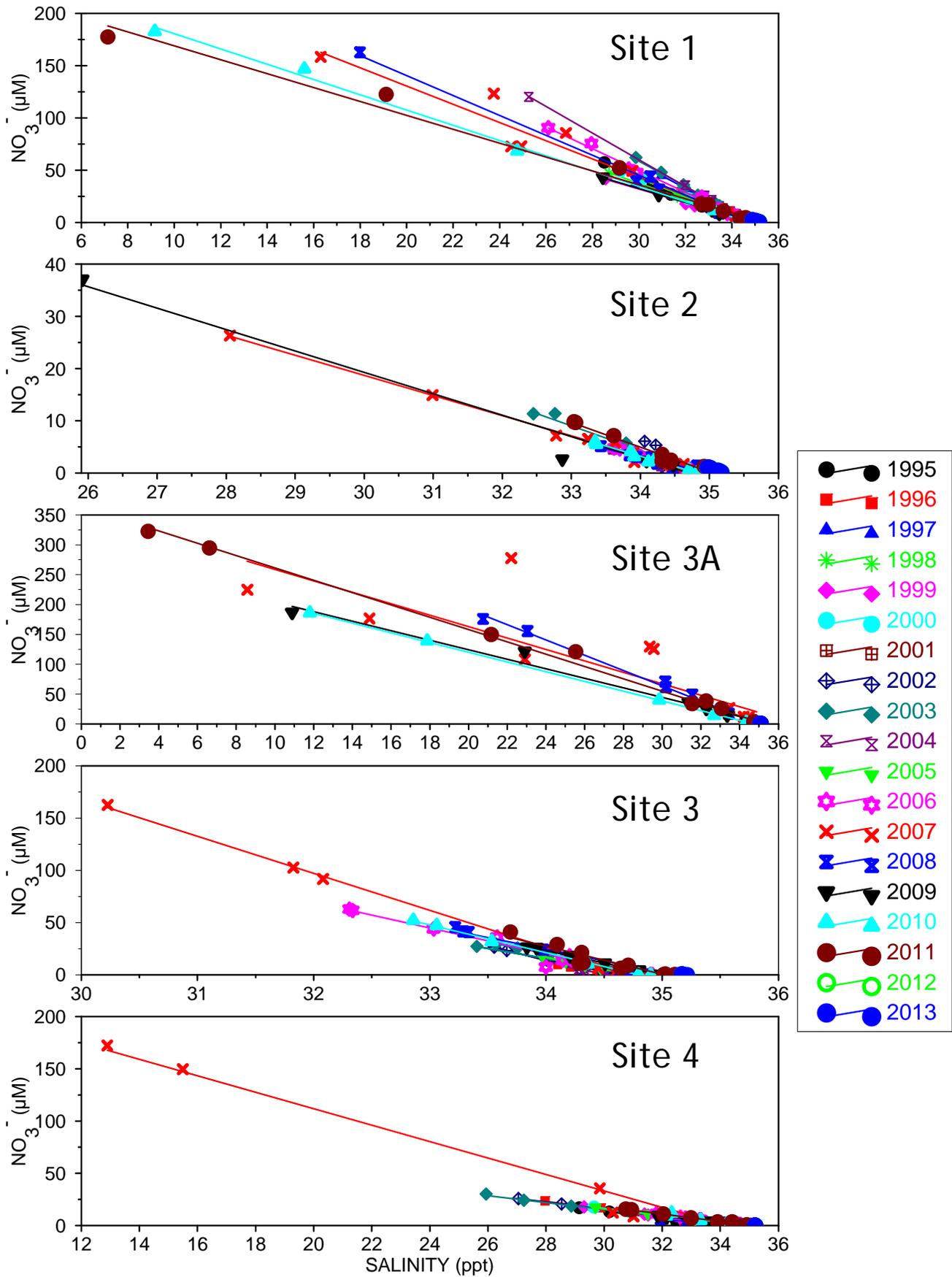


FIGURE 23. Mixing diagram showing yearly concentrations of nitrate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through data points for each year. For sampling site locations, see Figure 1.

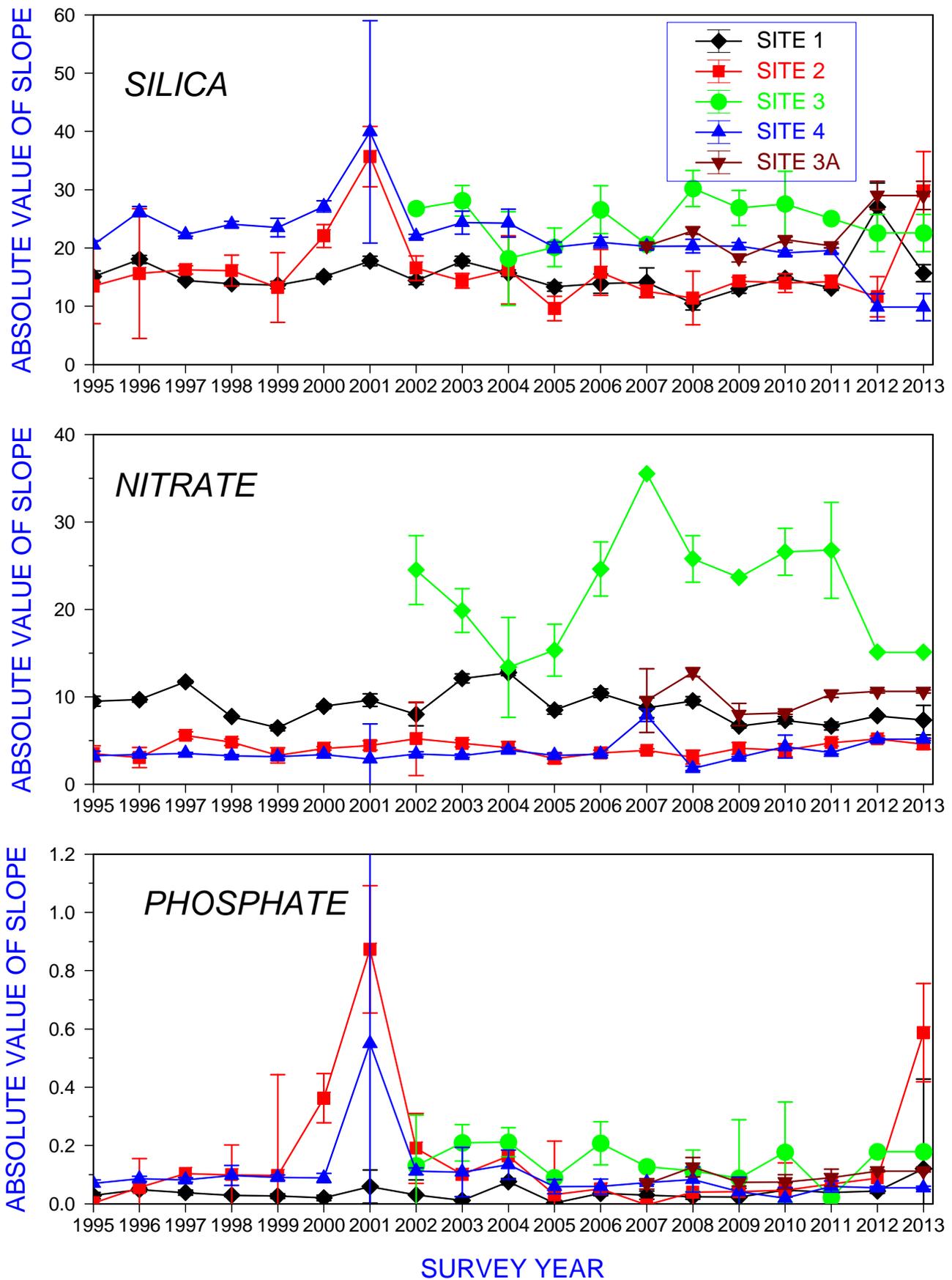


FIGURE 24. Time-course plots of absolute values of slopes of linear regressions of concentrations of silica, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits (Note error bar for Site 4 Phosphate is off scale). For locations of sampling transect sites, see Figure 1.

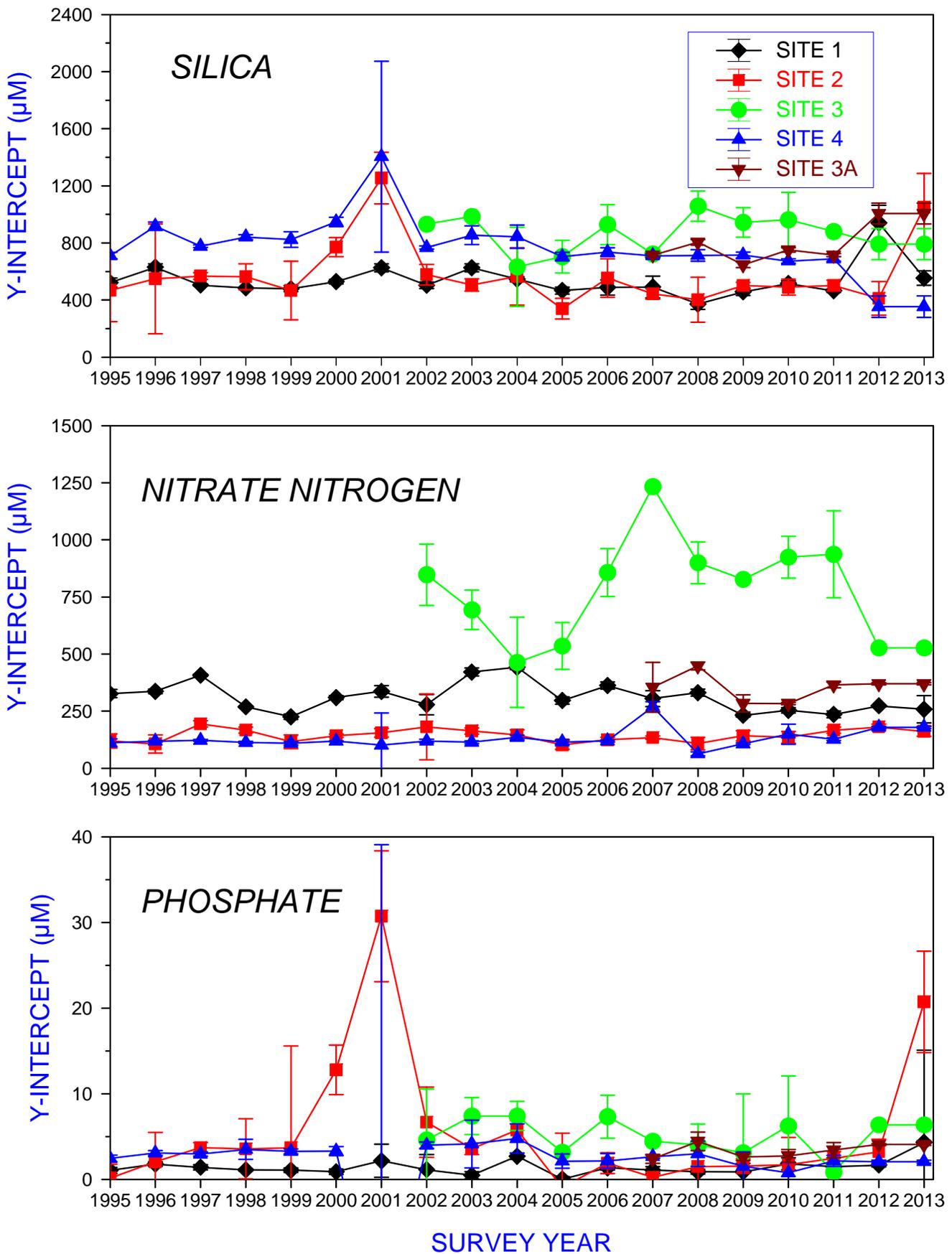


FIGURE 25. Time-course plots of Y-intercepts of linear regressions of concentrations of silica, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits. For locations of sampling transect sites, see Figure 1.

Exhibit C

THE ORIGINAL OF THIS DOCUMENT
RECORDED AS FOLLOWS:
STATE OF HAWAII

BUREAU OF CONVEYANCES

DATE_ Doc A-46330782

DOCUM September 7, 2012 1:00 PM

LAND COURT

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CARLSMITH BALL LLP
One Main Plaza, Suite 400
2200 Main Street
Wailuku, Maui, Hawaii 96793

Attention: B. Martin Luna
Telephone: (808) 242-4535

TITLE OF DOCUMENT:

AMENDED AND RESTATED DECLARATION OF CONDITIONS
APPLICABLE TO AN AMENDMENT OF
DISTRICT BOUNDARY FROM AGRICULTURAL TO URBAN

PARTIES TO DOCUMENT:

DECLARANT: ATC MAKENA N GOLF LLC
ATC MAKENA S GOLF LLC
ATC MAKENA LAND SF1 LLC
ATC MAKENA LAND MF1 LLC
ATC MAKENA LAND MF2 LLC
ATC MAKENA LAND MF3 LLC
ATC MAKENA LAND C1 LLC
ATC MAKENA U1 LLC
ATC MAKENA LAND B1 LLC
ATC MAKENA LAND MF4 LLC
ATC MAKENA LAND SF2 LLC
ATC MAKENA LAND AH1 LLC
Two Manhattanville Road, Suite 203
Purchase, New York 10577

TAX MAP KEY(S): (2) 2-1-005:083, 084, 085 and 108 (por.);
2-1-007:004; and 2-1-008:090 (por.)

(This document consists of 10 pages.)

**AMENDED AND RESTATED DECLARATION OF CONDITIONS
APPLICABLE TO AN AMENDMENT OF
DISTRICT BOUNDARY FROM AGRICULTURAL TO URBAN**

THIS AMENDED AND RESTATED DECLARATION OF CONDITIONS
APPLICABLE TO AN AMENDMENT OF DISTRICT BOUNDARY FROM
AGRICULTURAL TO URBAN (hereinafter called the "Declaration") is made this 7th
day of SEPTEMBER, 2012, by ATC MAKENA N GOLF LLC, ATC MAKENA S
GOLF LLC, ATC MAKENA LAND SF1 LLC, ATC MAKENA LAND MF1 LLC, ATC
MAKENA LAND MF2 LLC, ATC MAKENA LAND MF3 LLC, ATC MAKENA LAND
C1 LLC, ATC MAKENA U1 LLC, ATC MAKENA LAND B1 LLC, ATC MAKENA
LAND MF4 LLC, ATC MAKENA LAND SF2 LLC, and ATC MAKENA LAND AH1 LLC,
all Delaware limited liability companies, all whose mailing address is Two Manhattanville
Road, Suite 203, Purchase, New York 10577, as Petitioner in State of Hawaii Land Use
Commission Docket No. A97-721 (hereinafter called the "Declarant" or "Petitioner").

W I T N E S S E T H:

WHEREAS, the State of Hawaii Land Use Commission (hereinafter called the
"Commission"), by Findings of Fact, Conclusions of Law, and Decision and Order filed on
February 19, 1998 (hereinafter "Decision and Order"), in the aforementioned Docket
A97-721, amended the State Land Use district boundaries and reclassified approximately
145.943 acres of those certain parcels of real property situate at Makena, District of
Makawao, Island and County of Maui, State of Hawaii, as shown on the Map attached hereto
as Exhibit "A" and by reference made a part hereof ("LUC Reclassified Property"), and
identified as Tax Map Key Nos. (2) 2-1-005:083, 084, 085, portion of 108, (2) 2-1-007:004;

and (2) 2-1-008:portion of 090, from the State Land Use Agricultural District to the State Land Use Urban District, subject to certain conditions enumerated therein; and

WHEREAS, Declarant is the current owner of portions of the LUC Reclassified Property, specifically identified as Tax Map Key No. (2) 2-1-005:108 and TMK (2) 2-1-008:090, comprised of approximately 489.432 acres and 350.940 acres, respectively; and

WHEREAS, Declarant's successor in interest recorded that certain Declaration of Conditions Applicable to an Amendment of District Boundary from Agricultural to Urban dated April 17, 1998, in the Bureau of Conveyances of the State of Hawaii as Document No. 98-054982, as amended by First Amendment of Declaration of Conditions dated July 12, 2000, recorded as Document No. 2000-107512 (the "Original Declaration, as amended"); and

WHEREAS, the Commission, by Order Granting with Modification Movant's Motion for Sixth Amendment to the Findings of Fact, Conclusions of Law, and Decision and Order, Filed on February 19, 1998 and for Release of Certain Conditions, Filed on August 27, 2012 (the "August 27, 2012 Order"), in the aforementioned Docket A97-721, **(a)** approved the amendment to Condition Number 12 of this Commission's Order Granting Receiver's Motion For Fifth Amendment To The Findings Of Fact, Conclusions Of Law, And Decision And Order, Filed On February 19, 1998, dated May 10, 2010, **(b)** amended Condition Number 22 of the Decision and Order, and **(c)** released Condition Numbers 4, 15 and 21 enumerated in the Decision and Order; and

WHEREAS, this Declaration is intended to and shall replace and supersede the Original Declaration, as amended, in its entirety;

NOW, THEREFORE, Declarant hereby declares that the LUC Reclassified Property of 145.943 acres, shown on the Map attached as Exhibit "A", shall be subject to the

following conditions imposed by the Commission in Docket No. A97-721, which have been renumbered sequentially after the release of Conditions Number 4, 15 and 21:

1. Petitioner shall provide affordable housing opportunities for low, low-moderate, and gap group income residents of the State of Hawai'i in accordance with applicable laws, rules, and regulations of the County of Maui. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as may be mutually agreeable between Petitioner and the County of Maui.

2. Petitioner shall coordinate with the County of Maui Board of Water Supply to incorporate the proposed project into the County Water Use and Development Plan for the area. Prior to the granting of the first discretionary permit for the single-family and multi-family residential development described in paragraph 20 of the Decision and Order or the hotel described in paragraph 21 of the Decision and Order and by or before one year from the issuance date of this Decision and Order, Petitioner shall furnish the Commission with a letter from the County of Maui Board of Water Supply confirming that (a) the potable water allocation that will be credited to Petitioner will be available to and sufficient for the proposed project as it is described in the Petition, (b) the availability of potable water will not be an obstacle or impediment to the development of the proposed project as described in the Petition and (c) the proposed project as it is described in the Petition has been incorporated into the County Water Use and Development Plan for the area and that this plan will prevent the continued overpumping of the sustainable yield of the 'Iao aquifer.

3. Petitioner shall participate in the funding and construction of adequate water source, storage, and transmission facilities and improvements to accommodate the proposed project in accordance with the applicable laws, rules and regulations of the County of Maui, and consistent with the County of Maui water use and development plan.

4. Petitioner shall contribute to the development, funding, and/or construction of school facilities, on a pro rata basis for the residential developments in the proposed project, as determined by and to the satisfaction of the State Department of Education ("DOE"). Terms of the contribution shall be agreed upon by Petitioner and DOE prior to Petitioner acquiring county rezoning or prior to Petitioner applying for building permits if county rezoning is not required.

5. Petitioner shall participate in the pro rata funding and construction of adequate civil defense measures as determined by the State of Hawai'i and County of Maui civil defense agencies.

6. Should any human burials or any historic sites such as artifacts, charcoal deposits, stone platforms, pavings, or walls be found, Petitioner shall stop work in the immediate vicinity and contact SHPD. The significance of these finds shall then be determined and approved by SHPD, and an acceptable mitigation plan shall be approved by SHPD. SHPD must verify that the fieldwork portion of the mitigation plan has been successfully executed prior to work proceeding in the immediate vicinity of the find. Burials must be treated under specific provisions of Chapter 6E, Hawai'i Revised Statutes.

7. Petitioner shall follow the State DLNR recommendations for Petition Areas 1, 2 and 3, for archaeological data recovery and preservation. An archaeological data recovery plan (scope of work) must be approved by SHPD. That plan then must be successfully executed (to be verified in writing by the SHPD), prior to any grading, clearing, grubbing or other land alteration in these areas. In Petition Area 1, three significant historic sites (1969, 2563, 2569) are committed to preservation. A preservation plan must be approved by SHPD. This plan, or minimally its interim protection plan phase, must be

successfully executed (to be verified in writing by the SHPD), prior to any grading, clearing, grubbing or other land alteration in these areas.

8. Petitioner shall implement efficient soil erosion and dust control measures during and after the development process to the satisfaction of the State Department of Health and County of Maui.

9. Petitioner shall initiate and fund a nearshore water quality monitoring program. The monitoring program shall be approved by the State Department of Health in consultation with the U.S. Fish and Wildlife Service, the National Marine Fisheries Services, and the State Division of Aquatic Resources, DLNR. Petitioner shall coordinate this consultation process with the concurrence of the State Department of Health. Mitigation measures shall be implemented by Petitioner if the results of the monitoring program warrant them. Mitigation measures shall be approved by the State Department of Health in consultation with the above mentioned agencies.

10. Petitioner shall submit a Traffic Impact Analysis Report (TIAR) for review and approval by the State Department of Transportation and the County of Maui.

11. Petitioner shall participate in the pro rata funding and construction of local and regional transportation improvements and programs, including dedication of rights of way as determined by the State Department of Transportation ("DOT") and the County of Maui. Agreement between Petitioner and DOT as to the level of funding and participation shall be obtained within fourteen (14) years from June 1, 2000.

12. Petitioner shall fund the design and construction of drainage improvements required as a result of the development of the Property to the satisfaction of the appropriate State of Hawai'i and County of Maui agencies.

13. The Petition Areas shall be developed in accordance with the Kihei-Makena Community Plan.

14. Petitioner shall fund, design and construct all necessary traffic improvements necessitated by development of the Petition Areas as required by the State Department of Transportation and the County of Maui's Department of Public Works and Waste Management.

15. Petitioner shall develop the Property in substantial compliance with the representations made to the Commission. Failure to so develop the Property may result in a reversion of the Property to its former classification, a change to a more appropriate classification, or other reasonable remedy as determined by the Commission.

16. Petitioner shall give notice to the Commission of any intent to sell, lease, assign, place in trust, or otherwise voluntarily alter the ownership interests in the Property, prior to development of the Property.

17. Petitioner shall timely provide without any prior notice, annual reports to the Commission, the Office of Planning, and the County of Maui Planning Department in connection with the status of the subject project and Petitioner's progress in complying with the conditions imposed herein. The annual report shall be submitted in a form prescribed by the Executive Officer of the Commission.

18. The Commission may fully or partially release or amend the conditions provided herein as to all or any portion of the Property upon timely motion and upon the provision of adequate assurance of satisfaction of these conditions by Petitioner.

19. Petitioner shall record the conditions imposed herein by the Commission and every amendment thereto with the Bureau of Conveyances pursuant to Section 15-15-92, Hawai'i Administrative Rules.

The limitations, restrictions, covenants and conditions of this Declaration shall run with the land of the Property, and continue and remain in full force and effect at all times with respect to the Property included in this Declaration until such time that the State Land Use Commission removes or releases the conditions relating to the subject Property established through its Decision and Order, as amended.

IN WITNESS WHEREOF, Declarant has caused this instrument to be executed on the day and year first above written.

DECLARANT:

ATC MAKENA N GOLF LLC,
ATC MAKENA S GOLF LLC,
ATC MAKENA LAND SF1 LLC,
ATC MAKENA LAND MF1 LLC,
ATC MAKENA LAND MF2 LLC,
ATC MAKENA LAND MF3 LLC,
ATC MAKENA LAND C1 LLC,
ATC MAKENA U1 LLC,
ATC MAKENA LAND B1 LLC,
ATC MAKENA LAND MF4 LLC,
ATC MAKENA LAND SF2 LLC, and
ATC MAKENA LAND AH1 LLC, all
Delaware limited liability companies

By _____

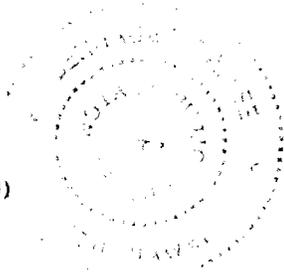
Name: Sean Hehir

Its: Authorized Signatory

STATE OF HAWAII)
) ss.
CITY AND COUNTY OF HONOLULU)

On this 7th day of September, 2012, before me personally appeared SEAN HEHIR, to me personally known/proved to me on the basis of satisfactory evidence, who, being by me duly sworn or affirmed, did say that such person executed the foregoing instrument as the free act and deed of such person, and if applicable in the capacity shown, having been duly authorized to execute such instrument in such capacity.

(Notary Stamp or Seal)



Bernadette A. Lee

Name: BERNADETTE A. LEE

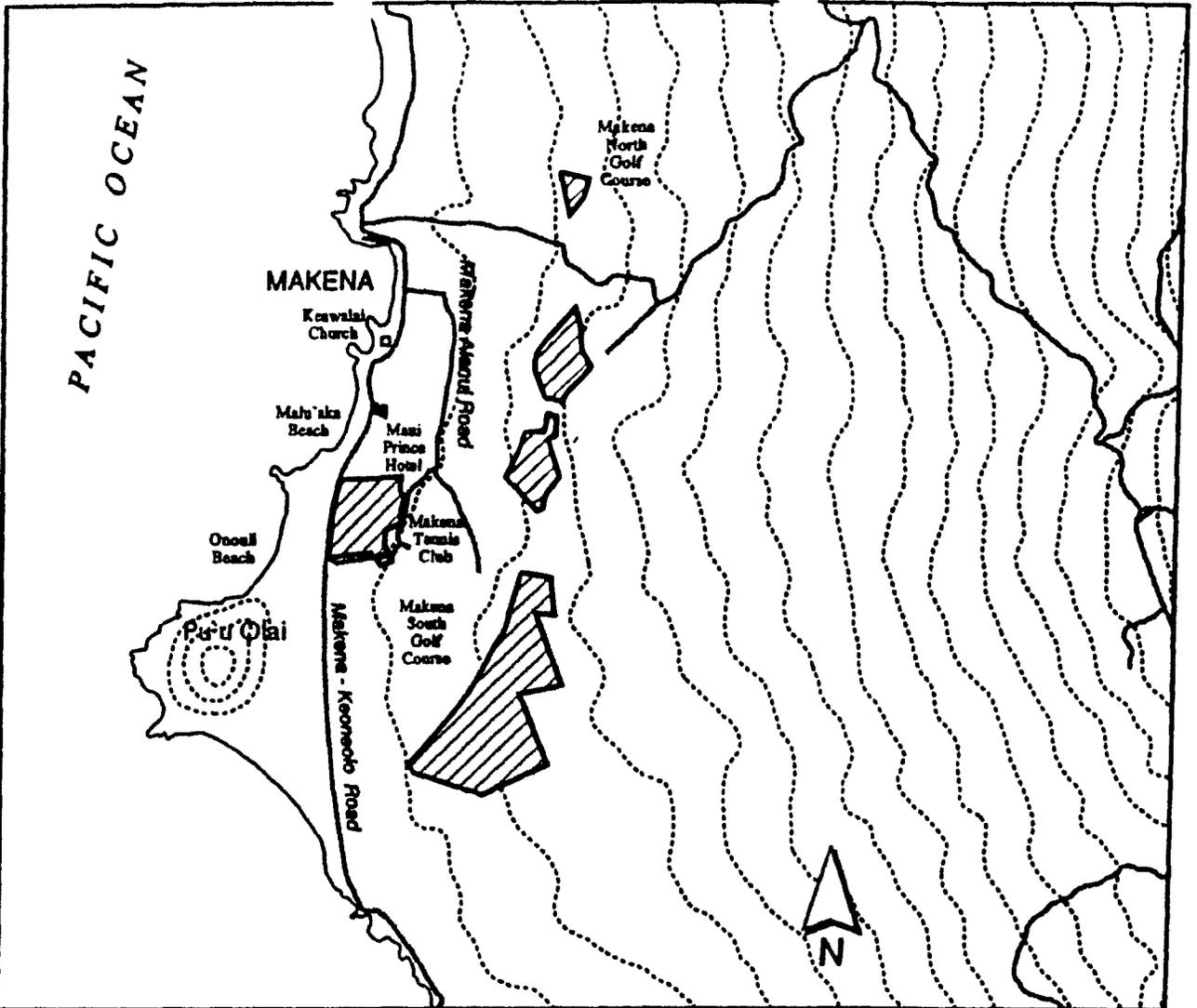
Notary Public, State of Hawaii

My commission expires: 6/29/2015

NOTARY CERTIFICATION STATEMENT	
Document Identification or Description:	<u>AMENDED AND RESTATED DECLARATION OF CONDITIONS APPLICABLE TO AN AMENDMENT OF DISTRICT BOUNDARY FROM AGRICULTURAL TO URBAN</u>
Document Date:	<u>September 7, 2012</u>
No. of Pages:	<u>10</u>
Jurisdiction (in which notarial act is performed):	<u>First</u> Circuit
Printed Name of Notary	<u>BERNADETTE A. LEE</u>
Signature of Notary	<u><i>Bernadette A. Lee</i></u>
Certification Date	<u>9-7-2012</u>

(Notary Stamp or Seal)





A97-721 / MAKENA RESORT
CORP.,
A Hawai'i Corporation

LOCATION MAP

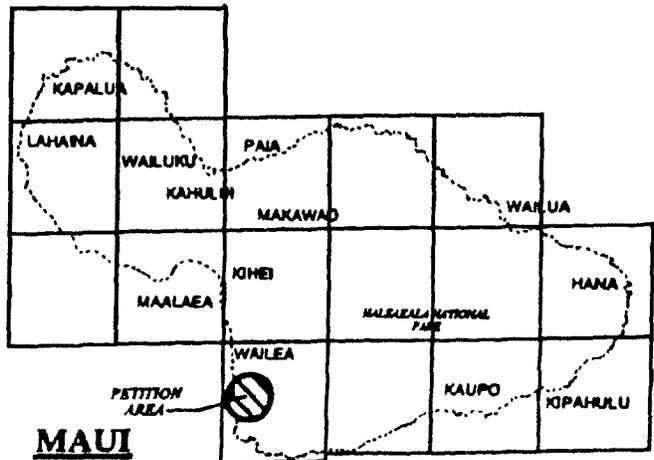
TAX MAP KEY NO.: 2-1-05: 83, 84,
85, & por. 108; 2-1-07: 4; &
2-1-08: por. 90

Makena, Maui, Hawai'i



APPROVED AREA

EXHIBIT " A "



MAUI