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SCANNED

TO: **Honorable Mike White, Council Chair**
Maui County Council
County of Maui
200 South High Street
Wailuku, Hawai'i 96793

DATE: January 5, 2018

SUBJECT: Annual Compliance Report (Change in Zoning Conditions for Makena Resort Area)

Enclosed is/are:

Copies	Date	Description
1 (HC) + 1 (CD)	January 2018	Annual Compliance Report

	For your information	For your use
	For necessary action	As requested
X	For your review	For your signature
	For your files	Returning

REMARKS: On behalf of ATC Makena Holdings, LLC we are submitting the enclosed Annual Compliance Report for your review in accordance with Condition No. 22 of Ordinance 3613 (Change in Zoning for Makena Resort Area). Condition No. 22 states that:

> "*The developer shall provide timely annual compliance reports to the Planning Director and the Council. The compliance reports shall include: (a) the status of the developer's compliance with each of these conditions; and (b) a reasonable estimate of the time needed for full compliance.*"

Should you have any questions or require additional information, please feel free to call me at 244-2015.

Signed: [signature]
Erin Mukai
Senior Associate

EM:yp
Copy to: Kaimi Judd, Discovery Land Company (w/enclosure)
K:\DATA\ATCMakena\CoordinationMonitoring 1483\Coordination\2018 CIZ Annual Report\2018CIZtoM.White.trans.doc

GENERAL COMMUNICATION NO. 18-1

Annual Compliance Report

CHANGE IN ZONING CONDITIONS FOR MAKENA RESORT AREA

Prepared by
ATC Makena Holdings, LLC

January 5, 2018

CONTENTS

LIST OF EXHIBITS

I. OVERVIEW

On August 27, 2010, 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 (collectively "ATC Makena Holdings, LLC"), acquired through foreclosure most, but not all, of the lands that are covered by Ordinance No. 3613. Lands covered in this Ordinance that are now owned by ATC Makena Holdings, LLC are identified by the following TMKs: 2-1-5: por 108, por 120, por 124, 2-1-6: 036, por 56, por 57, por 59, 2-1-7:004 por 068, 93, por 94, 2-1-8 por 078, por 79, por 81, por 90. (collectively the Zoned Parcels).

Ordinance No. 3613, entitled "A BILL FOR AN ORDINANCE TO AMEND PORTIONS OF LAND ZONING MAP NOS. 5 AND 514 TO ESTABLISH A-2 APARTMENT DISTRICT, B-2 COMMUNITY BUSINESS DISTRICT, B-R RESORT COMMERCIAL DISTRICT, H-M HOTEL DISTRICT, PK-1 NEIGHBORHOOD PARK DISTRICT, PK-4 GOLF COURSE PARK DISTRICT, R-1 AND R-3 RESIDENTIAL DISTRICT ZONING (CONDITIONAL ZONING) FOR LANDS SITUATED AT MAKENA, MAUI, HAWAII", which authorized a change in County zoning districts, requires compliance with 44 conditions of zoning. Approximately 603.303 acres of land located in Makena, Maui, Hawaii, were subject to the Change in Zoning action.

The intent of this document is to provide an Annual Compliance Report as required by Condition No. 22.

> *The developer shall provide timely annual compliance reports to the Planning Director and the Council. The compliance reports shall include: (a) the status of the developer's compliance with each of these conditions; and (b) a reasonable estimate of the time needed for full compliance.*

II. STATUS OF COMPLIANCE WITH CONDITIONS

The following is a report on the current status of compliance with the 44 conditions of the Change in Zoning action for the Zoned Parcels (Ordinance No. 3613).

1. *In the R-1, R-2, and R-3 Residential District zoned areas, the density shall not exceed 2.5 single-family dwelling units per acre.*

   Status: ATC Makena Holdings, LLC ('ATC Makena') will comply with the provisions of said condition.

   Estimate of Time for Compliance: This condition will continue during the life of the project.

2. *In the A-2 Apartment District zoned areas, the density shall not exceed eight units per acre, and the building height shall not exceed 45 feet. Height shall be measured from the natural or finish grade, whichever is lower.*

   Status: ATC Makena will comply with the provisions of said condition.

   Estimate of Time for Compliance: This condition will continue during the life of the project.

3. *In the B-2 Community Business District zoned areas, the gross floor area of each building shall not exceed 60 percent of the total lot area.*

   Status: ATC Makena will comply with the provisions of said condition.

   Estimate of Time for Compliance: This condition will continue during the life of the project.

4. *On Lot 19 (H-M Hotel District), the building height shall not exceed 45 feet and shall be consistent with the Urban Design Standards for Building Form in the Kihei-Makena Community Plan; no more than 89 units shall be developed; and no lockout units shall be allowed. Height shall be measured from the natural or finish grade, whichever is lower.*

   Status: Hawaii Development, LLC is the owner of Lot 19. Hawaii Development, LLC is responsible for compliance with the provisions of said condition.

5. *The developer shall preserve Makena's significant views of the Pacific Ocean and the broad vista to the Central Maui and Upcountry regions. The use of walls higher than four feet in front yard setbacks shall be prohibited.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

6. *In the B-2 Community Business District zoned areas, the following permitted uses shall incorporate acoustical measures into the facility to mitigate potential noise impacts: amusement enterprises, including billiard and pool halls; auditoriums and theaters; baseball and football stadiums and other sport activities and amusements; bowling alleys; dancing and hula studios; gymnasiums; miniature golf courses; music conservatories and music studios; physical-culture studios; and printing, lithography, and publishing shops.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

7. *All exterior lighting shall be shielded from adjacent residential properties and nearshore waters, and shall be fully shielded to prevent uplight. Lighting requirements in force at the time of building permit application shall be applied.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

8. *In the B-2 Community Business District zoned areas, merchandise, equipment, and supplies shall be stored within enclosed buildings or enclosed areas that are appropriately screened with fencing and landscape planting for the following permitted uses: equipment rental and sales yards; hardware and garden supply stores; parcel delivery stations; and printing, lithography, and publishing shops.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

9. *The developer, its successors and permitted assigns shall pay the Department of Education, $3,000 per dwelling unit upon issuance of each building permit to be used, to the extent possible, for schools serving the Kihei-Makena Community Plan area; provided that, should the State pass legislation imposing school impact fees that apply to the Makena Resort Area, the developer, its successors and permitted assigns, shall from that point forward comply with the State requirements, or contribute $3,000 per dwelling unit, whichever is greater. Should a previous agreement exist between the Department of Education and the landowner, this condition shall prevail.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: Upon issuance of each building permit for a new dwelling unit during the life of the project.

10. *The developer shall provide pedestrian and bicycle access ways within the roadways throughout and fronting the Makena Resort Area. A schematic plan for pedestrian and bicycle access ways throughout and fronting the Makena Resort Area shall be submitted to the Department of Planning for consideration by the Maui Planning Commission in conjunction with SMA permit applications.*

Status: The schematic plan for pedestrian, bicycle, and cart access ways throughout Makena Resort area prepared by Miyabara & Associates was transmitted with the 2010 Annual Report.

Estimate of Time for Compliance: A schematic plan was submitted with the 2010 Annual Report. Refinements of the plan, if necessary, will be submitted as the project develops.

11. *The developer shall make a contribution to the County for traffic improvements in an amount equal to $5,000 per unit. The contribution shall be paid to the County prior to issuance of the initial building permit. Upon adoption of a traffic impact fee ordinance, the developer shall comply with the ordinance in lieu of this voluntary contribution. Should a traffic impact fee ordinance be adopted prior to the collection of this contribution, the applicable amount shall be the greater of the two. Such contributions or fees shall not be counted towards Condition No. 12 below.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: Prior to issuance of the initial building permit and continuing with the issuance of additional building permits as the project is developed.

12. *Upon commencement of the first phase of construction, the developer shall pay its pro-rata share to upgrade Pi'ilani Highway from Kilohana Drive to Wailea Ike Drive to four lanes of traffic, and shall cooperate with the State Department of Transportation and other area developers to implement such improvements concurrent with development.*

Status: ATC Makena will comply with the provisions of said condition.

ATC Makena is pursuing an agreement with the State DOT that will address ATC Makena's fair share/pro-rata share contribution and means of implementing traffic improvements related to the development of the Zoned Parcels.

Estimate of Time for Compliance: It is anticipated that ATC Makena will have an agreement with DOT in place prior to the start of its first phase of construction on the Zoned Parcels.

13. *The developer shall provide construction access roads from Pi'ilani Highway to the construction sites. Construction traffic shall be prohibited on Kilohana Drive, Wailea Ike Drive, Wailea Alanui Drive, and Makena Alanui Drive to the extent practicable.*

Status: ATC Makena is not presently constructing improvements nor is any construction planned at this time on the Zoned Parcels. ATC Makena does not own the rights-of-way for a construction access road. ATC

Makena has, however, initiated discussions with adjacent landowners to identify a possible location of an access road route in the event of future construction, should construction access be warranted and practicable. These discussions are ongoing.

Further, it is noted that the Construction Transportation Management Plan, as required by Condition No. 14, include measures that are intended to reduce construction traffic. For further information see Condition No. 14.

Estimate of Time for Compliance: At the time of construction on the Zoned Parcels if warranted and available.

14. *The developer shall develop and submit a Transportation Management Plan ("TMP"), to be reviewed and approved by the State Department of Transportation, the County Department of Public Works, and the County Department of Transportation. The purpose of the TMP shall be to reduce traffic generated by construction activity related to the Makena Resort Area. The TMP shall provide for programs such as park and ride, shuttles, and/or restrictions on worker access to ongoing construction activity during peak hour traffic. Upon approval, project contractors shall implement the TMP during construction activities. The developer shall submit an annual report to the State Department of Transportation, the County Department of Public Works, the County Department of Transportation, and the Maui County Council to document the success of the TMP in meeting its benchmarks of reducing traffic during project construction.*

The TMP shall be reviewed and approved by the State Department of Transportation, the County Department of Public Works, and the County Department of Transportation prior to issuance of each SMA permit within the Makena Resort Area.

Status: A Construction Transportation Management Plan (CTMP) for the Makena Resort area was submitted to the State Department of Transportation (SDOT), the County Department of Public Works (DPW), and the County Department of Transportation (CDOT) on July 13, 2009, and included in the 2010 Annual Report. ATC Makena will work with applicable reviewing agencies to obtain approval of the CTMP.

ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: An approved CTMP will be in place prior to issuance of the first SMA Use Permit for development within the Zoned Parcels.

15. *As part of the first SMA application, the developer shall submit a TMP to reduce the dependency on individual vehicular transportation modes. The TMP shall be reviewed and approved by the State Department of Transportation, the County Department of Public Works, and the County Department of Transportation to address post-construction traffic issues.*

Status: A TMP for post-construction operations for the Makena Resort area was submitted to the State Department of Transportation (SDOT), Department of Public Works (DPW), and the County Department of Transportation (CDOT) on July 13, 2009, and included in the 2010 Annual Report. By letter dated, August 19, 2009, the SDOT approved the TMP for post-construction operations.

Estimate of Time for Compliance: An approved TMP for post-construction operations will be included in the first SMA Use Permit application for development within the Zoned Lands.

16. *The developer shall participate in the pro rata funding and construction of adequate civil defense measures as determined by the State and County civil defense agencies.*

Status: ATC Makena agreed to the two (2) locations for emergency sirens at the Makena Resort Wastewater Treatment Plant (WWTP) and near Makena State Park consistent with the representations in the 2010 Annual Report. Final Right-Of-Entry and Non-Exclusive License Agreements dated May 25, 2012 between ATC Makena and the State Of Hawaii, Department of Defense (DOD) were submitted with the 2012 annual compliance report. DOD informed ATC Makena on December 28, 2016 that one of the two sirens will be located at Makena State Park. The second siren will still be located on ATC Makena's WWTP and DOD informed ATC Makena on December 28, 2016 that final plans were being prepared for the contractor.

Estimate of Time for Compliance: ATC has complied with the provisions of this condition. DOD installed the siren at ATC Makena's WWTP site in 2017.

17. *Should any human burials or any historic sites such as artifacts, charcoal deposits, stone platforms, pavings, or walls be found, the developer shall stop construction work in the immediate vicinity and notify the State Historic Preservation Division (SHPD), the Maui/Lanai Island Burial Council (MLIBC), and the Maui County Cultural Resources Commission (CRC).*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

18. *The developer, its successors and permitted assigns, shall provide a comprehensive preservation/mitigation plan pursuant to Chapter 6E, Hawaii Revised Statutes, that has been approved by the State Historic Preservation Division, Department of Land and Natural Resources, and the Office of Hawaiian Affairs prior to any grading within the project area.*

Status: Preservation plans and related plans will be prepared in compliance with the requirements Chapter 6E, HRS, and consistent with the findings of SHPD-approved archaeological studies. All such plans will be presented to SHPD and, as appropriate, the Office of Hawaiian Affairs, for approval.

Estimate of Time for Compliance: ATC Makena will comply with Chapter 6E, Hawaii Revised Statutes (HRS), prior to any grading within the Zoned Parcels. In accordance with Chapter 6E, HRS, ATC Makena will prepare preservation/mitigation plans for each Zoned Parcel in compliance with the Department of Land and Natural Resources, State Historic Preservation Division (SHPD) requirements, and subject to the review and approval of SHPD and the Office of Hawaiian Affairs.

19. *Marine monitoring programs shall be conducted which include monitoring and assessment of coastal water resources (groundwater and surface water) that receive surface water or groundwater discharges from the hydrologic unit where the project is*

located. Monitoring programs shall include both water quality and ecological monitoring.

Water Quality Monitoring shall provide water quality data adequate to assess compliance with applicable State water quality standards at Hawaii Administrative Rules Chapter 11-54. Assessment procedures shall be in accordance with the current Hawaii Department of Health ("HIDOH") methodology for Clean Water Act Section 305(b) water quality assessment, including use of approved analytical methods and quality control/quality assurance measures. The water quality data shall be submitted biannually, or every six months, to HIDOH for use in the State's Integrated Report of Assessed Waters prepared under Clean Water Act Sections 303(d) and 305(b). If this report lists the receiving waters as impaired and requiring a Total Maximum Daily Load ("TMDL") study, then the monitoring program shall be amended to evaluate land-based pollutants, including: (1) monitoring of surface water and groundwater quality for the pollutants identified as the source of the impairment; and (2) providing estimates of total mass discharge of those pollutants on a daily and annual basis from all sources, including infiltration, injection, and runoff. The results of the land-based pollution water quality monitoring and loading estimate shall be submitted to the HIDOH Environmental Planning Office, TMDL Program.

The ecological monitoring shall include ecological assessment in accordance with the Coral Reef Assessment and Monitoring Program protocols used by the Department of Land and Natural Resources. The initial assessment shall use the full protocol. Subsequent biannual assessments can use the Rapid Assessment Techniques. Results shall be reported biannually to the Aquatic Resources Division, Department of Land and Natural Resources.

The monitoring and assessments shall be conducted by degreed scientists experienced with Clean Water Act programs, water quality monitoring, water quality assessment, water quality-based permitting, water quality modeling, watershed planning, and TMDL. Study design should be made available for both public review and peer review by the State Department of Health, Department of Aquatic Resources, and the University of Hawaii researchers. Results of monitoring shall be published and publicly available online.

<u>Status</u>: As part of this annual report, ATC Makena, is providing the monitoring report dated July 2017 (**See Exhibit A**), and the most recent report dated December, 2017 (**See Exhibit B).** These reports have been transmitted to the State DOH.

Estimate of Time for Compliance: Water quality monitoring and assessment will continue to be conducted twice a year in compliance with the provisions of said condition.

20. *The developer shall implement efficient soil-erosion and dust-control measures during and after development to the satisfaction of DOH and the County.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

21. *The developer shall give notice to the Department of Planning and the Council of any intent to sell, lease, assign, place in trust, or otherwise voluntarily alter the ownership interests in the Makena Resort Area, prior to any development.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

22. *The developer shall provide timely annual compliance reports to the Planning Director and the Council. The compliance reports shall include: (a) the status of the developer's compliance with each of these conditions; and (b) a reasonable estimate of the time needed for full compliance.*

Status: This Annual Compliance Report is being submitted in compliance with said condition.

Estimate of Time for Compliance: This condition will continue annually in January during the life of the project.

23. *Failure to fulfill any condition may result in a reversion to former or more appropriate zoning or community plan designations or other remedies.*

Status: ATC Makena acknowledges the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

24. *If any of the property subject to this Change in Zoning is consolidated with other property for purposes of an SMA permit application, these conditions shall apply to the entirety of the consolidated property.*

Status: ATC Makena acknowledges the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

25. *The developer shall comply with the County's Residential Workforce Housing Policy as provided in Chapter 2.96, Maui County Code.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

26. *The developer shall comply with all applicable County water ordinances. The water rates for the residential workforce housing units shall be no higher than the general water consumer rates set by the County in its annual budget, for as long as the units are subject to Chapter 2.96, Maui County Code.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

27. *The developer shall provide a water conservation plan for the Makena Resort Area, approved by the Department of Water Supply, prior to the issuance of any SMA permits. For each project, the developer shall construct a dual waterline system to accommodate the use of non-potable water for landscaping and irrigation purposes prior to the issuance of any building permits.*

Status: A Water Conservation Plan (WCP) for the Makena Resort area was approved by the County Department of Water Supply (DWS) on July 27, 2009 and submitted with the 2010 Annual Report.

Estimate of Time for Compliance: ATC Makena has complied with the requirement to provide a WCP. ATC Makena will comply with water conservation requirements prior to the issuance of any building permits for any development within the Zoned Parcels requiring a SMA Use Permit.

28. *All energy systems for all residential, commercial, and hotel units shall be designed and constructed to meet all applicable Energy Star® requirements established by the Climate Protection Division of the United States Environmental Protection Agency in effect at the time of construction. For purposes of this condition, energy systems shall include all hot-water systems, roof and attic areas, outside walls, windows, air-cooling systems, and heating systems.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

29. *All residential, commercial, and hotel units shall comply with Chapter 16.16, Maui County Code.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

30. *All air-cooling systems and all heating systems for laundry facilities, swimming pools, and spa areas shall make maximum use of energy-efficient construction and technology.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

31. *The developer shall construct a minimum of 60 new parking stalls at Maluaka Beach, including at least 10 at the north end, within one year of the issuance to the developer of*

any SMA permit by the Maui Planning Commission relating to a parcel or a portion thereof that is a subject of this Change in Zoning. Unless necessary to protect public safety or to comply with State or Federal law, the required parking stalls need not be asphalt surfaced. Development costs and land shall not satisfy park dedication requirements.

Status: ATC Makena will comply with the provisions of said condition. It should be noted that Hawaii Development, LLC owns Lot 19 where the South Maluaka beach parking is located.

Estimate of Time for Compliance: Within one year of issuance of any SMA permit relating to a Zoned Parcel. There are no immediate plans for the development of Zoned Parcels owned by ATC Makena and as such, this is not anticipated to occur in the near future. However, if Hawaii Development, LLC, proceeds with development before ATC, ATC Makena will cooperate towards satisfying this requirement.

32. *The developer shall develop an expansion of the beach park at the south end of Maluaka Beach, such that the beach park shall comprise at least 1.5 acres of land area for public use and beach access. The developer shall submit the necessary applications required for the expansion within six months of the approval of this Change in Zoning. The land area of the expansion of the existing park shall be applied as credit toward satisfying a portion of any applicable park dedication requirements.*

Status: ATC Makena has complied with the provisions of said condition. ATC Makena, in coordinating with Discovery Land Company, the Makena Cultural Focus Group, the Makena Community Advisory Group, and the Department of Parks and Recreation, implemented an expansion location acceptable to all parties to the south end of the existing Maluaka Beach Park. The expansion area is approximately 0.66 acres in size bringing the combined existing and proposed park up to 1.5 acres. ATC has formalized and documented the expansion in compliance with all County, State and Federal rules and regulations through the recordation of a Declaration of Restrictive Covenants for Park Purposes with the Bureau of Conveyances. A copy of the declaration and agreement is provided herewith as **Exhibit "C"**.

Estimate of Time for Compliance: ATC has complied with the provisions of this condition.

33. *To the extent practicable, the developer shall provide, in perpetuity, traversable lateral shoreline access in the area between the shoreward boundary and the mauka boundary of the Makena Resort Area. Costs associated with this condition shall not satisfy park dedication requirements.*

Status: Miyabara & Associates prepared a schematic plan for pedestrian and bicycle access ways throughout the Makena Resort area. A copy of this schematic plan was submitted as part of the 2010 Annual Report. In November 2015, ATC Makena restored approximately 1,600 lineal feet of the Maluaka Shoreline trail between the Maluaka Beach Park and the Southern boundary of their oceanfront parcel near the 15th Green of the South Golf Course. The trail will be maintained in perpetuity.

Estimate of Time for Compliance: Lateral shoreline access has been available and will continue through the life of the project.

34. *Within one year of the approval of this Change in Zoning, the developer shall initiate and fund a plan for the development of the State Park at Makena for the State Department of Land and Natural Resources and the Department of Parks and Recreation, soliciting and taking into consideration the comments of various user groups, including Surfrider Foundation, Savemakena.org, Maui Tomorrow, the Kihei Community Association, and the Makena Homeowner's Association. The plan shall incorporate recreational, landscaping, parking, and facility concepts as a guide for future development of the park. Costs associated with this condition shall not satisfy park dedication requirements.*

Status: This condition has been satisfied. ATC Makena submitted the final Makena State Park Plan dated February 2013 to the State Department of Land and Natural Resources, the County Department of Parks and Recreation and the Oneloa Coalition in March 2013. The final plan document and associated transmittals were submitted to the County of Maui Planning Department in March, 2013 in compliance with this condition. The County Department of Planning issued a letter of condition fulfillment dated June 3, 2013. These documents were provided with the 2014 Annual Report.

Estimate of Time for Compliance: ATC has complied with the provisions of this condition.

35. *The developer shall renovate and beautify Makena Landing (TMK: 2-1-007:094), see attached map, in coordination with the Department of Parks and Recreation and the State Department of Land and Natural Resources. Costs associated with this condition shall not satisfy park dedication requirements.*

Status: ATC Makena will comply with the provisions of said condition. Following submittal and processing of the necessary applications, a Shoreline Setback Determination (SSD) for the Makena Landing beach park property was issued by the Department of Planning on May 20, 2013 (see 2014 Annual Report). Further, a Special Management Area Minor Permit and Shoreline Setback Approval (SSA) for the proposed renovation and beautification work at the park were issued by the Department of Planning on October 1, 2013. Copies of these approvals were provided with the 2014 Annual Report.

ATC, in coordination with Discovery Land Company and the Department of Parks and Recreation, has since made various adjustments to the 2013 site plan to reflect input received from the Makena Community Advisory Group and the Makena Cultural Focus Group over the past few years. A request to amend the 2013 permits was recently granted by the Department of Planning.

Estimate of Time for Compliance: A construction schedule for the renovation and beautification work at Makena Landing beach park is in the process of being defined. The upgrades are anticipated to be initiated in 2018.

36. *The developer shall maintain Makena Landing (TMK: 2-1-007:094), North Maluaka (TMK: 2-1-007:068), and South Maluaka (TMK: 2-1-005:124), see attached map, and all future parklands within the Makena Resort Area.*

Status: A Unilateral Agreement was submitted to County of Maui, Department of Parks and Recreation for their approval on June 26, 2009 under the prior ownership. After working with the Department of Parks and Recreation to revise the agreement and update the obligations for maintenance to reflect the expansion to Maluaka Beach park discussed above in Condition No. 32, the Unilateral Maintenance Agreement was finalized and recorded with the Bureau of Conveyances. A copy of the agreement is provided herewith as **Exhibit "D".**

ATC Makena has and will continue to maintain Makena Landing, North Maluaka, and South Maluaka as well as all future parklands within the Makena Resort Area.

Estimate of Time for Compliance: As noted above, the formal agreement relating to maintenance was finalized and recorded with the Bureau of Conveyances in conjunction with work related to compliance with Condition 32; however, maintenance has been and will continue to be undertaken for the life of the project.

37. *To exhibit respect for the Hawaiian culture and a Hawaiian sense of place, structures within the Makena Resort Area shall be based on or inspired by principles of Hawaiian island architecture in design and construction.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

38. *The developer shall provide a baseline study survey of flora and fauna as part of each SMA permit application within the Makena Resort Area; the study shall be conducted by recognized independent experts on Hawaiian flora and fauna and list all endemic, indigenous, and endangered species, their distribution in the Makena Resort Area and adjacent shorelines. This study shall also include a preservation/mitigation plan and comments from the State Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and the U.S. Corps of Engineers, and the Maui representative of the Hawaii Wildlife Fund and The Nature Conservancy.*

Status: Robert Hobdy prepared a baseline coastal flora and fauna study of Makena's coastal lands. The study was circulated to the State Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, U.S. Corps of Engineers, the Maui representative of the Hawaii Wildlife Fund and The Nature Conservancy for review and comment. A copy of the flora and fauna study was submitted as part of the 2010 Annual Report.

Estimate of Time for Compliance: ATC Makena will continue to comply with this condition.

39. *No transient vacation rentals or time shares shall be allowed within this Makena Resort rezoning application area; and further, no special use permit or conditional permit for such accommodations shall be accepted by the Department of Planning.*

Status: ATC Makena acknowledges the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

40. *A second hotel shall not be constructed within the Makena Resort Area.*

Status: ATC Makena acknowledges the provisions of said condition as it applies to hotel zoned lands within the Zoned Parcels, which is limited to Parcel 19 that is owned by Hawaii Development, LLC.

41. *All buildings constructed within the Makena Resort Area shall be LEED (Leadership in Energy and Environmental Design) certified if they are 500 square feet or larger.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

42. *New dwelling units shall not exceed 800, excluding residential workforce housing.*

Status: ATC Makena acknowledges the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

43. *The developer, its successors and permitted assigns, shall contribute $1,000 per market-priced unit, collected at issuance of building permit, to the County, for the development and maintenance of a police station in South Maui.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: Upon issuance of each initial building permit for market-priced units within the Zoned Parcels.

44. *The developer shall provide Driveway "D" from Makena Alanui Road to Makena Resort Sewage Treatment Plant and beyond as an emergency evacuation route for the area.*

Status: ATC Makena will comply with the provisions of said condition.

Estimate of Time for Compliance: This condition will continue during the life of the project.

EXHIBIT A.

Exhibit A

ATC MAKENAHOLDINGS, LLC

c/o Makena Golf & Beach

55 Merchant Street, Suite 1500

Honolulu, HI 96813

January 5, 2018

Mr. Myron Honda
State of Hawaii, Department of Health
Clean Water Branch
2827 Waimano Home Rd #225
Pearl City, HI 96782

Via PDF to CleanWaterBranch@doh.hawaii.gov Only unless hardcopy is requested.

> Re: State Land Use District Boundary Amendment Docket A9-721 Condition No. 9, County of Maui Zoning Ordinance 3613 Condition No. 19, Marine Water Quality Monitoring.

Dear Mr. Honda,

ATC Makena Holdings, LLC, in compliance with the above referenced conditions, respectfully submits the enclosed Marine Water Quality Monitoring Reports prepared by Marine Research Consultants, Inc. dated July 2017 for tests performed in June 2017, and January 2018, for tests performed in December 2017.

Should you have any questions, require a hardcopy, or require additional information please do not hesitate to contact me at (808) 640-6023, or by e-mail at kjudd@makenagbc.com.

Sincerely,

Makena Golf & Beach Club
For ATC Makena Holdings, LLC

Kaimi Judd
Vice President of Development

cc. Mark Roy – Via E-Mail PDF Only

MARINE WATER QUALITY MONITORING

MAKENA RESORT, MAKENA, MAUI

WATER CHEMISTRY

REPORT 1-2017

(July 2017)

Prepared for:

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

By:

MRCI

MARINE RESEARCH CONSULTANTS, INC.

1039 Waakaua Pl.
Honolulu, Hawaii 96822

Submitted

August 2017

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 July 7, 2017. The report also incorporates the cumulative data from all of the 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. At shallower stations, only surface water was collected. 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 five sampling locations, it was highest in magnitude at Sites 1 (located off the northern boundary of the Makena Resort property), and 3A, (located directly downslope from the Makena Resort). Site 4 served as a control, in that it was located beyond the influence of the Makena Resort. As groundwater input was apparent at Site 4, such input is not solely a function of Resort land usage.

Vertical stratification of the water column was evident on all transects with substantial differences between surface and bottom water. Vertical gradients extended from the shoreline to the terminus of each transect. The observed patterns of distribution at these sampling sites 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 were mostly insufficient to mix the water column from top to bottom.

Overall, measurements of turbidity and chlorophyll *a* were high near the shoreline throughout the sampling area but low offshore. Elevated values close to the shoreline are most likely the 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 causing increases in plankton populations in nearshore waters. Low offshore 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. Temperature averaged 26.5°C for all surface waters during the July 2017 survey. As a comparison, in December 2015, the average temperature was 25.0°C.

Other organic water chemistry constituents that do not occur in high concentrations in groundwater, such as ammonium nitrogen showed no elevated levels near the shoreline and consistently low levels beyond 50 meter of the shoreline. 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 Courses 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 of nitrate and phosphate over the years of monitoring at the four five survey sites located downslope from the Makena Resort. 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 when monitoring has been taking place.

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, total nitrogen, ammonium, 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 past surveys, the results of the most recent increment of monitoring in 2017 reveal that there is an increase over natural conditions of dissolved inorganic nutrients (e.g., nitrate and 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 22-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.

However, it was noted during the July 2016 survey that many of the corals (primarily of the species *Pocillopora meandrina*) were bleached. Such bleaching has been observed at many of the reefs around Maui and is part of a global bleaching event triggered by anomalously warm ocean temperatures. Recent observations of the reefs indicate that in large part the bleaching was not lethal, and corals have returned to conditions that prevailed prior to the bleaching event.

The next scheduled testing for the Makena Resort monitoring program is planned for the fall-winter season of 2017.

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 36th increment in the monitoring program, and contains data from water chemistry sampling conducted on July 7, 2017, and represents the first survey conducted in 2017.

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 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 present 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 July 7, 2017. Environmental conditions during sample collection consisted of light winds (5-10 knots) and sunny skies. Ocean conditions were flat with a small 0.5-1 foot breaking surf at the shoreline. Sample collection at the shoreline occurred during a period closest to low tide with a tidal height of -0.2 feet. Rainfall was minimal in the area previous to the day of sampling.

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 (NO_3^- + 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 NO_3^- + NO_2^- (hereafter termed NO_3^-), NH_4^+ and PO_4^{3-}, were performed on filtered samples using a Technicon 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.

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 μg/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, 0.001pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity.

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.

The EPA and Standard Methods (SM) methods that were employed for chemical analyses, as well as detection limits, are listed in the Code of Federal Regulations (CRF) Title 40, Chapter 1, Part 136, are as follows:

- NH_4^+ EPA 350.1, Rev. 2.0 or SM4500-NH3 G, detection limit 0.42 µg/L.
- NO_3^- + NO_2^-, EPA 353.2, Rev. 2.0 or SM4500-NO3F, detection limit 0.28 µg/L.
- PO_4^{-3} EPA 365.5 or SM4500-P F, detection limit 0.31 µg/L.
- TP EPA 365.1, or SM 4500-P E J, detection limit 0.62 µg/L.
- TN SM 4500-N C., detection limit 5.60 µg/L.
- Si, SM 4500 SiO2 E, detection limit 5.32 µg/L.
- Chlorophyll a, SM 10200, detection limit 0.006 µg/L.
- pH, EPA 150.1 or SM 4500H+B, detection limit 0.002 pH units.
- Turbidity, EPA 180.1, Rev. 2.0 or SM2130 B, detection limit 0.008 NTU.
- Temperature, SM 2550 B, detection limit 0.01 degrees centigrade.
- Salinity, SM 2520, detection limit 0.003 ppt.
- Dissolved Oxygen, SM4500 O G, and detection limit 0.01% sat.

III. RESULTS and DISCUSSION

A. General Overview

Table 1 shows results of all marine water chemical analyses for samples collected off Makena on July 7, 2017 with nutrient concentrations reported in micromolar units (µM). Table 2 shows similar results with nutrient concentrations presented in units of micrograms per liter (µg/L). Tables 3 and 4 show geometric means of ocean samples at Sites 1, 2 and 4 for 36 surveys, 27 surveys at Site 3, and 18 surveys from Site 3A, with nutrient concentrations shown in µM and µg/L, respectively. Table 5 shows water chemistry measurements (in units of µM and µg/L) for samples collected from irrigation wells located on the Makena Resort Golf Courses. Concentrations of twelve chemical constituents in surface and deep-water samples from the July 2017 sampling are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (±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 2007are plotted in Figures 4-18. In addition, data from the most recent sampling in July 2017 are plotted on Figures 4-18.

During the July 2017 sampling, on all five transects concentrations of dissolved Si, NO_3^- and TN collected within 50 m of the shoreline were elevated by an order of magnitude compared to samples collected near the bottom at the sampling station located farthest offshore (Figure 2, Tables 1 and 2).

The horizontal gradients (defined as the decrease in value moving offshore) of Si, NO_3^- and TN were steepest on Transects 3-A, where concentrations of NO_3^- decreased by nearly two orders of magnitude (i.e., 100-fold) across the sampling transect. Horizontal gradients in concentrations of Si, NO_3^- and TN were on Transect 1 were slightly less than on Transect 3A, and while evident, were less pronounced on Transects 2, 3 and 4. These horizontal gradients extended nearly the entire length of each transect.

Salinity was lowest in samples collected nearest the shoreline, and increased with distance from shore across the sampling transect. At the seaward ends of the transects, bottom waters reflected open coastal ocean values of salinity (~34.7‰). As with the nutrients, gradients of salinity had the highest magnitude on Transects 3A and 1, where surface salinity increased by 13.29‰ and 8.34‰, respectively, from the shoreline to the seaward ends of the transects (Tables 1 and 2). At Sites 2, 3 and 4, the lowest salinity also occurred at the shoreline with increasing values with distance offshore (Figure 3).

As was the case for NO_3^- and Si, concentrations of phosphate phosphorus (PO_4^{3-}) and TP were highest at the shoreline and decreased moving offshore to the open ocean (Figure 2, Tables 1 and 2). The decreasing gradient of PO_4^{3-} was most evident at Sites 1 and 3A, and extended out to a distance of 50 meters from the shoreline (Figure 2). Concentrations of NH4+ were also elevated at sampling points near the shoreline. At Site 3A, the concentrations of NH_4^+ in the samples collected within 10 meters of the shoreline were approximately five times greater than measured in the offshore samples. The overall values of NH_4^+ on Transect 3A were higher than that measured at the other transect sites (Tables 1 and 2).

With no streams in the sampling area, nor heavy rainfall and subsequent surface runoff immediately preceding sampling, patterns of elevated Si, NO_3^-, TN and PO_4^{3-} with corresponding reduced salinity are a result of 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 and calm sea conditions, the zone of mixing between groundwater and ocean water is most pronounced. During high tidal stands, and high winds and waves, increased mixing near the shoreline dilutes the groundwater signal. During the July 2017 sampling, ocean swells were minimal. Comparing the results of the repetitive surveys conducted during different wind and sea conditions 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 (TON, TOP) showed no distinct horizontal gradients with distance offshore for four of the five sites (Table 1, Figure 2).

Turbidity was highest near the shoreline, and decreased with distance from shore at all five transects with Site 2 showing highest values of turbidity (Tables 1 and 2, Figure 3). Transect 2 bisects Makena Bay (Makena Landing), which is a semi-enclosed embayment with a silt/sand bottom rather than the predominantly "hard" reef or sand bottoms that occur at the other transect sites. Shoreline surf and on-shore winds often contribute to an increase in turbidity at this site. It has been observed that during flash floods originating in the ranch lands upslope of the Makena Resort, terrigenous sediment will flow to the ocean at 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. Values in 2001 documented the persistent effects of 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. Beyond the shoreline, turbidity was constant and of the same magnitude at the other four transect sites (Tables 1 and 2).

Values of Chl *a* were highest near the shoreline at all transects except Transect 3A. Values near the shoreline were slightly higher at Transects 2 and 1 compared to the other three sites (Table 1, Figure 3). Beyond 50 meters from the shoreline, the magnitude in Chl *a* concentrations were similar among all five sites (Tables 1 and 2). And uncharacteristic higher value for Chl a (0.58 µg/L)was detected in both the surface and deep sample from the 150 meter from shore station on Transect 3A (Table 1).

In July 2017, surface water temperature was considerably higher near the shoreline at Sites 3, 3A, and 4 compared to Sites 1 and 2 (Figure 3, Tables 1 and 2). Maximum temperature reached 27.7°C at Site 4 while at Sites 1 and 2, temperature at the shoreline was lowest (~25.5°C). For the entire data set during the July 2017 survey temperature ranged between 25.2°C and 27.7°C for all samples. Beyond 50 meters from the shoreline temperature remained constant at all five sites (Figure 3).

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 and 3 and Tables 1 and 2 show concentrations of water chemistry constituents with respect to vertical stratification. With a few exceptions, concentrations of constituents in deep samples were lower than surface values. These results were most evident at transect Sites 1 and 3A where input of groundwater nutrients were most prominent. The buoyant surface layer extended the entire length of all transects indicating that normal mixing processes from wind and waves were not pronounced during July 2017.

B. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (±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. The results of the most recent survey in July 2017 are also shown on each plot.

The long-term means of concentrations of groundwater nutrients (Si, NO_3^-, and PO_4^{3-}), salinity, NH_4^+, turbidity and Chl *a* show an overall trend of increasing nutrients and decreasing salinity with distance offshore. Additionally, differences between surface and deep concentrations show vertical stratification within 50 meters of the shoreline with nutrient concentrations higher and salinity lower in the surface water compared to the deep water. Mean concentrations of TON, TOP and temperature remain nearly constant along the length of each transect. Temperature at Site 3A also increased with increasing distance offshore, a finding dissimilar from the other sites where temperature was fairly constant (Figure 18). The lower temperature near the shoreline at Transect 3A likely reflects the substantial input of cool groundwater at this location.

In comparing the most recent survey with the overall dataset, a few constituents were higher during the July 2017 survey compared to the mean values. Temperature at Sites 3, 3A and 4 were distinctly higher during July 2017 compared to the mean values over the course of monitoring (Figures 12, 15 and 18) while offshore temperatures at Site 2 were higher (Figure 9). Concentration of Si was higher during the present survey compared to the means at Site 3 (Figure 10). The patterns comparing the concentrations measured in the most recent survey to the mean values over all survey dates are likely a reflection of the combination of low tide and low energy of physical mixing processes (wave action) in the nearshore zone.

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 July 2017. 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 all five sites fall in a linear array on, or close to the conservative mixing line. Data points from samples at the shoreline for Transect 1 fall slightly below the mixing line. 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 a distinct linear pattern (Figure 19). Inspection of the mixing plots from the most recent survey (Figure 19) and the long-term mixing data (Figure 20) indicate 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 other than natural processes. During the July 2017 survey, data points from Site 2 also fell close to the mixing line (Figure 19).

Conversely, data points from the nearshore samples at Transects 1, 3 and 3-A all fall in a linear array above the conservative mixing line. Such a pattern indicates that there are subsidies of NO_3^- to the ocean from sources on land (Figure 19). Most evident are the data points from Transects 1, 3 and 3-A with salinities less than 34‰ that are evident far above the mixing line (Figure 19). Transect sites 3 and 3A lie directly offshore of the golf course, residences and a wetland. Transect Site 1 lies offshore of an area populated by numerous residences, and is downslope from the northern end of the Makena Golf Courses and southern end of the Wailea Golf Courses. The mixing line relationships from Figures 19 and 20 indicate subsidies of NO_3^-

at these areas that are likely a result of leaching of fertilizers to the groundwater lens. The source of fertilizer nutrients is likely from both golf course and residential landscaping. Although the Makena South Course has been closed for an extended time, the greens and fairways continue to be maintained at the time of this survey.

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 residences that have been constructed over the course of monitoring 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 July 2017 survey (red symbols) are superimposed over the slopes of combined sets of data points from past surveys (black and blue symbols) it can be seen that subsidies of NO_3^- lie slightly below the approximate midpoint of the overall data set (Figure 20). Thus, it can be inferred that over the course of the monitoring program, results from the most recent survey do not indicate a progressive increase or decrease in subsidies of NO_3^- to the ocean from human activities. Future monitoring will continue to provide information on any directions of trends of NO_3^- input to the ocean.

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.

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, inspection of the entire shoreline fronting the Makena Resort revealed that there are no areas exhibiting excessive algal growth that could be termed an "algal bloom."

The area was affected by anomalously high temperatures associated with the El Nino event in the summer of 2015. Inspection of the reef at the time of the October 2015 survey revealed a substantial amount of bleaching to corals, particularly of the species *Pocillopora meandrina*. Coral bleaching during the summer of 2015 has been common throughout the Hawaiian Islands as part of a global bleaching event associated with warming of ocean waters associated with an ongoing El Nino event. However, visual inspection of the area in 2017 indicated that much of the bleached corals had returned to normal in the intervening interval. As coral bleaching is not necessarily lethal to corals, the recovery is typical of many other areas of the main Hawaiian Islands.

The other form of dissolved inorganic nitrogen, NH_4^+, does not show a linear pattern of distribution with respect to salinity for either the July 2017 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. The reversed gradient of increasing concentrations of NH_4^+ with increasing salinity on most of the transects indicates that the source of NH_4^+ is not from groundwater entering the nearshore zone (Figure 19). In addition, it can be seen in Figure 19 that with the exception of the two samples collected nearest the shoreline on Transect 3A, the highest concentration of NH_4^+ do not occur at the lowest salinities, but rather near the highest salinities. The lack of linearity with respect to salinity in the distribution of NH_4^+ indicates that the elevated concentrations are from a marine source, and not from input from land.

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. However, as with NO_3^-, when concentrations of PO_4^{3-} are plotted as functions of salinity, samples from each transect fall in distinct linear arrays. Most of the data points from transect sites 2, 3, 3A and 4 lie close to the mixing line, while data points for transect 1 lie below the mixing line. The location of all data points on or below the mixing line indicates that there are not subsidies of PO_4^{3-} to the ocean from activities on land.

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 sources 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 though 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 a single slope (Si at Transect 4) and none of the 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 four of the five 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). Examination of Table 6, shows a slight decrease in in the Y-intercept and a slight increase in the slope for Si at Site 4, which is the Control site that is not affected by human activities at Makena.

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 entire course of monitoring since 1995. Sites 2 (Makena Landing) and 4 ('Ahihi-Kina`u) also show relatively constant trends with time. The single exception occurred in 2001 which is marked by spikes in Si and PO_4^{3-}, although not for NO_3^-. 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 from 2007 to 2013. Followed by a slight upturn to 2015(Figures 24 and 25). As a result of these reversing trends, there is no significant change over the 14-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 effects of stormwater runoff. At the time of the July 2017 survey, new turf grass had been applied but the course remained closed. Construction has been completed on the filtration systems but they are 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 either10% 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 July 2017 survey indicated that numerous measurements of NO_3^- TN, NH_4^+ and Chl *a* exceeded the 10% DOH criteria under wet or dry conditions (Tables 1 and 2). Only two measurements each of TP and turbidity exceeded the 10% DOH criteria under any 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 for NO_3^- occurred at a similar number of sampling sites as for the transects located directly offshore of the golf courses.

Tables 3 and 4 show geometric means of samples collected at the same locations during the 36 increments of the monitoring program at Sites 1, 2 and 4. Geometric means of samples collected over 27 increments of sampling at Site 3 and 18 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^+, TN and Chl *a*, nearly all samples exceeded the dry and wet standards within 100 m of the shoreline. Eight samples of TP and 21 samples of turbidity exceeded standards.
As noted above, Site 4 is considered a control transect, in that it is not located offshore of the Makena Resort 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 could 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 indeed 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 36th phase of water chemistry monitoring of the nearshore ocean off the Makena Resort was carried out on July 7, 2017. 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, NO_3^- and TN) displayed horizontal gradients with highest concentrations nearest to shore and decreasing concentrations moving seaward at all of the five sites. Groundwater input (based on salinity) was greatest at Transect sites 3-A and 1, followed by sites 3, 2 and 4.

- Vertical stratification of the water column was evident during July 2017, indicating that 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 Site 2 having the highest values of turbidity in nearshore samples. The elevated levels of Chl *a* 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 offshore water column indicates the lack of plankton blooms in the area. Elevated values of turbidity in the nearshore samples is likely a result of wave resuspension of fine-grained particulate material in the surf zone.

- Other organic water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, TON, TOP) did not show any horizontal pattern of increased concentration near the shoreline and decreasing with distance offshore. Transect site 3A had distinctly higher concentrations of NH_4^+ near the shoreline compared to the other four sites.

- 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 (1, 3, 3-A). No subsidies of NO_3^- other than the chemical constituents of naturally occurring groundwater 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 were the golf course extends to the shoreline. In addition, private residences and a wetland are present upslope of Transect 3 and 3A. Hence, the subsidies of NO_3^- noted at these sites may result from a combination of sources.

- Linear regression statistics of repetitive slopes and Y-intercepts of nutrient concentration plotted as functions of salinity over time 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 22 years of monitoring at any of the survey sites located off the Makena Resort. The lack of increase in these slopes and intercepts indicate that there has not been consistent changes 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, with progressive decreases from 2008 through 2013. Since 2013 input has been relatively stable. Further monitoring at this site will be of interest to note the future direction of the oscillating trends noted in the last ten years.

- Comparing water chemistry parameters to DOH standards revealed that several measurements of NO_3^-, TN, NH_4^+ and Chl *a*, and two measurements of TP and 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., Si and NO_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 2017.

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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 (with nutrients reported in micromolar units) from ocean water samples collected in the vicinity of the Makena Resort on July 7, 2017. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL *a* = chlorophyll *a*; TEMP = temperture; O2 = dissolved oxygen; 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

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	0.43	98.94	0.04	134.1	0.23	2.52	0.66	101.5	0.43	25.610	0.85	25.5	7.98	102.1
	2 S	0.1	0.19	67.48	BDL	92.62	0.27	3.26	0.46	70.74	0.31	28.760	0.89	25.7	8.01	104.3
	5 S	0.5	0.09	40.31	0.04	57.89	0.65	6.60	0.74	46.95	0.17	31.220	0.47	25.5	8.04	101.7
	5 D	1.5	0.08	31.20	0.07	46.37	0.35	5.96	0.43	37.23	0.21	32.020	0.55	25.5	8.04	100.1
	10 S	0.5	0.12	18.16	0.07	28.83	0.27	5.37	0.39	23.60	0.13	33.110	0.30	25.2	8.05	98.2
	10 D	2.4	0.10	12.13	0.09	20.91	0.32	5.43	0.42	17.65	0.13	33.650	0.33	25.6	8.08	98.4
	50 S	0.5	0.03	9.12	0.06	17.20	0.37	5.53	0.40	14.71	0.12	33.790	0.19	26.5	8.13	99.4
	50 D	4.1	0.09	1.81	0.10	5.78	0.24	5.28	0.33	7.19	0.06	34.540	0.18	26.5	8.16	95.6
	100 S	0.5	0.08	5.19	0.12	12.55	0.24	5.30	0.32	10.61	0.11	34.120	0.17	26.3	8.14	99.6
	100 D	5.5	0.08	0.48	0.10	4.01	0.22	5.23	0.30	5.81	0.09	34.760	0.12	26.4	8.16	94.7
	150 S	0.6	0.13	8.56	0.12	17.75	0.20	5.01	0.33	13.69	0.08	33.950	0.12	26.2	8.13	94.8
	150 D	10.4	0.09	0.28	0.07	3.76	0.21	5.39	0.30	5.74	0.05	34.840	0.11	26.3	8.16	97.0
MAKENA 2	0 S	0.1	0.17	10.07	0.30	33.67	0.25	6.54	0.42	16.91	0.81	32.660	1.25	25.3	8.14	103.5
	2 S	0.1	0.18	9.91	0.34	33.18	0.25	6.30	0.43	16.55	0.55	32.820	0.86	25.6	8.14	102.7
	5 S	0.6	0.10	3.36	0.06	13.31	0.24	5.12	0.34	8.54	0.12	34.160	0.23	25.6	8.15	103.5
	5 D	2.2	0.11	2.33	0.07	10.29	0.22	5.35	0.33	7.75	0.13	34.230	0.20	25.6	8.15	102.0
	10 S	0.5	0.09	1.65	0.06	7.84	0.27	6.14	0.36	7.85	0.11	34.420	0.22	25.8	8.16	101.1
	10 D	3.0	0.11	1.26	0.05	6.54	0.25	5.51	0.36	6.82	0.16	34.460	0.19	26.4	8.16	100.3
	50 S	0.6	0.11	7.79	0.06	26.46	0.38	5.53	0.49	13.38	0.23	33.210	0.31	26.6	8.14	95.0
	50 D	4.4	0.10	0.27	0.05	4.02	0.20	5.42	0.30	5.74	0.09	34.710	0.23	26.5	8.16	92.6
	100 S	0.6	0.08	2.41	0.04	11.53	0.24	5.48	0.32	7.93	0.17	34.160	0.23	26.5	8.13	97.3
	100 D	5.6	0.11	BDL	0.05	4.05	0.19	5.39	0.30	5.44	0.11	34.760	0.12	26.6	8.16	95.1
	150 S	0.5	0.09	3.41	0.06	12.52	0.22	6.03	0.31	9.50	0.18	34.120	0.19	26.4	8.11	96.9
	150 D	7.2	0.10	0.53	0.05	5.04	0.22	5.67	0.32	6.25	0.08	34.610	0.16	26.7	8.15	98.9
	200 S	0.6	0.11	1.69	0.04	9.69	0.22	5.97	0.33	7.70	0.15	34.230	0.23	26.9	8.13	100.4
	200 D	12.0	0.11	0.28	0.06	4.39	0.22	8.69	0.33	9.03	0.10	34.680	0.24	26.8	8.15	98.7
MAKENA 3-A	0 S	0.1	1.16	144.7	1.18	277.3	0.08	9.88	1.24	155.7	0.25	20.940	0.30	27.4	7.87	99.9
	2 S	0.1	0.96	102.1	1.42	186.0	0.16	10.33	1.12	113.9	0.20	25.560	0.31	27.1	7.95	104.6
	5 S	0.5	0.31	23.50	0.57	46.75	0.24	7.73	0.55	31.80	0.15	32.640	0.26	26.8	8.10	105.3
	5 D	1.1	0.18	13.24	0.42	29.84	0.23	5.19	0.41	18.85	0.14	33.540	0.19	26.7	8.13	105.4
	10 S	0.5	0.15	16.25	0.12	35.48	0.24	4.69	0.39	21.06	0.11	33.190	0.25	26.7	8.12	103.2
	10 D	2.9	0.13	3.81	0.22	11.25	0.20	5.40	0.33	9.43	0.10	34.490	0.29	26.6	8.14	100.9
	50 S	0.5	0.30	25.11	0.22	52.35	0.19	4.87	0.49	30.20	0.16	32.350	0.19	26.5	8.06	100.2
	50 D	4.5	0.15	1.76	0.17	7.09	0.22	6.58	0.37	8.51	0.25	34.610	0.17	26.8	8.14	97.6
	100 S	0.5	0.15	5.36	0.29	15.54	0.25	6.07	0.40	11.72	0.18	34.270	0.22	26.7	8.11	97.9
	100 D	5.0	0.12	0.51	0.24	5.11	0.20	4.96	0.32	5.71	0.09	34.610	0.58	26.7	8.15	97.6
	150 S	0.5	0.12	3.00	0.22	10.91	0.22	5.03	0.34	8.25	0.12	34.230	0.58	26.6	8.12	97.4
	150 D	10.4	0.09	0.25	0.19	4.20	0.24	5.43	0.33	5.87	0.06	34.490	0.15	26.7	8.16	98.4
MAKENA 3	0 S	0.1	0.22	22.12	0.25	41.99	0.21	5.07	0.43	27.44	0.37	33.160	0.22	27.4	8.12	97.3
	2 S	0.1	0.31	19.93	0.34	42.69	0.18	4.47	0.49	24.74	0.20	33.410	0.19	26.8	8.09	99.4
	5 S	0.5	0.17	11.28	0.18	27.68	0.25	6.18	0.42	17.64	0.23	33.910	0.16	26.7	8.10	100.2
	5 D	1.7	0.17	7.56	0.18	21.79	0.22	5.62	0.39	13.36	0.13	34.160	0.14	26.7	8.10	100.5
	10 S	0.5	0.12	4.34	0.16	14.56	0.27	5.60	0.39	10.10	0.17	34.380	0.10	26.8	8.09	97.6
	10 D	2.8	0.28	2.17	0.38	10.81	0.06	4.91	0.34	7.46	0.15	34.570	0.12	26.9	8.08	97.1
	50 S	0.5	0.12	3.78	0.15	12.21	0.24	5.44	0.36	9.37	0.09	34.340	0.17	26.7	8.09	99.4
	50 D	5.2	0.12	4.86	0.08	14.19	0.24	6.50	0.36	11.44	0.13	34.270	0.17	26.7	8.08	98.6
	100 S	0.5	0.13	7.10	0.02	17.04	0.22	5.64	0.35	12.76	0.12	34.120	0.11	26.8	8.09	96.7
	100 D	7.6	0.10	0.34	0.02	3.74	0.20	5.36	0.30	5.72	0.12	34.610	0.14	26.8	8.14	98.1
	150 S	0.5	0.10	4.11	0.04	11.98	0.24	6.75	0.34	10.90	0.06	34.310	0.11	26.5	8.11	97.7
	150 D	13.7	0.11	0.23	BDL	3.29	0.20	5.45	0.31	5.69	0.05	34.720	0.12	26.8	8.15	98.0
MAKENA 4	0 S	0.1	0.22	8.44	0.23	46.82	0.20	7.97	0.42	16.64	0.34	32.280	0.41	27.7	8.20	109.6
	2 S	0.1	0.19	9.37	0.02	49.61	0.25	5.82	0.44	15.21	0.23	32.550	0.62	27.6	8.21	115.2
	5 S	0.7	0.21	6.17	0.29	35.55	0.20	6.75	0.41	13.21	0.19	33.030	0.41	27.2	8.20	111.5
	5 D	2.7	0.19	5.75	0.20	33.82	0.18	4.98	0.37	10.93	0.16	33.170	0.51	26.9	8.20	116.1
	10 S	0.8	0.15	1.05	0.40	9.86	0.20	5.38	0.35	6.83	0.08	34.350	0.16	27.0	8.17	106.8
	10 D	2.5	0.13	1.12	0.21	11.07	0.21	4.98	0.34	6.31	0.11	34.240	0.23	27.1	8.17	107.3
	50 S	0.9	0.15	0.94	0.30	13.33	0.20	6.01	0.35	7.25	0.12	34.200	0.22	26.8	8.07	100.1
	50 D	4.5	0.17	0.63	0.37	9.68	0.19	6.05	0.36	7.05	0.14	34.390	0.37	26.9	8.10	99.5
	100 S	0.8	0.10	1.09	0.92	14.36	0.23	6.48	0.33	8.49	0.12	34.160	0.16	26.9	8.07	100.3
	100 D	7.0	0.13	0.22	0.32	4.83	0.18	5.39	0.31	5.93	0.09	34.570	0.17	26.8	8.12	98.2
	150 S	0.5	0.12	1.02	0.53	14.02	0.22	6.20	0.34	7.75	0.10	34.200	0.16	26.8	8.06	100.4
	150 D	9.7	0.13	0.07	0.07	3.81	0.19	5.77	0.32	5.91	0.12	34.580	0.20	26.8	8.14	101.6
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 form 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 (with nutrient data reported in µg/L) from ocean water samples collected in the vicinity of the Makena Resort on July 7, 2017. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL *a* = chlorophyll *a*; TEMP = temperture; O2 = dissolved oxygen; S=surface; D=deep; BDL=below detection limit. **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**

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 a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	13.33	1385	0.56	3769	7.13	35.28	20.46	1421	0.43	25.610	0.85	25.5	7.98	102.1
	2 S	0.1	5.89	944.7	BDL	2603	8.37	45.64	14.26	990.4	0.31	28.760	0.89	25.7	8.01	104.3
	5 S	0.5	2.79	564.3	0.56	1627	20.15	92.40	22.94	657.3	0.17	31.220	0.47	25.5	8.04	101.7
	5 D	1.5	2.48	436.8	0.98	1303	10.85	83.44	13.33	521.2	0.21	32.020	0.55	25.5	8.04	100.1
	10 S	0.5	3.72	254.2	0.98	810.1	8.37	75.18	12.09	330.4	0.13	33.110	0.30	25.2	8.05	98.2
	10 D	2.4	3.10	169.8	1.26	587.6	9.92	76.02	13.02	247.1	0.13	33.650	0.33	25.6	8.08	98.4
	50 S	0.5	0.93	127.7	0.84	483.3	11.47	77.42	12.40	205.9	0.12	33.790	0.19	26.5	8.13	99.4
	50 D	4.1	2.79	25.34	1.40	162.4	7.44	73.92	10.23	100.7	0.06	34.540	0.18	26.5	8.16	95.6
	100 S	0.5	2.48	72.66	1.68	352.7	7.44	74.20	9.92	148.5	0.11	34.120	0.17	26.3	8.14	99.6
	100 D	5.5	2.48	6.72	1.40	112.7	6.82	73.22	9.30	81.34	0.09	34.760	0.12	26.4	8.16	94.7
	150 S	0.6	4.03	119.8	1.68	498.8	6.20	70.14	10.23	191.7	0.08	33.950	0.12	26.2	8.13	94.8
	150 D	10.4	2.79	3.92	0.98	105.7	6.51	75.46	9.30	80.36	0.05	34.840	0.11	26.3	8.16	97.0
MAKENA 2	0 S	0.1	5.27	141.0	4.20	946.1	7.75	91.56	13.02	236.7	0.81	32.660	1.25	25.3	8.14	103.5
	2 S	0.1	5.58	138.7	4.76	932.4	7.75	88.20	13.33	231.7	0.55	32.820	0.86	25.6	8.14	102.7
	5 S	0.6	3.10	47.04	0.84	374.0	7.44	71.68	10.54	119.6	0.12	34.160	0.23	25.6	8.15	103.5
	5 D	2.2	3.41	32.62	0.98	289.1	6.82	74.90	10.23	108.5	0.13	34.230	0.20	25.6	8.15	102.0
	10 S	0.5	2.79	23.10	0.84	220.3	8.37	85.96	11.16	109.9	0.11	34.420	0.22	25.8	8.16	101.1
	10 D	3.0	3.41	17.64	0.70	183.8	7.75	77.14	11.16	95.48	0.16	34.460	0.19	26.4	8.16	100.3
	50 S	0.6	3.41	109.1	0.84	743.5	11.78	77.42	15.19	187.3	0.23	33.210	0.31	26.6	8.14	95.0
	50 D	4.4	3.10	3.78	0.70	113.0	6.20	75.88	9.30	80.36	0.09	34.710	0.23	26.5	8.16	92.6
	100 S	0.6	2.48	33.74	0.56	324.0	7.44	76.72	9.92	111.0	0.17	34.160	0.23	26.5	8.13	97.3
	100 D	5.6	3.41	BDL	0.70	113.8	5.89	75.46	9.30	76.16	0.11	34.760	0.12	26.6	8.16	95.1
	150 S	0.5	2.79	47.74	0.84	351.8	6.82	84.42	9.61	133.0	0.18	34.120	0.19	26.4	8.11	96.9
	150 D	7.2	3.10	7.42	0.70	141.6	6.82	79.38	9.92	87.50	0.08	34.610	0.16	26.7	8.15	98.9
	200 S	0.6	3.41	23.66	0.56	272.3	6.82	83.58	10.23	107.8	0.15	34.230	0.23	26.9	8.13	100.4
	200 D	12.0	3.41	3.92	0.84	123.4	6.82	121.7	10.23	126.4	0.10	34.680	0.24	26.8	8.15	98.7
MAKENA 3-A	0 S	0.1	35.96	2025	16.53	7791	2.48	138.3	38.44	2180	0.25	20.940	0.30	27.4	7.87	99.9
	2 S	0.1	29.76	1430	19.89	5227	4.96	144.6	34.72	1594	0.20	25.560	0.31	27.1	7.95	104.6
	5 S	0.5	9.61	329.0	7.98	1314	7.44	108.2	17.05	445.2	0.15	32.640	0.26	26.8	8.10	105.3
	5 D	1.1	5.58	185.4	5.88	838.5	7.13	72.66	12.71	263.9	0.14	33.540	0.19	26.7	8.13	105.4
	10 S	0.5	4.65	227.5	1.68	997.0	7.44	65.66	12.09	294.8	0.11	33.190	0.25	26.7	8.12	103.2
	10 D	2.9	4.03	53.34	3.08	316.1	6.20	75.60	10.23	132.0	0.10	34.490	0.29	26.6	8.14	100.9
	50 S	0.5	9.30	351.5	3.08	1471	5.89	68.18	15.19	422.8	0.16	32.350	0.19	26.5	8.06	100.2
	50 D	4.5	4.65	24.64	2.38	199.2	6.82	92.12	11.47	119.1	0.25	34.610	0.17	26.8	8.14	97.6
	100 S	0.5	4.65	75.04	4.06	436.7	7.75	84.98	12.40	164.1	0.18	34.270	0.22	26.7	8.11	97.9
	100 D	5.0	3.72	7.14	3.36	143.6	6.20	69.44	9.92	79.94	0.09	34.610	0.58	26.7	8.15	97.6
	150 S	0.5	3.72	42.00	3.08	306.6	6.82	70.42	10.54	115.5	0.12	34.230	0.58	26.6	8.12	97.4
	150 D	10.4	2.79	3.50	2.66	118.0	7.44	76.02	10.23	82.18	0.06	34.490	0.15	26.7	8.16	98.4
MAKENA 3	0 S	0.1	6.82	309.7	3.50	1180	6.51	70.98	13.33	384.2	0.37	33.160	0.22	27.4	8.12	97.3
	2 S	0.1	9.61	279.0	4.76	1200	5.58	62.58	15.19	346.4	0.20	33.410	0.19	26.8	8.09	99.4
	5 S	0.5	5.27	157.9	2.52	777.8	7.75	86.52	13.02	247.0	0.23	33.910	0.16	26.7	8.10	100.2
	5 D	1.7	5.27	105.8	2.52	612.3	6.82	78.68	12.09	187.0	0.13	34.160	0.14	26.7	8.10	100.5
	10 S	0.5	3.72	60.76	2.24	409.1	8.37	78.40	12.09	141.4	0.17	34.380	0.10	26.8	8.09	97.6
	10 D	2.8	8.68	30.38	5.32	303.8	1.86	68.74	10.54	104.4	0.15	34.570	0.12	26.9	8.08	97.1
	50 S	0.5	3.72	52.92	2.10	343.1	7.44	76.16	11.16	131.2	0.09	34.340	0.17	26.7	8.09	99.4
	50 D	5.2	3.72	68.04	1.12	398.7	7.44	91.00	11.16	160.2	0.13	34.270	0.17	26.7	8.08	98.6
	100 S	0.5	4.03	99.40	0.28	478.8	6.82	78.96	10.85	178.6	0.12	34.120	0.11	26.8	8.09	96.7
	100 D	7.6	3.10	4.76	0.28	105.1	6.20	75.04	9.30	80.08	0.12	34.610	0.14	26.8	8.14	98.1
	150 S	0.5	3.10	57.54	0.56	336.6	7.44	94.50	10.54	152.6	0.06	34.310	0.11	26.5	8.11	97.7
	150 D	13.7	3.41	3.22	BDL	92.45	6.20	76.30	9.61	79.66	0.05	34.720	0.12	26.8	8.15	98.0
MAKENA 4	0 S	0.1	6.82	118.2	3.22	1316	6.20	111.6	13.02	233.0	0.34	32.280	0.41	27.7	8.20	109.6
	2 S	0.1	5.89	131.2	0.28	1394	7.75	81.48	13.64	212.9	0.23	32.550	0.62	27.6	8.21	115.2
	5 S	0.7	6.51	86.38	4.06	999.0	6.20	94.50	12.71	184.9	0.19	33.030	0.41	27.2	8.20	111.5
	5 D	2.7	5.89	80.50	2.80	950.3	5.58	69.72	11.47	153.0	0.16	33.170	0.51	26.9	8.20	116.1
	10 S	0.8	4.65	14.70	5.60	277.1	6.20	75.32	10.85	95.62	0.08	34.350	0.16	27.0	8.17	106.8
	10 D	2.5	4.03	15.68	2.94	311.1	6.51	69.72	10.54	88.34	0.11	34.240	0.23	27.1	8.17	107.3
	50 S	0.9	4.65	13.16	4.20	374.6	6.20	84.14	10.85	101.5	0.12	34.200	0.22	26.8	8.07	100.1
	50 D	4.5	5.27	8.82	5.18	272.0	5.89	84.70	11.16	98.70	0.14	34.390	0.37	26.9	8.10	99.5
	100 S	0.8	3.10	15.26	12.89	403.5	7.13	90.72	10.23	118.9	0.12	34.160	0.16	26.9	8.07	100.3
	100 D	7.0	4.03	3.08	4.48	135.7	5.58	75.46	9.61	83.02	0.09	34.570	0.17	26.8	8.12	98.2
	150 S	0.5	3.72	14.28	7.42	394.0	6.82	86.80	10.54	108.5	0.10	34.200	0.16	26.8	8.06	100.4
	150 D	9.7	4.03	0.98	0.98	107.1	5.89	80.78	9.92	82.74	0.12	34.580	0.20	26.8	8.14	101.6
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 form 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 (with nutrients reported in micromolar units) from water chemistry measurements off the Makena Resort collected since August 1995 from Sites 1, 2, and 4 (N=36); since June 2002 from Site 3 (N=27) and since June 2007 from Site 3-A (N=17). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL *a* = chlorophyll *a;* TEMP = temperture; O2 = dissolved oxygen; S=surface; D=deep; BDL=below detection limit. 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 a (µg/L)	TEMP (deg.C)	pH	O2
MAKENA 1	0 S	0.22	42.08	0.23	74.26	0.23	7.67	0.54	58.28	0.33	25.965	0.76	25.6	8.11	103.1
	2 S	0.18	27.72	0.19	51.27	0.27	8.06	0.50	40.72	0.30	29.43	0.76	25.7	8.14	104.9
	5 S	0.13	12.44	0.14	26.54	0.26	7.87	0.43	24.33	0.24	32.27	0.53	25.6	8.16	104.6
	5 D	0.11	9.54	0.18	21.80	0.27	7.32	0.41	20.04	0.21	33.07	0.48	25.6	8.17	104.5
	10 S	0.11	4.33	0.17	11.39	0.26	7.38	0.39	13.89	0.19	33.98	0.34	25.6	8.15	103.5
	10 D	0.10	2.77	0.21	8.16	0.28	7.16	0.39	11.55	0.17	34.29	0.35	25.6	8.15	103.3
	50 S	0.08	2.39	0.19	7.28	0.27	7.14	0.37	10.85	0.16	34.45	0.28	25.6	8.14	101.4
	50 D	0.08	0.34	0.15	2.84	0.27	7.10	0.37	7.96	0.12	34.80	0.26	25.6	8.14	99.1
	100 S	0.09	0.95	0.18	4.83	0.27	6.57	0.38	9.14	0.13	34.59	0.22	25.6	8.14	99.0
	100 D	0.07	0.12	0.11	2.29	0.28	7.07	0.37	7.57	0.10	34.85	0.19	25.6	8.15	98.1
	150 S	0.08	0.35	0.16	3.42	0.27	7.01	0.37	8.51	0.12	34.73	0.18	25.7	8.14	97.8
	150 D	0.08	0.06	0.13	2.03	0.27	6.92	0.37	7.25	0.10	34.88	0.16	25.6	8.16	98.5
MAKENA 2	0 S	0.19	4.80	0.37	23.07	0.31	8.00	0.54	14.37	0.86	33.38	0.76	25.6	8.14	99.5
	2 S	0.19	4.44	0.26	20.82	0.30	7.56	0.52	13.36	0.63	33.53	0.73	25.8	8.15	100.8
	5 S	0.17	3.52	0.24	15.61	0.28	6.94	0.47	11.50	0.43	33.96	0.55	25.7	8.14	100.7
	5 D	0.18	3.30	0.28	15.65	0.29	7.21	0.50	11.79	0.42	34.00	0.66	25.7	8.14	100.3
	10 S	0.13	1.77	0.19	9.50	0.29	5.87	0.44	9.29	0.31	34.39	0.38	25.6	8.14	99.4
	10 D	0.12	1.08	0.22	7.74	0.29	6.91	0.44	8.87	0.28	34.50	0.44	25.6	8.14	98.3
	50 S	0.11	1.22	0.24	7.68	0.31	7.38	0.44	9.62	0.23	34.44	0.32	25.6	8.14	97.8
	50 D	0.11	0.23	0.21	3.36	0.29	7.20	0.42	7.87	0.16	34.81	0.34	25.6	8.15	98.1
	100 S	0.10	0.43	0.17	4.25	0.28	7.06	0.40	8.05	0.16	34.67	0.26	25.7	8.14	98.4
	100 D	0.09	0.11	0.16	2.52	0.28	6.89	0.38	7.34	0.13	34.85	0.25	25.6	8.15	97.7
	150 S	0.09	0.25	0.18	3.31	0.28	7.13	0.39	7.85	0.13	34.78	0.20	25.7	8.15	97.8
	150 D	0.09	0.09	0.13	2.29	0.29	7.12	0.39	7.48	0.11	34.86	0.20	25.6	8.16	97.9
	200 S	0.07	0.12	0.14	2.62	0.29	6.95	0.38	7.48	0.11	34.84	0.21	25.8	8.15	98.4
	200 D	0.08	0.04	0.16	1.93	0.29	7.41	0.38	7.71	0.10	34.89	0.21	25.6	8.16	98.1
MAKENA 3-A	0 S	1.19	115.3	0.35	235.2	0.15	8.11	1.57	136.2	0.31	17.57	0.36	25.0	7.89	99.5
	2 S	0.83	78.25	0.38	155.0	0.23	7.68	1.28	100.8	0.24	23.57	0.43	25.2	7.93	100.8
	5 S	0.33	26.83	0.40	56.61	0.29	7.71	0.71	43.25	0.20	30.53	0.37	25.2	8.04	100.8
	5 D	0.25	17.76	0.37	40.31	0.27	7.15	0.60	29.70	0.19	32.23	0.40	25.4	8.08	101.1
	10 S	0.14	6.34	0.25	18.15	0.27	7.10	0.46	17.99	0.16	33.53	0.25	25.2	8.09	99.5
	10 D	0.11	1.90	0.23	7.62	0.26	6.76	0.40	10.67	0.16	34.42	0.28	25.4	8.12	99.6
	50 S	0.11	2.11	0.23	8.72	0.26	7.12	0.41	11.95	0.14	34.37	0.19	25.7	8.11	99.8
	50 D	0.08	0.25	0.23	3.51	0.30	7.47	0.41	8.26	0.14	34.84	0.21	25.6	8.13	98.4
	100 S	0.11	0.93	0.17	5.46	0.29	7.06	0.41	9.14	0.13	34.70	0.18	25.7	8.12	98.4
	100 D	0.11	0.09	0.24	2.80	0.26	6.80	0.39	7.34	0.11	34.90	0.17	25.6	8.14	98.7
	150 S	0.09	0.19	0.14	3.51	0.28	7.06	0.40	8.14	0.11	34.81	0.16	25.6	8.14	97.9
	150 D	0.08	0.04	0.17	2.37	0.28	6.87	0.38	7.24	0.10	34.90	0.16	25.6	8.15	99.7
MAKENA 3	0 S	0.16	9.19	0.31	20.93	0.26	6.41	0.48	23.57	0.33	33.61	0.45	25.9	8.14	100.2
	2 S	0.17	12.72	0.24	24.94	0.25	6.18	0.49	25.75	0.29	33.69	0.48	25.8	8.12	100.5
	5 S	0.15	8.88	0.23	18.03	0.27	7.13	0.47	20.32	0.23	34.04	0.33	25.7	8.12	101.0
	5 D	0.15	6.83	0.21	14.84	0.27	6.80	0.46	17.61	0.22	34.21	0.40	25.7	8.12	100.2
	10 S	0.11	3.69	0.25	9.62	0.28	7.06	0.42	14.08	0.18	34.41	0.25	25.6	8.11	99.1
	10 D	0.11	1.95	0.20	6.78	0.27	7.07	0.41	11.33	0.16	34.61	0.27	25.6	8.11	98.2
	50 S	0.09	1.18	0.18	5.06	0.28	7.21	0.39	9.72	0.13	34.72	0.20	25.7	8.11	96.9
	50 D	0.10	0.32	0.17	3.32	0.28	7.29	0.39	8.22	0.11	34.84	0.20	25.6	8.13	95.5
	100 S	0.09	0.48	0.19	3.40	0.28	7.09	0.38	8.35	0.11	34.79	0.15	25.6	8.13	96.9
	100 D	0.08	0.12	0.18	2.28	0.28	6.65	0.38	7.13	0.09	34.87	0.17	25.6	8.14	96.9
	150 S	0.07	0.18	0.14	2.69	0.27	6.77	0.36	7.51	0.10	34.83	0.14	25.6	8.15	97.1
	150 D	0.07	0.07	0.11	2.05	0.27	6.74	0.36	7.04	0.09	34.90	0.16	25.6	8.16	98.2
MAKENA 4	0 S	0.25	6.87	0.36	51.25	0.25	6.89	0.61	18.75	0.42	30.44	0.56	25.4	8.09	102.1
	2 S	0.26	5.69	0.30	43.87	0.26	6.82	0.57	16.42	0.35	31.55	0.44	25.4	8.10	102.7
	5 S	0.16	1.87	0.27	18.42	0.25	7.27	0.44	10.79	0.23	33.72	0.37	25.4	8.11	103.2
	5 D	0.13	1.56	0.22	16.22	0.26	6.90	0.43	9.86	0.21	33.94	0.41	25.4	8.11	102.3
	10 S	0.11	0.82	0.23	9.34	0.27	6.90	0.40	8.27	0.18	34.45	0.23	25.4	8.10	100.3
	10 D	0.12	0.58	0.20	8.38	0.26	6.85	0.39	8.02	0.18	34.49	0.25	25.4	8.10	100.8
	50 S	0.09	0.53	0.27	6.54	0.28	7.36	0.38	8.54	0.15	34.61	0.20	25.3	8.10	96.4
	50 D	0.09	0.21	0.17	4.08	0.27	6.86	0.38	7.35	0.14	34.80	0.20	25.4	8.10	96.0
	100 S	0.09	0.27	0.18	4.54	0.28	6.88	0.39	7.60	0.12	34.73	0.15	25.4	8.12	96.0
	100 D	0.09	0.13	0.16	3.12	0.27	6.85	0.38	7.34	0.11	34.83	0.17	25.4	8.13	95.0
	150 S	0.10	0.13	0.16	2.87	0.26	6.90	0.41	7.50	0.10	34.81	0.13	25.5	8.14	97.1
	150 D	0.08	0.07	0.13	2.36	0.27	6.83	0.38	7.21	0.10	34.87	0.15	25.5	8.15	96.4
DOH WQS GEOMETRIC MEAN	DRY	0.25	0.14					0.52	7.86	0.20	*	0.15	**	***	
	WET	0.36	0.25					0.64	10.71	0.50		0.30			

* Salinity shall not vary more than ten percent form 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 (with nutrient data reported in µg/L) from water chemistry measurements off the Makena Resort collected since August 1995 for Sites 1, 2, and 4 (N=35); since June 2002 from Site 3 (N=26) and since June 2007 from Site 3-A (N=17). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL *a* = chlorophyll *a*; TEMP = temperture; O2 = dissolved oxygen; 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-} (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 a (µg/L)	TEMP (deg.C)	pH	O2
MAKENA 1	0 S	6.80	589.3	3.20	2086	7.10	107.4	16.70	816.2	0.33	25.965	0.76	25.6	8.11	103.1
	2 S	5.50	388.2	2.60	1440	8.30	112.8	15.40	570.3	0.30	29.43	0.76	25.7	8.14	104.9
	5 S	4.00	174.2	1.90	745.5	8.00	110.2	13.30	340.7	0.24	32.27	0.53	25.6	8.16	104.6
	5 D	3.40	133.6	2.50	612.4	8.30	102.5	12.60	280.6	0.21	33.07	0.48	25.6	8.17	104.5
	10 S	3.40	60.60	2.30	319.9	8.00	103.3	12.00	194.5	0.19	33.98	0.34	25.6	8.15	103.5
	10 D	3.00	38.70	2.90	229.2	8.60	100.2	12.00	161.7	0.17	34.29	0.35	25.6	8.15	103.3
	50 S	2.40	33.40	2.60	204.5	8.30	100.0	11.40	151.9	0.16	34.45	0.28	25.6	8.14	101.4
	50 D	2.40	4.70	2.10	79.78	8.30	99.40	11.40	111.4	0.12	34.80	0.26	25.6	8.14	99.1
	100 S	2.70	13.30	2.50	135.7	8.30	92.00	11.70	128.0	0.13	34.59	0.22	25.6	8.14	99.0
	100 D	2.10	1.60	1.50	64.33	8.60	99.00	11.40	106.0	0.10	34.85	0.19	25.6	8.15	98.1
	150 S	2.40	4.90	2.20	96.07	8.30	98.10	11.40	119.1	0.12	34.73	0.18	25.7	8.14	97.8
	150 D	2.40	0.80	1.80	57.02	8.30	96.90	11.40	101.5	0.10	34.88	0.16	25.6	8.16	98.5
MAKENA 2	0 S	5.80	67.20	5.10	648.0	9.60	112.0	16.70	201.2	0.86	33.38	0.76	25.6	8.14	99.5
	2 S	5.80	62.10	3.60	584.8	9.20	105.8	16.10	187.1	0.63	33.53	0.73	25.8	8.15	100.8
	5 S	5.20	49.30	3.30	438.5	8.60	97.20	14.50	161.0	0.43	33.96	0.55	25.7	8.14	100.7
	5 D	5.50	46.20	3.90	439.6	8.90	100.9	15.40	165.1	0.42	34.00	0.66	25.7	8.14	100.3
	10 S	4.00	24.70	2.60	266.9	8.90	82.20	13.60	130.1	0.31	34.39	0.38	25.6	8.14	99.4
	10 D	3.70	15.10	3.00	217.4	8.90	96.70	13.60	124.2	0.28	34.50	0.44	25.6	8.14	98.3
	50 S	3.40	17.00	3.30	215.7	9.60	103.3	13.60	134.7	0.23	34.44	0.32	25.6	8.14	97.8
	50 D	3.40	3.20	2.90	94.38	8.90	100.8	13.00	110.2	0.16	34.81	0.34	25.6	8.15	98.1
	100 S	3.00	6.00	2.30	119.4	8.60	98.80	12.30	112.7	0.16	34.67	0.26	25.7	8.14	98.4
	100 D	2.70	1.50	2.20	70.79	8.60	96.50	11.70	102.8	0.13	34.85	0.25	25.6	8.15	97.7
	150 S	2.70	3.50	2.50	92.98	8.60	99.80	12.00	109.9	0.13	34.78	0.20	25.7	8.15	97.8
	150 D	2.70	1.20	1.80	64.33	8.90	99.70	12.00	104.7	0.11	34.86	0.20	25.6	8.16	97.9
	200 S	2.10	1.60	1.90	73.60	8.90	97.30	11.70	104.7	0.11	34.84	0.21	25.8	8.15	98.4
	200 D	2.40	0.50	2.20	54.21	8.90	103.7	11.70	107.9	0.10	34.89	0.21	25.6	8.16	98.1
MAKENA 3-A	0 S	36.80	1615	4.90	6606	4.60	113.5	48.60	1907	0.31	17.57	0.36	25.0	7.89	99.5
	2 S	25.70	1096	5.30	4355	7.10	107.5	39.60	1411	0.24	23.57	0.43	25.2	7.93	100.8
	5 S	10.20	375.7	5.60	1590	8.90	107.9	21.90	605.7	0.20	30.53	0.37	25.2	8.04	100.8
	5 D	7.70	248.7	5.10	1132	8.30	100.1	18.50	415.9	0.19	32.23	0.40	25.4	8.08	101.1
	10 S	4.30	88.70	3.50	509.8	8.30	99.40	14.20	251.9	0.16	33.53	0.25	25.2	8.09	99.5
	10 D	3.40	26.60	3.20	214.0	8.00	94.60	12.30	149.4	0.16	34.42	0.28	25.4	8.12	99.6
	50 S	3.40	29.50	3.20	244.9	8.00	99.70	12.60	167.3	0.14	34.37	0.19	25.7	8.11	99.8
	50 D	2.40	3.50	3.20	98.60	9.20	104.6	12.60	115.6	0.14	34.84	0.21	25.6	8.13	98.4
	100 S	3.40	13.00	2.30	153.4	8.90	98.80	12.60	128.0	0.13	34.70	0.18	25.7	8.12	98.4
	100 D	3.40	1.20	3.30	78.65	8.00	95.20	12.00	102.8	0.11	34.90	0.17	25.6	8.14	98.7
	150 S	2.70	2.60	1.90	98.60	8.60	98.80	12.30	114.0	0.11	34.81	0.16	25.6	8.14	97.9
	150 D	2.40	0.50	2.30	66.57	8.60	96.20	11.70	101.4	0.10	34.90	0.16	25.6	8.15	99.7
MAKENA 3	0 S	4.90	128.7	4.30	587.9	8.00	89.70	14.80	330.1	0.33	33.61	0.45	25.9	8.14	100.2
	2 S	5.20	178.1	3.30	700.6	7.70	86.50	15.10	360.6	0.29	33.69	0.48	25.8	8.12	100.5
	5 S	4.60	124.3	3.20	506.5	8.30	99.80	14.50	284.6	0.23	34.04	0.33	25.7	8.12	101.0
	5 D	4.60	95.60	2.90	416.9	8.30	95.20	14.20	246.6	0.22	34.21	0.40	25.7	8.12	100.2
	10 S	3.40	51.60	3.50	270.2	8.60	98.80	13.00	197.2	0.18	34.41	0.25	25.6	8.11	99.1
	10 D	3.40	27.30	2.80	190.5	8.30	99.00	12.60	158.6	0.16	34.61	0.27	25.6	8.11	98.2
	50 S	2.70	16.50	2.50	142.1	8.60	100.9	12.00	136.1	0.13	34.72	0.20	25.7	8.11	96.9
	50 D	3.00	4.40	2.30	93.26	8.60	102.1	12.00	115.1	0.11	34.84	0.20	25.6	8.13	95.5
	100 S	2.70	6.70	2.60	95.51	8.60	99.30	11.70	116.9	0.11	34.79	0.15	25.6	8.13	96.9
	100 D	2.40	1.60	2.50	64.05	8.60	93.10	11.70	99.80	0.09	34.87	0.17	25.6	8.14	96.9
	150 S	2.10	2.50	1.90	75.56	8.30	94.80	11.10	105.1	0.10	34.83	0.14	25.6	8.15	97.1
	150 D	2.10	0.90	1.50	57.58	8.30	94.40	11.10	98.60	0.09	34.90	0.16	25.6	8.16	98.2
MAKENA 4	0 S	7.70	96.20	5.00	1440	7.70	96.50	18.80	262.6	0.42	30.44	0.56	25.4	8.09	102.1
	2 S	8.00	79.60	4.20	1232	8.00	95.50	17.60	229.9	0.35	31.55	0.44	25.4	8.1	102.7
	5 S	4.90	26.10	3.70	517.4	7.70	101.8	13.60	151.1	0.23	33.72	0.37	25.4	8.11	103.2
	5 D	4.00	21.80	3.00	455.6	8.00	96.60	13.30	138.0	0.21	33.94	0.41	25.4	8.11	102.3
	10 S	3.40	11.40	3.20	262.4	8.30	96.60	12.30	115.8	0.18	34.45	0.23	25.4	8.1	100.3
	10 D	3.70	8.10	2.80	235.4	8.00	95.90	12.00	112.3	0.18	34.49	0.25	25.4	8.1	100.8
	50 S	2.70	7.40	3.70	183.7	8.60	103.0	11.70	119.6	0.15	34.61	0.20	25.3	8.1	96.4
	50 D	2.70	2.90	2.30	114.6	8.30	96.00	11.70	102.9	0.14	34.80	0.20	25.4	8.10	96.0
	100 S	2.70	3.70	2.50	127.5	8.60	96.30	12.00	106.4	0.12	34.73	0.15	25.4	8.12	96.0
	100 D	2.70	1.80	2.20	87.64	8.30	95.90	11.70	102.8	0.11	34.83	0.17	25.4	8.13	95.0
	150 S	3.00	1.80	2.20	80.62	8.00	96.60	12.60	105.0	0.10	34.81	0.13	25.5	8.14	97.1
	150 D	2.40	0.90	1.80	66.29	8.30	95.60	11.70	100.9	0.10	34.87	0.15	25.5	8.15	96.4
DOH WQS GEOMETRIC MEAN	DRY	3.50	2.00					16.00	110.0	0.20	*	0.15	**	***	
	WET	5.00	3.50					20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form 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 (top) and µg/L (bottom) 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)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	SALINITY (ppt)
1	2.10	124.6	1.00	483.9	0.55	6.80	2.65	132.4	1.359
2	2.95	142.6	0.80	648.4	0.10	7.25	3.05	150.7	1.827
3	3.10	137.2	0.65	650.2	0.15	12.95	3.25	150.8	2.007
4	3.00	126.1	0.60	612.5	0.30	16.80	3.30	143.5	1.739
5	2.70	161.4	0.65	555.9	0.60	10.70	3.30	172.8	1.528
6	2.45	166.0	0.35	523.8	0.45	14.15	2.90	180.5	1.611
8	2.80	111.3	0.25	564.0	0.30	14.55	3.10	126.1	2.312
10	2.40	168.2	4.75	578.2	0.35	21.70	2.75	194.7	1.829
11	2.45	117.1	1.05	589.4	0.65	17.80	3.10	136.0	2.002

WELL	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)	SALINITY (ppt)
1	65.10	1744.4	14.00	13597.6	17.05	95.20	82.15	1853.6	1.359
2	91.45	1996.4	11.20	18220.0	3.10	101.50	94.55	2109.1	1.827
3	96.10	1920.8	9.10	18270.6	4.65	181.30	100.75	2111.2	2.007
4	93.00	1765.4	8.40	17211.3	9.30	235.20	102.30	2009.0	1.739
5	83.70	2259.6	9.10	15620.8	18.60	149.80	102.30	2418.5	1.528
6	75.95	2323.3	4.90	14717.4	13.95	198.10	89.90	2526.3	1.611
8	86.80	1557.5	3.50	15847.0	9.30	203.70	96.10	1764.7	2.312
10	74.40	2354.8	66.50	16246.0	10.85	303.80	85.25	2725.1	1.829
11	75.95	1639.4	14.70	16562.1	20.15	249.20	96.10	1903.3	2.002

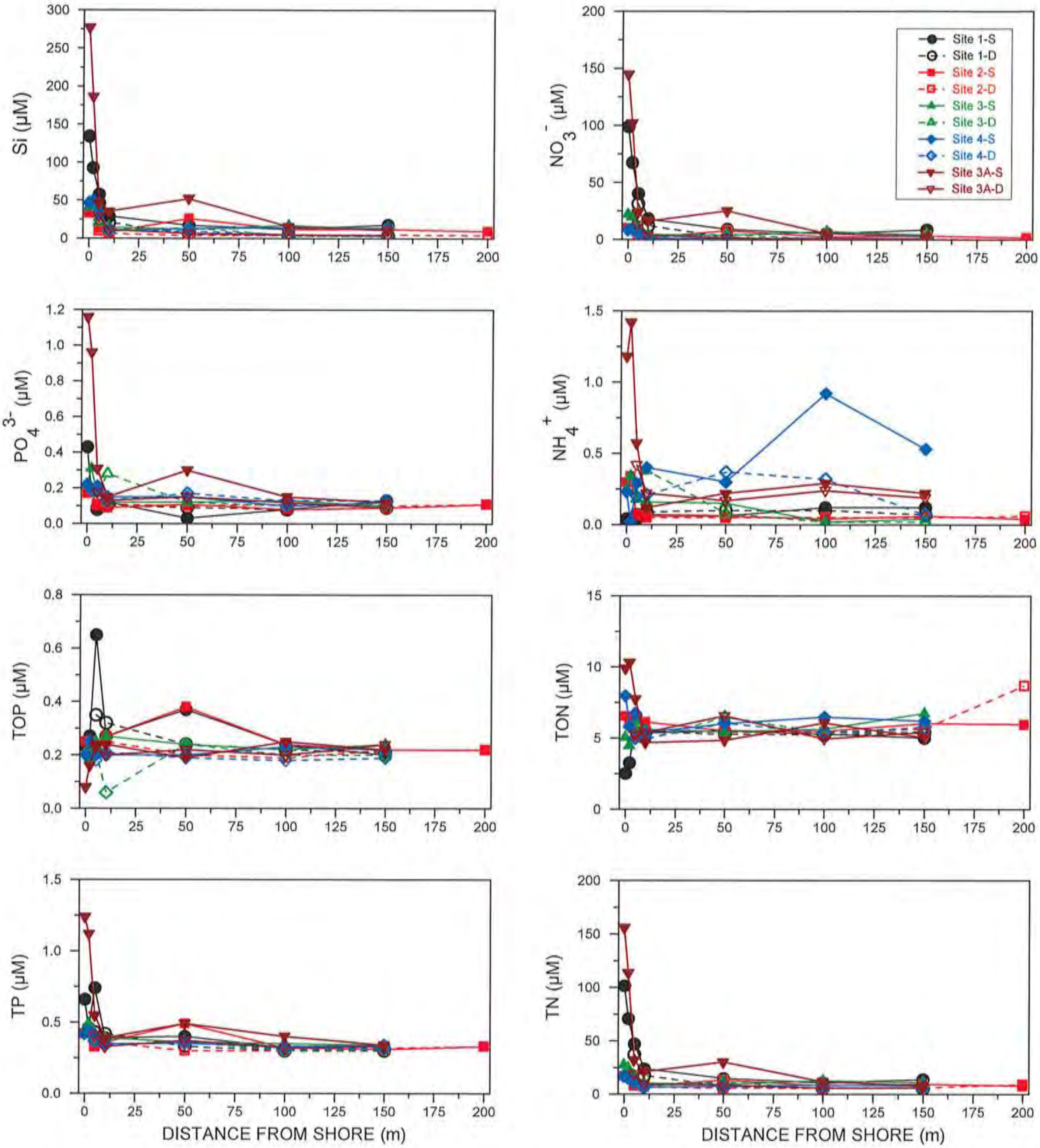


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on July 7, 2017 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

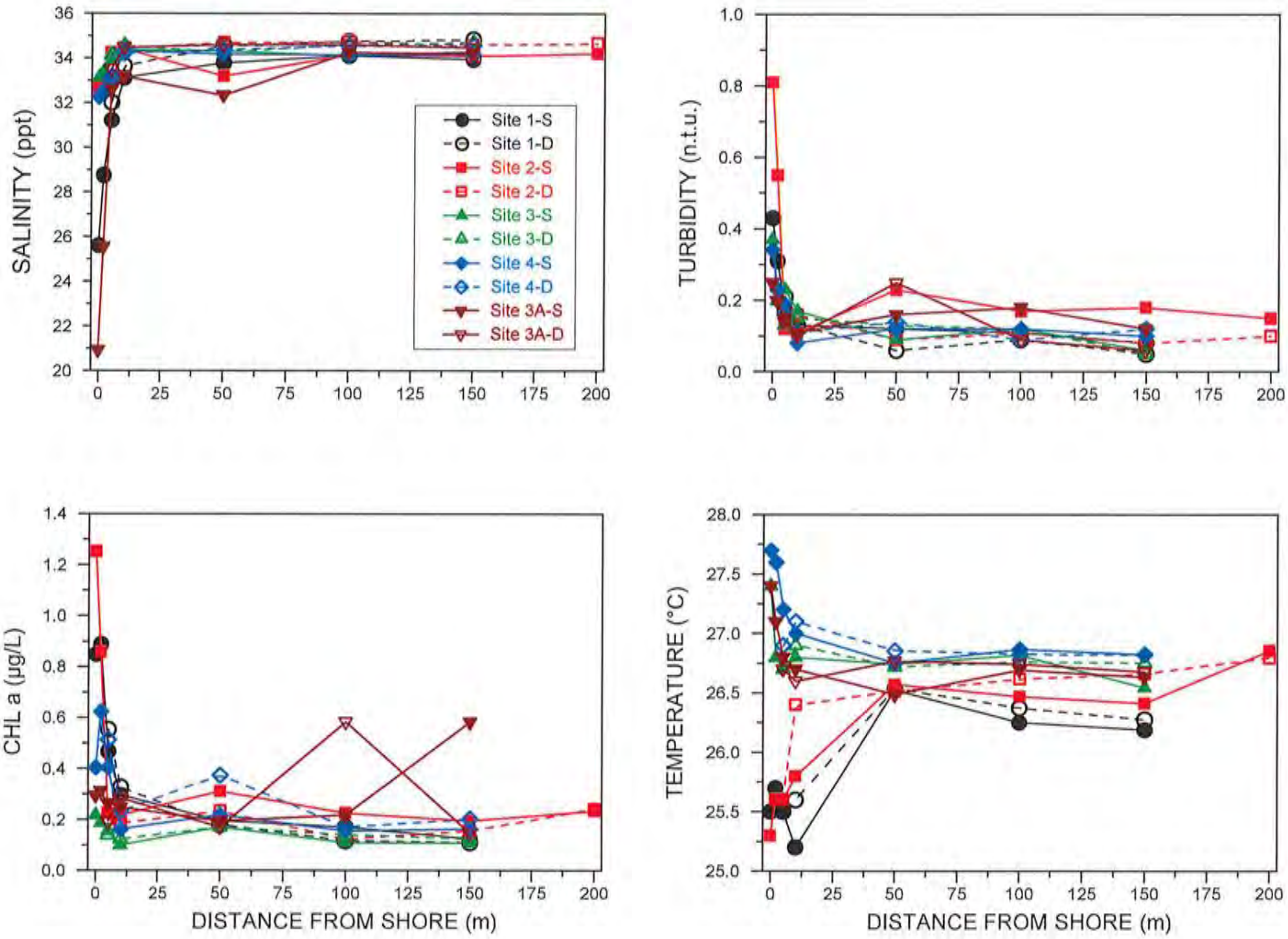


FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on July 7, 2017 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

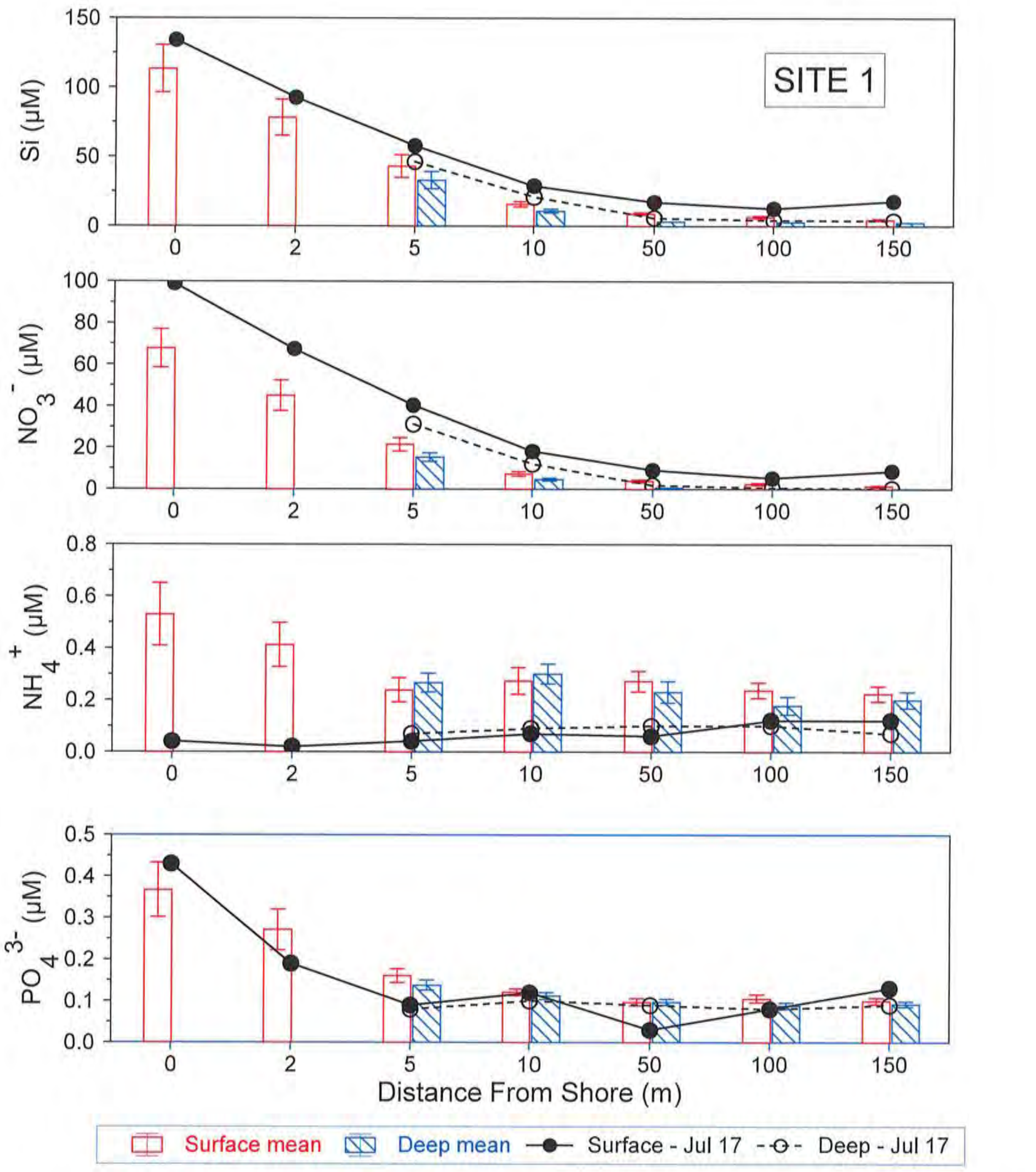


FIGURE 4. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

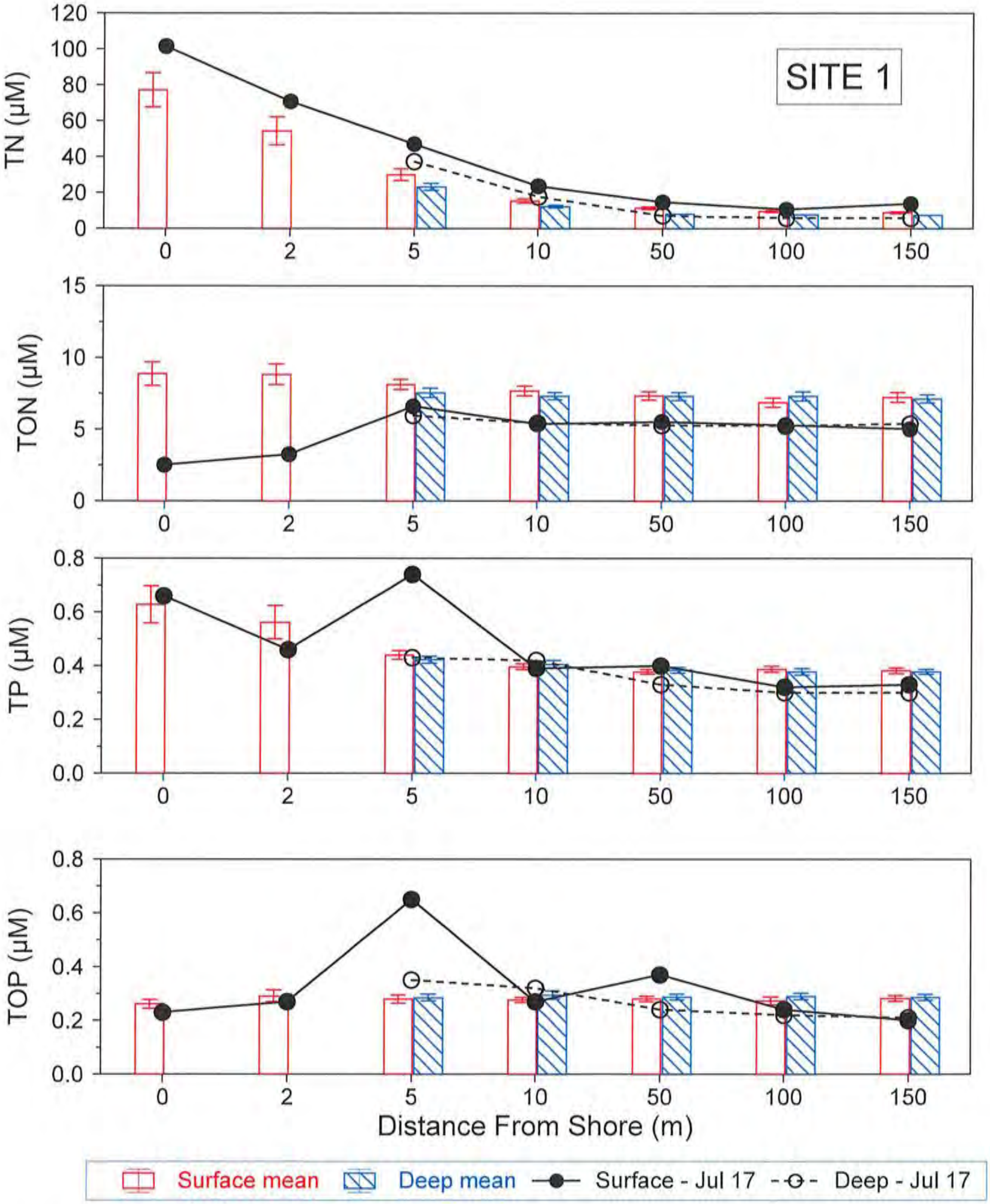


FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

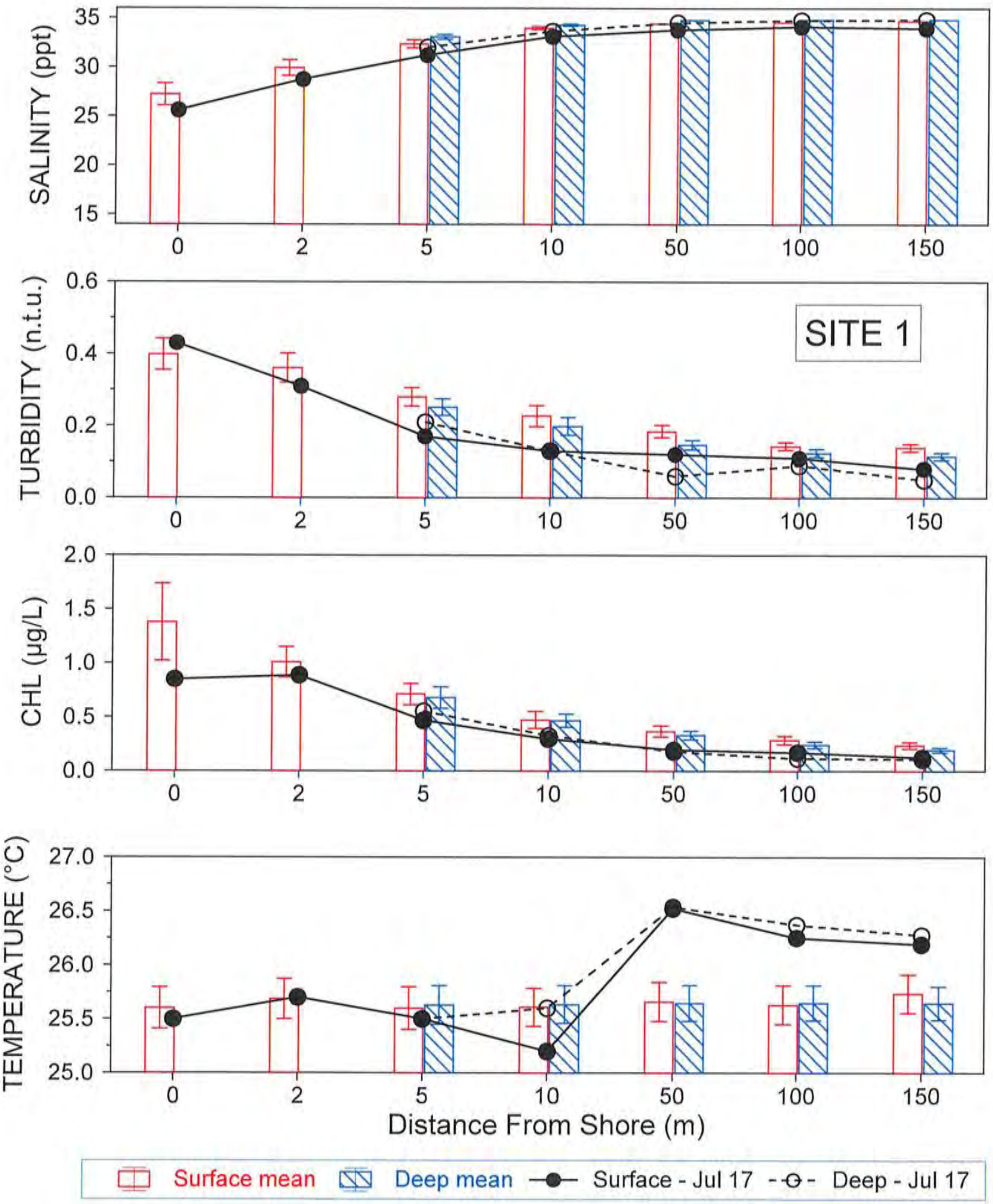


FIGURE 6. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

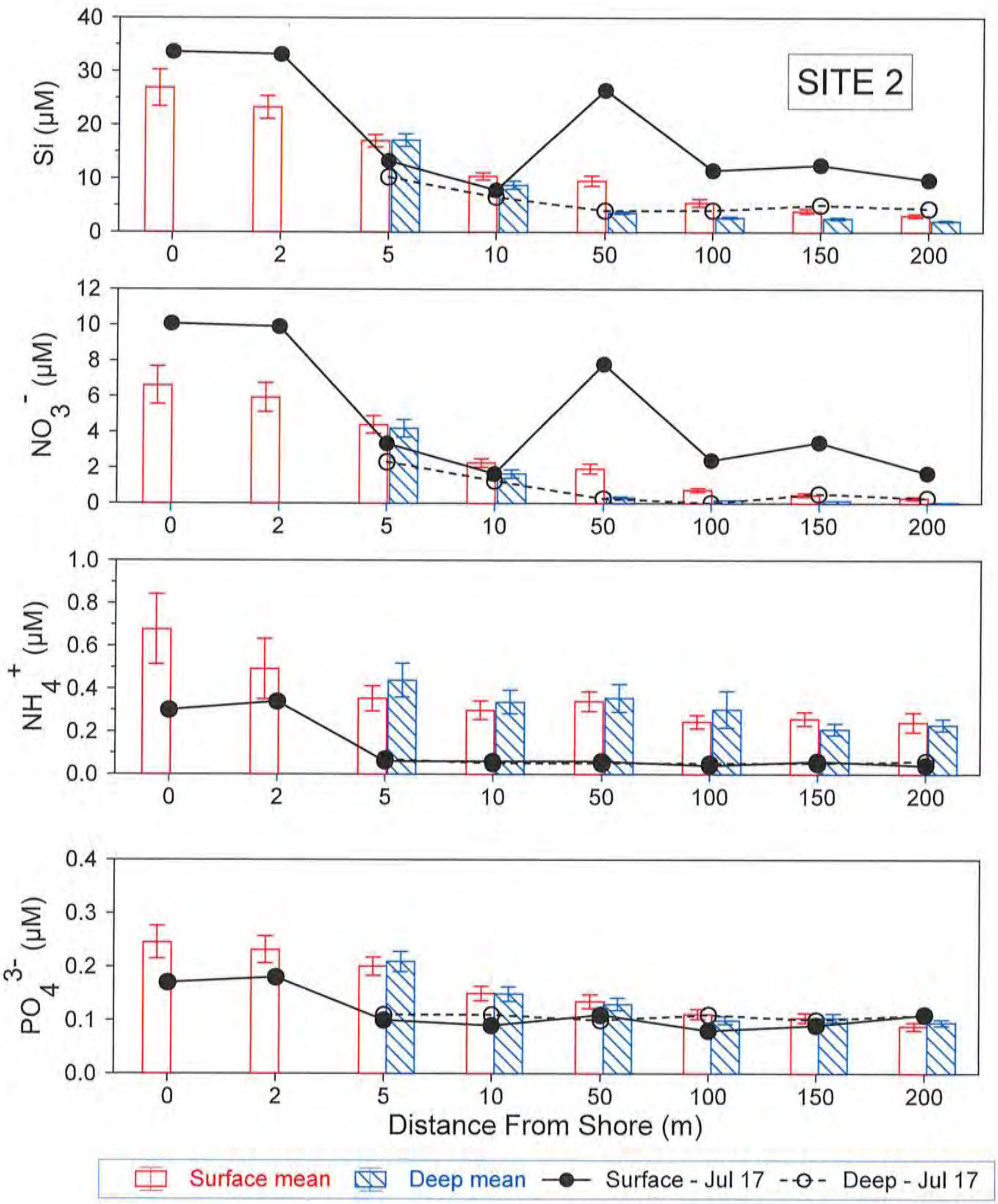


FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

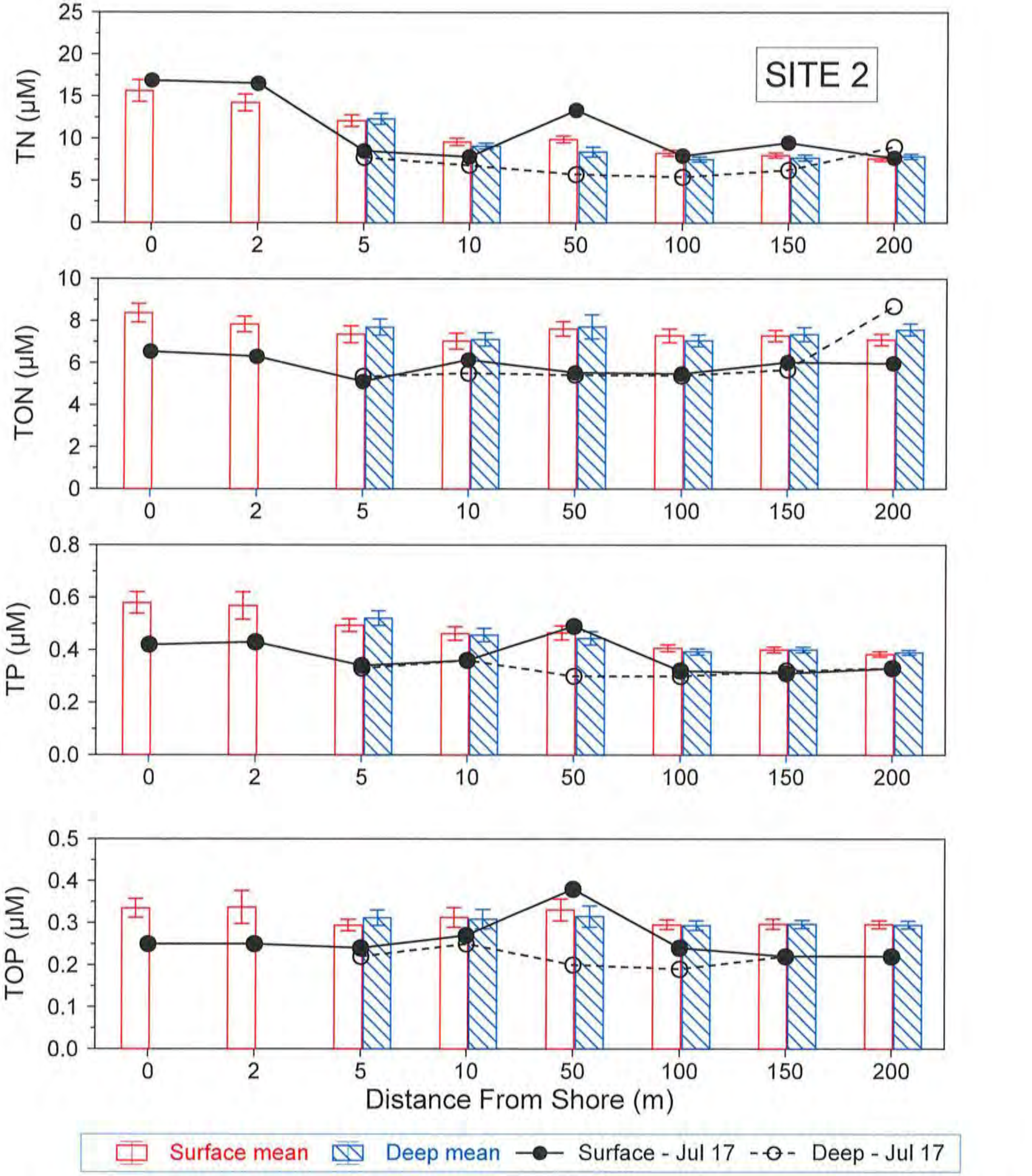


FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

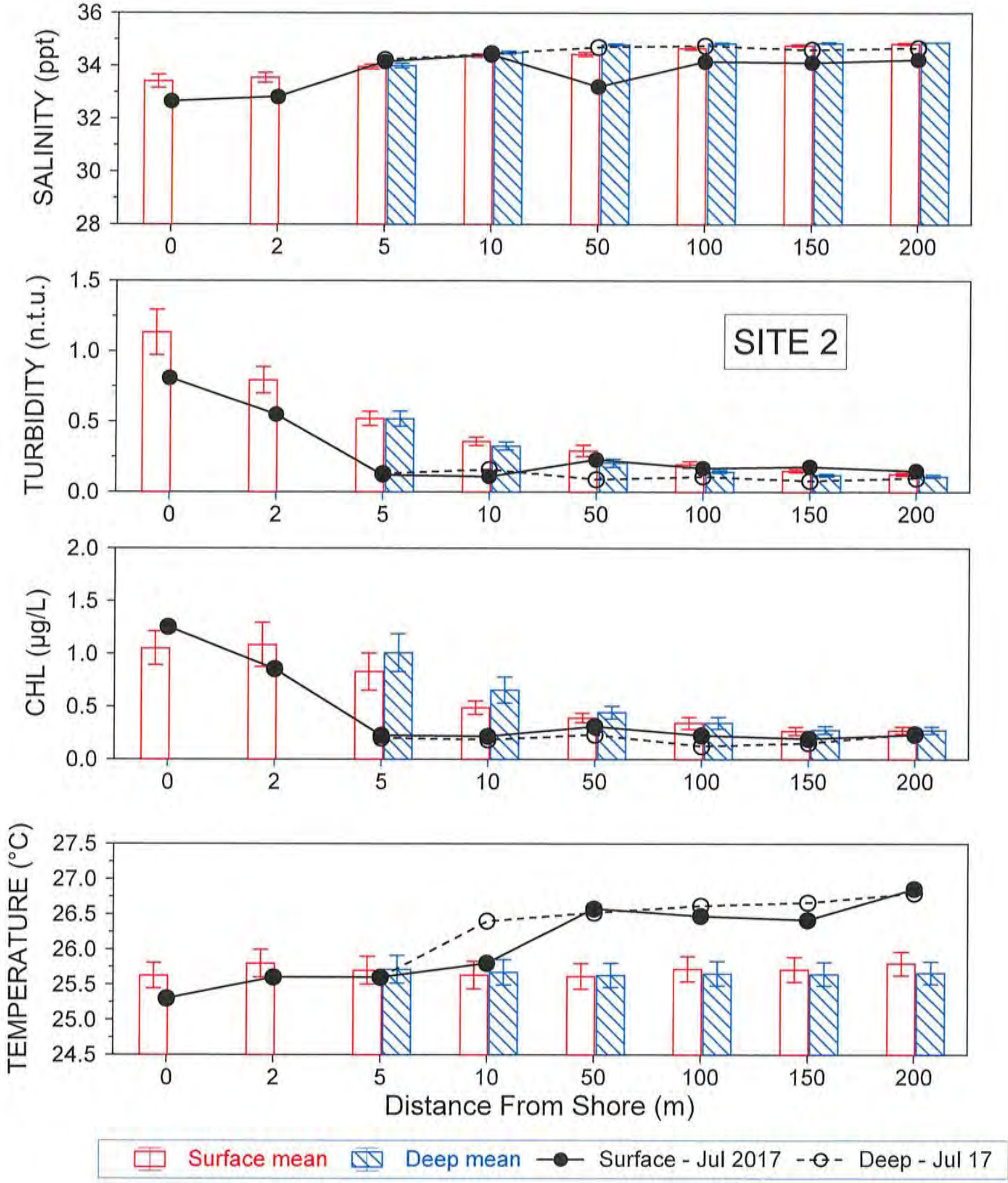


FIGURE 9. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey,bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

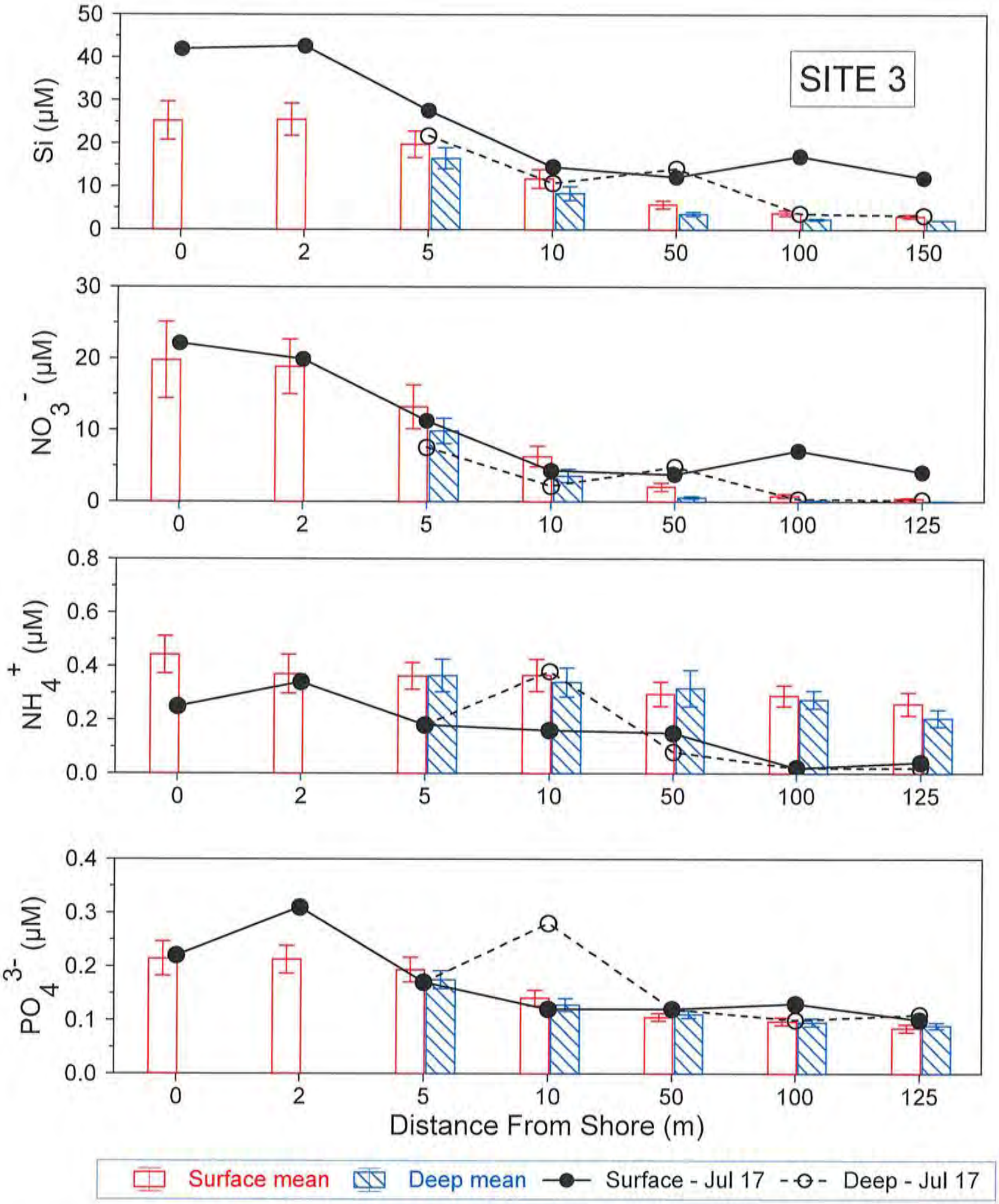


FIGURE 10. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

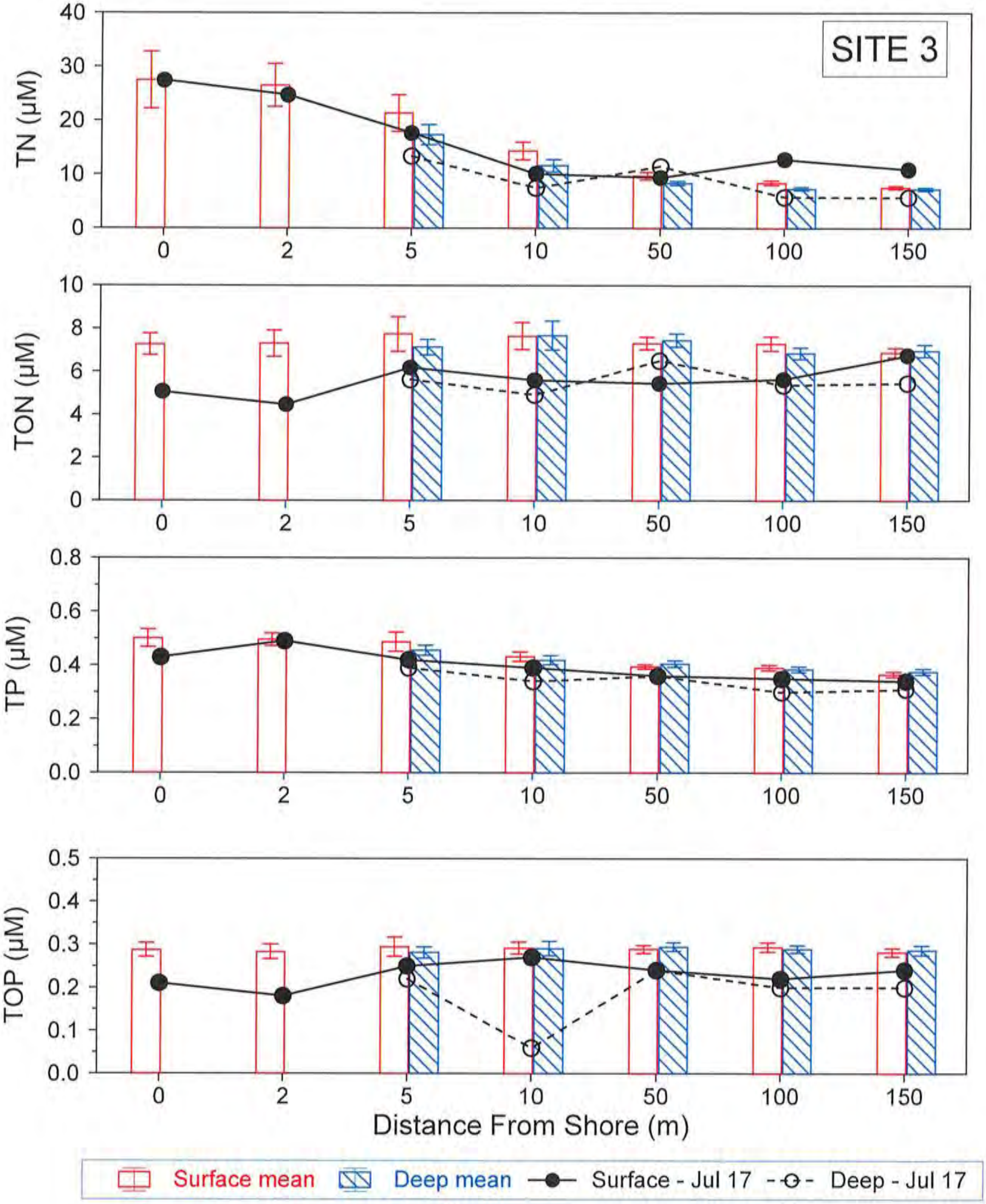


FIGURE 11. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

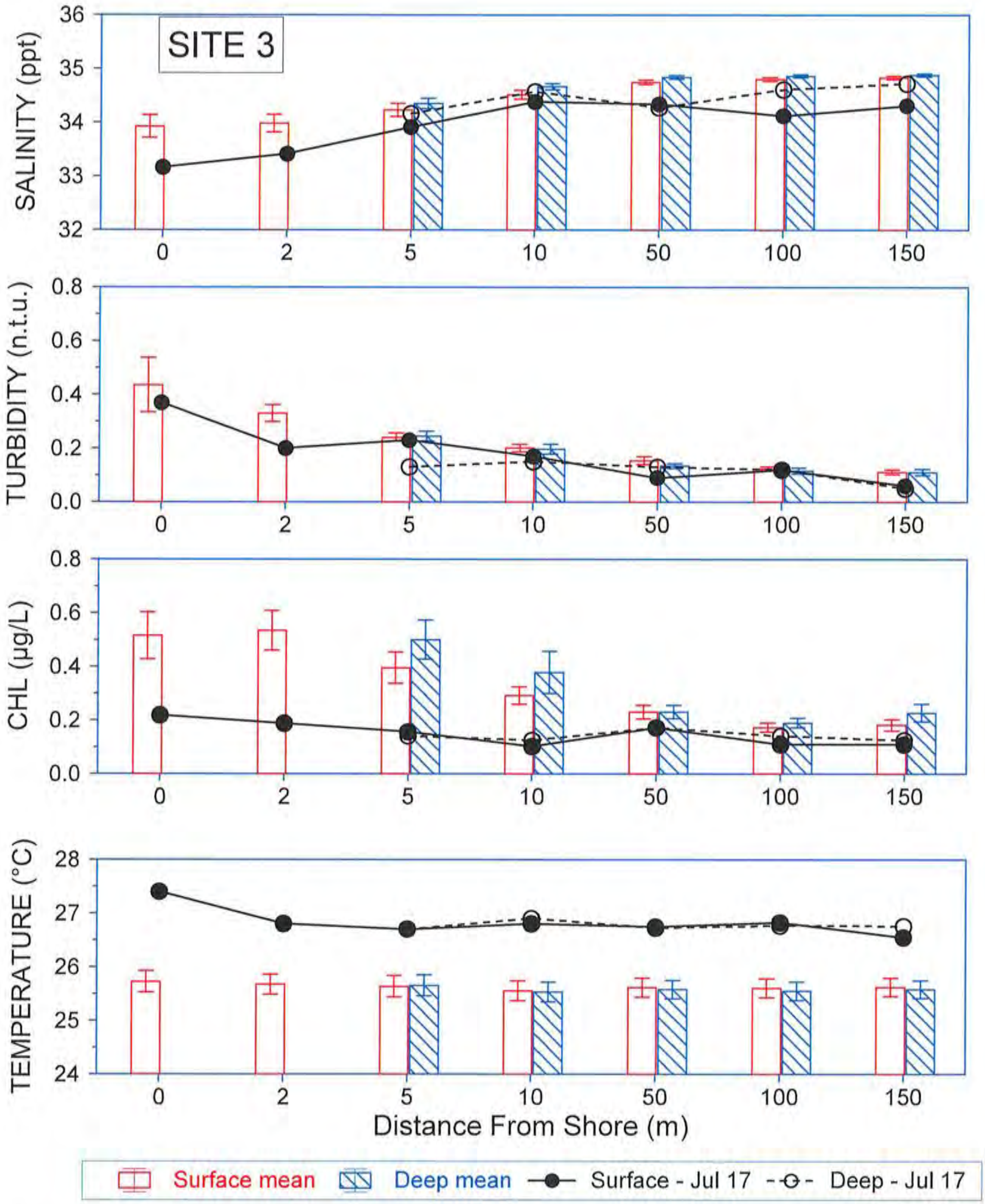


FIGURE 12. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

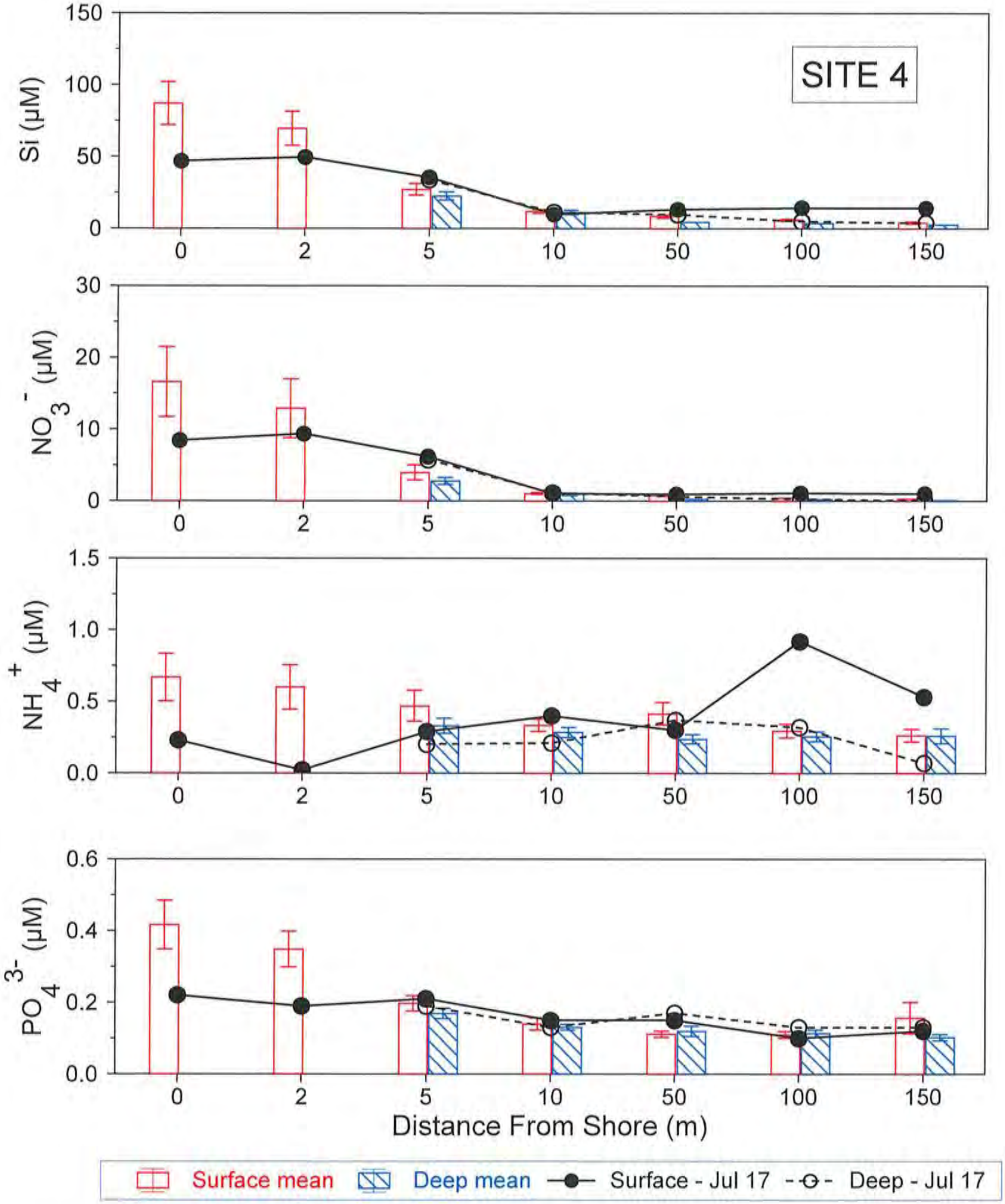


FIGURE 13. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

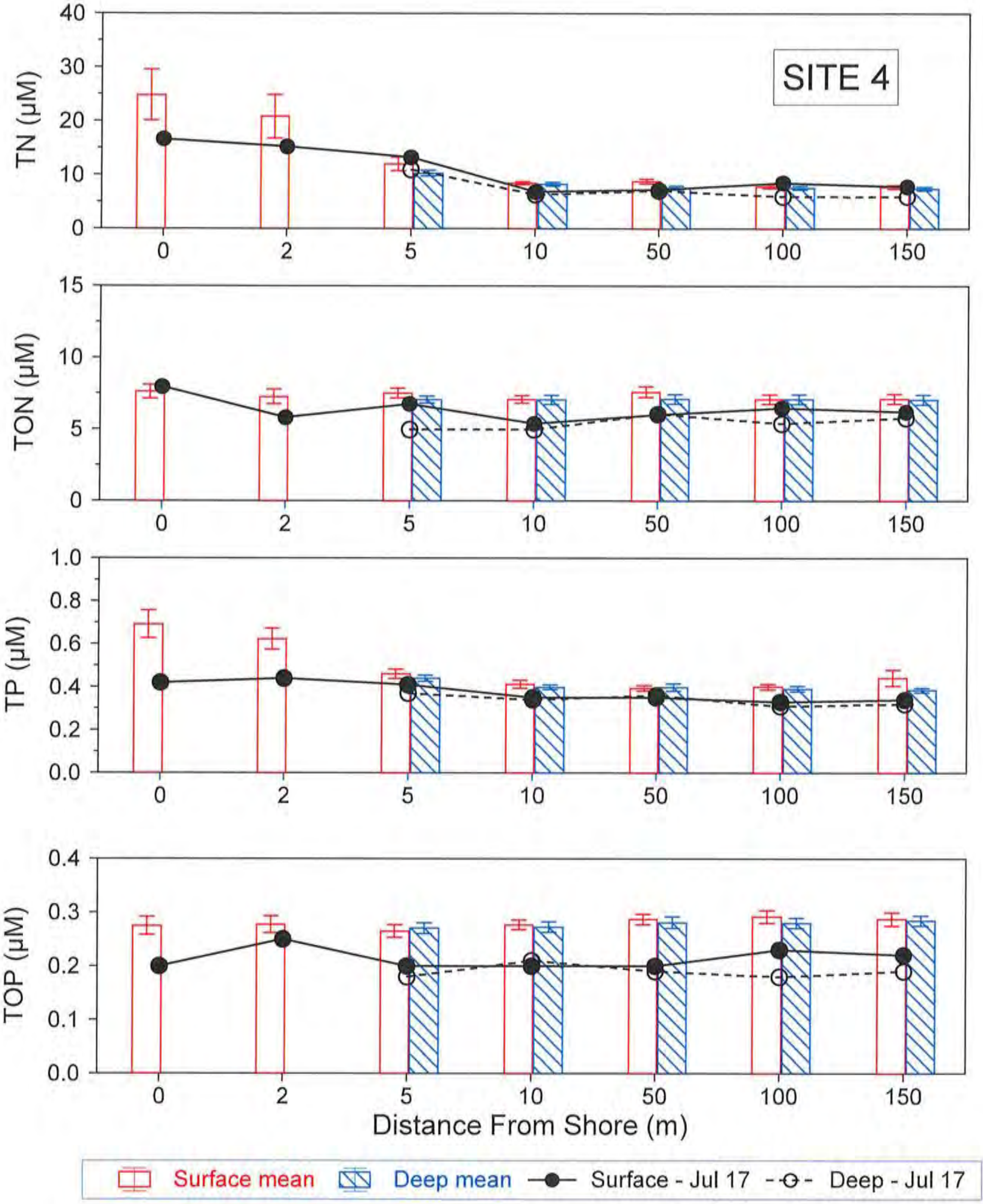


FIGURE 14. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

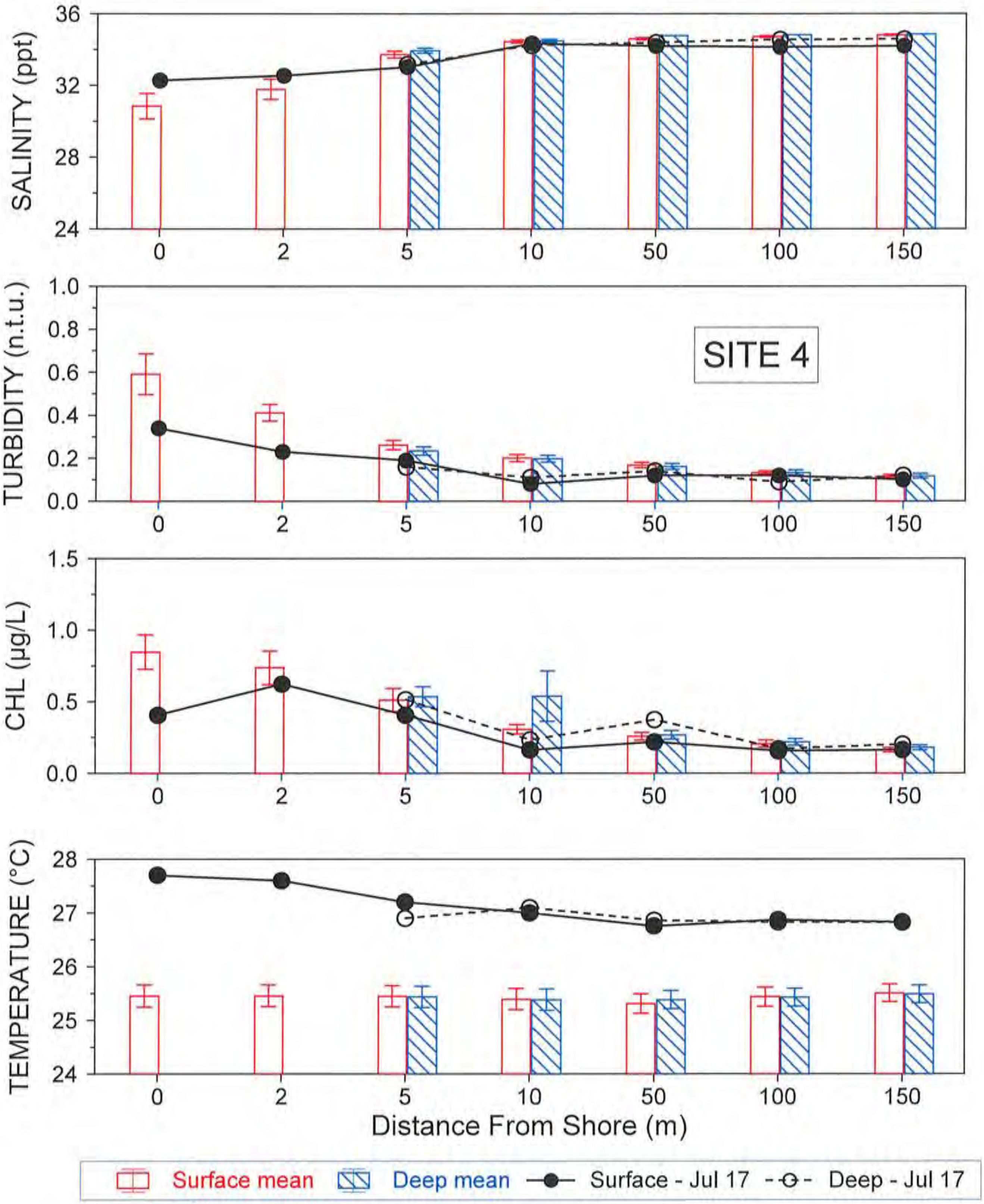


FIGURE 15. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=36). Error bars represent standard error of the mean. For site location, see Figure 1.

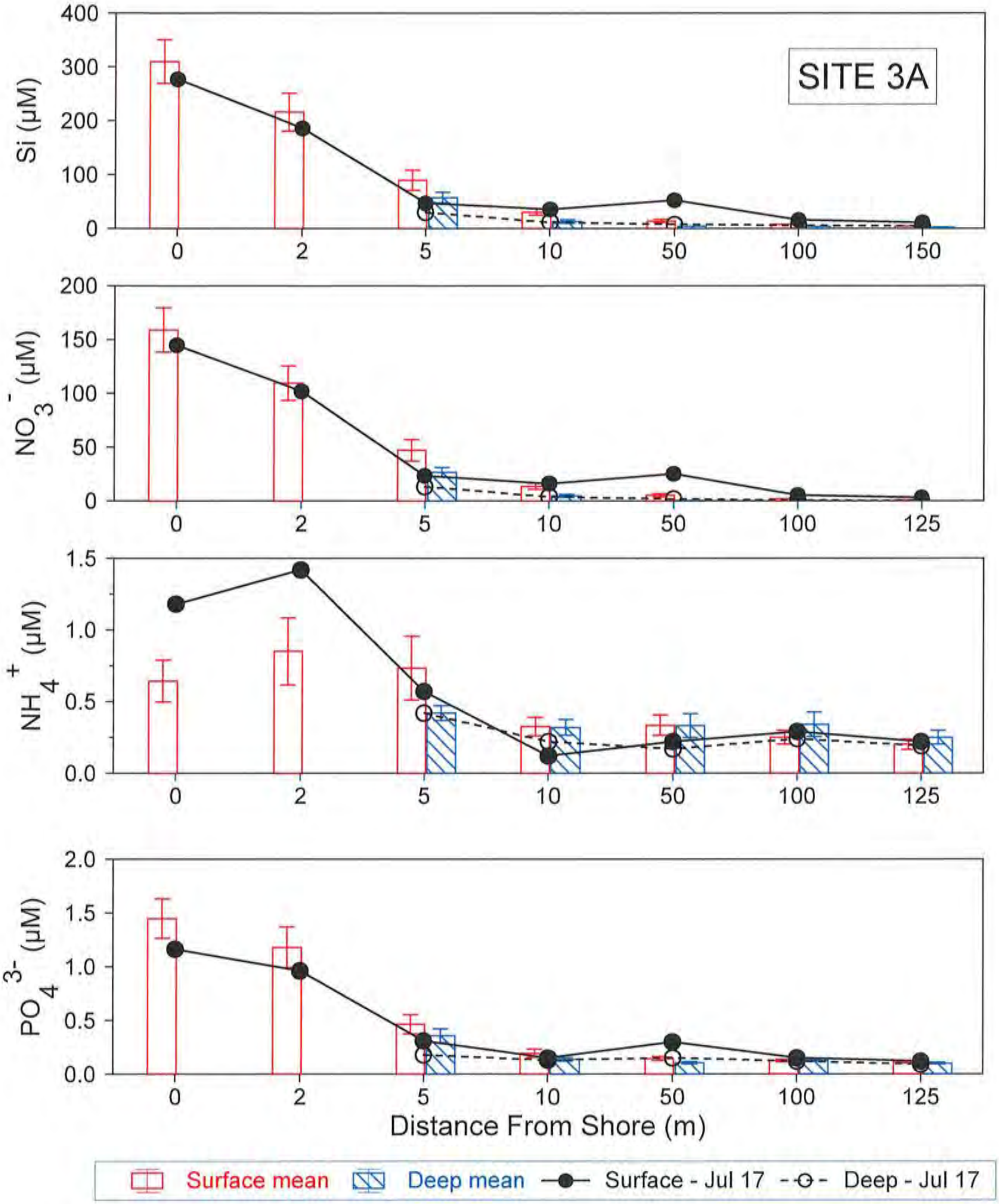


FIGURE 16. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=18). Error bars represent standard error of the mean. For site location, see Figure 1.

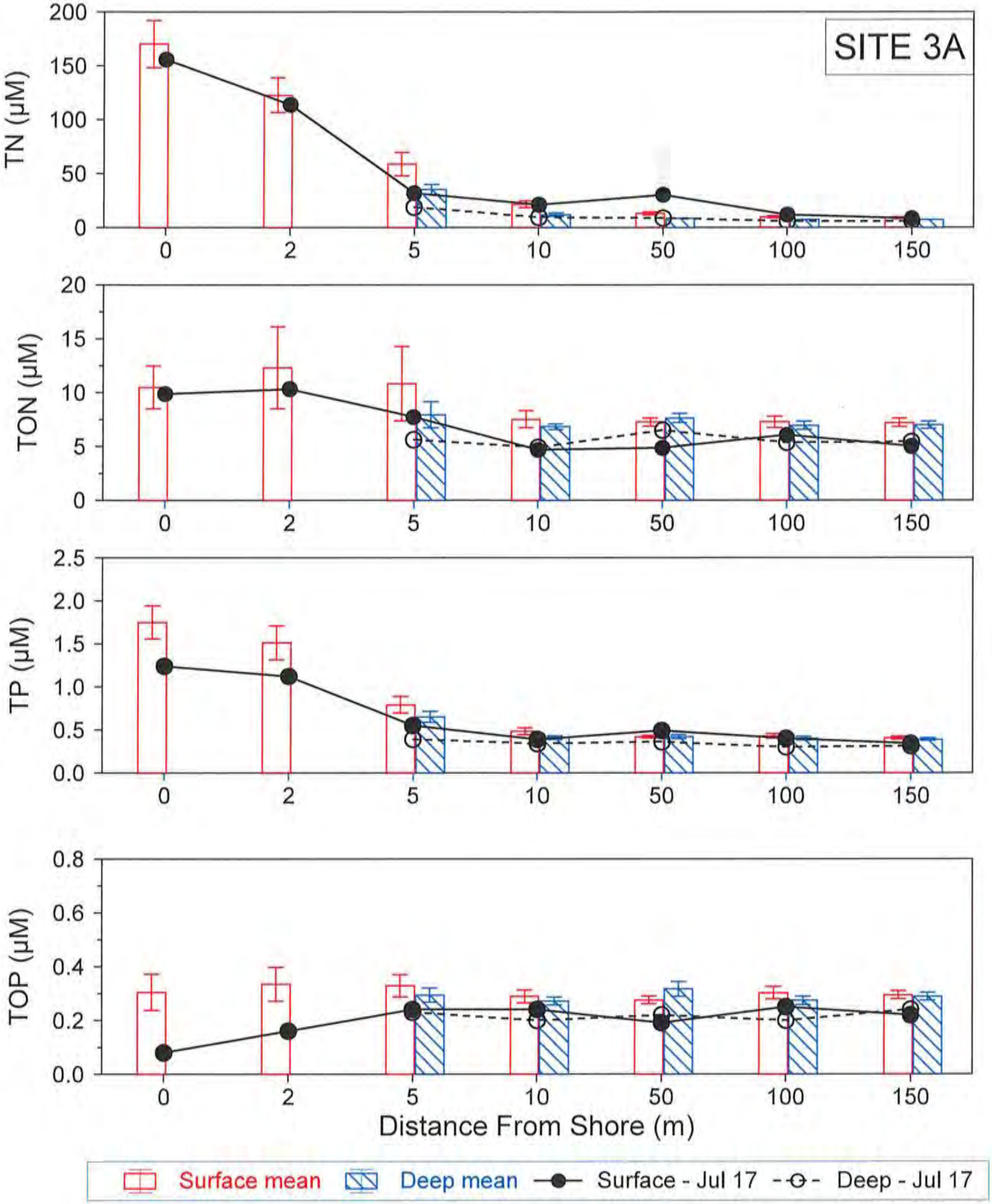


FIGURE 17. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=18). Error bars represent standard error of the mean. For site location, see Figure 1.

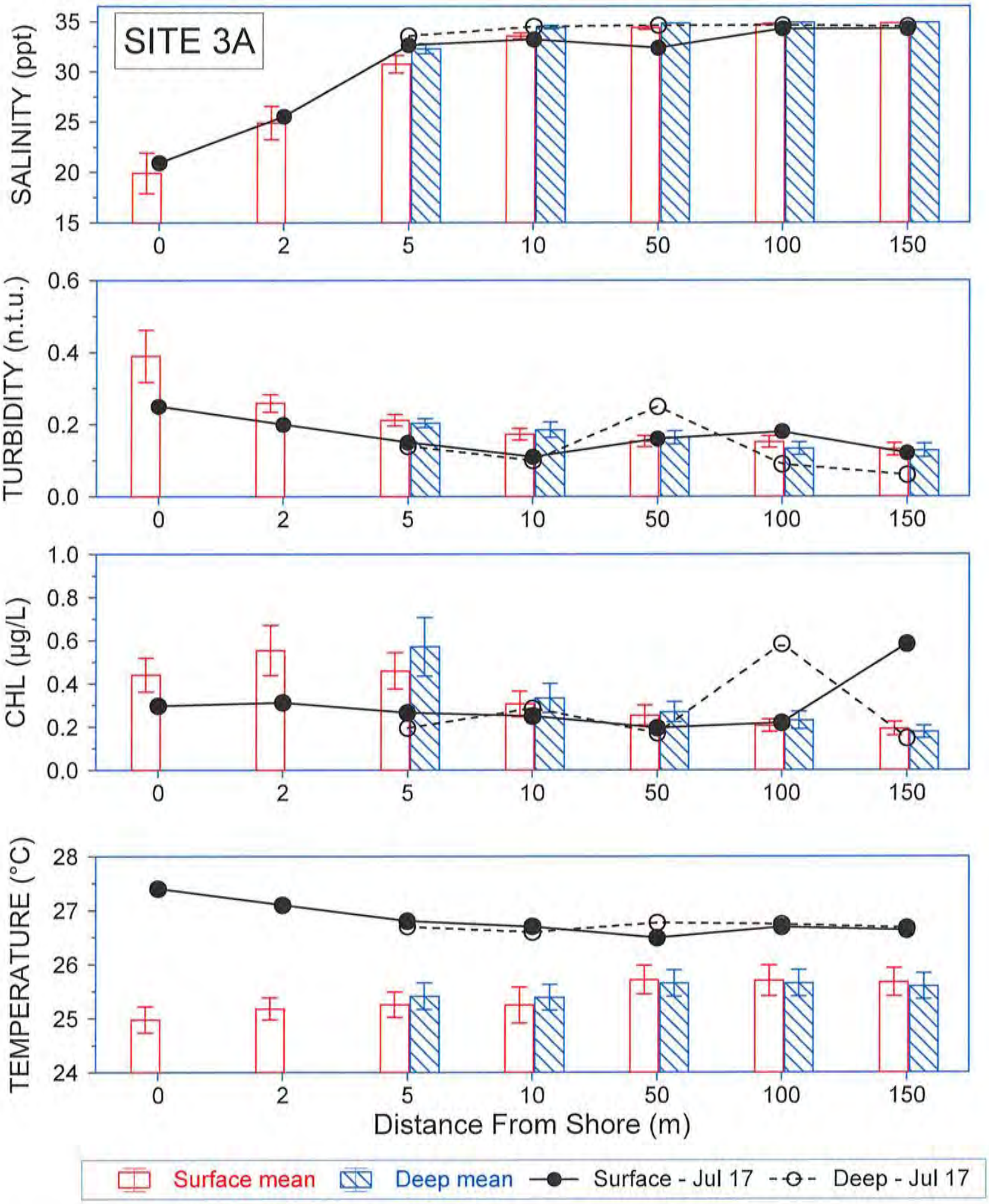


FIGURE 18. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at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

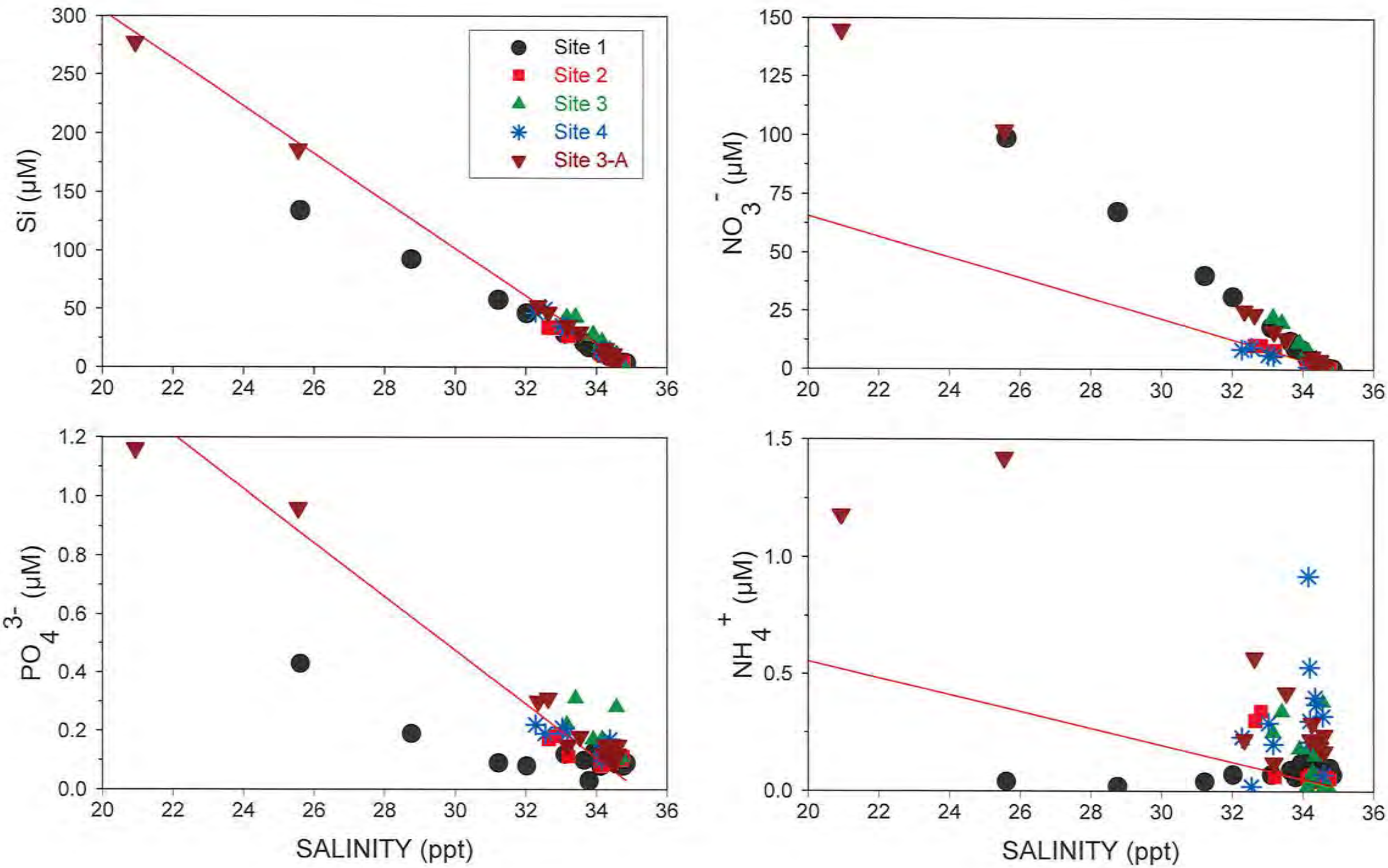


FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Makena Resort on July 7, 2017 as functions of salinity. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from an irrigation well upslope of the Makena Golf Courses. For sampling site locations, see Figure 1.

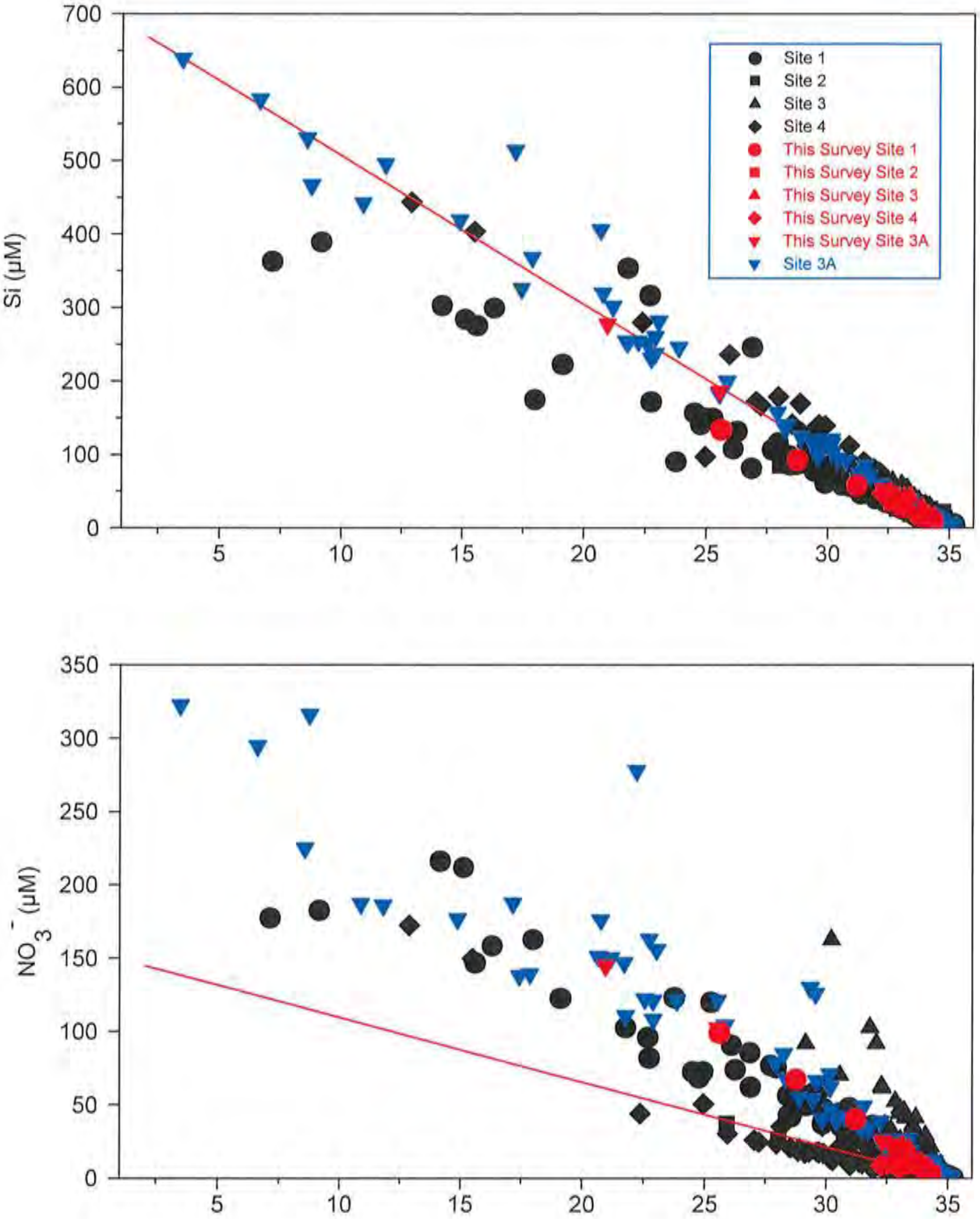
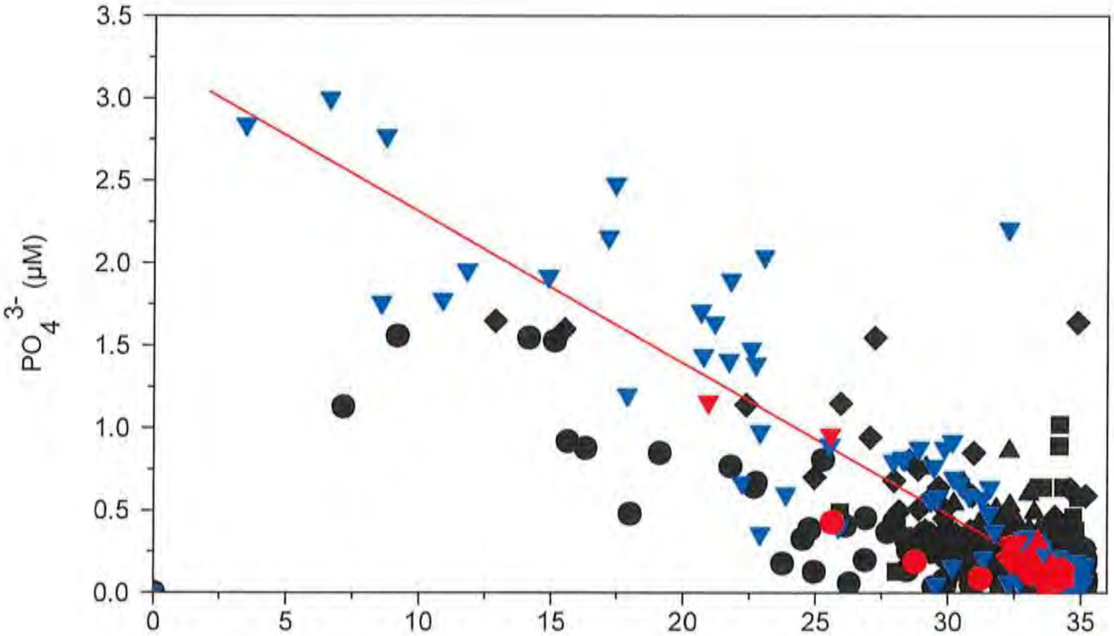


FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and July 2017. Blue symbols represent data from surveys 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.



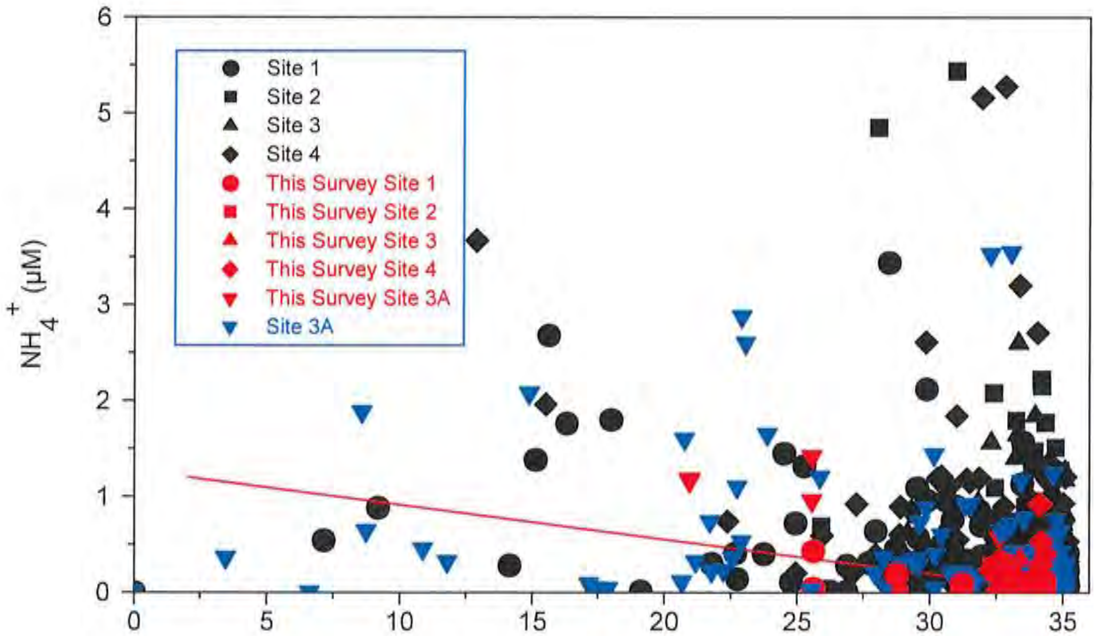


FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and July 2017. Brown symbols represent data from surveys 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 July 2017 (Transect Site 3 has been monitored since 2002; Trasect 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

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 1				
1995	522.34	12.18	491.03	553.66
1996	629.56	11.05	605.49	653.64
1997	504.17	2.83	496.89	511.46
1998	484.14	2.44	477.86	490.41
1999	479.11	9.89	457.55	500.66
2000	528.68	5.87	513.58	543.77
2001	625.85	10.91	597.82	653.88
2002	502.98	8.68	480.66	525.30
2003	625.85	10.91	597.82	653.88
2004	546.00	8.33	527.84	564.16
2005	466.59	11.09	442.42	490.75
2006	487.68	24.60	434.08	541.28
2007	491.19	34.99	414.95	567.42
2008	371.80	16.96	334.85	408.75
2009	457.28	10.01	431.54	483.02
2010	515.27	7.85	495.09	535.45
2011	464.80	5.70	452.37	477.22
2012	940.29	48.49	815.64	1064.94
2013	486.60	5.46	474.70	498.50
2014	509.44	9.47	488.81	530.06
2015	507.51	2.81	501.39	513.63
2016	525.36	8.05	507.82	542.90
2017	502.26	7.60	482.72	521.81
Regslope	**-0.09**	**3.42**	**-7.21**	**7.02**
SITE 2				
1995	468.41	85.54	248.51	688.30
1996	549.09	177.83	164.91	933.28
1997	567.57	9.71	543.80	591.33
1998	563.20	37.23	472.10	654.30
1999	466.74	95.75	261.37	672.11
2000	770.15	27.32	703.31	837.00
2001	1254.31	74.17	1072.82	1435.81
2002	577.53	29.40	505.60	649.46
2003	505.05	20.10	461.94	548.15
2004	565.31	93.71	364.33	766.29
2005	339.08	33.78	266.64	411.52
2006	553.48	62.93	418.51	688.45
2007	443.05	17.15	406.27	479.84
2008	402.41	73.66	244.42	560.41
2009	501.76	9.02	479.69	523.82
2010	490.17	22.77	434.46	545.87
2011	501.35	17.35	464.13	538.56
2012	411.67	48.31	293.48	529.87
2013	495.00	16.53	459.56	530.45
2014	538.49	26.79	481.03	595.94
2015	506.01	13.98	476.03	535.99
2016	529.75	53.83	414.30	645.19
2017	530.98	17.05	489.27	572.70
Regslope	**-6.48**	**5.44**	**-17.80**	**4.84**

SILICA - SLOPE

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 1				
1995	-15.08	0.38	-16.05	-14.12
1996	-18.05	0.32	-18.75	-17.34
1997	-14.43	0.08	-14.65	-14.21
1998	-13.83	0.07	-14.02	-13.64
1999	-13.63	0.29	-14.27	-12.99
2000	-15.08	0.18	-15.54	-14.62
2001	-17.76	0.32	-18.57	-16.94
2002	-14.38	0.26	-15.05	-13.72
2003	-17.76	0.32	-18.57	-16.94
2004	-15.68	0.25	-16.23	-15.14
2005	-13.31	0.33	-14.02	-12.61
2006	-13.88	0.76	-15.53	-12.23
2007	-14.11	1.14	-16.59	-11.62
2008	-10.46	0.52	-11.59	-9.33
2009	-12.98	0.30	-13.76	-12.20
2010	-14.78	0.28	-15.49	-14.06
2011	-13.13	0.18	-13.52	-12.74
2012	-26.98	1.61	-31.13	-22.84
2013	-13.72	0.16	-14.07	-13.37
2014	-14.47	0.29	-15.09	-13.85
2015	-14.54	0.09	-14.73	-14.34
2016	-14.97	0.24	-15.49	-14.44
2017	-14.30	0.24	-14.92	-13.69
Regslope	**0.01**	**0.10**	**-0.20**	**0.21**
SITE 2				
1995	-13.47	2.51	-19.93	-7.00
1996	-15.62	5.15	-26.75	-4.49
1997	-16.26	0.29	-16.96	-15.56
1998	-16.11	1.08	-18.76	-13.45
1999	-13.21	2.78	-19.18	-7.23
2000	-22.06	0.80	-24.02	-20.11
2001	-35.68	2.12	-40.87	-30.49
2002	-16.54	0.86	-18.64	-14.44
2003	-14.37	0.59	-15.63	-13.11
2004	-16.23	2.73	-22.09	-10.38
2005	-9.61	0.98	-11.70	-7.52
2006	-15.82	1.83	-19.75	-11.89
2007	-12.54	0.51	-13.64	-11.45
2008	-11.41	2.14	-15.99	-6.83
2009	-14.32	0.27	-14.98	-13.66
2010	-13.97	0.67	-15.61	-12.33
2011	-14.24	0.50	-15.31	-13.16
2012	-11.62	1.41	-15.06	-8.18
2013	-13.97	0.48	-14.99	-12.95
2014	-15.29	0.78	-16.96	-13.62
2015	-14.51	0.41	-15.39	-13.62
2016	-15.07	1.58	-18.46	-11.69
2017	-15.20	0.51	-16.43	-13.96
Regslope	**0.19**	**0.16**	**-0.13**	**0.51**

SILICA -Y-INTERCEPT

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 3				
2002	931.92	27.54	861.13	1002.71
2003	984.76	41.58	894.16	1075.35
2004	632.75	127.62	354.68	910.82
2005	704.38	52.31	590.40	818.35
2006	928.22	64.18	788.40	1068.05
2007	722.80	15.07	689.97	755.63
2008	1058.06	48.59	952.18	1163.94
2009	943.91	40.06	840.94	1046.89
2010	962.57	74.39	771.34	1153.79
2011	880.51	26.78	822.17	938.85
2012	792.34	42.16	683.97	900.71
2013	840.08	7.86	822.95	857.22
2014	830.08	68.71	680.38	979.78
2015	688.97	18.04	649.66	728.29
2016	738.28	54.68	619.15	857.41
2017	952.01	91.96	715.61	1188.41
Regslope	**-2.85**	**6.97**	**-17.79**	**12.10**
SITE 3A				
2007	714.10	5.58	701.94	726.27
2008	805.12	9.00	785.52	824.73
2009	646.37	7.80	626.32	666.43
2010	750.91	5.70	736.26	765.56
2011	715.44	5.06	704.42	726.45
2012	1005.34	28.55	931.95	1078.73
2013	651.22	3.75	643.05	659.40
2014	680.15	9.84	658.72	701.59
2015	654.59	17.94	615.51	693.67
2016	725.77	11.07	701.65	749.89
2017	691.87	4.57	680.12	703.61
Regslope	**-5.54**	**10.14**	**-28.48**	**17.40**
SITE 4				
1995	710.45	8.83	687.74	733.15
1996	917.33	13.38	888.18	946.47
1997	776.74	3.53	767.66	785.82
1998	841.35	6.75	824.00	858.70
1999	823.63	24.78	769.63	877.62
2000	946.97	12.51	914.80	979.14
2001	1403.91	260.13	735.22	2072.61
2002	767.85	4.37	756.63	779.08
2003	854.37	29.88	789.26	919.48
2004	843.49	37.55	761.67	925.31
2005	703.97	14.00	673.47	734.46
2006	735.05	14.01	704.53	765.57
2007	710.11	7.14	694.56	725.66
2008	712.32	18.22	672.63	752.01
2009	715.30	7.99	694.75	735.84
2010	673.09	6.27	656.98	689.21
2011	688.21	7.10	672.74	703.68
2012	353.00	29.28	277.74	428.26
2013	642.86	7.88	625.69	660.03
2014	767.19	45.16	668.80	865.57
2015	704.12	6.94	689.00	719.25
2016	519.87	47.66	416.03	623.70
2017	670.42	39.73	568.29	772.55
Regslope	**-14.94**	**5.08**	**-25.51**	**-4.37**

SILICA - SLOPE

YEAR	*Coefficients*	*Std Err*	*Lower 95%*	*Upper 95%*
SITE 3				
2002	-26.75	0.81	-28.83	-24.68
2003	-28.10	1.21	-30.73	-25.47
2004	-18.19	3.69	-26.24	-10.14
2005	-20.11	1.51	-23.40	-16.83
2006	-26.56	1.89	-30.67	-22.46
2007	-20.60	0.44	-21.56	-19.63
2008	-30.22	1.41	-33.29	-27.14
2009	-26.90	1.17	-29.90	-23.91
2010	-27.56	2.19	-33.18	-21.93
2011	-25.06	0.77	-26.74	-23.37
2012	-22.57	1.24	-25.75	-19.39
2013	-23.79	0.23	-24.29	-23.29
2014	-23.62	1.98	-27.94	-19.31
2015	-19.74	0.54	-20.91	-18.58
2016	-21.03	1.59	-24.49	-17.56
2017	-27.34	2.71	-34.30	-20.37
Regslope	**0.09**	**0.20**	**-0.34**	**0.51**
SITE 3A				
2007	-20.35	0.19	-20.75	-19.94
2008	-22.96	0.28	-23.57	-22.36
2009	-18.28	0.26	-18.96	-17.61
2010	-21.44	0.19	-21.94	-20.94
2011	-20.35	0.17	-20.72	-19.99
2012	-29.01	0.94	-31.44	-26.59
2013	-18.41	0.12	-18.66	-18.16
2014	-19.32	0.30	-19.98	-18.66
2015	-18.67	0.58	-19.94	-17.40
2016	-20.76	0.35	-21.52	-19.99
2017	-19.79	0.15	-20.17	-19.41
Regslope	**0.15**	**0.30**	**-0.53**	**0.83**
SITE 4				
1995	-20.55	0.27	-21.25	-19.85
1996	-26.23	0.40	-27.10	-25.37
1997	-22.27	0.11	-22.55	-21.99
1998	-24.07	0.20	-24.58	-23.56
1999	-23.50	0.73	-25.10	-21.90
2000	-27.12	0.37	-28.08	-26.16
2001	-39.92	7.42	-58.99	-20.86
2002	-21.99	0.13	-22.34	-21.65
2003	-24.36	0.91	-26.34	-22.39
2004	-24.27	1.10	-26.66	-21.88
2005	-20.11	0.41	-21.00	-19.22
2006	-20.96	0.41	-21.86	-20.06
2007	-20.27	0.23	-20.77	-19.78
2008	-20.33	0.53	-21.49	-19.17
2009	-20.34	0.24	-20.95	-19.73
2010	-19.14	0.19	-19.62	-18.66
2011	-19.57	0.21	-20.03	-19.11
2012	-9.86	0.90	-12.17	-7.54
2013	-18.19	0.23	-18.69	-17.70
2014	-21.85	1.31	-24.71	-18.99
2015	-20.22	0.21	-20.67	-19.77
2016	-14.72	1.39	-17.75	-11.70
2017	-19.21	1.18	-22.25	-16.16
Regslope	**0.43**	**0.14**	**0.13**	**0.74**

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 July 2017 (Transect Site 3 has been monitored since 2002; Trasect 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
2013	232.39	1.37	229.40	235.37
2014	316.83	9.55	296.03	337.63
2015	370.90	2.36	365.76	376.04
2016	308.54	5.66	296.20	320.87
2017	383.78	6.12	368.05	399.51
REGSLOPE	**-1.14**	**1.98**	**-5.26**	**2.99**
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
2013	135.18	3.15	128.41	141.94
2014	153.54	6.45	139.71	167.38
2015	240.30	5.74	227.99	252.62
2016	182.01	9.07	162.54	201.47
2017	176.47	8.93	154.62	198.33
REGSLOPE	**1.80**	**0.98**	**-0.25**	**3.85**

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
2013	-6.59	0.04	-6.68	-6.50
2014	-9.04	0.29	-9.67	-8.41
2015	-10.68	0.08	-10.84	-10.51
2016	-8.86	0.17	-9.22	-8.49
2017	-11.06	0.19	-11.55	-10.56
REGSLOPE	**0.03**	**0.06**	**-0.09**	**0.15**
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
2013	-3.84	0.09	-4.03	-3.64
2014	-4.38	0.19	-4.78	-3.97
2015	-6.93	0.17	-7.30	-6.57
2016	-5.22	0.27	-5.79	-4.65
2017	-5.08	0.26	-5.73	-4.44
REGSLOPE	**-0.05**	**0.03**	**-0.11**	**0.01**

NITRATE -Y-INTERCEPT

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
2013	444.28	6.57	429.97	458.60
2014	538.82	51.38	426.87	650.77
2015	580.33	8.68	561.42	599.23
2016	249.59	27.69	189.27	309.91
2017	549.92	22.43	492.26	607.59
REGSLOPE	**-22.25**	**12.71**	**-49.50**	**5.00**
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
2013	281.00	3.14	274.17	287.83
2014	385.66	10.40	362.99	408.32
2015	425.68	7.05	410.32	441.04
2016	361.17	8.19	343.32	379.01
2017	371.23	6.13	355.47	386.99
REGSLOPE	**2.57**	**5.51**	**-9.90**	**15.05**
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
2013	40.48	3.63	32.58	48.39
2014	113.51	9.69	92.40	134.62
2015	150.03	4.80	139.57	160.48
2016	53.95	10.73	30.58	77.32
2017	146.94	11.12	118.36	175.51
REGSLOPE	**0.12**	**1.43**	**-2.85**	**3.09**

NITRATE - SLOPE

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
2013	-12.62	0.19	-13.03	-12.20
2014	-15.39	1.48	-18.61	-12.16
2015	-16.75	0.26	-17.31	-16.19
2016	-7.14	0.80	-8.89	-5.39
2017	-15.89	0.66	-17.59	-14.20
REGSLOPE	**0.64**	**0.37**	**-0.14**	**1.43**
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
2013	-7.97	0.10	-8.18	-7.76
2014	-11.03	0.32	-11.73	-10.33
2015	-12.29	0.23	-12.78	-11.79
2016	-10.41	0.26	-10.97	-9.84
2017	-10.69	0.20	-11.20	-10.18
REGSLOPE	**-0.11**	**0.16**	**-0.47**	**0.00**
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
2013	-1.14	0.10	-1.37	-0.91
2014	-3.24	0.28	-3.86	-2.63
2015	-4.33	0.14	-4.64	-4.02
2016	-1.53	0.31	-2.21	-0.85
2017	-4.26	0.33	-5.11	-3.41
REGSLOPE	**0.00**	**0.04**	**-0.09**	**0.08**

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 July 2017 (Transect site 3 has been monitored since 2002; Trasect 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
2013	1.73	0.08	1.56	1.90
2014	0.06	0.27	-0.53	0.65
2015	2.57	0.09	2.37	2.76
2016	1.50	0.21	1.05	1.95
2017	1.30	0.25	0.65	1.96
REGSLOPE	**0.01**	**0.02**	**-0.04**	**0.05**
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
2013	2.12	0.57	0.90	3.34
2014	2.21	0.61	0.90	3.51
2015	2.52	0.30	1.88	3.16
2016	3.98	0.55	2.81	5.15
2017	1.72	0.33	0.90	2.54
REGSLOPE	**-0.22**	**0.20**	**-0.64**	**0.19**

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
2013	-0.05	0.00	-0.05	-0.04
2014	0.00	0.01	-0.02	0.02
2015	-0.07	0.00	-0.08	-0.07
2016	-0.04	0.01	-0.05	-0.03
2017	-0.04	0.01	-0.06	-0.02
REGSLOPE	**0.00**	**0.00**	**0.00**	**0.00**
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
2013	-0.06	0.02	-0.09	-0.02
2014	-0.06	0.02	-0.10	-0.02
2015	-0.07	0.01	-0.09	-0.05
2016	-0.11	0.02	-0.15	-0.08
2017	-0.05	0.01	-0.07	-0.02
REGSLOPE	**0.01**	**0.01**	**-0.01**	**0.02**

PHOSPHATE -Y-INTERCEPT

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
2013	4.80	0.28	4.19	5.42
2014	5.15	0.98	3.00	7.29
2015	4.53	0.23	4.01	5.04
2016	6.32	0.62	4.98	7.66
2017	4.69	1.18	1.66	7.71
REGSLOPE	**-0.06**	**0.10**	**-0.27**	**0.15**
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
2013	4.76	0.07	4.61	4.91
2014	3.60	0.10	3.38	3.82
2015	3.36	0.26	2.80	3.92
2016	3.93	0.06	3.80	4.07
2017	2.95	0.17	2.51	3.39
REGSLOPE	**0.06**	**0.07**	**-0.11**	**0.23**
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
2013	0.20	1.93	-4.02	4.41
2014	0.47	1.63	-3.09	4.02
2015	2.49	0.17	2.12	2.85
2016	3.40	0.70	1.86	4.93
2017	1.64	0.38	0.65	2.63
REGSLOPE	**0.02**	**0.15**	**-0.29**	**0.33**

PHOSPHATE - SLOPE

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
2013	-0.13	0.01	-0.15	-0.12
2014	-0.14	0.03	-0.20	-0.08
2015	-0.13	0.01	-0.14	-0.11
2016	-0.18	0.02	-0.22	-0.14
2017	-0.13	0.03	-0.22	-0.04
REGSLOPE	**0.00**	**0.00**	**0.00**	**0.01**
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
2013	-0.13	0.00	-0.14	-0.13
2014	-0.10	0.00	-0.11	-0.09
2015	-0.10	0.01	-0.11	-0.08
2016	-0.11	0.00	-0.11	-0.11
2017	-0.08	0.01	-0.10	-0.07
REGSLOPE	**-9.90**	**15.05**	**-0.01**	**0.00**
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
2013	0.00	0.06	-0.12	0.12
2014	-0.01	0.05	-0.11	0.09
2015	-0.07	0.00	-0.08	-0.06
2016	-0.09	0.02	-0.14	-0.05
2017	-0.04	0.01	-0.07	-0.01
REGSLOPE	**0.00**	**0.00**	**-0.01**	**0.01**

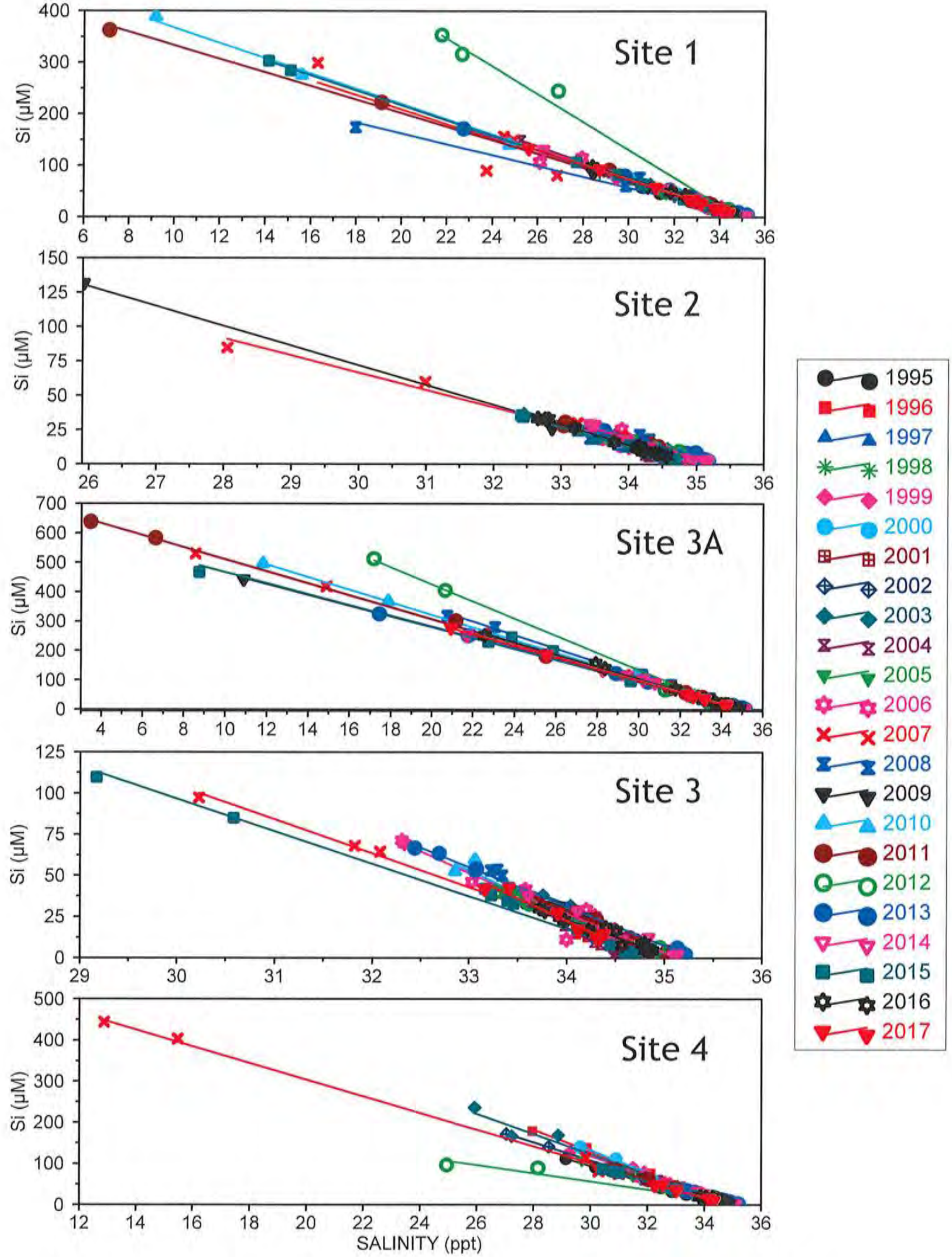


FIGURE 22. Mixing diagram showing yearly concentrations of silicate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions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

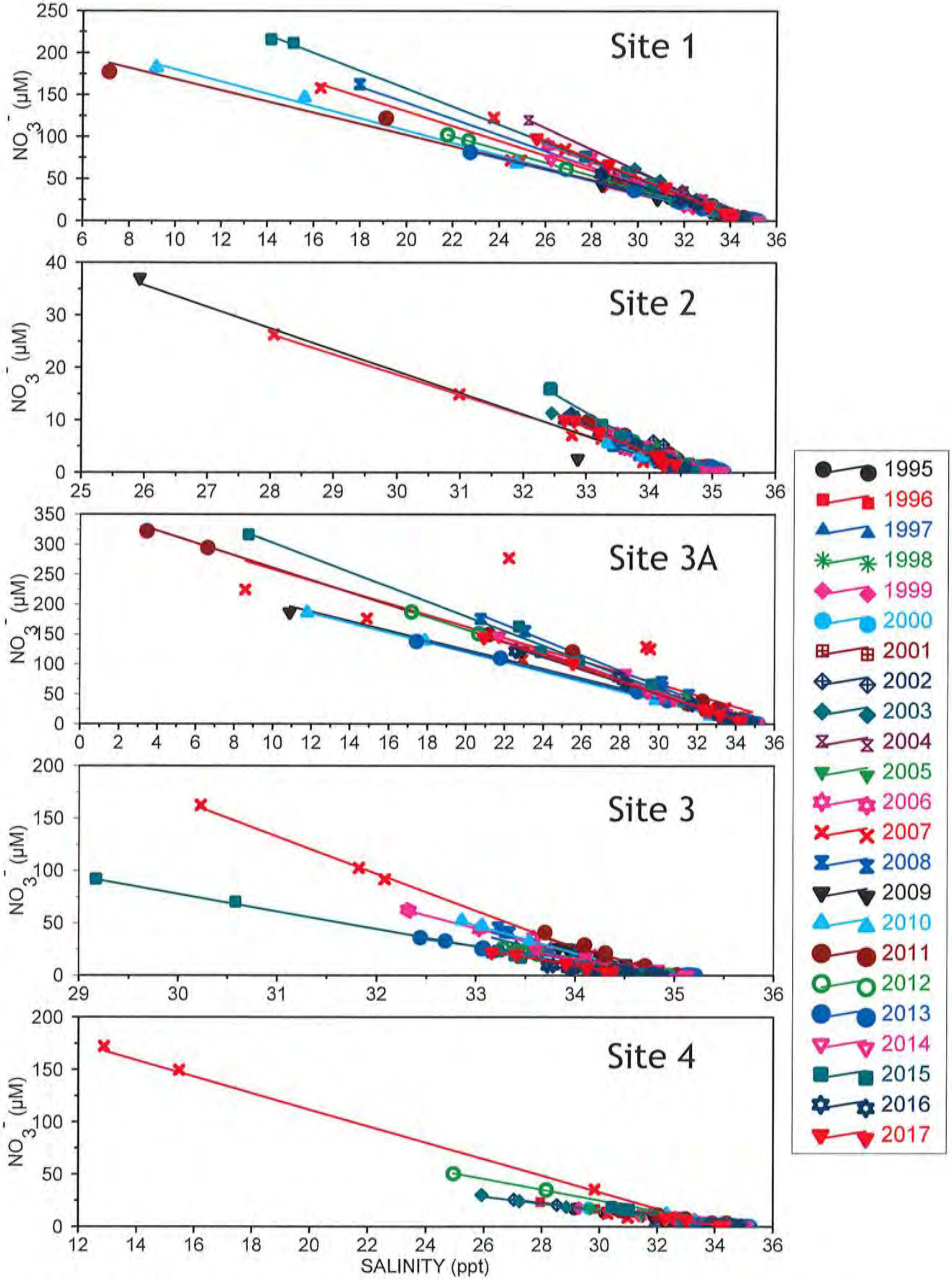


FIGURE 23. Mixing diagram showing yearly concentrations of nitrate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through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

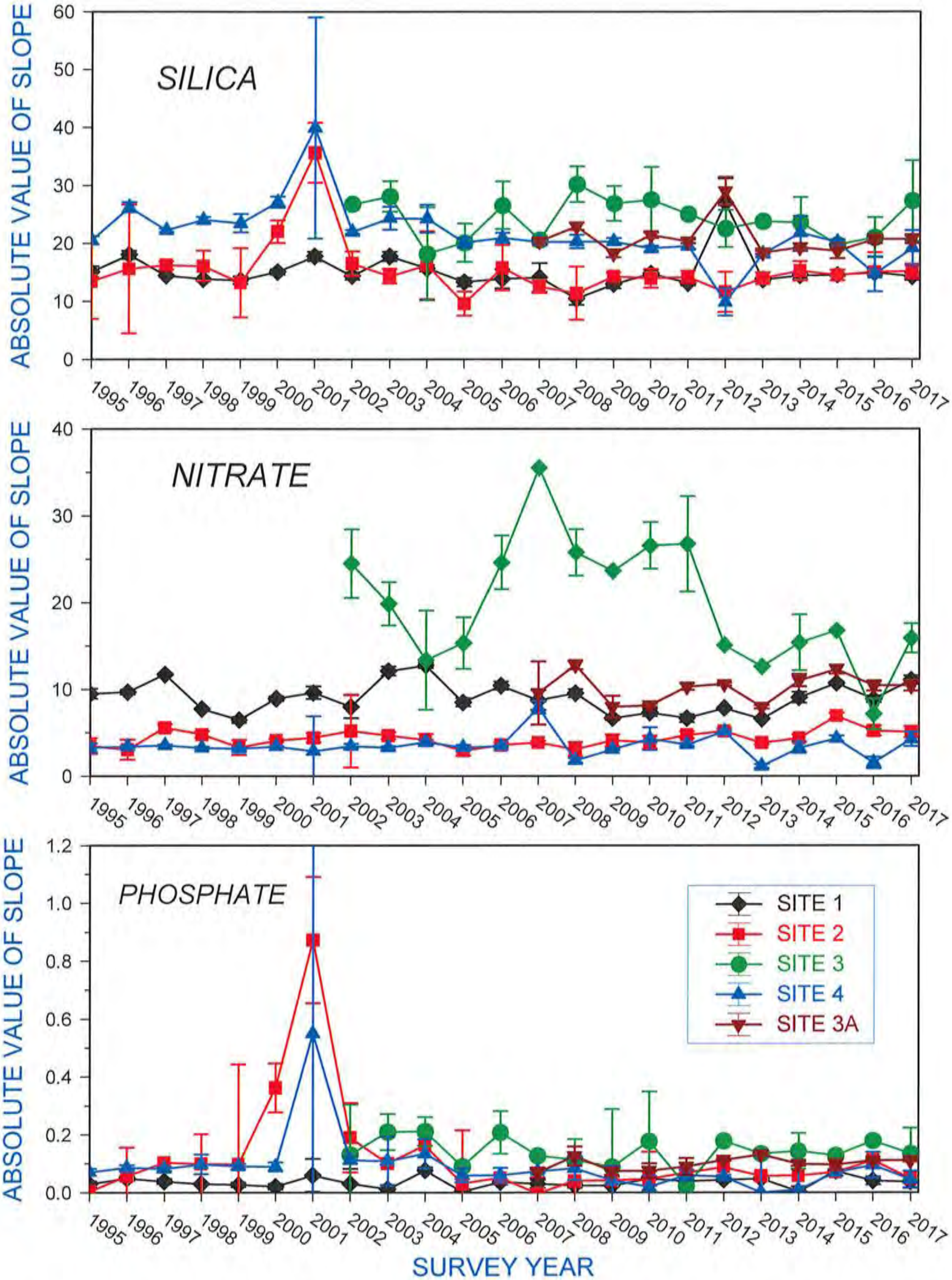


FIGURE 24. Time-course plots of absolute values of slopes of linear regressions of concentrations of silca, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits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

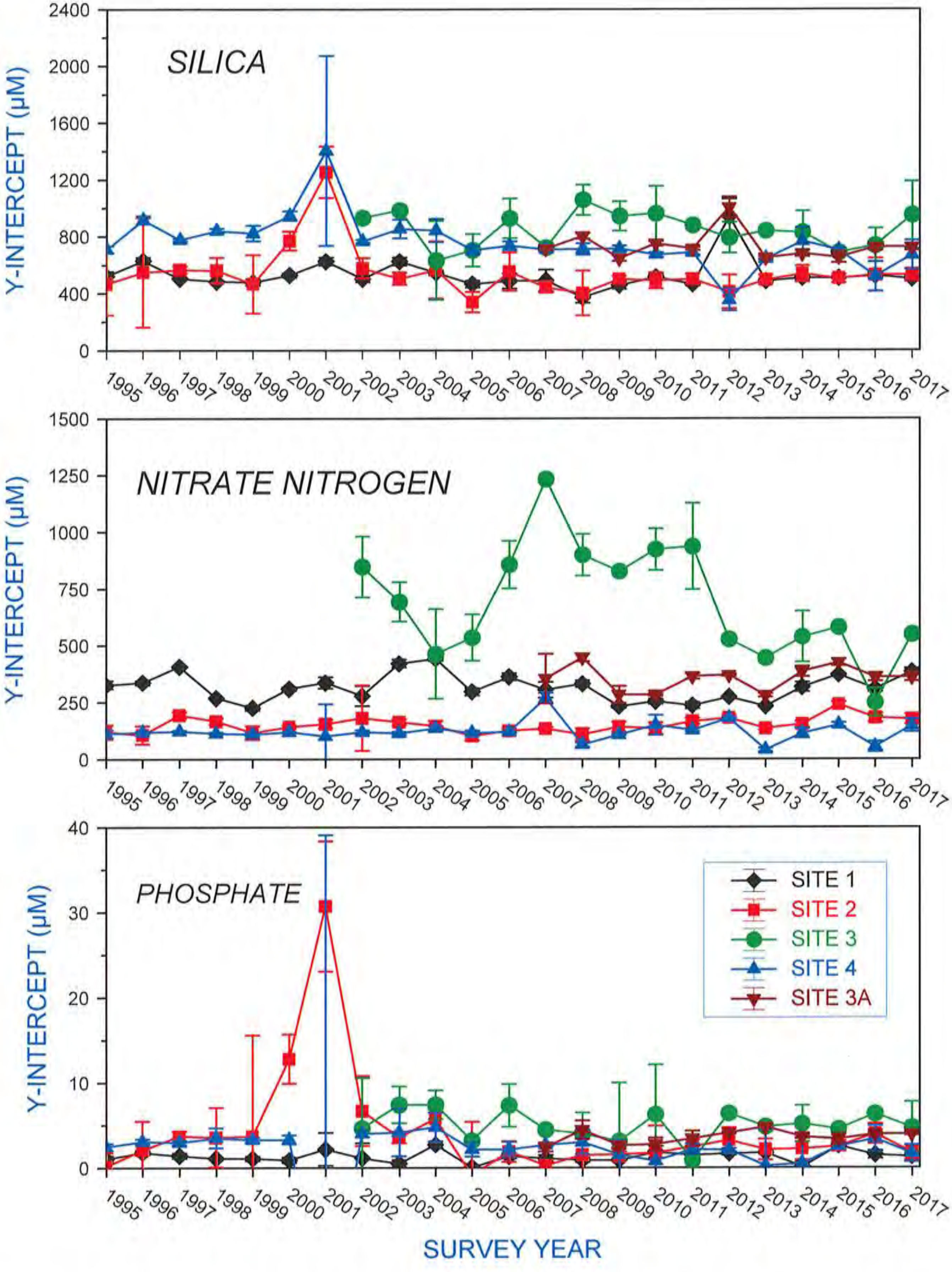


FIGURE 25. Time-course plots of Y-intercepts of linear regressions of concentrations of silca, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits. For locations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

EXHIBIT B.

Exhibit B

ATC MAKENAHOLDINGS, LLC
c/o Makena Golf & Beach
55 Merchant Street, Suite 1500
Honolulu, HI 96813

January 5, 2018

Mr. Myron IIonda
State of Hawaii, Department of Health
Clean Water Branch
2827 Waimano Home Rd #225
Pearl City, HI 96782

Via PDF to CleanWaterBranch@doh.hawaii.gov Only unless hardcopy is requested.

Re: State Land Use District Boundary Amendment Docket A9-721 Condition No. 9, County of Maui Zoning Ordinance 3613 Condition No. 19, Marine Water Quality Monitoring.

Dear Mr. Honda,

ATC Makena Holdings, LLC, in compliance with the above referenced conditions, respectfully submits the enclosed Marine Water Quality Monitoring Reports prepared by Marine Research Consultants, Inc. dated July 2017 for tests performed in June 2017, and January 2018, for tests performed in December 2017.

Should you have any questions, require a hardcopy, or require additional information please do not hesitate to contact me at (808) 640-6023, or by e-mail at kjudd@makenagbc.com.

Sincerely,

Makena Golf & Beach Club
For ATC Makena Holdings, LLC

Kaimi Judd
Vice President of Development

cc. Mark Roy – Via E-Mail PDF Only

MARINE WATER QUALITY MONITORING

MAKENA RESORT, MAKENA, MAUI

WATER CHEMISTRY

REPORT 2-2017

(December 2017)

Prepared for:

ATC Makena Holdings, LLC
c/o
Makena Golf & Beach Club
5415 Makena Alanui Drive
Wailea-Makena, HI 96753

By:

MARINE RESEARCH CONSULTANTS, INC.

1039 Waakaua Pl.
Honolulu, Hawaii 96822

Submitted

December 2017

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 2, 2017. The report also incorporates the cumulative data from all of the 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. At shallower stations, only surface water was collected. 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 on November 20, 2017 from six 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 five sampling locations, it was highest in magnitude at Sites 1 (located off the northern boundary of the Makena Resort property), and 3A, (located directly downslope from the Makena Resort). Site 4 served as a control, in that it was located beyond the influence of the Makena Resort. As groundwater input was apparent at Site 4, such input is not solely a function of Resort land usage.

Other organic water chemistry constituents that do not occur in high concentrations in groundwater, such as ammonium nitrogen showed no elevated levels near the shoreline and consistently low levels beyond 50 meter of the shoreline. Organic nitrogen and phosphorus, were consistently low and did not show any distinctive patterns with respect to input from land.

Vertical stratification of the water column was evident on all transects with substantial differences between surface and bottom water. Vertical gradients extended from the shoreline to the terminus of each transect. The observed patterns of distribution at these sampling sites 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 were mostly insufficient to mix the water column from top to bottom.

Measurements of turbidity and chlorophyll *a* were high near the shoreline throughout the sampling area but low offshore. Elevated values close to the shoreline are most likely the 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 causing increases in plankton populations in nearshore waters. Low offshore 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. Temperature averaged 26.5°C for all surface waters during the December 2017 survey.

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 survey sites 1 and 3A, both of which are located off the Makena Golf Courses and adjacent residential areas.). 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. No subsidies of nitrate were apparent at Site 2 (Makena Landing) or Site 4 ('Ahihi-Kina`u). The distinct lack of distinguishable upward curvature of these data arrays indicates that the nutrients from groundwater that enter the ocean, from both 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 of nitrate and phosphate over the years of monitoring at the four five survey sites located downslope from the Makena Resort. 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 when monitoring has been taking place.

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, total nitrogen, ammonium, 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 past surveys, the results of the most recent increment of monitoring in 2017 reveal that there is an increase over natural conditions of dissolved inorganic nutrients (e.g., nitrate and 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 22-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.

However, it was noted during the July 2016 survey that many of the corals (primarily of the species *Pocillopora meandrina*) were bleached. Such bleaching has been observed at many of the reefs around Maui and is part of a global bleaching event triggered by anomalously warm ocean temperatures. Recent observations of the reefs indicate that in large part the bleaching was not lethal, and corals have returned to conditions that prevailed prior to the bleaching event.

The next scheduled testing for the Makena Resort monitoring program is planned for the spring-summer season of 2018.

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 37th increment in the monitoring program, and contains data from water chemistry sampling conducted on December 2, 2017, and represents the second survey conducted in 2017.

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 for a total of five monitoring sites.

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 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 present 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 2, 2017. Environmental conditions during sample collection consisted of very light winds (2-5 knots) and overcast skies. Ocean conditions were flat with a small 0.5-1 foot breaking surf at the shoreline. Sample collection at the shoreline occurred during a period closest to low tide with a tidal height of 0.4 feet. Rainfall was minimal in the area previous to the day of sampling.

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 six golf course irrigation wells (No's 1, 2, 3, 4, 6 and 8) on November 30, 2017.

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 (NO_3^- + 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 NO_3^- + NO_2^- (hereafter termed NO_3^-), NH_4^+ and PO_4^{3-}, were performed on filtered samples using a Technicon 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.

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 µg/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, 0.001pH units, 0.001% oxygen saturation, and 0.001 parts per thousand (‰) salinity.

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.

The EPA and Standard Methods (SM) methods that were employed for chemical analyses, as well as detection limits, are listed in the Code of Federal Regulations (CRF) Title 40, Chapter 1, Part 136, are as follows:

- NH_4^+ EPA 350.1, Rev. 2.0 or SM4500-NH3 G, detection limit 0.42 µg/L.
- NO_3^- + NO_2^-, EPA 353.2, Rev. 2.0 or SM4500-NO3F, detection limit 0.28 µg/L.
- PO_4^{-3} EPA 365.5 or SM4500-P F, detection limit 0.31 µg/L.
- TP EPA 365.1, or SM 4500-P E J, detection limit 0.62 µg/L.
- TN SM 4500-N C., detection limit 5.60 µg/L.
- Si, SM 4500 SiO2 E, detection limit 5.32 µg/L.
- Chlorophyll a, SM 10200, detection limit 0.006 µg/L.
- pH, EPA 150.1 or SM 4500H+B, detection limit 0.002 pH units.
- Turbidity, EPA 180.1, Rev. 2.0 or SM2130 B, detection limit 0.008 NTU.
- Temperature, SM 2550 B, detection limit 0.01 degrees centigrade.
- Salinity, SM 2520, detection limit 0.003 ppt.
- Dissolved Oxygen, SM4500 O G, and detection limit 0.01% sat.

III. RESULTS and DISCUSSION

A. General Overview

Table 1 shows results of all marine water chemical analyses for samples collected off Makena on December 2, 2017 with nutrient concentrations reported in micromolar units (µM). Table 2 shows the same results with nutrient concentrations presented in units of micrograms per liter (µg/L). Tables 3 and 4 show geometric means of ocean samples at Sites 1, 2 and 4 for 37 surveys, 28 surveys at Site 3, and 19 surveys from Site 3A, with nutrient concentrations shown in µM and µg/L, respectively. Table 5 shows water chemistry measurements (in units of µM and µg/L) for samples collected from irrigation wells located on the Makena Golf and Beach Club property. Concentrations of twelve chemical constituents in surface and deep-water samples from the December 2017 sampling are plotted as functions of distance from the shoreline in Figures 2 and 3. Mean concentrations (±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 2007are plotted in Figures 4-18. In addition, data from the most recent sampling in December 2017 are plotted on Figures 4-18.

During the December 2017 sampling concentrations of dissolved Si, NO_3^- and TN collected within 10m - 50 m of the shoreline on all five transects were elevated by an order of magnitude compared to samples collected near the bottom at the sampling station located farthest offshore (Figure 2, Tables 1 and 2).

The horizontal gradients (defined as the decrease in values moving offshore) of Si, NO_3^- and TN were steepest on Transects 1 and 3-A, where concentrations of NO_3^- decreased by two orders of magnitude (i.e., 100-fold) across the length of the sampling transect. These horizontal gradients extended the entire length of each transect at Sites 1 and 3-A and to 100 m offshore at Site 2. Horizontal gradients in concentrations of Si, NO_3^- and TN on Transects 2, 3 and 4 were less pronounced compared to the other transect sites and horizontal gradients dissipated within 10 m of the shoreline.

On all transects salinity was lowest nearest the shoreline, and increased with distance from shore. At the seaward ends of the transects, bottom waters reflected open coastal ocean values of salinity (~34.7‰). Gradients of salinity had the highest magnitude on Transects 1 and 3A, where surface salinity increased by 5.03‰ and 4.64‰, respectively, from the shoreline to the seaward ends of the transects (Tables 1 and 2). At Sites 2, 3 and 4, the lowest salinity also occurred at the shoreline with increasing values with distance offshore (Figure 3).

With the exception of Control Site 4, concentrations of phosphate phosphorus (PO_4^{3-}) and TP were highest at the shoreline and decreased moving offshore to the open ocean (Figure 2, Tables 1 and 2). The decreasing gradients of PO_4^{3-} were most evident at Sites 1 and 3A, extending 50 meters from the shoreline (Figure 2). Concentrations of NH_4^+ were also elevated at sampling points near the shoreline at four of the five sites. At Site 1, the concentrations of NH_4^+ in samples collected within 10 meters of the shoreline were an order of magnitude greater than that measured in the offshore samples. On Transect 3 the concentration of NH_4^+ was constant along its length (Figure 2 and Tables 1 and 2).

With no streams in the sampling area, nor heavy rainfall and subsequent surface runoff immediately preceding sampling, patterns of elevated Si, NO_3^-, TN and PO_4^{3-} with corresponding reduced salinity are a result of 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 and calm sea conditions, the zone of mixing between groundwater and ocean water is most pronounced. During high tidal stands, and high winds and waves, increased mixing near the shoreline dilutes the groundwater signal. During the December 2017 sampling, ocean swells and wind-driven chop were minimal. Comparing the results of the repetitive surveys conducted during different wind and sea conditions 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 (TON, TOP) showed no distinct horizontal gradients with distance offshore for three of the five sites (Table 1, Figure 2). At Sites 3 and 4, a slight horizontal gradient of decreasing TON with increasing distance offshore was visible.

Turbidity was highest near the shoreline, and decreased with distance from shore at all five transects with Control Site 4 showing highest values of turbidity at the shoreline (Tables 1 and 2, Figure 3). Transect 2 bisects Makena Bay (Makena Landing), which is a semi-enclosed embayment with a silt/sand bottom rather than the predominantly "hard" reef or sand bottoms that occur at the other transect sites. Shoreline surf and on-shore winds often contribute to an increase in turbidity at this site. It has been observed that during flash floods originating in the ranch lands upslope of the Makena Resort, terrigenous sediment will flow to the ocean at 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. Values in 2001 documented the persistent effects of 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. 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. Beyond the shoreline, turbidity was constant and of the same magnitude at all five transect sites (Tables 1 and 2).

Values of Chl *a* were highest near the shoreline at all transects (Figure 3 and Tables 1 and 2). Values near the shoreline were slightly lower at Transect 4 compared to the other four sites (Table 1, Figure 3). Beyond 50 meters from the shoreline, Chl *a* concentrations were constant with distance offshore and similar in magnitude among all five sites (Tables 1 and 2). And uncharacteristic higher values for Chl a (0.57 and 0.76 µg/L)was detected in both two deep samples from the 5 and 10 meter from shore station on Transect 3A (Table 1).

In December 2017, surface water temperature was slightly lower near the shoreline, and was constant beyond 10 meters of the shoreline at all five sites (Figure 3, Tables 1 and 2). For the entire data set during the December 2017 survey surface temperature ranged between 24.8°C and 26.2°C with an average temperature for all surface samples of 25.9°C. The lowest temperature measured during the December 2017 survey was 24.4°C from the deep water sample at Site 1 (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 and 3 and Tables 1 and 2 show concentrations of water chemistry constituents with respect to vertical stratification. With a few exceptions, concentrations of constituents in deep samples were lower than surface values. These results were most evident at transect Sites 1 and 3A where input of groundwater nutrients were most prominent. The buoyant surface layer extended the entire length of all transects indicating that normal mixing processes from wind and waves were not pronounced during December 2017.

B. Temporal Comparison of Monitoring Results

Figures 4-18 show mean concentrations (±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. The results of the most recent survey in December 2017 are also shown on each plot.

The long-term means of concentrations of groundwater nutrients (Si, NO_3^-, and PO_4^{3-}), salinity, NH_4^+, turbidity and Chl *a* show an overall trend of increasing nutrients and decreasing salinity with distance offshore. Additionally, differences between surface and deep concentrations show vertical stratification within 50 meters of the shoreline with nutrient concentrations higher and salinity lower in the surface water compared to the deep water. Mean concentrations of TON, TOP and temperature remain nearly constant along the length of each transect. Temperature at Site 3A also increased with increasing distance offshore, a finding dissimilar from the other sites where temperature was fairly constant (Figure 18). The lower temperature near the shoreline at Transect 3A likely reflects the substantial input of cool groundwater at this location.

In comparing the most recent survey with the overall dataset, a few constituents showed differences during the December 2017 survey compared to the mean values. Temperature at Sites 2, 3, 3A and 4 were higher during December 2017 compared to the mean values over the course of monitoring (Figures 9, 12, 15 and 18). With the exception of Site 1, nearshore concentrations of Si, NO_3^-, PO_4^{3-} and NH_4^+ were lower during the present survey compared to the mean values (Figures 4, 7, 10, 13 and 16). The patterns comparing the concentrations measured in the most recent survey to the mean values over all survey dates are likely a reflection of the combination of low tide and low energy of physical mixing processes (wave action) in the nearshore zone.

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 2017. 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 Golf and Beach Club property (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, all of the data points from all five sites fall in a linear array on, or close to the conservative mixing line. Data points from samples at the shoreline for Transect 1 fall slightly below the mixing line. The overall linearity of the data points indicates that marine waters at the five transect sites are 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 a distinct linear pattern (Figure 19). Inspection of the mixing plots from the most recent survey (Figure 19) and the long-term mixing data (Figure 20) indicate 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 other than natural processes. During the December 2017 survey, data points from Site 2 also fell close to the mixing line (Figure 19).

Conversely, data points from the nearshore samples at Transects 1, 3 and 3-A all fall in a linear array above the conservative mixing line. Such a pattern indicates that there are subsidies of NO_3^- to the ocean from sources on land (Figure 19). Most evident are the data points from Transects 1 and 3-A with salinities less than 34‰ that are evident far above the mixing line (Figure 19). Transect site 3A lies directly offshore of the golf course, residences and a wetland. Transect Site 1 lies offshore of an area populated by numerous residences, and is downslope from the northern end of the Makena Golf Courses and southern end of the Wailea Golf Courses. The mixing line relationships from Figures 19 and 20 indicate subsidies of NO_3^- at these areas that are likely a result of leaching of fertilizers to the groundwater lens. The source of fertilizer nutrients is likely from both golf course and residential landscaping. Although the Makena South Course has been closed for an extended time, the greens and fairways continue to be maintained at the time of this survey.

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 residences that have been constructed over the course of monitoring 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 2017 survey (red symbols) are superimposed over the slopes of combined sets of data points from past surveys (black and blue symbols) it can be seen that subsidies of NO_3^- lie near the approximate midpoint of the overall data set (Figure 20). Thus, it can be inferred that over the course of the monitoring program, results from the most recent survey do not indicate a progressive increase or decrease in subsidies of NO_3^- to the ocean from human activities. Future monitoring will continue to provide information on any directions of trends of NO_3^- input to the ocean.

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.

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, inspection of the entire shoreline fronting the Makena Resort revealed that there are no areas exhibiting excessive algal growth that could be termed an "algal bloom."

The area was affected by anomalously high temperatures associated with the El Nino event in the summer of 2015. Inspection of the reef at the time of the October 2015 survey revealed a substantial amount of bleaching to corals, particularly of the species *Pocillopora meandrina*. Coral bleaching during the summer of 2015 has been common throughout the Hawaiian Islands as part of a global bleaching event associated with warming of ocean waters associated with an ongoing El Nino event. However, visual inspection of the area in 2017 indicated that much of the bleached corals had returned to normal in the intervening interval. As coral bleaching is not necessarily lethal to corals, the recovery is typical of many other areas of the main Hawaiian Islands.

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 2017 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. The reversed gradient of increasing concentrations of NH_4^+ with increasing salinity on most of the transects indicates that the source of NH_4^+ is not from groundwater entering the nearshore zone (Figure 19). In addition, it can be seen in Figure 19 that with the exception of the four samples collected at the shoreline on Transects 1 and 3A, the highest concentration of NH_4^+ do not occur at the lowest salinities, but rather near the highest salinities. The lack of linearity with respect to salinity in the distribution of NH_4^+ indicates that the elevated concentrations are from a marine source, and not from input from land.

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. However, as with NO_3^-, when concentrations of PO_4^{3-} are plotted as functions of salinity, samples from each transect fall in distinct linear arrays. Most of the data points from transect sites 2, 3, 3A and 4 lie close to the mixing line, while data points for Transect 1 lie below the mixing line. The location of all data points on or below the mixing line indicates that there are not subsidies of PO_4^{3-} to the ocean from activities on land.

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 sources 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 though 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 a single slope (Si at Transect 4) and none of the 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 four of the five 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). Examination of Table 6, shows a slight decrease in in the Y-intercept and a slight increase in the slope for Si at Site 4, which is the Control site that is not affected by human activities at Makena.

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 entire course of monitoring since 1995. Sites 2 (Makena Landing) and 4 ('Ahihi-Kina`u) also show relatively constant trends with time. The single exception occurred in 2001 which is marked by spikes in Si and PO_4^{3-}, although not for NO_3^-. 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 an overall downturn from 2007 to 2016. Analysis for 2017 shows a slight upturn in NO_3^- (Figures 24 and 25). These reversing trends over the 16-year period of monitoring 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 effects of stormwater runoff but as of December 2017 they are not operational. New turf grass had been applied to the area but the course remains closed. Construction activities for new housing is on-going.

~~F.~~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 either10% 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 2017 survey indicated that numerous measurements of NO_3^- TN, NH_4^+ and Chl *a* exceeded the 10% DOH criteria under wet or dry conditions (Tables 1 and 2). Only one measurement of turbidity and no measurements of TP turbidity exceeded the 10% DOH criteria under any 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 for NO_3^- occurred at a similar number of sampling sites as for the transects located directly offshore of the golf courses.

Tables 3 and 4 show geometric means of samples collected at the same locations during the 37 increments of the monitoring program at Sites 1, 2 and 4, 28 increments of sampling at Site 3, and 19 increments of sampling at Site 3A. 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^+, TN and Chl *a*, nearly all samples exceeded the dry and wet standards within 100 m of the shoreline. Eight samples of TP and 21 samples of turbidity exceeded standards.

As discussed above, Site 4 is considered a control transect, in that it is not located offshore of either the Makena Resort 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 could 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 indeed 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 37th phase of water chemistry monitoring of the nearshore ocean off the Makena Resort was carried out on December 2, 2017. 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.

- At all five survey sites, water chemistry constituents that occur in high concentration in groundwater (Si, NO_3^- and TN) displayed consistent patterns of highest concentrations nearest to shore with steadily decreasing concentrations moving seaward. Groundwater input (based on salinity) was greatest at Transect sites 3-A and 1, followed by sites 3, 2 and 4.

- Vertical stratification of the water column was evident during December 2017, with elevated concentrations of nutrients found in groundwater and lower salinity in surface waters relative to water near the bottom. Such vertical stratification indicates that physical mixing processes generated by tidal exchange, wind stirring, and breaking waves were not 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 3 having the lowest values of turbidity in nearshore samples. The elevated levels of Chl *a* 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 offshore water column indicates the lack of plankton blooms in the area. Elevated values of turbidity in the nearshore samples is likely a result of wave resuspension of fine-grained particulate material in the surf zone.

- Other organic water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, TON, TOP) did not show any horizontal pattern of increased concentration near the shoreline and decreasing with distance offshore.

- Scaling nutrient concentrations to salinity indicates that there are measurable subsidies of NO_3^- to groundwater that enters the nearshore ocean at all transect sites. At two sites (1 and 3-A) it is evident that there are subsidies of $NO3^-$ to the ocean from sources other than naturally occurring groundwater. 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 were the golf course extends to the shoreline. In addition, private residences, a wetland and active construction projects are present upslope of Transect 3 and 3A. Hence, the subsidies of NO_3^- noted at these sites may result from a combination of sources.

- No subsidies of NO_3^- other than the chemical constituents of naturally occurring groundwater were apparent at Site 2 (Makena Landing) or Control Site 4 ('Ahihi-Kina`u).

- Linear regression statistics of repetitive slopes and Y-intercepts of nutrient concentration plotted as functions of salinity over time 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 22 years of monitoring at any of the survey sites located off the Makena Resort. The lack of increase in these slopes and intercepts indicate that there has not been consistent changes 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 an overall decrease from 2008 through 2016. A slight increasing trend is evident for 2017. Further monitoring at this site will be of interest to note the future direction of the oscillating trends noted in the last 16 years.

- Comparing water chemistry parameters to DOH standards revealed that several measurements of NO_3^-, TN, NH_4^+ and Chl *a*, one measurements of turbidity and no measurements of TP 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 (particularly $NO3^-$) 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 2017.

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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 (with nutrients reported in micromolar units) from ocean water samples collected in the vicinity of the Makena Resort on December 2, 2017. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL a = chlorophyll a; TEMP = temperture; O2 = dissolved oxygen; 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 a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	0.39	56.58	0.47	91.57	0.20	7.46	0.59	64.51	0.33	29.520	0.47	25.5	8.16	99.2
	2 S	0.1	0.25	23.85	0.47	43.59	0.22	7.04	0.47	31.36	0.17	32.550	0.30	25.7	8.19	98.1
	5 S	0.5	0.24	24.93	0.51	41.75	0.21	6.93	0.45	32.37	0.23	32.550	0.32	25.8	8.19	97.2
	5 D	1.5	0.25	24.38	0.54	40.82	0.18	7.33	0.43	32.25	0.22	32.570	0.35	24.4	8.19	96.2
	10 S	0.5	0.16	8.56	0.45	17.26	0.22	6.67	0.38	15.68	0.22	33.980	0.31	25.9	8.19	96.4
	10 D	2.4	0.16	6.29	0.61	14.25	0.23	6.23	0.39	13.13	0.17	34.130	0.39	26.1	8.19	97.4
	50 S	0.5	0.13	6.41	0.19	13.50	0.31	6.87	0.44	13.47	0.20	34.390	0.23	25.9	8.16	95.7
	50 D	4.1	0.11	2.95	0.28	7.92	0.31	7.37	0.42	10.60	0.14	34.600	0.26	26.1	8.16	96.3
	100 S	0.5	0.15	3.77	0.11	9.81	0.24	6.86	0.39	10.74	0.18	34.560	0.25	25.9	8.15	93.4
	100 D	5.5	0.16	1.19	0.45	5.92	0.28	7.10	0.44	8.74	0.11	34.690	0.23	26.2	8.16	86.5
	150 S	0.6	0.12	2.72	0.04	9.24	0.27	7.00	0.39	9.76	0.07	34.550	0.16	26.0	8.18	94.3
	150 D	10.4	0.11	0.54	0.09	5.27	0.27	8.08	0.38	8.71	0.08	34.730	0.23	26.2	8.21	93.6
MAKENA 2	0 S	0.1	0.21	3.61	0.30	19.34	0.24	5.87	0.45	9.78	0.33	33.940	0.40	25.9	8.21	99.2
	2 S	0.1	0.20	3.48	0.28	19.80	0.23	7.88	0.43	11.64	0.32	34.010	0.36	25.9	8.21	97.4
	5 S	0.6	0.22	3.09	0.12	18.23	0.22	6.05	0.44	9.26	0.24	34.130	0.33	25.9	8.21	97.9
	5 D	2.2	0.22	2.14	0.35	15.62	0.22	6.13	0.44	8.62	0.25	34.310	0.37	25.9	8.21	96.2
	10 S	0.5	0.15	1.04	0.24	10.05	0.35	5.85	0.50	7.13	0.18	34.480	0.25	25.9	8.21	96.4
	10 D	3.0	0.18	0.86	0.24	9.41	0.24	9.86	0.42	10.96	0.21	34.580	0.28	26.0	8.21	95.4
	50 S	0.6	0.16	1.03	0.09	11.69	0.32	7.36	0.48	8.48	0.26	34.590	0.26	26.0	8.20	96.2
	50 D	4.4	0.15	0.62	0.15	8.77	0.29	6.46	0.44	7.23	0.19	34.590	0.26	26.0	8.20	92.3
	100 S	0.6	0.13	1.27	0.25	10.35	0.30	5.89	0.43	7.41	0.19	34.600	0.18	26.0	8.19	97.6
	100 D	5.6	0.13	0.31	0.26	5.75	0.27	5.55	0.40	6.12	0.09	34.740	0.20	26.2	8.21	93.7
	150 S	0.5	0.11	0.08	0.18	5.00	0.25	5.30	0.36	5.56	0.05	34.800	0.12	26.1	8.21	95.7
	150 D	7.2	0.11	0.04	0.17	4.39	0.27	5.64	0.38	5.85	0.05	34.760	0.16	26.2	8.21	94.3
	200 S	0.6	0.09	BDL	0.17	4.13	0.33	6.95	0.42	7.13	0.05	34.790	0.13	26.2	8.22	96.2
	200 D	12.0	0.09	BDL	0.20	3.84	0.28	5.76	0.37	5.97	0.06	34.720	0.13	26.2	8.22	95.7
MAKENA 3-A	0 S	0.1	0.56	59.44	0.05	103.2	0.21	6.64	0.77	66.13	0.38	30.100	0.49	25.7	8.06	97.3
	2 S	0.1	0.44	39.80	0.47	68.81	0.21	9.62	0.65	49.89	0.43	31.680	0.48	25.8	8.09	96.2
	5 S	0.5	0.22	6.91	0.45	15.69	0.29	9.95	0.51	17.31	0.24	34.220	0.41	25.7	8.16	97.2
	5 D	1.1	0.26	7.07	0.69	16.89	0.22	9.38	0.48	17.14	0.26	34.140	0.57	25.8	8.16	97.2
	10 S	0.5	0.20	7.25	0.24	17.10	0.27	10.21	0.47	17.70	0.18	34.150	0.41	25.9	8.16	97.8
	10 D	2.9	0.28	5.10	0.51	13.57	0.28	10.08	0.56	15.69	0.20	34.330	0.76	25.9	8.17	96.2
	50 S	0.5	0.10	3.18	0.22	10.77	0.30	7.10	0.40	10.50	0.16	34.510	0.30	26.0	8.18	98.9
	50 D	4.5	0.14	3.71	0.29	11.27	0.29	6.34	0.43	10.34	0.16	34.530	0.30	26.1	8.17	92.4
	100 S	0.5	0.13	2.01	0.19	7.83	0.25	5.85	0.38	8.05	0.18	34.590	0.21	26.1	8.17	92.4
	100 D	5.0	0.09	0.69	0.28	5.04	0.29	5.93	0.38	6.90	0.10	34.770	0.19	26.2	8.20	93.1
	150 S	0.5	0.12	1.41	0.28	6.88	0.28	5.98	0.40	7.67	0.12	34.740	0.19	26.1	8.15	90.7
	150 D	10.4	0.16	0.40	0.28	4.91	0.21	6.64	0.37	7.32	0.11	34.760	0.15	26.2	8.19	94.1
MAKENA 3	0 S	0.1	0.15	2.41	0.34	8.43	0.39	10.91	0.54	13.66	0.16	34.550	0.51	26.0	8.22	99.2
	2 S	0.1	0.15	4.51	0.25	12.96	0.38	8.21	0.53	12.97	0.24	34.390	0.30	24.9	8.20	96.2
	5 S	0.5	0.11	0.23	0.34	4.16	0.30	8.93	0.41	9.50	0.09	34.740	0.30	26.2	8.20	97.4
	5 D	1.7	0.13	0.41	0.29	4.49	0.27	7.66	0.40	8.36	0.10	34.670	0.42	26.2	8.20	96.2
	10 S	0.5	0.13	0.05	0.25	3.80	0.26	8.27	0.39	8.57	0.08	34.700	0.20	26.2	8.20	97.2
	10 D	2.8	0.13	0.02	0.56	4.07	0.24	8.23	0.37	8.81	0.10	34.770	0.28	26.2	8.20	96.2
	50 S	0.5	0.10	0.21	0.42	4.68	0.26	5.95	0.36	6.58	0.10	34.840	0.16	26.1	8.17	99.7
	50 D	5.2	0.09	0.28	0.40	4.98	0.27	5.97	0.36	6.65	0.10	34.810	0.16	26.1	8.16	89.7
	100 S	0.5	0.12	0.58	0.24	5.92	0.26	6.05	0.38	6.87	0.12	34.740	0.16	26.1	8.16	90.0
	100 D	7.6	0.10	0.26	0.32	5.24	0.25	6.06	0.35	6.64	0.15	34.710	0.16	26.1	8.16	89.8
	150 S	0.5	0.11	BDL	0.16	3.97	0.26	6.58	0.37	6.74	0.07	34.810	0.09	26.2	8.20	101.6
	150 D	13.7	0.13	0.03	0.32	4.03	0.40	8.95	0.53	9.30	0.04	34.770	0.09	26.2	8.20	88.8
MAKENA 4	0 S	0.1	0.12	5.33	0.73	28.52	0.28	9.44	0.40	15.50	0.47	33.770	0.36	25.5	8.12	100.4
	2 S	0.1	0.16	3.71	1.01	21.96	0.29	9.02	0.45	13.74	0.51	34.000	0.30	26.0	8.13	99.4
	5 S	0.7	0.18	2.31	0.48	16.92	0.24	8.47	0.42	11.26	0.23	34.250	0.23	25.9	8.13	99.1
	5 D	2.7	0.19	2.20	0.57	16.69	0.27	11.95	0.46	14.72	0.23	34.210	0.40	26.0	8.13	98.2
	10 S	0.8	0.14	0.77	0.41	8.65	0.22	7.42	0.36	8.60	0.13	34.570	0.19	26.0	8.14	97.4
	10 D	2.5	0.14	0.60	0.43	8.53	0.19	7.06	0.33	8.09	0.13	34.570	0.20	26.0	8.15	97.4
	50 S	0.9	0.12	0.36	0.39	7.16	0.25	5.78	0.37	6.53	0.10	34.830	0.16	26.0	8.13	90.6
	50 D	4.5	0.09	0.38	1.02	7.24	0.32	7.07	0.41	8.47	0.09	34.780	0.19	26.0	8.13	87.4
	100 S	0.8	0.12	0.49	0.48	8.18	0.29	5.71	0.41	6.68	0.10	34.660	0.16	26.0	8.13	87.8
	100 D	7.0	0.12	0.13	0.53	5.74	0.27	5.68	0.39	6.34	0.09	34.700	0.17	26.0	8.14	84.9
	150 S	0.5	0.13	0.07	0.24	5.24	0.29	5.06	0.42	5.37	0.05	34.710	0.13	26.1	8.17	88.1
	150 D	9.7	0.12	0.04	0.26	4.73	0.32	6.51	0.44	6.81	0.09	34.710	0.13	26.1	8.16	83.8
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 form 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 (with nutrient data reported in µg/L) from ocean water samples collected in the vicinity of the Makena Resort on December 2, 2017. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL a = chlorophyll a; TEMP = temperture; O2 = dissolved oxygen; S=surface; D=deep; BDL=below detection limit. 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-} (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 a (µg/L)	TEMP (deg.C)	pH (std.units)	O2 % Sat
MAKENA 1	0 S	0.1	12.09	792.1	6.58	2573	6.20	104.4	18.29	903.1	0.33	29.520	0.47	25.5	8.16	99.2
	2 S	0.1	7.75	333.9	6.58	1225	6.82	98.56	14.57	439.0	0.17	32.550	0.30	25.7	8.19	98.1
	5 S	0.5	7.44	349.0	7.14	1173	6.51	97.02	13.95	453.2	0.23	32.550	0.32	25.8	8.19	97.2
	5 D	1.5	7.75	341.3	7.56	1147	5.58	102.6	13.33	451.5	0.22	32.570	0.35	24.4	8.19	96.2
	10 S	0.5	4.96	119.8	6.30	485.0	6.82	93.38	11.78	219.5	0.22	33.980	0.31	25.9	8.19	96.4
	10 D	2.4	4.96	88.06	8.54	400.4	7.13	87.22	12.09	183.8	0.17	34.130	0.39	26.1	8.19	97.4
	50 S	0.5	4.03	89.74	2.66	379.4	9.61	96.18	13.64	188.6	0.20	34.390	0.23	25.9	8.16	95.7
	50 D	4.1	3.41	41.30	3.92	222.6	9.61	103.2	13.02	148.4	0.14	34.600	0.26	26.1	8.16	96.3
	100 S	0.5	4.65	52.78	1.54	275.7	7.44	96.04	12.09	150.4	0.18	34.560	0.25	25.9	8.15	93.4
	100 D	5.5	4.96	16.66	6.30	166.4	8.68	99.40	13.64	122.4	0.11	34.690	0.23	26.2	8.16	86.5
	150 S	0.6	3.72	38.08	0.56	259.6	8.37	98.00	12.09	136.6	0.07	34.550	0.16	26.0	8.18	94.3
	150 D	10.4	3.41	7.56	1.26	148.1	8.37	113.1	11.78	121.9	0.08	34.730	0.23	26.2	8.21	93.6
MAKENA 2	0 S	0.1	6.51	50.54	4.20	543.5	7.44	82.18	13.95	136.9	0.33	33.940	0.40	25.9	8.21	99.2
	2 S	0.1	6.20	48.72	3.92	556.4	7.13	110.3	13.33	163.0	0.32	34.010	0.36	25.9	8.21	97.4
	5 S	0.6	6.82	43.26	1.68	512.3	6.82	84.70	13.64	129.6	0.24	34.130	0.33	25.9	8.21	97.9
	5 D	2.2	6.82	29.96	4.90	438.9	6.82	85.82	13.64	120.7	0.25	34.310	0.37	25.9	8.21	96.2
	10 S	0.5	4.65	14.56	3.36	282.4	10.85	81.90	15.50	99.82	0.18	34.480	0.25	25.9	8.21	96.4
	10 D	3.0	5.58	12.04	3.36	264.4	7.44	138.0	13.02	153.4	0.21	34.580	0.28	26.0	8.21	95.4
	50 S	0.6	4.96	14.42	1.26	328.5	9.92	103.0	14.88	118.7	0.26	34.590	0.26	26.0	8.20	96.2
	50 D	4.4	4.65	8.68	2.10	246.4	8.99	90.44	13.64	101.2	0.19	34.590	0.26	26.0	8.20	92.3
	100 S	0.6	4.03	17.78	3.50	290.8	9.30	82.46	13.33	103.7	0.19	34.600	0.18	26.0	8.19	97.6
	100 D	5.6	4.03	4.34	3.64	161.6	8.37	77.70	12.40	85.68	0.09	34.740	0.20	26.2	8.21	93.7
	150 S	0.5	3.41	1.12	2.52	140.5	7.75	74.20	11.16	77.84	0.05	34.800	0.12	26.1	8.21	95.7
	150 D	7.2	3.41	0.56	2.38	123.4	8.37	78.96	11.78	81.90	0.05	34.760	0.16	26.2	8.21	94.3
	200 S	0.6	2.79	BDL	2.38	116.1	10.23	97.30	13.02	99.82	0.05	34.790	0.13	26.2	8.22	96.2
	200 D	12.0	2.79	BDL	2.80	107.9	8.68	80.64	11.47	83.58	0.06	34.720	0.13	26.2	8.22	95.7
MAKENA 3-A	0 S	0.1	17.36	832.2	0.70	2900	6.51	92.96	23.87	925.8	0.38	30.100	0.49	25.7	8.06	97.3
	2 S	0.1	13.64	557.2	6.58	1934	6.51	134.7	20.15	698.5	0.43	31.680	0.48	25.8	8.09	96.2
	5 S	0.5	6.82	96.74	6.30	440.9	8.99	139.3	15.81	242.3	0.24	34.220	0.41	25.7	8.16	97.2
	5 D	1.1	8.06	98.98	9.66	474.6	6.82	131.3	14.88	240.0	0.26	34.140	0.57	25.8	8.16	97.2
	10 S	0.5	6.20	101.5	3.36	480.5	8.37	142.9	14.57	247.8	0.18	34.150	0.41	25.9	8.16	97.8
	10 D	2.9	8.68	71.40	7.14	381.3	8.68	141.1	17.36	219.7	0.20	34.330	0.76	25.9	8.17	96.2
	50 S	0.5	3.10	44.52	3.08	302.6	9.30	99.40	12.40	147.0	0.16	34.510	0.30	26.0	8.18	98.9
	50 D	4.5	4.34	51.94	4.06	316.7	8.99	88.76	13.33	144.8	0.16	34.530	0.30	26.1	8.17	92.4
	100 S	0.5	4.03	28.14	2.66	220.0	7.75	81.90	11.78	112.7	0.18	34.590	0.21	26.1	8.17	92.4
	100 D	5.0	2.79	9.66	3.92	141.6	8.99	83.02	11.78	96.60	0.10	34.770	0.19	26.2	8.20	93.1
	150 S	0.5	3.72	19.74	3.92	193.3	8.68	83.72	12.40	107.4	0.12	34.740	0.19	26.1	8.15	90.7
	150 D	10.4	4.96	5.60	3.92	138.0	6.51	92.96	11.47	102.5	0.11	34.760	0.15	26.2	8.19	94.1
MAKENA 3	0 S	0.1	4.65	33.74	4.76	236.9	12.09	152.7	16.74	191.2	0.16	34.550	0.51	26.0	8.22	99.2
	2 S	0.1	4.65	63.14	3.50	364.2	11.78	114.9	16.43	181.6	0.24	34.390	0.30	24.9	8.20	96.2
	5 S	0.5	3.41	3.22	4.76	116.9	9.30	125.0	12.71	133.0	0.09	34.740	0.30	26.2	8.20	97.4
	5 D	1.7	4.03	5.74	4.06	126.2	8.37	107.2	12.40	117.0	0.10	34.670	0.42	26.2	8.20	96.2
	10 S	0.5	4.03	0.70	3.50	106.8	8.06	115.8	12.09	120.0	0.08	34.700	0.20	26.2	8.20	97.2
	10 D	2.8	4.03	0.28	7.84	114.4	7.44	115.2	11.47	123.3	0.10	34.770	0.28	26.2	8.20	96.2
	50 S	0.5	3.10	2.94	5.88	131.5	8.06	83.30	11.16	92.12	0.10	34.840	0.16	26.1	8.17	99.7
	50 D	5.2	2.79	3.92	5.60	139.9	8.37	83.58	11.16	93.10	0.10	34.810	0.16	26.1	8.16	89.7
	100 S	0.5	3.72	8.12	3.36	166.4	8.06	84.70	11.78	96.18	0.12	34.740	0.16	26.1	8.16	90.0
	100 D	7.6	3.10	3.64	4.48	147.2	7.75	84.84	10.85	92.96	0.15	34.710	0.16	26.1	8.16	89.8
	150 S	0.5	3.41	BDL	2.24	111.6	8.06	92.12	11.47	94.36	0.07	34.810	0.09	26.2	8.20	101.6
	150 D	13.7	4.03	0.42	4.48	113.2	12.40	125.3	16.43	130.2	0.04	34.770	0.09	26.2	8.20	88.8
MAKENA 4	0 S	0.1	3.72	74.62	10.22	801.4	8.68	132.2	12.40	217.0	0.47	33.770	0.36	25.5	8.12	100.4
	2 S	0.1	4.96	51.94	14.15	617.1	8.99	126.3	13.95	192.4	0.51	34.000	0.30	26.0	8.13	99.4
	5 S	0.7	5.58	32.34	6.72	475.5	7.44	118.6	13.02	157.6	0.23	34.250	0.23	25.9	8.13	99.1
	5 D	2.7	5.89	30.80	7.98	469.0	8.37	167.3	14.26	206.1	0.23	34.210	0.40	26.0	8.13	98.2
	10 S	0.8	4.34	10.78	5.74	243.1	6.82	103.9	11.16	120.4	0.13	34.570	0.19	26.0	8.14	97.4
	10 D	2.5	4.34	8.40	6.02	239.7	5.89	98.84	10.23	113.3	0.13	34.570	0.20	26.0	8.15	97.4
	50 S	0.9	3.72	5.04	5.46	201.2	7.75	80.92	11.47	91.42	0.10	34.830	0.16	26.0	8.13	90.6
	50 D	4.5	2.79	5.32	14.29	203.4	9.92	98.98	12.71	118.6	0.09	34.780	0.19	26.0	8.13	87.4
	100 S	0.8	3.72	6.86	6.72	229.9	8.99	79.94	12.71	93.52	0.10	34.660	0.16	26.0	8.13	87.8
	100 D	7.0	3.72	1.82	7.42	161.3	8.37	79.52	12.09	88.76	0.09	34.700	0.17	26.0	8.14	84.9
	150 S	0.5	4.03	0.98	3.36	147.2	8.99	70.84	13.02	75.18	0.05	34.710	0.13	26.1	8.17	88.1
	150 D	9.7	3.72	0.56	3.64	132.9	9.92	91.14	13.64	95.34	0.09	34.710	0.13	26.1	8.16	83.8
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 form 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 (with nutrients reported in micromolar units) from water chemistry measurements off the Makena Resort collected since August 1995 from Sites 1, 2, and 4 (N=37); since June 2002 from Site 3 (N=28) and since June 2007 from Site 3-A (N=19). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL *a* = chlorophyll *a;* TEMP = temperture; O2 = dissolved oxygen; S=surface; D=deep; BDL=below detection limit. 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 a (µg/L)	TEMP (deg.C)	pH	O2
MAKENA 1	0 S	0.22	42.42	0.24	74.68	0.23	7.66	0.55	58.44	0.33	26.055	0.75	25.6	8.11	102.9
	2 S	0.19	27.60	0.19	51.04	0.26	8.03	0.50	40.43	0.30	29.510	0.74	25.7	8.14	104.6
	5 S	0.13	12.68	0.14	26.86	0.26	7.85	0.43	24.52	0.24	32.278	0.52	25.6	8.16	104.3
	5 D	0.11	9.79	0.19	22.17	0.27	7.32	0.41	20.30	0.21	33.058	0.48	25.6	8.17	104.1
	10 S	0.11	4.41	0.17	11.52	0.26	7.36	0.39	13.94	0.19	33.982	0.34	25.6	8.16	103.2
	10 D	0.10	2.84	0.22	8.29	0.28	7.14	0.39	11.59	0.17	34.285	0.35	25.6	8.15	103.1
	50 S	0.08	2.45	0.19	7.40	0.27	7.13	0.37	10.92	0.16	34.448	0.28	25.6	8.14	101.2
	50 D	0.08	0.36	0.15	2.92	0.28	7.11	0.37	8.02	0.12	34.796	0.26	25.6	8.14	99.0
	100 S	0.09	0.99	0.17	4.93	0.27	6.57	0.38	9.18	0.13	34.592	0.22	25.6	8.14	98.8
	100 D	0.07	0.13	0.11	2.35	0.28	7.07	0.37	7.60	0.10	34.848	0.20	25.6	8.15	97.6
	150 S	0.09	0.37	0.16	3.51	0.27	7.01	0.37	8.54	0.12	34.720	0.18	25.7	8.15	97.7
	150 D	0.08	0.07	0.13	2.08	0.27	6.95	0.37	7.29	0.10	34.872	0.16	25.6	8.16	98.3
MAKENA 2	0 S	0.20	4.77	0.37	22.96	0.31	7.93	0.54	14.22	0.84	33.399	0.74	25.6	8.15	99.5
	2 S	0.19	4.41	0.26	20.79	0.30	7.57	0.52	13.31	0.62	33.546	0.72	25.8	8.15	100.6
	5 S	0.17	3.50	0.24	15.67	0.28	6.91	0.47	11.44	0.43	33.967	0.54	25.7	8.15	100.6
	5 D	0.18	3.27	0.28	15.65	0.29	7.18	0.49	11.70	0.42	34.009	0.65	25.7	8.14	100.1
	10 S	0.13	1.74	0.20	9.51	0.29	5.87	0.44	9.22	0.31	34.388	0.38	25.6	8.15	99.2
	10 D	0.13	1.07	0.22	7.78	0.29	6.97	0.43	8.92	0.28	34.501	0.43	25.7	8.15	98.2
	50 S	0.11	1.21	0.23	7.76	0.31	7.38	0.44	9.58	0.23	34.439	0.31	25.6	8.14	97.7
	50 D	0.11	0.23	0.21	3.45	0.29	7.18	0.42	7.86	0.16	34.802	0.33	25.6	8.15	97.8
	100 S	0.10	0.44	0.17	4.35	0.28	7.02	0.40	8.03	0.16	34.669	0.25	25.7	8.14	98.4
	100 D	0.09	0.11	0.17	2.58	0.28	6.85	0.38	7.30	0.13	34.842	0.24	25.6	8.15	97.5
	150 S	0.09	0.24	0.18	3.35	0.28	7.08	0.39	7.78	0.13	34.778	0.20	25.7	8.15	97.7
	150 D	0.09	0.09	0.13	2.33	0.29	7.08	0.39	7.43	0.10	34.860	0.20	25.6	8.16	97.8
	200 S	0.07	0.11	0.14	2.66	0.29	6.95	0.38	7.47	0.11	34.839	0.21	25.8	8.16	98.3
	200 D	0.08	0.04	0.16	1.97	0.29	7.36	0.38	7.65	0.10	34.881	0.21	25.7	8.16	98.0
MAKENA 3-A	0 S	1.14	111.4	0.32	225.2	0.15	8.02	1.51	131.1	0.31	18.072	0.37	25.0	7.90	99.4
	2 S	0.80	75.51	0.38	148.5	0.23	7.77	1.24	97.09	0.24	23.935	0.44	25.2	7.94	100.6
	5 S	0.33	24.98	0.40	52.91	0.29	7.81	0.70	41.22	0.20	30.713	0.38	25.3	8.04	100.6
	5 D	0.25	16.92	0.38	38.50	0.27	7.26	0.59	28.85	0.19	32.331	0.41	25.4	8.08	100.9
	10 S	0.14	6.38	0.25	18.09	0.27	7.23	0.46	17.97	0.16	33.562	0.26	25.2	8.10	99.4
	10 D	0.11	2.00	0.24	7.85	0.26	6.90	0.40	10.89	0.16	34.416	0.30	25.4	8.12	99.4
	50 S	0.11	2.16	0.23	8.82	0.27	7.12	0.41	11.87	0.14	34.375	0.20	25.7	8.12	99.8
	50 D	0.08	0.29	0.24	3.73	0.30	7.40	0.41	8.36	0.14	34.824	0.21	25.7	8.13	98.1
	100 S	0.11	0.97	0.17	5.56	0.28	6.99	0.41	9.08	0.14	34.695	0.18	25.7	8.13	98.1
	100 D	0.11	0.10	0.24	2.89	0.26	6.75	0.39	7.32	0.11	34.889	0.17	25.7	8.14	98.4
	150 S	0.10	0.21	0.15	3.63	0.28	7.00	0.40	8.11	0.11	34.809	0.16	25.7	8.14	97.5
	150 D	0.09	0.05	0.18	2.46	0.27	6.86	0.38	7.25	0.10	34.894	0.16	25.6	8.15	99.4
MAKENA 3	0 S	0.15	8.76	0.31	20.26	0.27	6.54	0.48	23.11	0.32	33.647	0.45	25.9	8.14	100.1
	2 S	0.17	12.26	0.24	24.37	0.26	6.24	0.49	25.13	0.29	33.717	0.47	25.7	8.12	100.3
	5 S	0.15	7.79	0.23	17.11	0.27	7.19	0.47	19.77	0.22	34.067	0.33	25.7	8.12	100.9
	5 D	0.15	6.18	0.21	14.22	0.27	6.83	0.46	17.15	0.21	34.224	0.40	25.8	8.12	100.0
	10 S	0.11	3.16	0.25	9.30	0.28	7.10	0.42	13.83	0.18	34.422	0.25	25.6	8.11	99.0
	10 D	0.11	1.66	0.20	6.66	0.27	7.11	0.40	11.22	0.16	34.618	0.27	25.6	8.11	98.1
	50 S	0.09	1.11	0.18	5.04	0.28	7.16	0.39	9.59	0.13	34.722	0.20	25.7	8.12	97.0
	50 D	0.10	0.32	0.18	3.37	0.28	7.24	0.39	8.16	0.11	34.839	0.20	25.6	8.13	95.3
	100 S	0.09	0.48	0.19	3.46	0.28	7.05	0.38	8.29	0.11	34.791	0.15	25.7	8.13	96.6
	100 D	0.08	0.13	0.19	2.35	0.28	6.62	0.38	7.11	0.09	34.862	0.16	25.6	8.14	96.6
	150 S	0.07	0.16	0.14	2.73	0.27	6.76	0.36	7.48	0.10	34.829	0.14	25.7	8.15	97.2
	150 D	0.07	0.06	0.11	2.10	0.27	6.81	0.36	7.11	0.09	34.895	0.16	25.6	8.17	97.9
MAKENA 4	0 S	0.25	6.82	0.37	50.44	0.25	6.95	0.60	18.65	0.42	30.526	0.55	25.4	8.09	102.0
	2 S	0.25	5.63	0.31	43.06	0.26	6.87	0.57	16.34	0.35	31.612	0.43	25.4	8.10	102.6
	5 S	0.16	1.88	0.27	18.38	0.25	7.30	0.44	10.80	0.23	33.733	0.37	25.4	8.11	103.0
	5 D	0.14	1.58	0.23	16.23	0.26	7.00	0.43	9.97	0.21	33.948	0.41	25.4	8.11	102.1
	10 S	0.11	0.82	0.24	9.32	0.27	6.91	0.40	8.27	0.18	34.457	0.23	25.4	8.10	100.1
	10 D	0.12	0.58	0.20	8.39	0.26	6.85	0.39	8.02	0.17	34.495	0.24	25.4	8.10	100.6
	50 S	0.10	0.52	0.27	6.55	0.28	7.31	0.38	8.48	0.15	34.613	0.20	25.3	8.10	96.2
	50 D	0.09	0.21	0.18	4.14	0.27	6.87	0.38	7.38	0.14	34.795	0.20	25.4	8.10	95.6
	100 S	0.09	0.28	0.19	4.61	0.28	6.84	0.39	7.57	0.12	34.732	0.15	25.4	8.12	95.6
	100 D	0.09	0.13	0.17	3.17	0.27	6.82	0.38	7.31	0.11	34.830	0.17	25.4	8.13	94.6
	150 S	0.10	0.12	0.16	2.92	0.26	6.84	0.41	7.43	0.10	34.809	0.13	25.5	8.14	96.8
	150 D	0.08	0.07	0.13	2.41	0.27	6.82	0.38	7.19	0.10	34.864	0.15	25.5	8.15	95.9
DOH WQS GEOMETRIC MEAN	DRY	0.25	0.14				0.52	7.86	0.20	*	0.15	**	***		
	WET	0.36	0.25				0.64	10.71	0.50		0.30				

* Salinity shall not vary more than ten percent form 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 (with nutrient data reported in µg/L) from water chemistry measurements off the Makena Resort collected since August 1995 for Sites 1, 2, and 4 (N=37); since June 2002 from Site 3 (N=28) and since June 2007 from Site 3-A (N=19). For geometric mean calculations, detection limits were used in cases where sample was below detection limit. Abbreviations as follows: DFS=distance from shore; TURB = turbidity; CHL *a* = chlorophyll *a*; TEMP = temperture; O2 = dissolved oxygen; 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-} (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 *a* (µg/L)	TEMP (deg.C)	pH	O2
MAKENA 1	0 S	6.80	594.1	3.30	2098	7.10	107.2	17.00	818.5	0.33	26.055	0.75	25.6	8.11	102.9
	2 S	5.80	386.5	2.60	1434	8.00	112.4	15.40	566.2	0.30	29.510	0.74	25.7	8.14	104.6
	5 S	4.00	177.5	1.90	754.5	8.00	109.9	13.30	343.4	0.24	32.278	0.52	25.6	8.16	104.3
	5 D	3.40	137.1	2.60	622.8	8.30	102.5	12.60	284.3	0.21	33.058	0.48	25.6	8.17	104.1
	10 S	3.40	61.70	2.30	323.6	8.00	103.0	12.00	195.2	0.19	33.982	0.34	25.6	8.16	103.2
	10 D	3.00	39.70	3.00	232.9	8.60	100.0	12.00	162.3	0.17	34.285	0.35	25.6	8.15	103.1
	50 S	2.40	34.30	2.60	207.9	8.30	99.80	11.40	152.9	0.16	34.448	0.28	25.6	8.14	101.2
	50 D	2.40	5.00	2.10	82.02	8.60	99.50	11.40	112.3	0.12	34.796	0.26	25.6	8.14	99.0
	100 S	2.70	13.80	2.30	138.5	8.30	92.00	11.70	128.5	0.13	34.592	0.22	25.6	8.14	98.8
	100 D	2.10	1.80	1.50	66.01	8.60	99.00	11.40	106.4	0.10	34.848	0.20	25.6	8.15	97.6
	150 S	2.70	5.10	2.20	98.60	8.30	98.10	11.40	119.6	0.12	34.720	0.18	25.7	8.15	97.7
	150 D	2.40	0.90	1.80	58.43	8.30	97.30	11.40	102.1	0.10	34.872	0.16	25.6	8.16	98.3
MAKENA 2	0 S	6.10	66.80	5.10	644.9	9.60	111.0	16.70	199.1	0.84	33.399	0.74	25.6	8.15	99.5
	2 S	5.80	61.70	3.60	584.0	9.20	106.0	16.10	186.4	0.62	33.546	0.72	25.8	8.15	100.6
	5 S	5.20	49.00	3.30	440.2	8.60	96.70	14.50	160.2	0.43	33.967	0.54	25.7	8.15	100.6
	5 D	5.50	45.70	3.90	439.6	8.90	100.5	15.10	163.8	0.42	34.009	0.65	25.7	8.14	100.1
	10 S	4.00	24.30	2.80	267.1	8.90	82.20	13.60	129.1	0.31	34.388	0.38	25.6	8.15	99.2
	10 D	4.00	14.90	3.00	218.5	8.90	97.60	13.30	124.9	0.28	34.501	0.43	25.7	8.15	98.2
	50 S	3.40	16.90	3.20	218.0	9.60	103.3	13.60	134.1	0.23	34.439	0.31	25.6	8.14	97.7
	50 D	3.40	3.20	2.90	96.91	8.90	100.5	13.00	110.0	0.16	34.802	0.33	25.6	8.15	97.8
	100 S	3.00	6.10	2.30	122.2	8.60	98.30	12.30	112.4	0.16	34.669	0.25	25.7	8.14	98.4
	100 D	2.70	1.50	2.30	72.47	8.60	95.90	11.70	102.2	0.13	34.842	0.24	25.6	8.15	97.5
	150 S	2.70	3.30	2.50	94.10	8.60	99.10	12.00	108.9	0.13	34.778	0.20	25.7	8.15	97.7
	150 D	2.70	1.20	1.80	65.45	8.90	99.10	12.00	104.0	0.10	34.860	0.20	25.6	8.16	97.8
	200 S	2.10	1.50	1.90	74.72	8.90	97.30	11.70	104.6	0.11	34.839	0.21	25.8	8.16	98.3
	200 D	2.40	0.50	2.20	55.34	8.90	103.0	11.70	107.1	0.10	34.881	0.21	25.7	8.16	98.0
MAKENA 3-A	0 S	35.30	1560	4.40	6326	4.60	112.3	46.70	1836	0.31	18.072	0.37	25.0	7.9	99.4
	2 S	24.70	1058	5.30	4172	7.10	108.8	38.40	1360	0.24	23.935	0.44	25.2	7.94	100.6
	5 S	10.20	349.8	5.60	1486	8.90	109.3	21.60	577.3	0.20	30.713	0.38	25.3	8.04	100.6
	5 D	7.70	236.9	5.30	1081	8.30	101.6	18.20	404.0	0.19	32.331	0.41	25.4	8.08	100.9
	10 S	4.30	89.30	3.50	508.1	8.30	101.2	14.20	251.6	0.16	33.562	0.26	25.2	8.1	99.4
	10 D	3.40	28.00	3.30	220.5	8.00	96.60	12.30	152.5	0.16	34.416	0.30	25.4	8.12	99.4
	50 S	3.40	30.20	3.20	247.8	8.30	99.70	12.60	166.2	0.14	34.375	0.20	25.7	8.12	99.8
	50 D	2.40	4.00	3.30	104.8	9.20	103.6	12.60	117.0	0.14	34.824	0.21	25.7	8.13	98.1
	100 S	3.40	13.50	2.30	156.2	8.60	97.90	12.60	127.1	0.14	34.695	0.18	25.7	8.13	98.1
	100 D	3.40	1.40	3.30	81.18	8.00	94.50	12.00	102.5	0.11	34.889	0.17	25.7	8.14	98.4
	150 S	3.00	2.90	2.10	102.0	8.60	98.00	12.30	113.5	0.11	34.809	0.16	25.7	8.14	97.5
	150 D	2.70	0.70	2.50	69.10	8.30	96.00	11.70	101.5	0.10	34.894	0.16	25.6	8.15	99.4
MAKENA 3	0 S	4.60	122.6	4.30	569.1	8.30	91.50	14.80	323.6	0.32	33.647	0.45	25.9	8.14	100.1
	2 S	5.20	171.7	3.30	684.6	8.00	87.30	15.10	351.9	0.29	33.717	0.47	25.7	8.12	100.3
	5 S	4.60	109.1	3.20	480.6	8.30	100.7	14.50	276.8	0.22	34.067	0.33	25.7	8.12	100.9
	5 D	4.60	86.50	2.90	399.4	8.30	95.60	14.20	240.2	0.21	34.224	0.40	25.8	8.12	100.0
	10 S	3.40	44.20	3.50	261.2	8.60	99.40	13.00	193.7	0.18	34.422	0.25	25.6	8.11	99.0
	10 D	3.40	23.20	2.80	187.1	8.30	99.50	12.30	157.1	0.16	34.618	0.27	25.6	8.11	98.1
	50 S	2.70	15.50	2.50	141.6	8.60	100.2	12.00	134.3	0.13	34.722	0.20	25.7	8.12	97.0
	50 D	3.00	4.40	2.50	94.66	8.60	101.4	12.00	114.2	0.11	34.839	0.20	25.6	8.13	95.3
	100 S	2.70	6.70	2.60	97.19	8.60	98.70	11.70	116.1	0.11	34.791	0.15	25.7	8.13	96.6
	100 D	2.40	1.80	2.60	66.01	8.60	92.70	11.70	99.50	0.09	34.862	0.16	25.6	8.14	96.6
	150 S	2.10	2.20	1.90	76.69	8.30	94.60	11.10	104.7	0.10	34.829	0.14	25.7	8.15	97.2
	150 D	2.10	0.80	1.50	58.99	8.30	95.30	11.10	99.50	0.09	34.895	0.16	25.6	8.17	97.9
MAKENA 4	0 S	7.70	95.50	5.10	1417	7.70	97.30	18.50	261.2	0.42	30.526	0.55	25.4	8.09	102.0
	2 S	7.70	78.80	4.30	1210	8.00	96.20	17.60	228.8	0.35	31.612	0.43	25.4	8.1	102.6
	5 S	4.90	26.30	3.70	516.3	7.70	102.2	13.60	151.2	0.23	33.733	0.37	25.4	8.11	103.0
	5 D	4.30	22.10	3.20	455.9	8.00	98.00	13.30	139.6	0.21	33.948	0.41	25.4	8.11	102.1
	10 S	3.40	11.40	3.30	261.8	8.30	96.70	12.30	115.8	0.18	34.457	0.23	25.4	8.1	100.1
	10 D	3.70	8.10	2.80	235.7	8.00	95.90	12.00	112.3	0.17	34.495	0.24	25.4	8.1	100.6
	50 S	3.00	7.20	3.70	184.0	8.60	102.3	11.70	118.7	0.15	34.613	0.20	25.3	8.1	96.2
	50 D	2.70	2.90	2.50	116.3	8.30	96.20	11.70	103.3	0.14	34.795	0.20	25.4	8.10	95.6
	100 S	2.70	3.90	2.60	129.5	8.60	95.80	12.00	106.0	0.12	34.732	0.15	25.4	8.12	95.6
	100 D	2.70	1.80	2.30	89.05	8.30	95.50	11.70	102.3	0.11	34.830	0.17	25.4	8.13	94.6
	150 S	3.00	1.60	2.20	82.02	8.00	95.80	12.60	104.0	0.10	34.809	0.13	25.5	8.14	96.8
	150 D	2.40	0.90	1.80	67.70	8.30	95.50	11.70	100.7	0.10	34.864	0.15	25.5	8.15	95.9
DOH WQS GEOMETRIC MEAN	DRY	3.50	2.00					16.00	110.0	0.20	*	0.15	**	***	
	WET	5.00	3.50					20.00	150.00	0.50		0.30			

* Salinity shall not vary more than ten percent form 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 (top) and µg/L (bottom) from irrigation wells collected in the vicinity of the Makena Resort on November 30, 2017. For sampling site locations, see Figure 1.

WELL	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	SALINITY (ppt)	pH (std.units)
1	2.25	141.1	0.35	514.0	0.20	6.10	2.45	147.5	1.040	7.95
2	3.05	134.2	bdl	689.0	0.70	10.40	3.75	144.6	1.480	7.57
3	3.30	129.8	0.25	690.0	0.10	5.10	3.40	135.1	1.630	7.56
4	3.55	124.8	0.50	637.0	0.35	27.80	3.90	153.1	1.570	7.68
6	2.85	187.6	0.55	543.3	0.30	13.25	3.15	201.4	1.260	7.97
8	2.90	109.9	0.30	601.4	0.35	17.00	3.25	127.2	1.820	7.90

WELL	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)	SALINITY (ppt)	pH (std.units)
1	69.75	1974.7	4.90	14442.0	6.20	85.40	75.95	2065.0	1.040	7.95
2	94.55	1878.1	bdl	19360.9	21.70	145.60	116.25	2023.7	1.480	7.57
3	102.30	1816.5	3.50	19389.0	3.10	71.40	105.40	1891.4	1.630	7.56
4	110.05	1747.2	7.00	17898.3	10.85	389.20	120.90	2143.4	1.570	7.68
6	88.35	2626.4	7.70	15265.3	9.30	185.50	97.65	2819.6	1.260	7.97
8	89.90	1538.6	4.20	16897.9	10.85	238.00	100.75	1780.8	1.820	7.90

bdl=below detection limit

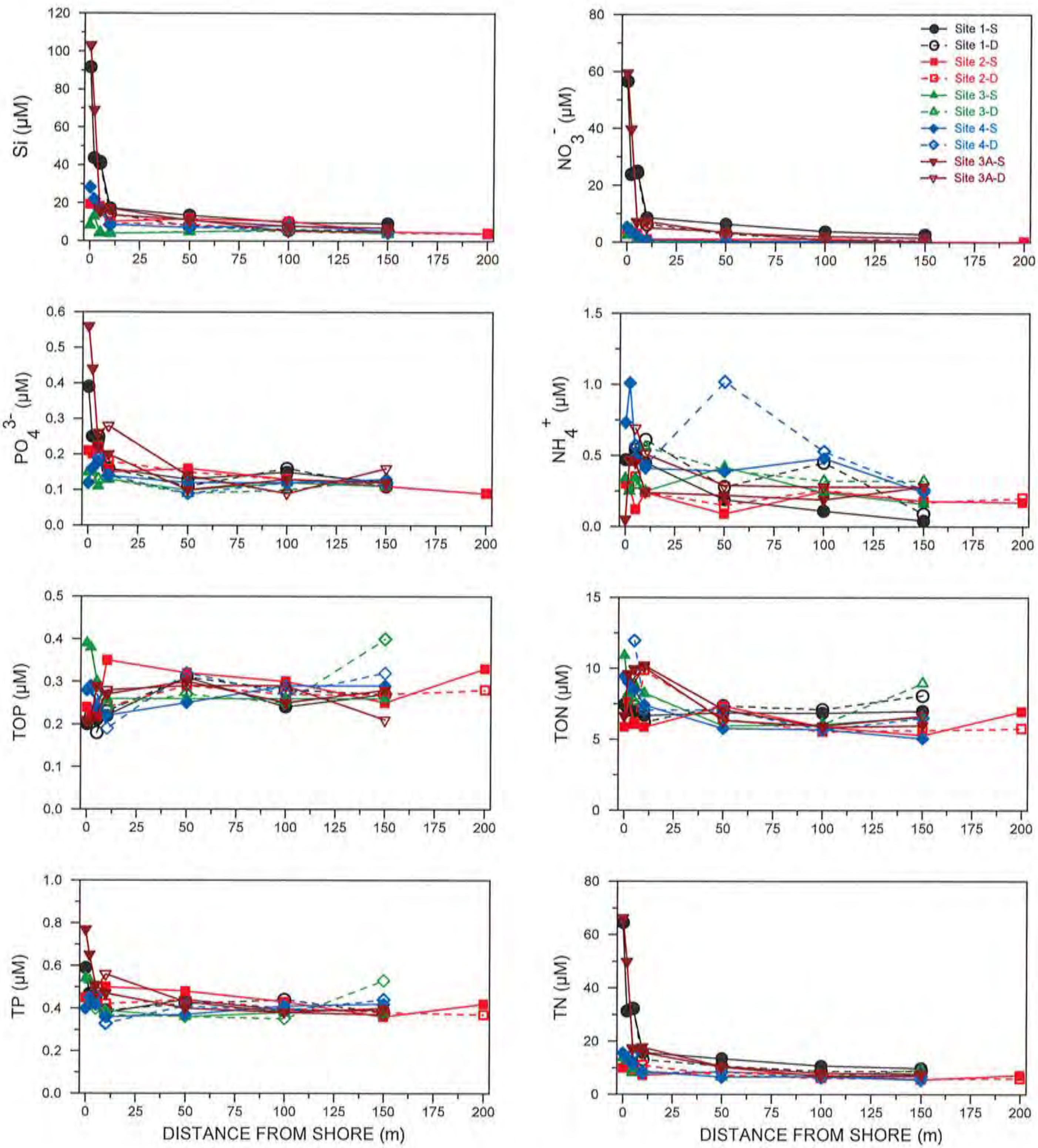

FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on December 2, 2017 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

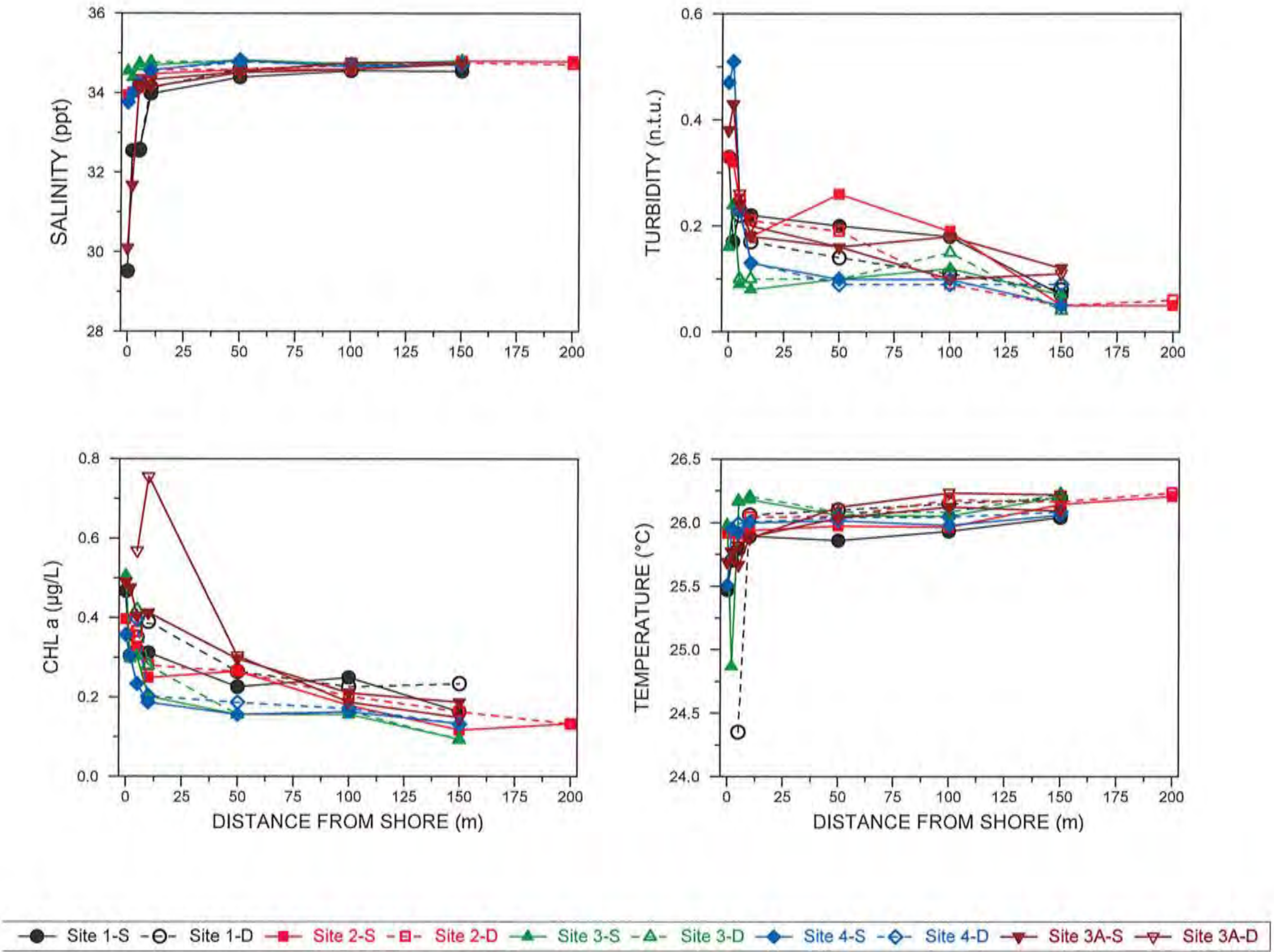

FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on December 2, 2017 as a function of distance from the shoreline in the vicinity of Makena Resort. For site locations, see Figure 1.

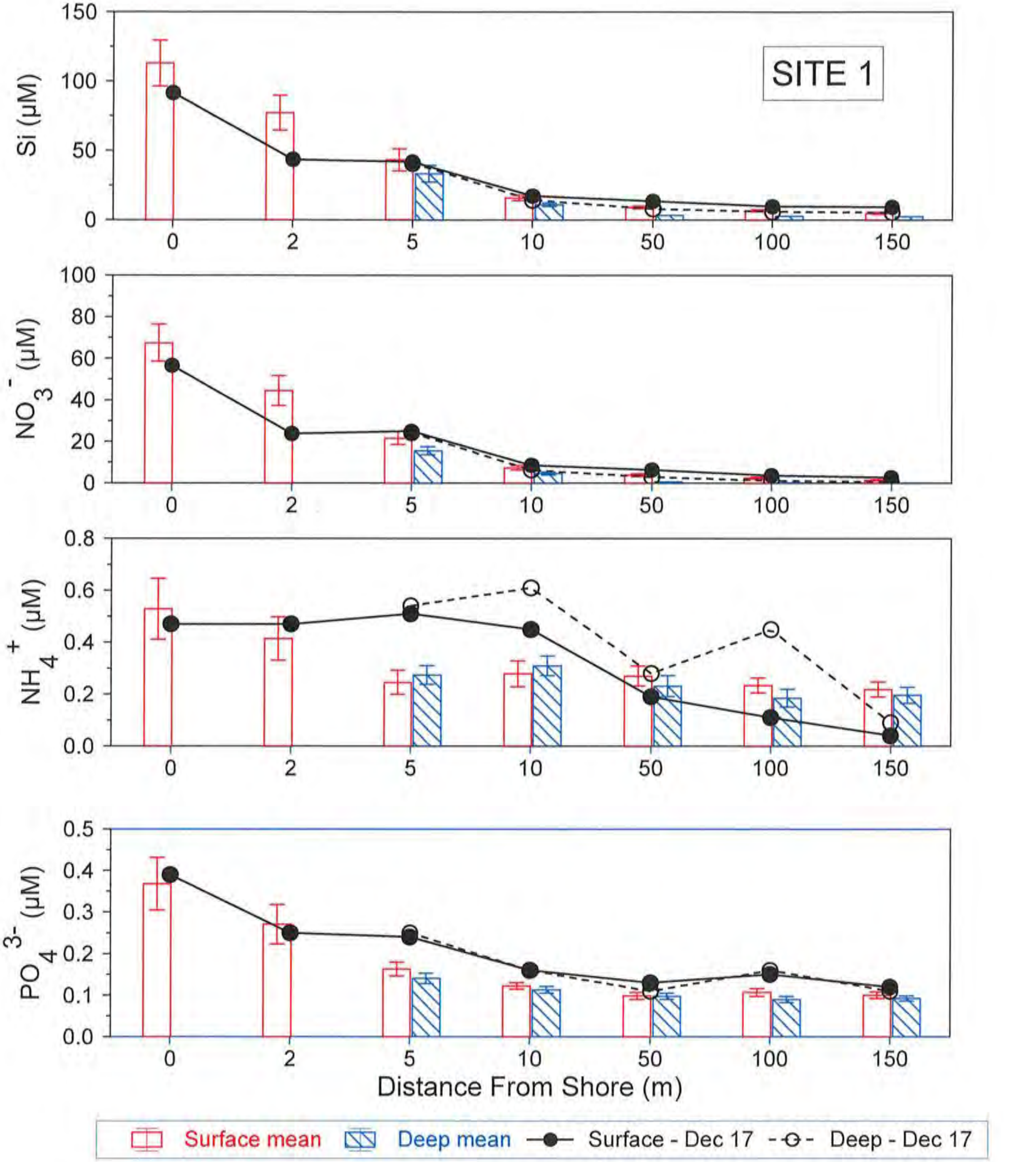

FIGURE 4. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

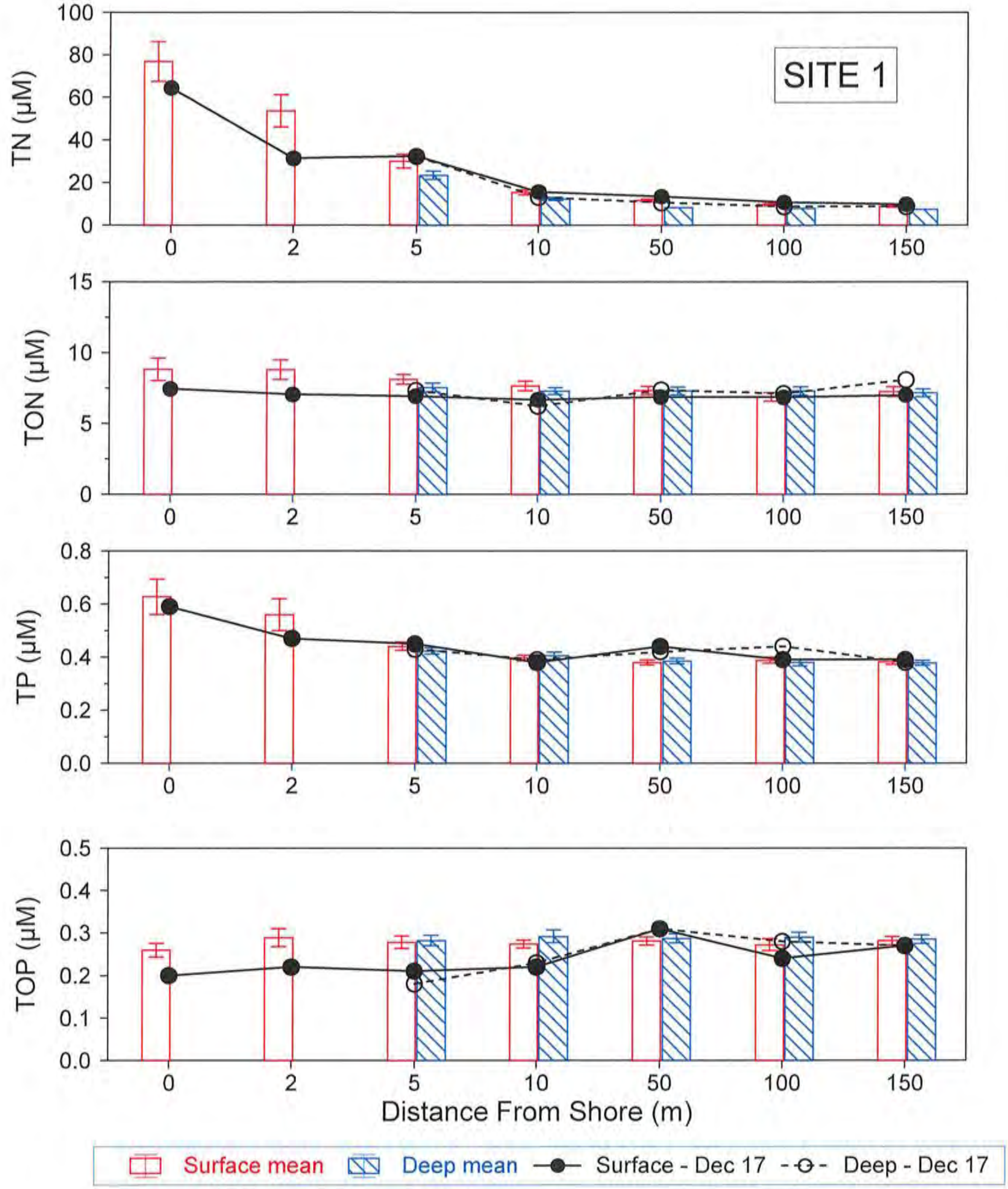

FIGURE 5. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

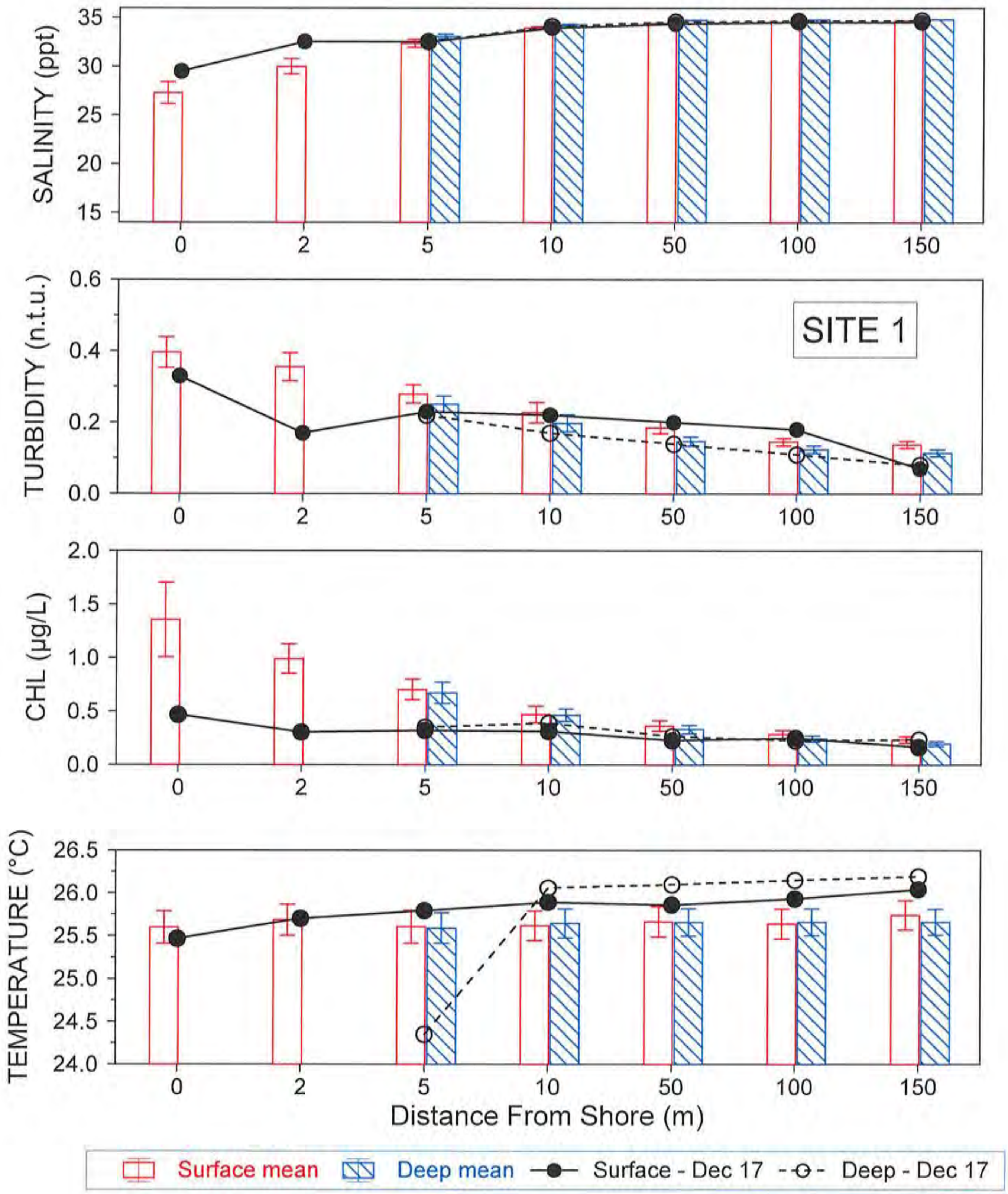

FIGURE 6. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 1, offshore of the Makena Resort. Data points and connected lines from samples collected during the most survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

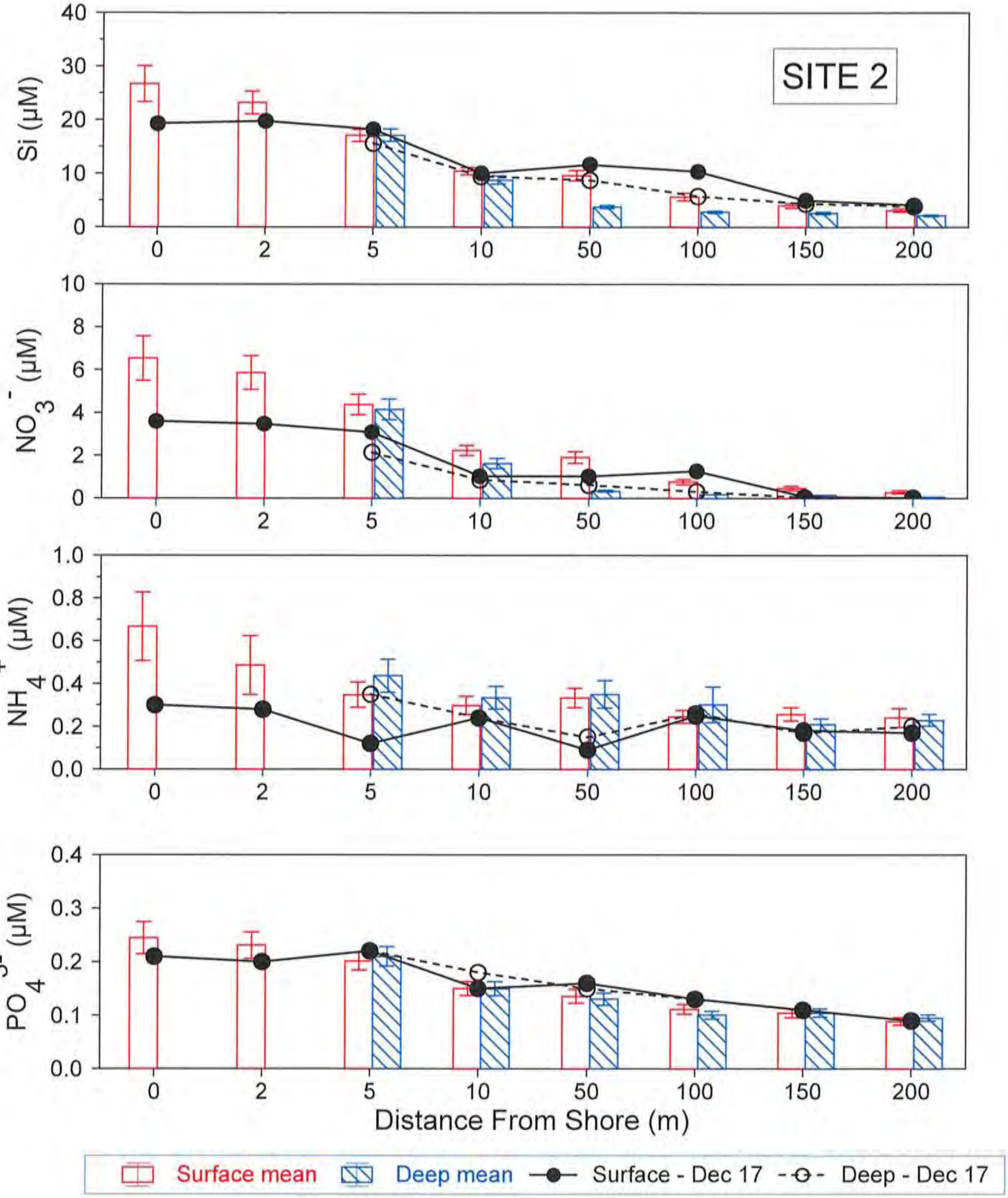

FIGURE 7. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

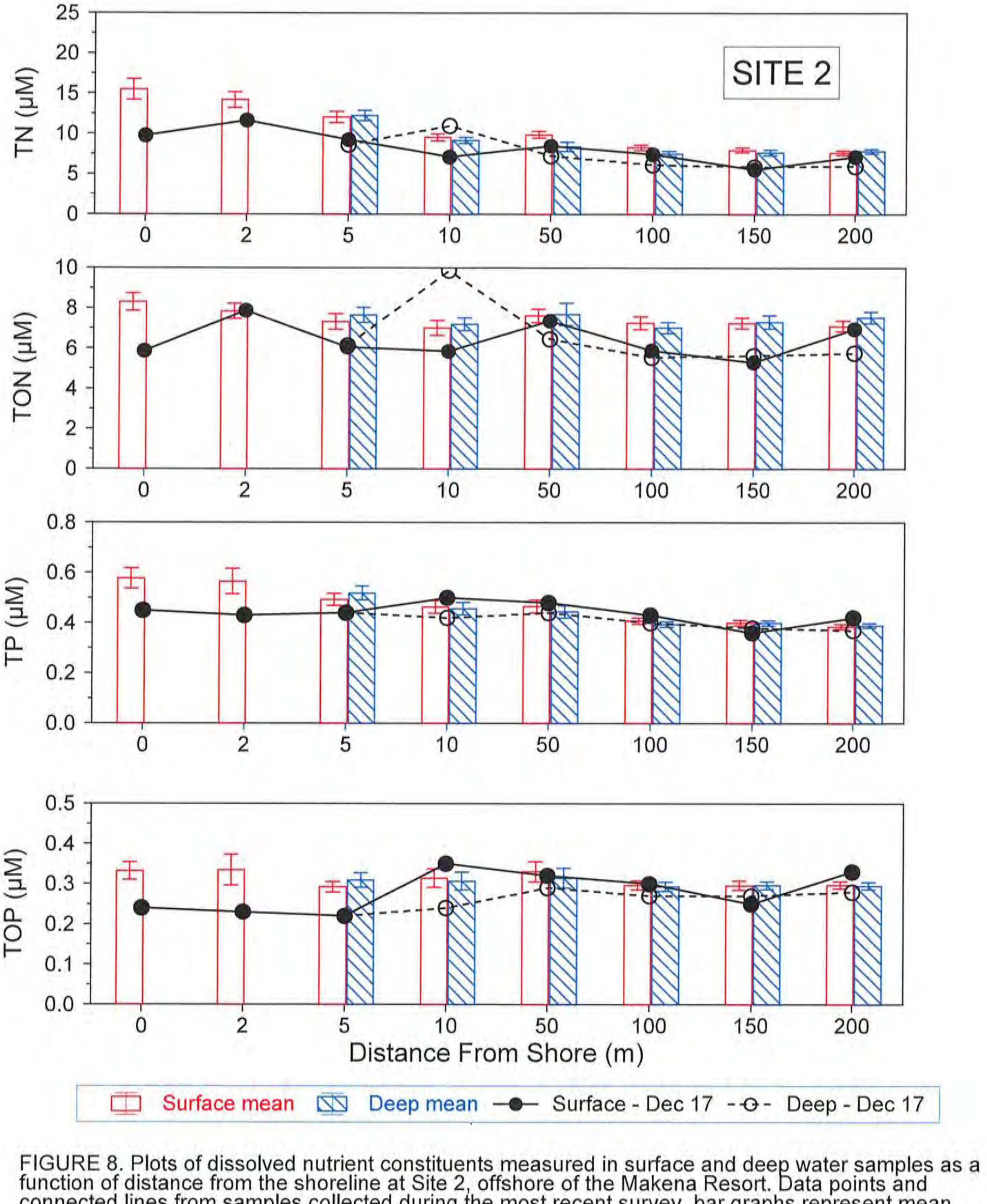

FIGURE 8. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

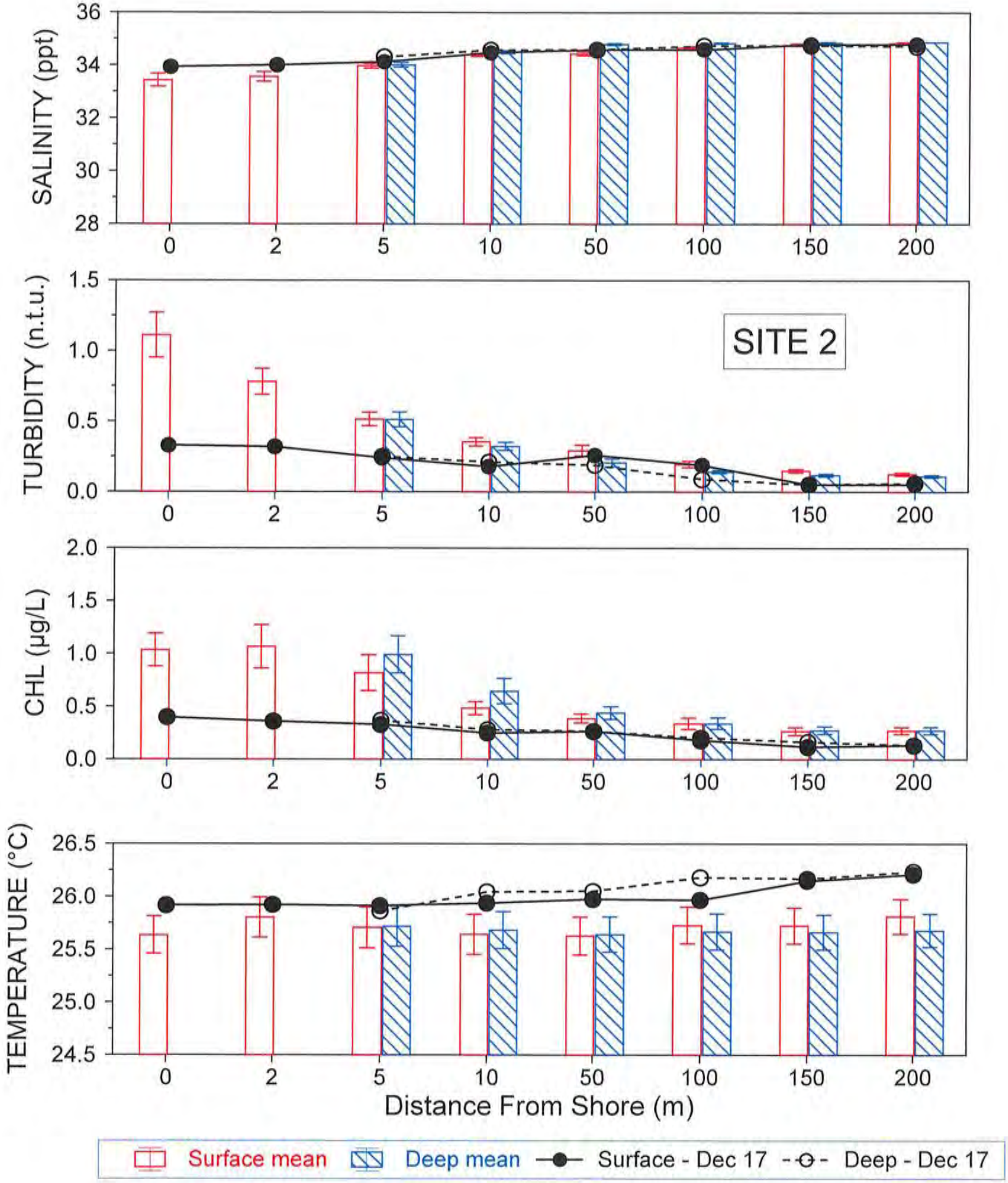

FIGURE 9. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 2, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey,bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

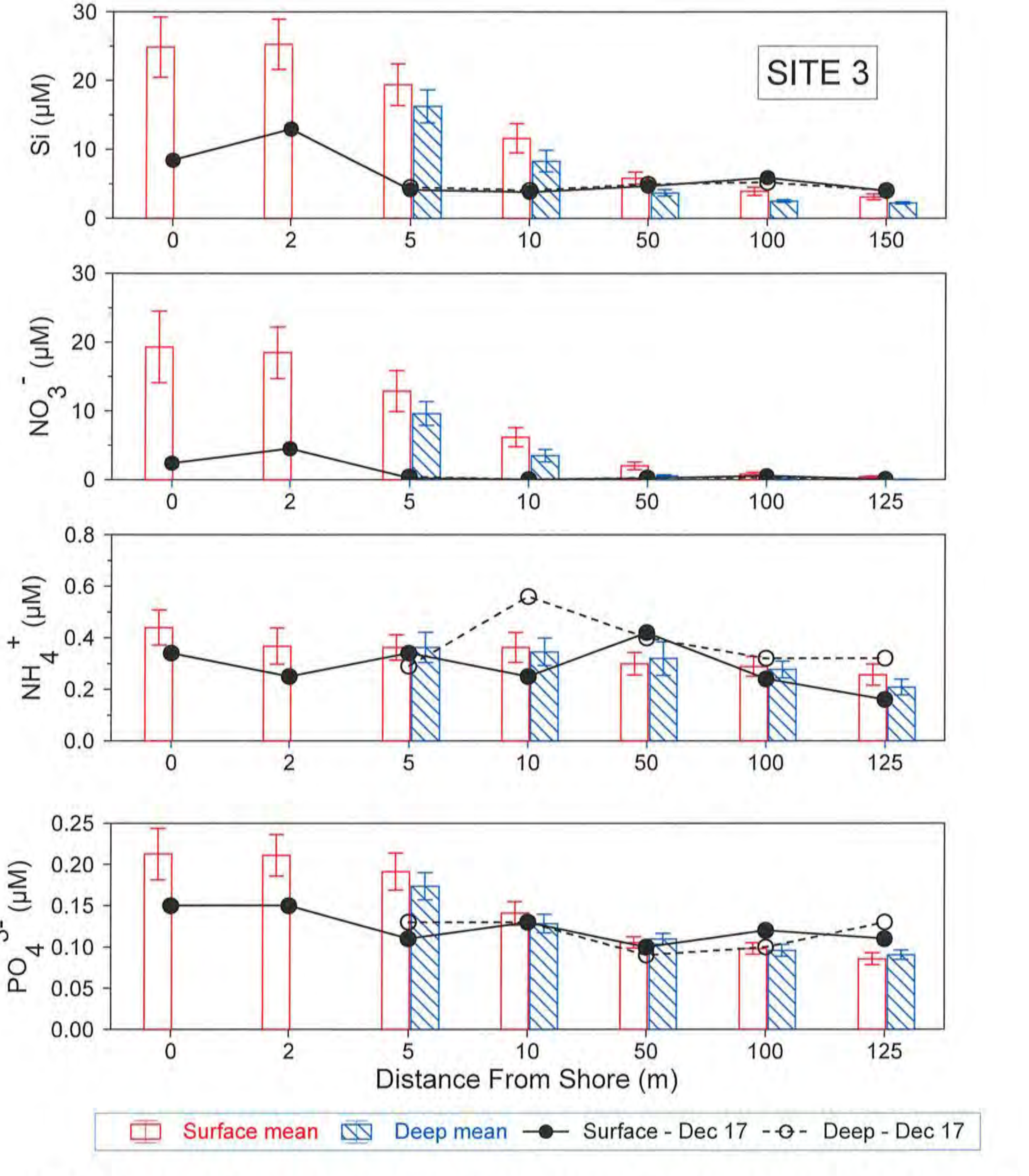

FIGURE 10. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

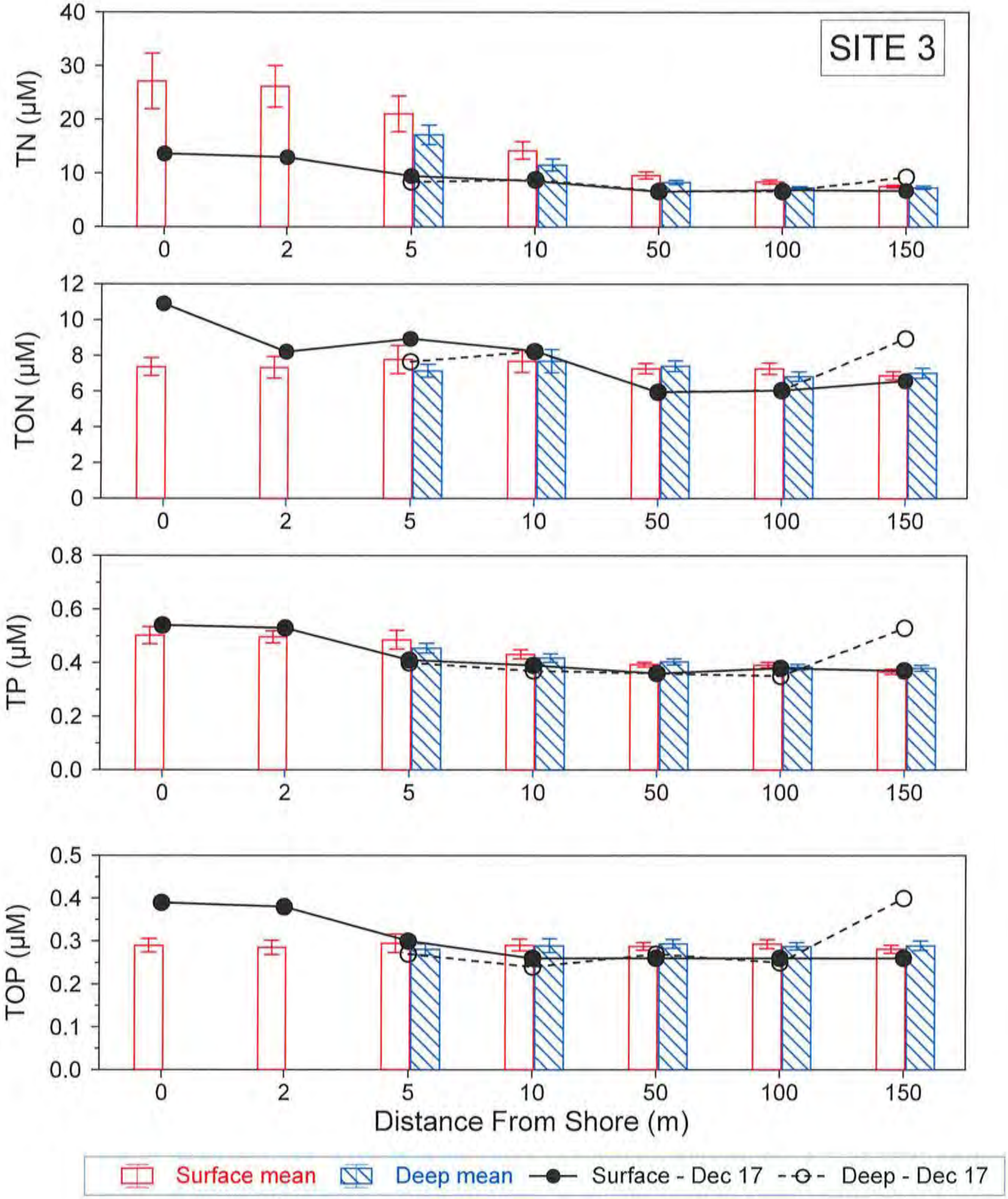

FIGURE 11. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

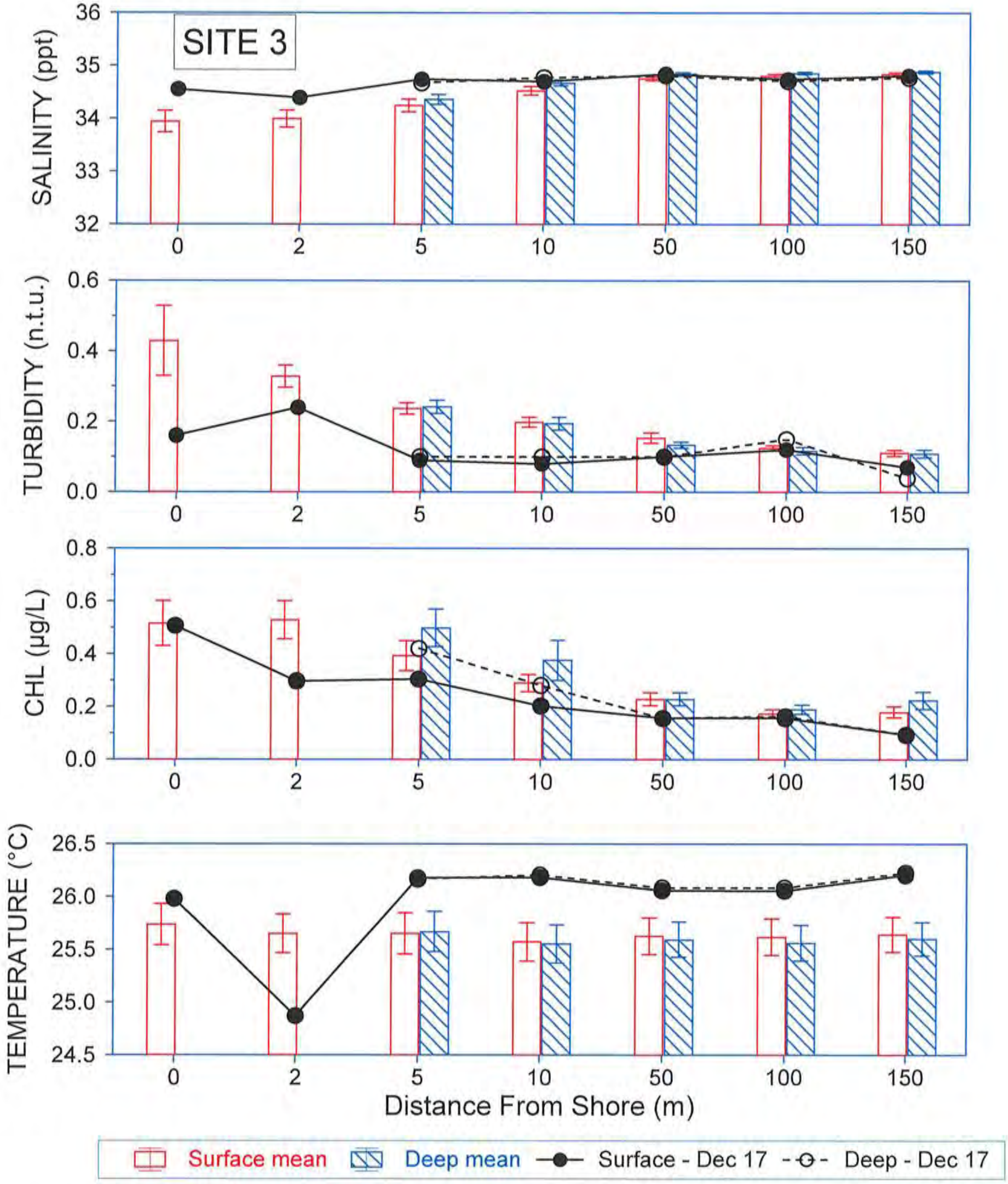

FIGURE 12. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

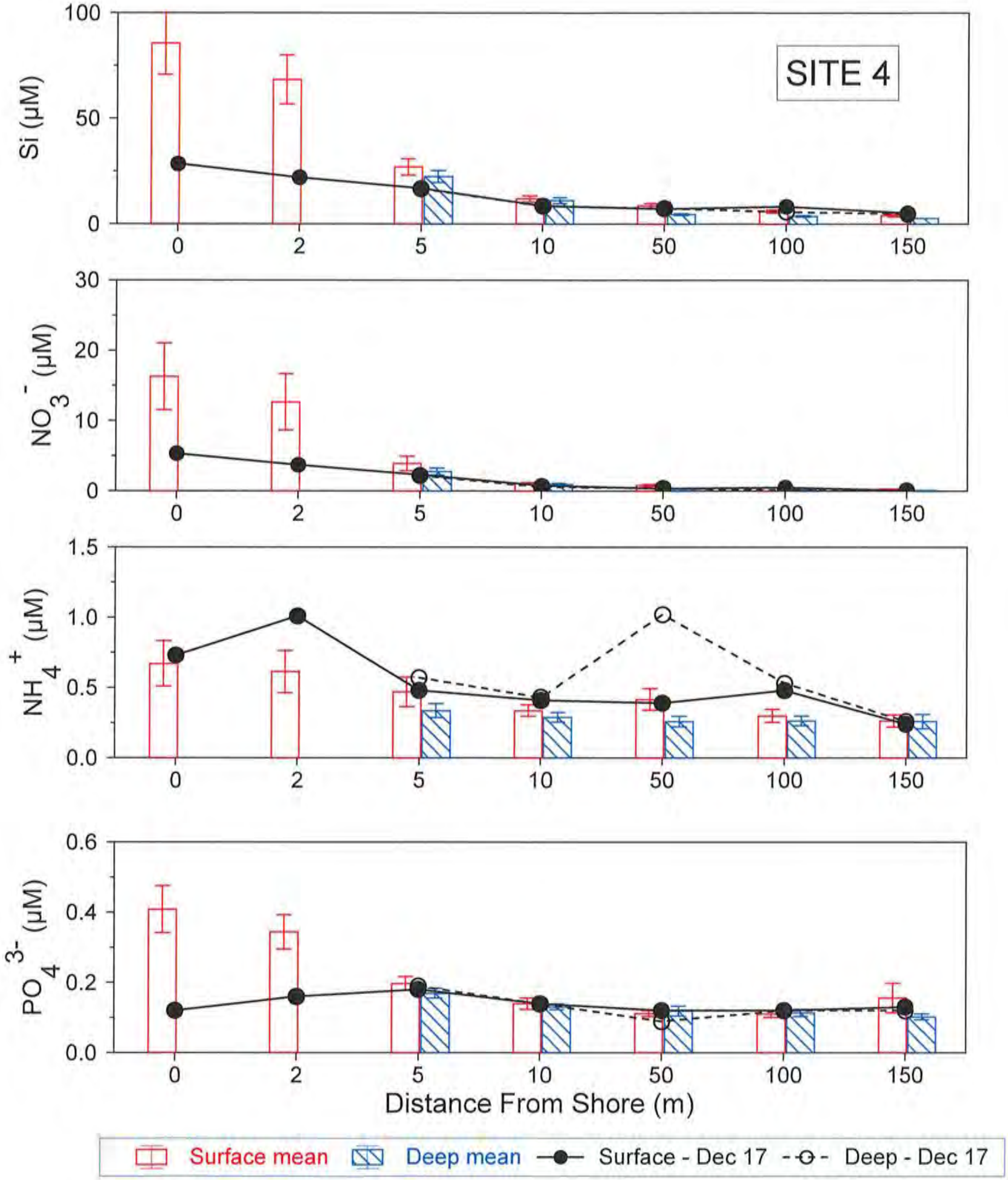

FIGURE 13. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

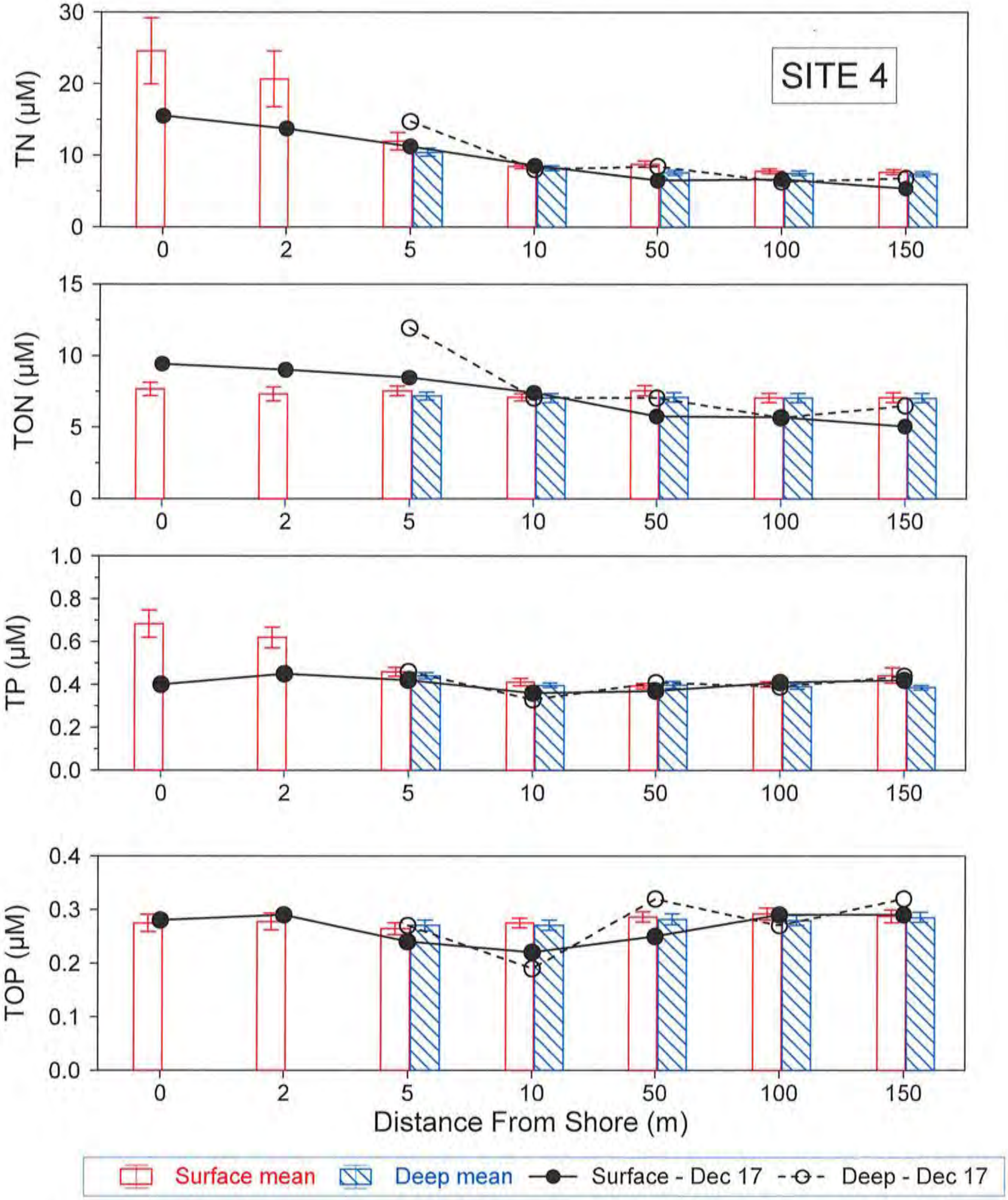

FIGURE 14. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

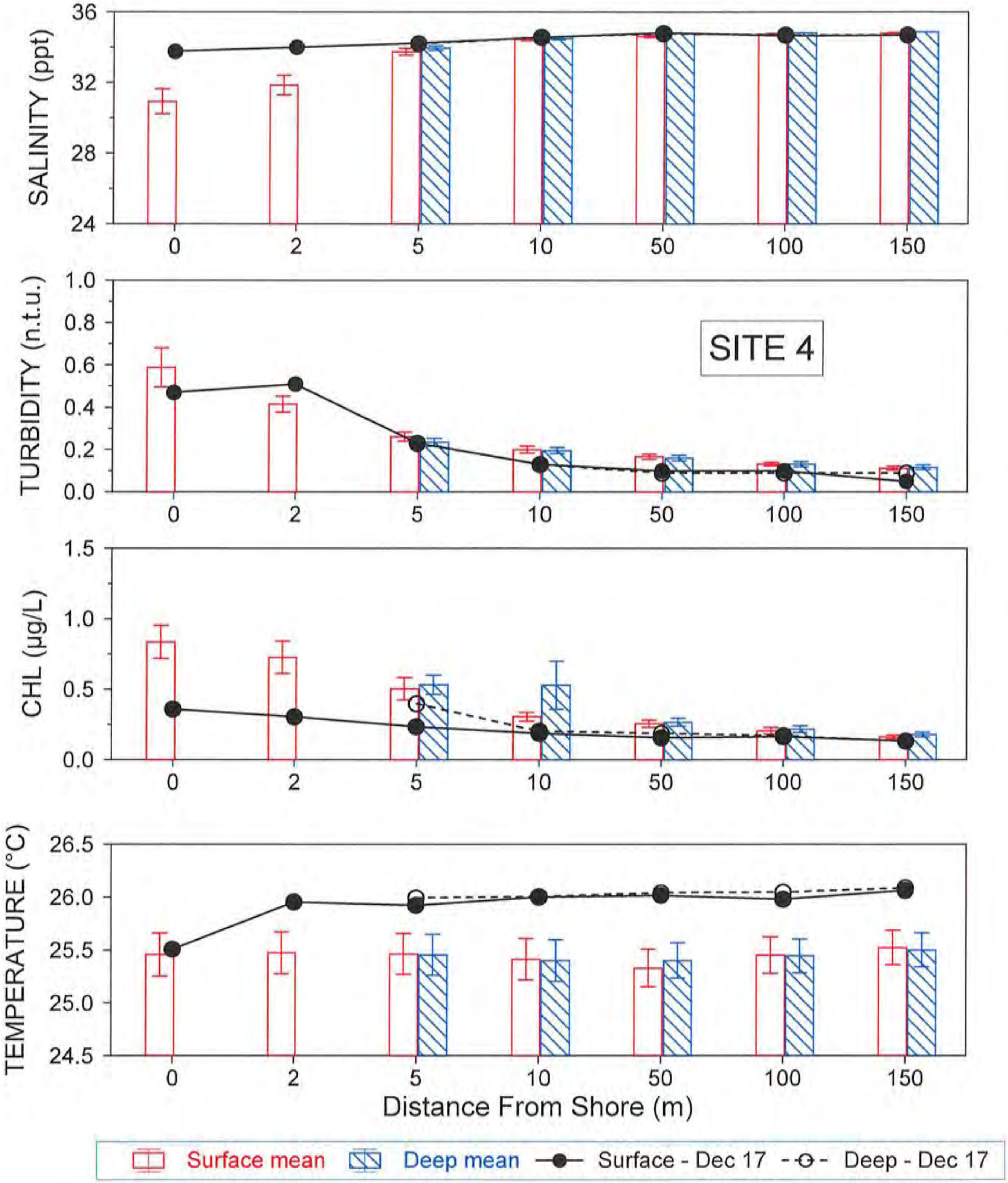

FIGURE 15. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 4, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since August 1995 (N=37). Error bars represent standard error of the mean. For site location, see Figure 1.

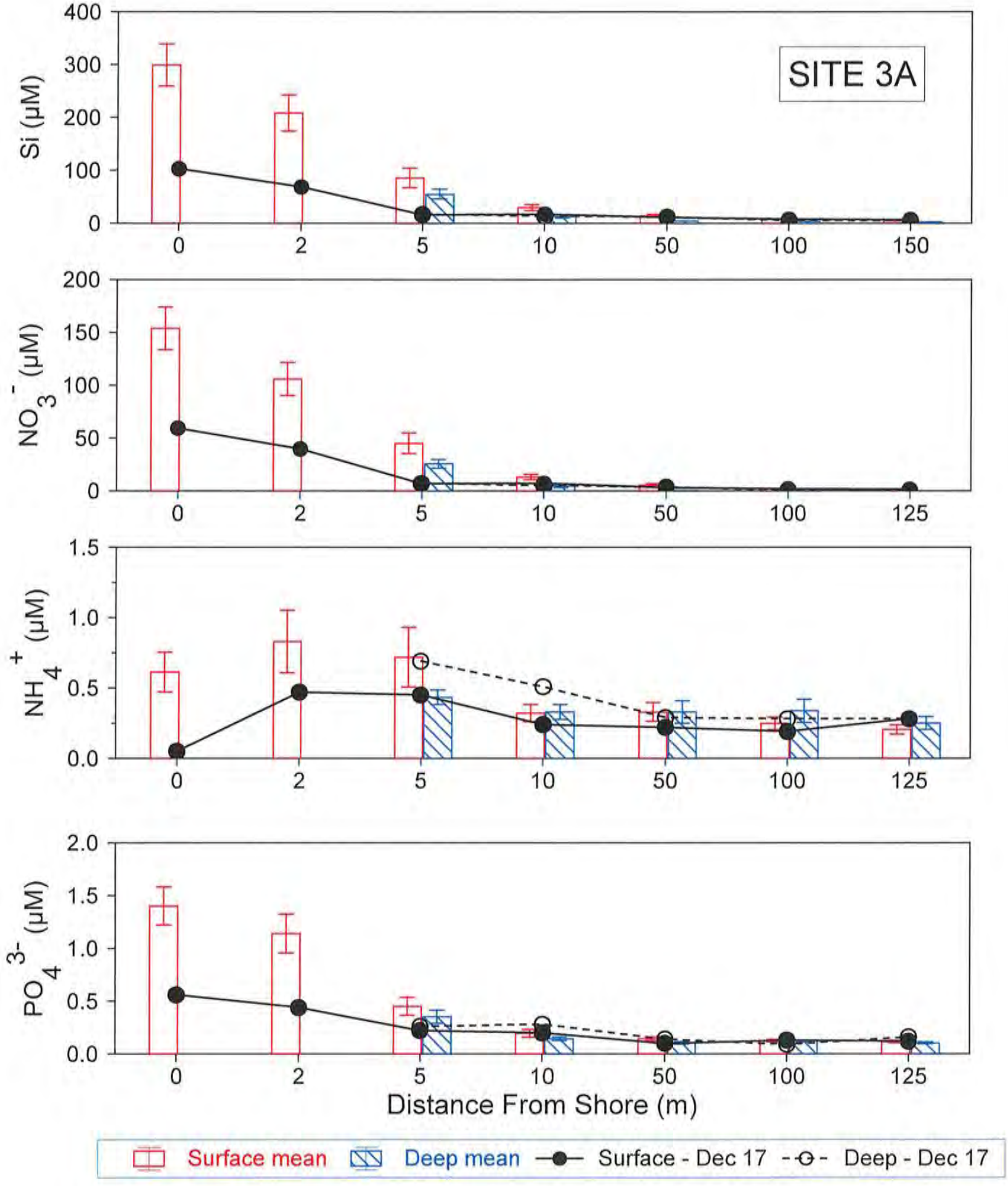

FIGURE 16. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=19). Error bars represent standard error of the mean. For site location, see Figure 1.

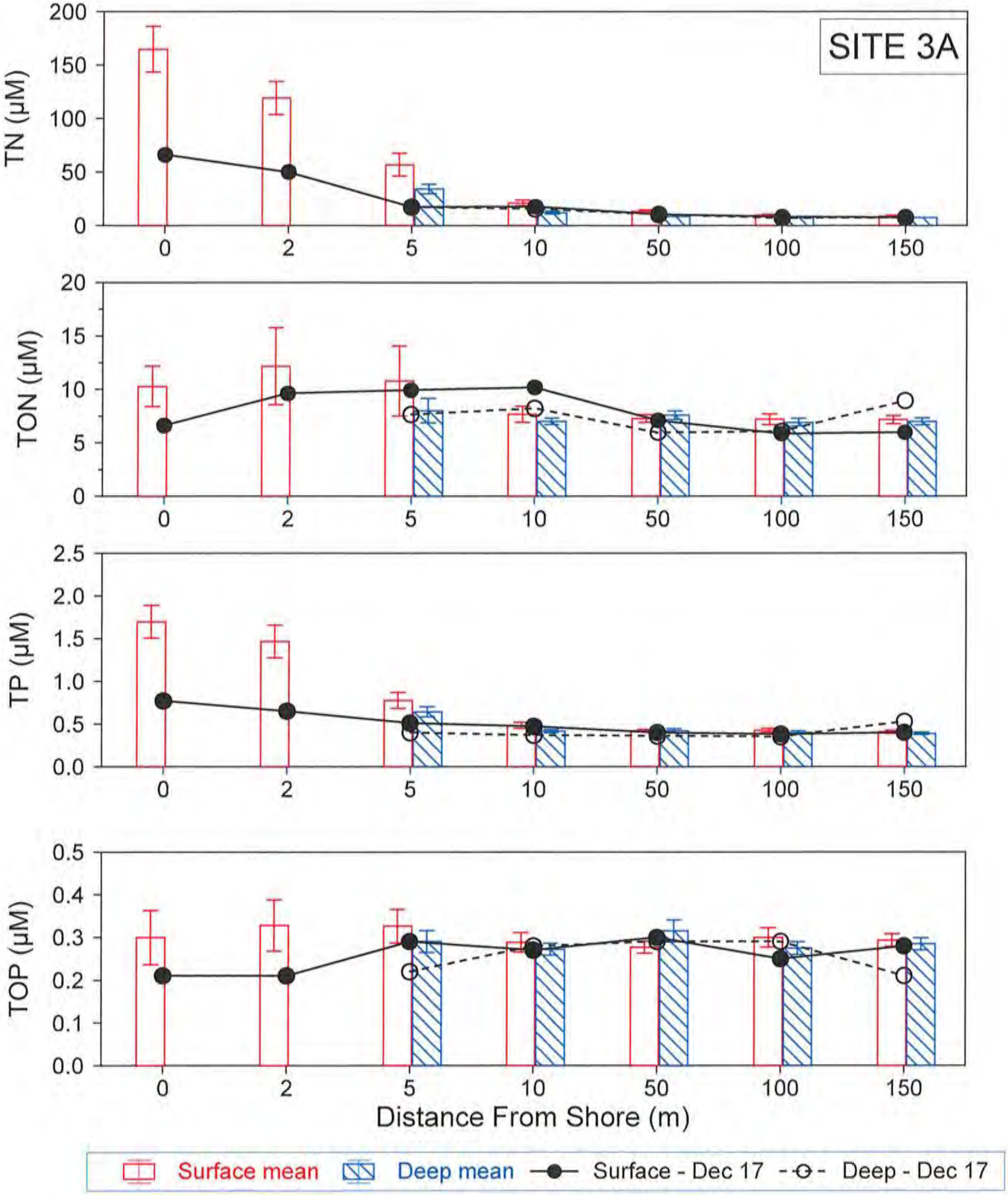

FIGURE 17. Plots of dissolved nutrient constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=19). Error bars represent standard error of the mean. For site location, see Figure 1.

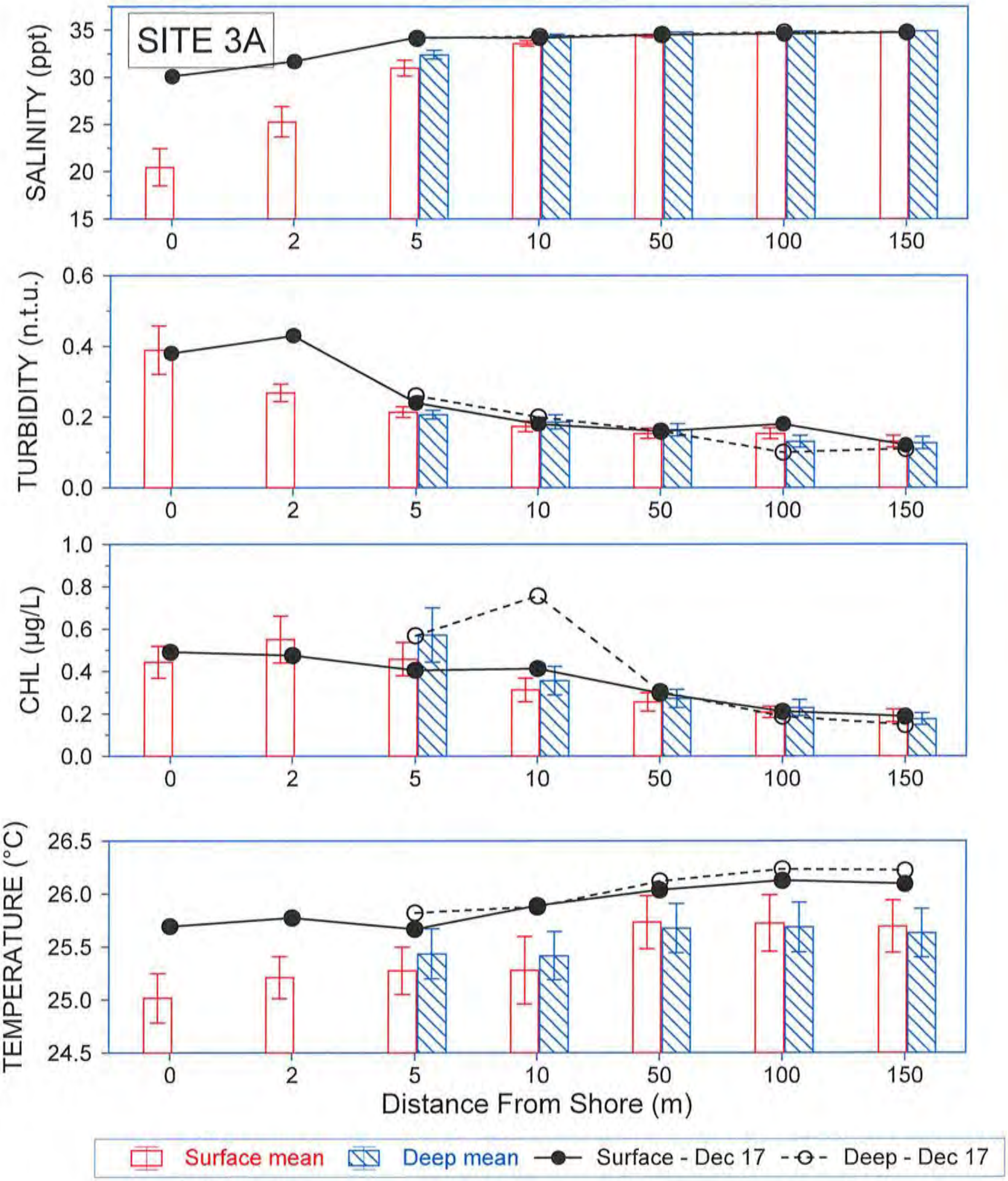

FIGURE 18. Plots of water chemistry constituents measured in surface and deep water samples as a function of distance from the shoreline at Site 3A, offshore of the Makena Resort. Data points and connected lines from samples collected during the most recent survey, bar graphs represent mean values at each sampling station for surveys conducted since June 2007 (N=19). Error bars represent standard error of the mean. For site location, see Figure 1.

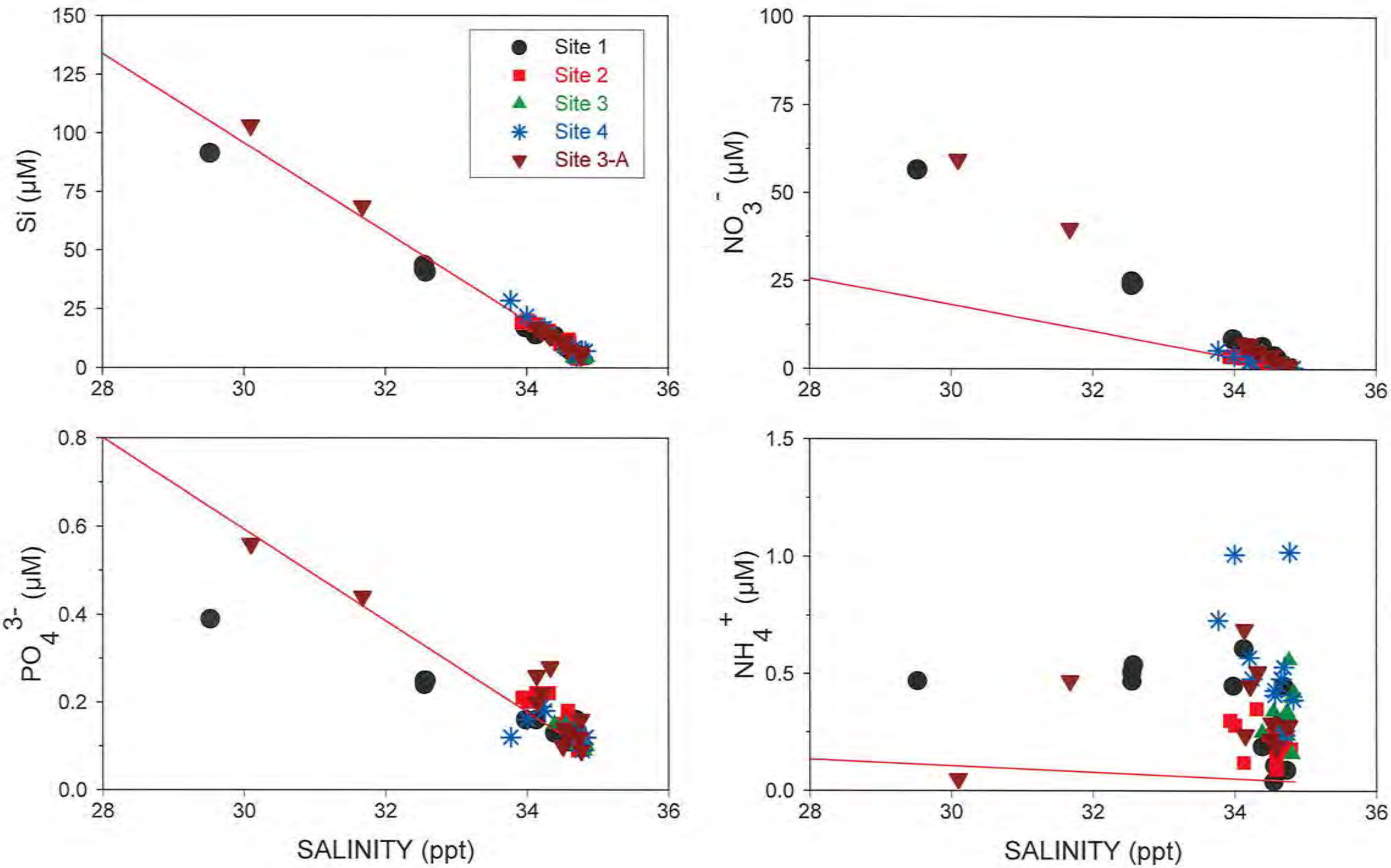

FIGURE 19. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Makena Resort on December 2, 2017 as functions of salinity. Solid red line in each plot is conservative mixing line constructed by connecting the concentrations in open coastal water with water from an irrigation well upslope of the Makena Golf Courses. For sampling site locations, see Figure 1.

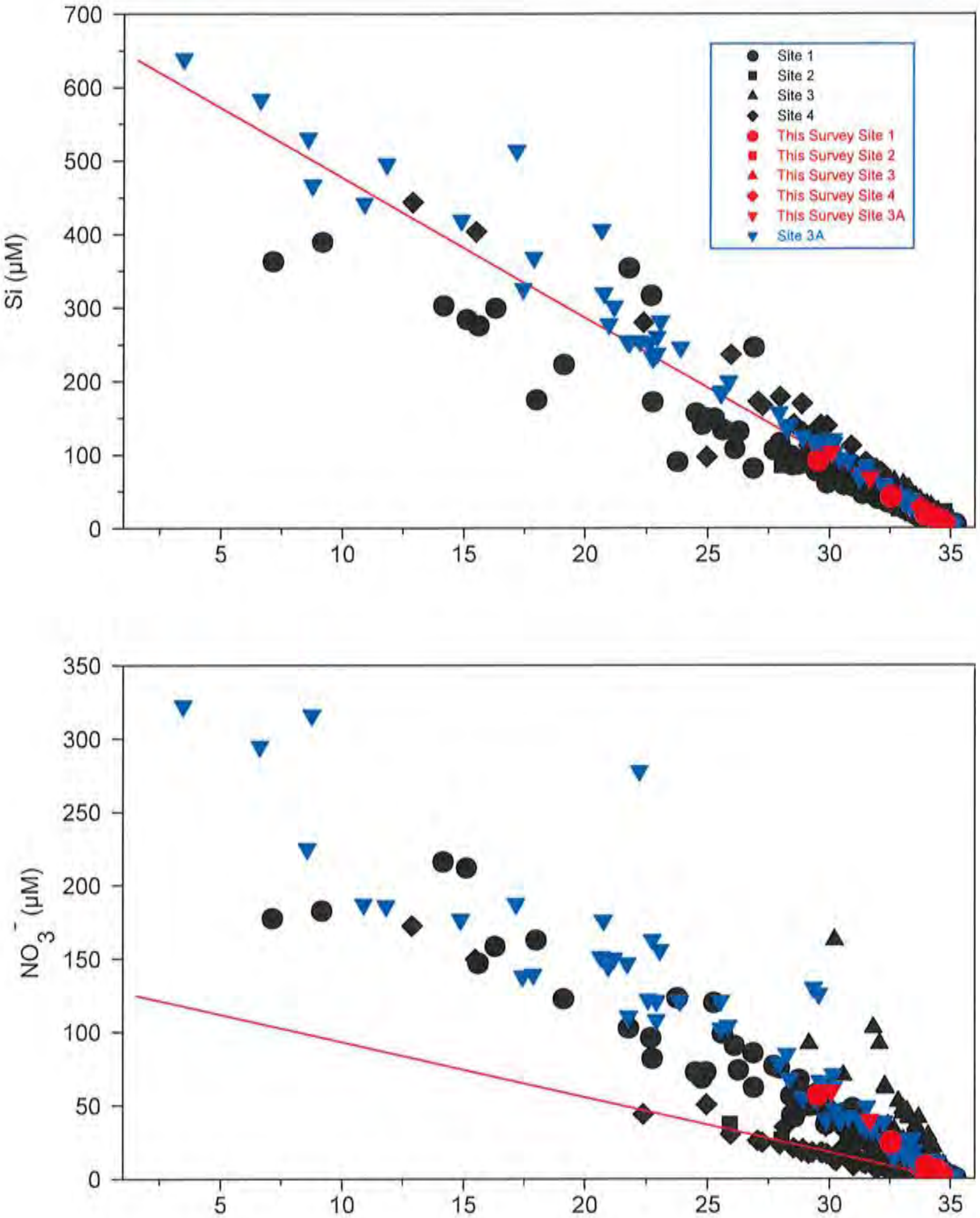

FIGURE 20. Silicate and nitrate, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and December 2017. Blue symbols represent data from surveys 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.

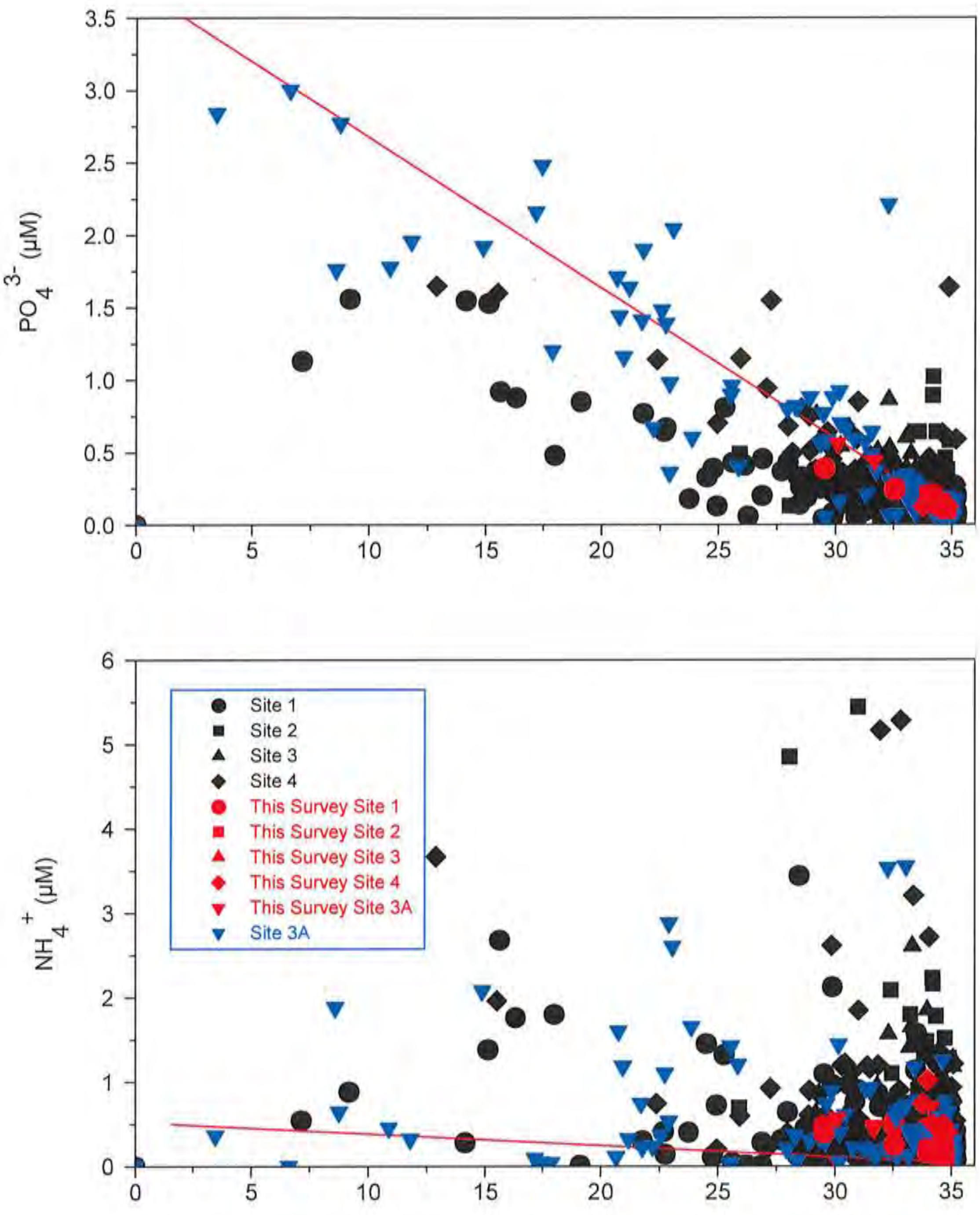

FIGURE 21. Phosphate and ammonium, plotted as a function of salinity for surface samples collected since August 1995 at four sites offshore of the Makena Golf Course. Black symbols represent combined data from surveys conducted between August 1995 and December 2017. Brown symbols represent data from 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.

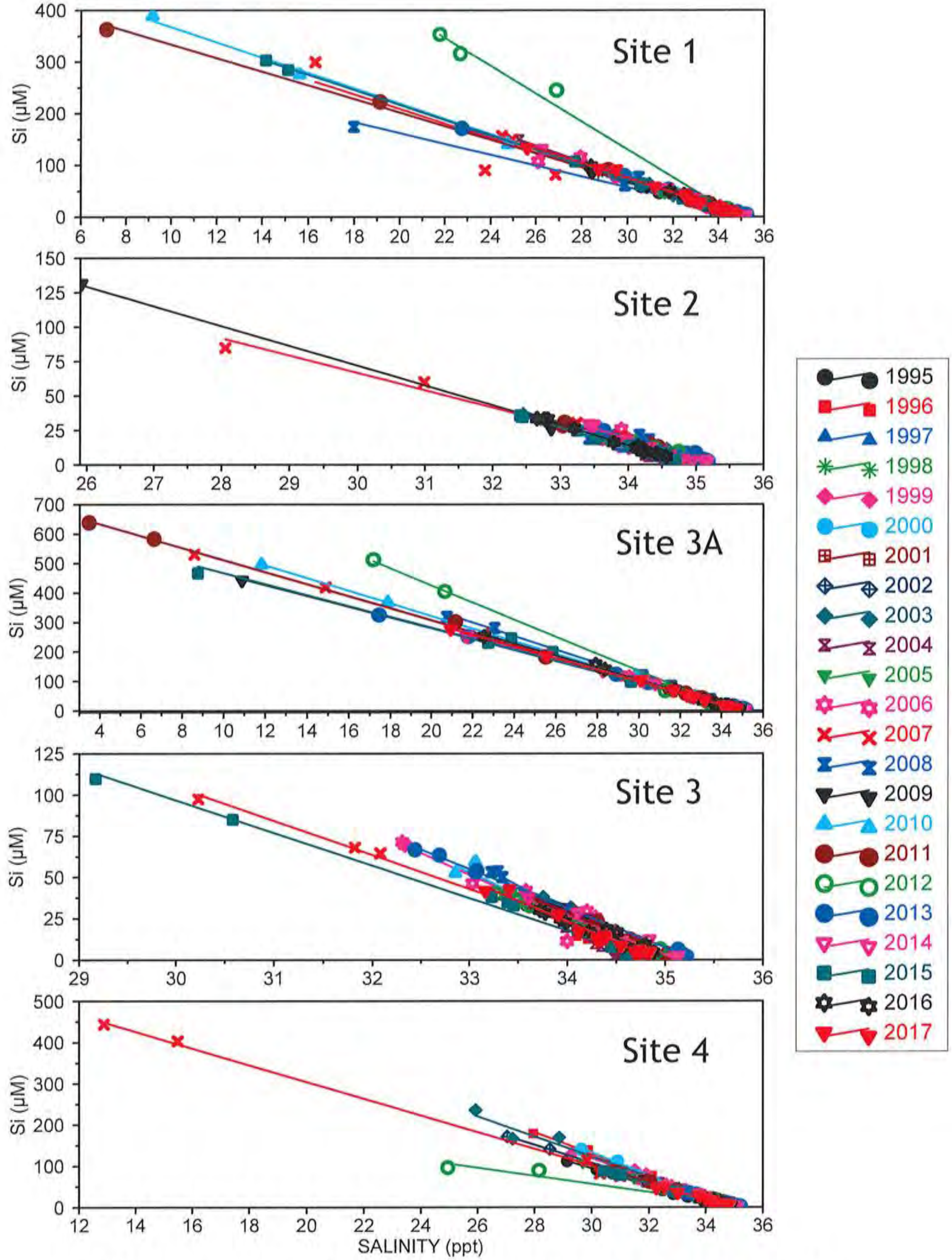

FIGURE 22. Mixing diagram showing yearly concentrations of silicate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions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

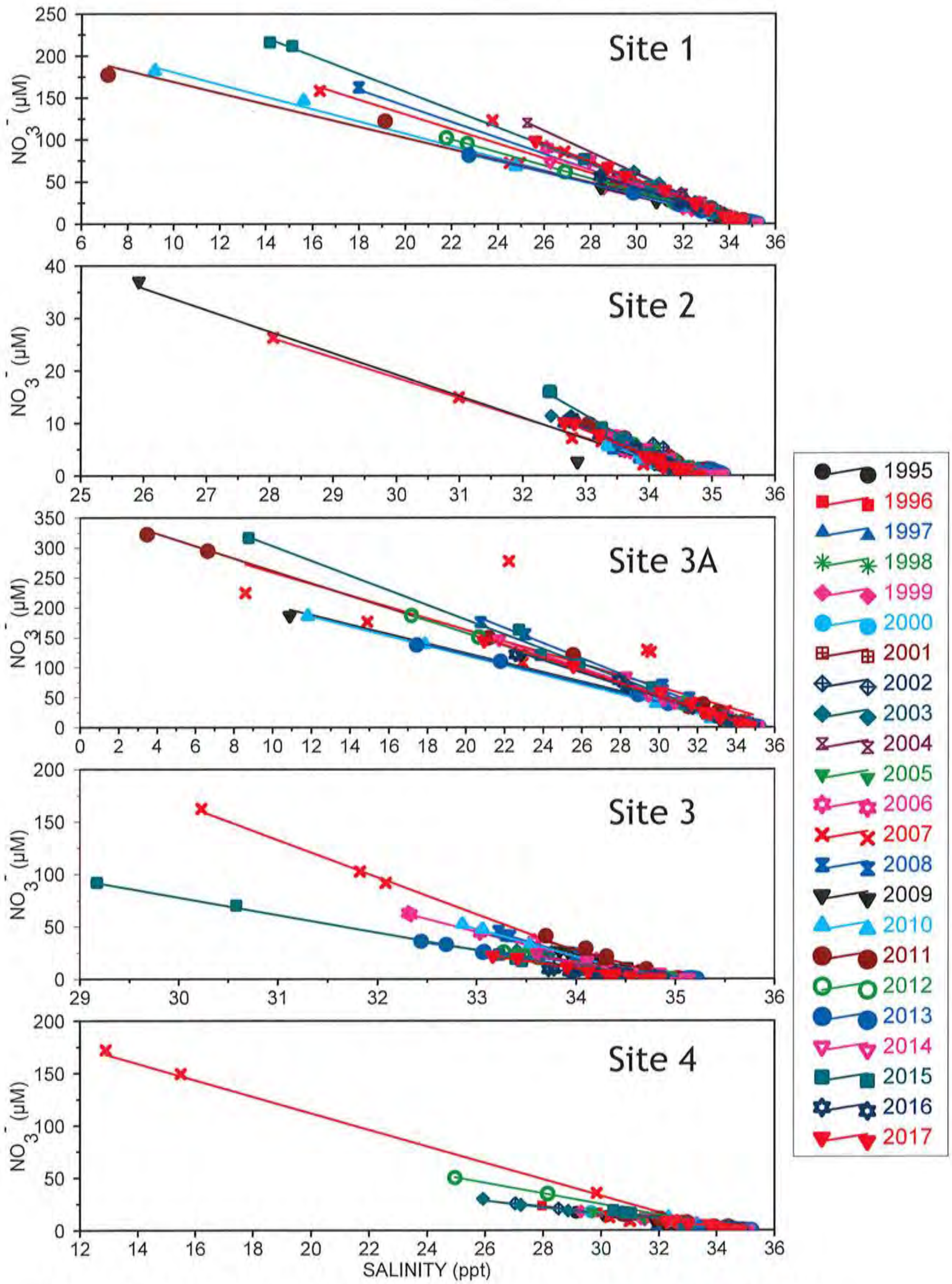

FIGURE 23. Mixing diagram showing yearly concentrations of nitrate as functions of salinity from samples collected during annual monitoring surveys at five transect sites offshore of the Makena Resort (Site 3A since 2007). Note axis scale changes between sites. Straight lines are linear regressions through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

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 2017 (Transect Site 3 has been monitored since 2002; Trasect 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

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	522.34	12.18	491.03	553.66
1996	629.56	11.05	605.49	653.64
1997	504.17	2.83	496.89	511.46
1998	484.14	2.44	477.86	490.41
1999	479.11	9.89	457.55	500.66
2000	528.68	5.87	513.58	543.77
2001	625.85	10.91	597.82	653.88
2002	502.98	8.68	480.66	525.30
2003	625.85	10.91	597.82	653.88
2004	546.00	8.33	527.84	564.16
2005	466.59	11.09	442.42	490.75
2006	487.68	24.60	434.08	541.28
2007	491.19	34.99	414.95	567.42
2008	371.80	16.96	334.85	408.75
2009	457.28	10.01	431.54	483.02
2010	515.27	7.85	495.09	535.45
2011	464.80	5.70	452.37	477.22
2012	940.29	48.49	815.64	1064.94
2013	486.60	5.46	474.70	498.50
2014	509.44	9.47	488.81	530.06
2015	507.51	2.81	501.39	513.63
2016	525.36	8.05	507.82	542.90
2017	509.66	12.73	481.92	537.41
Regslope	**-0.01**	**3.42**	**-7.12**	**7.10**
SITE 2				
1995	468.41	85.54	248.51	688.30
1996	549.09	177.83	164.91	933.28
1997	567.57	9.71	543.80	591.33
1998	563.20	37.23	472.10	654.30
1999	466.74	95.75	261.37	672.11
2000	770.15	27.32	703.31	837.00
2001	1254.31	74.17	1072.82	1435.81
2002	577.53	29.40	505.60	649.46
2003	505.05	20.10	461.94	548.15
2004	565.31	93.71	364.33	766.29
2005	339.08	33.78	266.64	411.52
2006	553.48	62.93	418.51	688.45
2007	443.05	17.15	406.27	479.84
2008	402.41	73.66	244.42	560.41
2009	501.76	9.02	479.69	523.82
2010	490.17	22.77	434.46	545.87
2011	501.35	17.35	464.13	538.56
2012	411.67	48.31	293.48	529.87
2013	495.00	16.53	459.56	530.45
2014	538.49	26.79	481.03	595.94
2015	506.01	13.98	476.03	535.99
2016	529.75	53.83	414.30	645.19
2017	477.82	33.39	406.22	549.43
Regslope	**-7.06**	**5.43**	**-18.34**	**4.23**

SILICA - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 1				
1995	-15.08	0.38	-16.05	-14.12
1996	-18.05	0.32	-18.75	-17.34
1997	-14.43	0.08	-14.65	-14.21
1998	-13.83	0.07	-14.02	-13.64
1999	-13.63	0.29	-14.27	-12.99
2000	-15.08	0.18	-15.54	-14.62
2001	-17.76	0.32	-18.57	-16.94
2002	-14.38	0.26	-15.05	-13.72
2003	-17.76	0.32	-18.57	-16.94
2004	-15.68	0.25	-16.23	-15.14
2005	-13.31	0.33	-14.02	-12.61
2006	-13.88	0.76	-15.53	-12.23
2007	-14.11	1.14	-16.59	-11.62
2008	-10.46	0.52	-11.59	-9.33
2009	-12.98	0.30	-13.76	-12.20
2010	-14.78	0.28	-15.49	-14.06
2011	-13.13	0.18	-13.52	-12.74
2012	-26.98	1.61	-31.13	-22.84
2013	-13.72	0.16	-14.07	-13.37
2014	-14.47	0.29	-15.09	-13.85
2015	-14.54	0.09	-14.73	-14.34
2016	-14.97	0.24	-15.49	-14.44
2017	-14.46	0.39	-15.32	-13.61
Regslope	**0.00**	**0.10**	**-0.20**	**0.21**
SITE 2				
1995	-13.47	2.51	-19.93	-7.00
1996	-15.62	5.15	-26.75	-4.49
1997	-16.26	0.29	-16.96	-15.56
1998	-16.11	1.08	-18.76	-13.45
1999	-13.21	2.78	-19.18	-7.23
2000	-22.06	0.80	-24.02	-20.11
2001	-35.68	2.12	-40.87	-30.49
2002	-16.54	0.86	-18.64	-14.44
2003	-14.37	0.59	-15.63	-13.11
2004	-16.23	2.73	-22.09	-10.38
2005	-9.61	0.98	-11.70	-7.52
2006	-15.82	1.83	-19.75	-11.89
2007	-12.54	0.51	-13.64	-11.45
2008	-11.41	2.14	-15.99	-6.83
2009	-14.32	0.27	-14.98	-13.66
2010	-13.97	0.67	-15.61	-12.33
2011	-14.24	0.50	-15.31	-13.16
2012	-11.62	1.41	-15.06	-8.18
2013	-13.97	0.48	-14.99	-12.95
2014	-15.29	0.78	-16.96	-13.62
2015	-14.51	0.41	-15.39	-13.62
2016	-15.07	1.58	-18.46	-11.69
2017	-13.57	0.98	-15.67	-11.47
Regslope	**0.21**	**0.15**	**-0.12**	**0.53**

SILICA -Y-INTERCEPT

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3				
2002	931.92	27.54	861.13	1002.71
2003	984.76	41.58	894.16	1075.35
2004	632.75	127.62	354.68	910.82
2005	704.38	52.31	590.40	818.35
2006	928.22	64.18	788.40	1068.05
2007	722.80	15.07	689.97	755.63
2008	1058.06	48.59	952.18	1163.94
2009	943.91	40.06	840.94	1046.89
2010	962.57	74.39	771.34	1153.79
2011	880.51	26.78	822.17	938.85
2012	792.34	42.16	683.97	900.71
2013	840.08	7.86	822.95	857.22
2014	830.08	68.71	680.38	979.78
2015	688.97	18.04	649.66	728.29
2016	738.28	54.68	619.15	857.41
2017	882.22	45.99	782.02	982.43
Regslope	**-4.39**	**6.76**	**-18.89**	**10.12**
SITE 3A				
2007	714.10	5.58	701.94	726.27
2008	805.12	9.00	785.52	824.73
2009	646.37	7.80	626.32	666.43
2010	750.91	5.70	736.26	765.56
2011	715.44	5.06	704.42	726.45
2012	1005.34	28.55	931.95	1078.73
2013	651.22	3.75	643.05	659.40
2014	680.15	9.84	658.72	701.59
2015	654.59	17.94	615.51	693.67
2016	725.77	11.07	701.65	749.89
2017	692.56	5.40	680.79	704.33
Regslope	**-5.51**	**10.14**	**-28.45**	**17.43**
SITE 4				
1995	710.45	8.83	687.74	733.15
1996	917.33	13.38	888.18	946.47
1997	776.74	3.53	767.66	785.82
1998	841.35	6.75	824.00	858.70
1999	823.63	24.78	769.63	877.62
2000	946.97	12.51	914.80	979.14
2001	1403.91	260.13	735.22	2072.61
2002	767.85	4.37	756.63	779.08
2003	854.37	29.88	789.26	919.48
2004	843.49	37.55	761.67	925.31
2005	703.97	14.00	673.47	734.46
2006	735.05	14.01	704.53	765.57
2007	710.11	7.14	694.56	725.66
2008	712.32	18.22	672.63	752.01
2009	715.30	7.99	694.75	735.84
2010	673.09	6.27	656.98	689.21
2011	688.21	7.10	672.74	703.68
2012	353.00	29.28	277.74	428.26
2013	642.86	7.88	625.69	660.03
2014	767.19	45.16	668.80	865.57
2015	704.12	6.94	689.00	719.25
2016	519.87	47.66	416.03	623.70
2017	631.99	34.22	557.43	706.55
Regslope	**-15.36**	**5.06**	**-25.89**	**-4.83**

SILICA - SLOPE

YEAR	Coefficients	Std Err	Lower 95%	Upper 95%
SITE 3				
2002	-26.75	0.81	-28.83	-24.68
2003	-28.10	1.21	-30.73	-25.47
2004	-18.19	3.69	-26.24	-10.14
2005	-20.11	1.51	-23.40	-16.83
2006	-26.56	1.89	-30.67	-22.46
2007	-20.60	0.44	-21.56	-19.63
2008	-30.22	1.41	-33.29	-27.14
2009	-26.90	1.17	-29.90	-23.91
2010	-27.56	2.19	-33.18	-21.93
2011	-25.06	0.77	-26.74	-23.37
2012	-22.57	1.24	-25.75	-19.39
2013	-23.79	0.23	-24.29	-23.29
2014	-23.62	1.98	-27.94	-19.31
2015	-19.74	0.54	-20.91	-18.58
2016	-21.03	1.59	-24.49	-17.56
2017	-25.27	1.34	-28.19	-22.35
Regslope	**0.13**	**0.19**	**-0.28**	**0.55**
SITE 3A				
2007	-20.35	0.19	-20.75	-19.94
2008	-22.96	0.28	-23.57	-22.36
2009	-18.28	0.26	-18.96	-17.61
2010	-21.44	0.19	-21.94	-20.94
2011	-20.35	0.17	-20.72	-19.99
2012	-29.01	0.94	-31.44	-26.59
2013	-18.41	0.12	-18.66	-18.16
2014	-19.32	0.30	-19.98	-18.66
2015	-18.67	0.58	-19.94	-17.40
2016	-20.76	0.35	-21.52	-19.99
2017	-19.77	0.17	-20.14	-19.41
Regslope	**0.15**	**0.30**	**-0.53**	**0.83**
SITE 4				
1995	-20.55	0.27	-21.25	-19.85
1996	-26.23	0.40	-27.10	-25.37
1997	-22.27	0.11	-22.55	-21.99
1998	-24.07	0.20	-24.58	-23.56
1999	-23.50	0.73	-25.10	-21.90
2000	-27.12	0.37	-28.08	-26.16
2001	-39.92	7.42	-58.99	-20.86
2002	-21.99	0.13	-22.34	-21.65
2003	-24.36	0.91	-26.34	-22.39
2004	-24.27	1.10	-26.66	-21.88
2005	-20.11	0.41	-21.00	-19.22
2006	-20.96	0.41	-21.86	-20.06
2007	-20.27	0.23	-20.77	-19.78
2008	-20.33	0.53	-21.49	-19.17
2009	-20.34	0.24	-20.95	-19.73
2010	-19.14	0.19	-19.62	-18.66
2011	-19.57	0.21	-20.03	-19.11
2012	-9.86	0.90	-12.17	-7.54
2013	-18.19	0.23	-18.69	-17.70
2014	-21.85	1.31	-24.71	-18.99
2015	-20.22	0.21	-20.67	-19.77
2016	-14.72	1.39	-17.75	-11.70
2017	-18.02	1.01	-20.21	-15.82
Regslope	**0.45**	**0.14**	**0.15**	**0.75**

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 2017 (Transect Site 3 has been monitored since 2002; Trasect 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
2013	232.39	1.37	229.40	235.37
2014	316.83	9.55	296.03	337.63
2015	370.90	2.36	365.76	376.04
2016	308.54	5.66	296.20	320.87
2017	378.66	4.51	368.83	388.48
REGSLOPE	**-1.19**	**1.97**	**-5.30**	**2.92**

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
2013	135.18	3.15	128.41	141.94
2014	153.54	6.45	139.71	167.38
2015	240.30	5.74	227.99	252.62
2016	182.01	9.07	162.54	201.47
2017	169.76	5.52	157.93	181.60
REGSLOPE	**1.73**	**0.98**	**-0.32**	**3.77**

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
2013	-6.59	0.04	-6.68	-6.50
2014	-9.04	0.29	-9.67	-8.41
2015	-10.68	0.08	-10.84	-10.51
2016	-8.86	0.17	-9.22	-8.49
2017	-10.88	0.14	-11.19	-10.58
REGSLOPE	**0.04**	**0.06**	**-0.08**	**0.16**

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
2013	-3.84	0.09	-4.03	-3.64
2014	-4.38	0.19	-4.78	-3.97
2015	-6.93	0.17	-7.30	-6.57
2016	-5.22	0.27	-5.79	-4.65
2017	-4.88	0.16	-5.23	-4.54
REGSLOPE	**-0.05**	**0.03**	**-0.11**	**0.01**

NITRATE -Y-INTERCEPT

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
2013	444.28	6.57	429.97	458.60
2014	538.82	51.38	426.87	650.77
2015	580.33	8.68	561.42	599.23
2016	249.59	27.69	189.27	309.91
2017	480.43	21.06	434.55	526.30
REGSLOPE	**-23.78**	**12.71**	**-51.04**	**3.48**

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
2013	281.00	3.14	274.17	287.83
2014	385.66	10.40	362.99	408.32
2015	425.68	7.05	410.32	441.04
2016	361.17	8.19	343.32	379.01
2017	373.89	7.91	356.65	391.13
REGSLOPE	**2.70**	**5.51**	**-9.78**	**15.17**

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
2013	40.48	3.63	32.58	48.39
2014	113.51	9.69	92.40	134.62
2015	150.03	4.80	139.57	160.48
2016	53.95	10.73	30.58	77.32
2017	131.68	10.78	108.18	155.17
REGSLOPE	**-0.04**	**1.42**	**-2.99**	**2.90**

NITRATE - SLOPE

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
2013	-12.62	0.19	-13.03	-12.20
2014	-15.39	1.48	-18.61	-12.16
2015	-16.75	0.26	-17.31	-16.19
2016	-7.14	0.80	-8.89	-5.39
2017	-13.83	0.61	-15.17	-12.50
REGSLOPE	**0.69**	**0.37**	**-0.10**	**1.47**

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
2013	-7.97	0.10	-8.18	-7.76
2014	-11.03	0.32	-11.73	-10.33
2015	-12.29	0.23	-12.78	-11.79
2016	-10.41	0.26	-10.97	-9.84
2017	-10.72	0.25	-11.26	-10.19
REGSLOPE	**-0.11**	**0.16**	**-0.48**	**0.00**

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
2013	-1.14	0.10	-1.37	-0.91
2014	-3.24	0.28	-3.86	-2.63
2015	-4.33	0.14	-4.64	-4.02
2016	-1.53	0.31	-2.21	-0.85
2017	-3.79	0.32	-4.48	-3.10
REGSLOPE	**0.00**	**0.04**	**-0.08**	**0.09**

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 2017 (Transect site 3 has been monitored since 2002; Trasect 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
2013	1.73	0.08	1.56	1.90
2014	0.06	0.27	-0.53	0.65
2015	2.57	0.09	2.37	2.76
2016	1.50	0.21	1.05	1.95
2017	1.24	0.26	0.68	1.80
REGSLOPE	**0.01**	**0.02**	**-0.04**	**0.05**
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
2013	2.12	0.57	0.90	3.34
2014	2.21	0.61	0.90	3.51
2015	2.52	0.30	1.88	3.16
2016	3.98	0.55	2.81	5.15
2017	0.99	0.62	-0.35	2.33
REGSLOPE	**-0.23**	**0.20**	**-0.65**	**0.18**

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
2013	-0.05	0.00	-0.05	-0.04
2014	0.00	0.01	-0.02	0.02
2015	-0.07	0.00	-0.08	-0.07
2016	-0.04	0.01	-0.05	-0.03
2017	-0.03	0.01	-0.05	-0.02
REGSLOPE	**0.00**	**0.00**	**0.00**	**0.00**
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
2013	-0.06	0.02	-0.09	-0.02
2014	-0.06	0.02	-0.10	-0.02
2015	-0.07	0.01	-0.09	-0.05
2016	-0.11	0.02	-0.15	-0.08
2017	-0.03	0.02	-0.06	0.01
REGSLOPE	**0.01**	**0.01**	**-0.01**	**0.02**

PHOSPHATE -Y-INTERCEPT

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
2013	4.80	0.28	4.19	5.42
2014	5.15	0.98	3.00	7.29
2015	4.53	0.23	4.01	5.04
2016	6.32	0.62	4.98	7.66
2017	3.29	0.62	1.94	4.63
REGSLOPE	**-0.09**	**0.10**	**-0.31**	**0.12**
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
2013	4.76	0.07	4.61	4.91
2014	3.60	0.10	3.38	3.82
2015	3.36	0.26	2.80	3.92
2016	3.93	0.06	3.80	4.07
2017	2.94	0.13	2.66	3.23
REGSLOPE	**0.06**	**0.07**	**-0.11**	**0.23**
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
2013	0.20	1.93	-4.02	4.41
2014	0.47	1.63	-3.09	4.02
2015	2.49	0.17	2.12	2.85
2016	3.40	0.70	1.86	4.93
2017	1.38	0.28	0.77	1.99
REGSLOPE	**0.02**	**0.15**	**-0.30**	**0.33**

PHOSPHATE - SLOPE

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
2013	-0.13	0.01	-0.15	-0.12
2014	-0.14	0.03	-0.20	-0.08
2015	-0.13	0.01	-0.14	-0.11
2016	-0.18	0.02	-0.22	-0.14
2017	-0.09	0.02	-0.13	-0.05
REGSLOPE	**0.00**	**0.00**	**0.00**	**0.01**
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
2013	-0.13	0.00	-0.14	-0.13
2014	-0.10	0.00	-0.11	-0.09
2015	-0.10	0.01	-0.11	-0.08
2016	-0.11	0.00	-0.11	-0.11
2017	-0.08	0.00	-0.09	-0.07
REGSLOPE	**-9.78**	**15.17**	**-0.01**	**0.00**
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
2013	0.00	0.06	-0.12	0.12
2014	-0.01	0.05	-0.11	0.09
2015	-0.07	0.00	-0.08	-0.06
2016	-0.09	0.02	-0.14	-0.05
2017	-0.04	0.01	-0.05	-0.02
REGSLOPE	**0.00**	**0.00**	**-0.01**	**0.01**

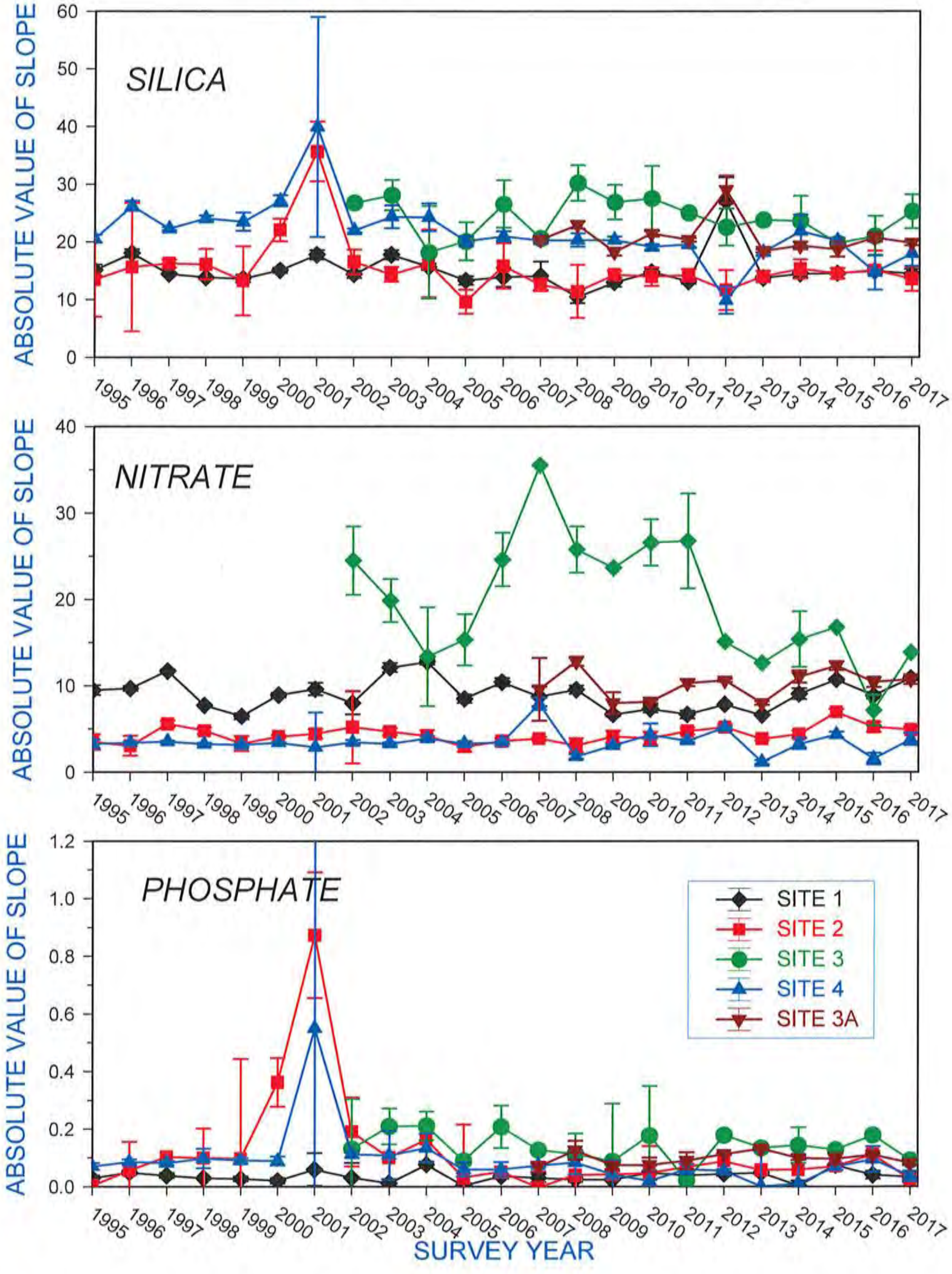

FIGURE 24. Time-course plots of absolute values of slopes of linear regressions of concentrations of silca, nitrate and phosphate as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits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

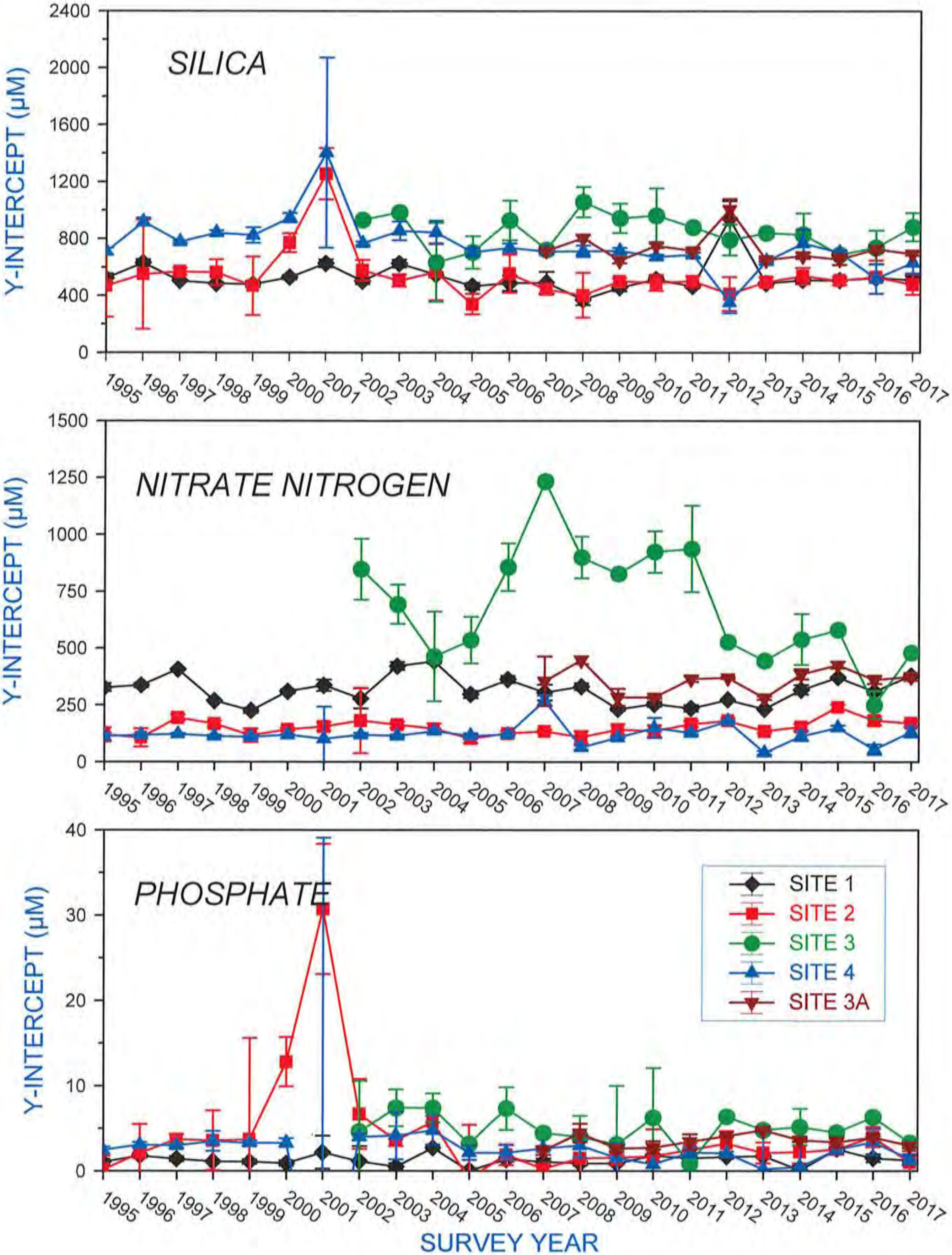

FIGURE 25. Time-course plots of Y-intercepts of linear regressions of concentrations of silca, nitrate and phosphorus as functions of salinity collected annually at each of the transect monitoring stations off the Makena Resort (Site 3A began in June 2007). Error bars are 95% confidence limits. For locations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

EXHIBIT C.

THE ORIGINAL OF THE DOCUMENT
RECORDED AS FOLLOWS:
STATE OF HAWAII
BUREAU OF CONVEYANCES
DOCUMENT NO. Doc A – 65200823A thru A – 65200823C
DATE - TIME November 07, 2017 1:00 PM

LAND COURT SYSTEM	REGULAR SYSTEM

Return by Mail ( ) Pickup ( ) To:

Sullivan Meheula Lee
745 Fort Street, Suite 800
Honolulu, Hawaii 96813
Attn: Barry A. Sullivan

Tax Keys: (2) 2-1-006: 057 (por.), 036 (por.) and 111 Total No. of Pages: 14

DECLARATION OF RESTRICTIVE
COVENANTS FOR PARK PURPOSES

This Declaration of Restrictive Covenants for Park Purposes ("Declaration") is made this 21st day of February, 2017, 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 Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, ATC Makena Land AH1 LLC** (collectively, the "TICs") and **ATC Makena Hotel LLC** ("Hotel"), all of which are Delaware limited liability companies and whose mailing address is c/o ATC Makena Holdings, LLC, 1100 Alakea Street, 27th Floor, Honolulu, Hawaiʻi 96813 (the TICs and Hotel are hereinafter collectively called "Declarants").

RECITALS:

A. The TICs, as tenants in common, are the fee simple owners of the following parcels of land comprising a portion of the Makena Beach & Golf Resort:

(i) Lot 4 of the "Maui Prince Hotel Subdivision", described as Tax Map Key No. (2) 2-1-006: 111 ("Lot 4"), located at the south end of Maluaka Beach, and depicted on the map attached hereto as Exhibit "A" and incorporated by reference herein. Lot 4 is also known as and referred to herein as "Maluaka Park";

(ii) Lot 3 of the "Maui Prince Hotel Subdivision", described as Tax Map Key No. (2) 2-1-006: 057 ("Lot 3"), abutting Maluaka Park on the south, and depicted on Exhibit "A" hereto; and

(iii) Lot 2 of the "Seibu Makena Hotel Subdivision II", described as Tax Map Key No. (2) 2-1-006: 036 ("Lot 2"), abutting Lot 3 on the south, and depicted on Exhibit "A" hereto.

B. Maui County Ordinance No. 3613, effective on January 7, 2009 (the "Rezoning Ordinance") changed the zoning applicable to some of the Makena Beach & Golf Resort lands. Condition No. 32 of the Rezoning Ordinance (the "Park Expansion Condition"), requires Declarants to "develop an expansion of the beach park at the south end of Maluaka Beach, such that the beach park shall comprise at least 1.5 acres of land area for public use and beach access."

C. Pursuant to and in satisfaction of the Park Expansion Condition, Declarants wish to submit the land consisting of all of Lot 4 (0.84 acres) and a portion of Lots 2 and 3 (0.66 acres), described and depicted as "Easement P-1" (1.50 acres) on Exhibit "A" hereto (hereinafter referred to as "Expanded Maluaka Park") to the restrictive covenants set forth hereinbelow.

D. Accordingly, in order to ensure that use of Expanded Maluaka Park is restricted to public recreational use and beach access and to ensure the maintenance of Expanded Maluaka Park, Declarants agree to be bound, and to encumber Expanded Maluaka Park, by recordation of this Declaration in the Bureau of Conveyances of the State of Hawaii (the "Bureau").

AGREEMENT:

NOW, THEREFORE, Declarants hereby agree and declare as follows:

1. Public Use and Beach Access. Expanded Maluaka Park shall be held and managed for the benefit of the public for purposes of recreational use and beach access in accordance with the terms of this Declaration.

2. Term. This Declaration shall become effective upon its recordation in the Bureau and shall continue in effect unless and until: (i) a written release of this Declaration by the County of Maui (the "County") is recorded in said Bureau; or (ii) Expanded Maluaka Park is dedicated to and accepted by the County.

3. Park Maintenance and Operation. Expanded Maluaka Park shall be maintained and operated by Declarants in accordance with that certain Unilateral Maintenance

Agreement for Expanded Maluaka Park, North Maluaka and Makena Landing of even date herewith.

4. Runs With Land. This Declaration shall run with, and be binding upon, the land comprising Expanded Maluaka Park and all persons having or who acquire any right, title or interest in and to Expanded Maluaka Park, without the execution, delivery or recordation of any further instrument, document, agreement or declaration by Declarants, their successors or assigns, or the County. Upon the transfer of any right, title or interest in or to Expanded Maluaka Park, or any portion thereof, the transferee shall be bound by and shall assume, observe and perform all of the terms of this Declaration.

5. Recreational Use. Any person using Expanded Maluaka Park for recreational, non-commercial purposes shall do so without charge. Such person shall be deemed to be a permittee for recreational purposes or "recreational user" as defined in Hawaii Revised Statutes ("HRS"), Chapter 520, relating to Landowners' Liability. Nothing in this Declaration shall amend, qualify or otherwise limit: (i) the liability protections given to Declarants, and their respective members, managers, officers, employees, agents and affiliates under HRS Chapter 520, including, without limitation, HRS Section 520-4, as the same may be amended from time to time; or (ii) the liability protections given to the owners or operators of any businesses providing recreational activities to the public who obtain voluntary written release waivers from their patrons pursuant to the provisions of HRS Section 663-1.54 relating to Recreational Activity Liability, as the same may be amended from time to time.

6. Declarants' Reserved Rights. Declarants reserve the right to enter upon and use Expanded Maluaka Park at any time and for any purpose that is not inconsistent with and does not unreasonably interefere with the purposes of this Declaration. Such reserved rights include, without limitation: (i) the right to grant nonexclusive easements over Expanded Maluaka Park to the United States of America, State of Hawaii, County, or any public or private utility for utilities, drainage or access purposes; (ii) the right to construct improvements within Expanded Maluaka Park; and (iii) the right to landscape Expanded Maluaka Park.

7. Enforcement. This Declaration shall inure to the benefit of the County and the County shall have the right, but not the obligation, to enforce the terms of this Declaration.

8. Satisfaction of Park Expansion Condition. The recordation of this Declaration in the Bureau shall constitute full and final compliance with Condition No. 32 of the Rezoning Ordinance.

9. Definitions. The term "Declarants" as used herein, and any pronoun in reference thereto, shall mean and include each Declarant and its respective successors and assigns.

10. Amendment. Any amendment of this Declaration shall be in writing and executed by both Declarants and the County.

11. Governing Law. This Declaration shall be governed by and construed in accordance with the laws of the State of Hawaii.

IN WITNESS WHEREOF, the undersigned have executed this instrument as of the day and year first above written.

ACKNOWLEDGED AND APPROVED

By: ______________________
Butch Ka`ala Buenconsejo
Director, Parks and Recreation
County of Maui

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, ATC Makena Land AH1 LLC and ATC Makena Hotel LLC

By: ______________________
Their Authorized Signatory

APPROVED AS TO FORM AND LEGALITY:

By: ______________________
Deputy Corporation Counsel

"DECLARANTS"

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

On this 9th day of March, 2017, before me personally appeared Sean Henry, to me personally known, who, being by me duly sworn or affirmed, did say that such person(s) executed the foregoing instrument as the free act and deed of such person(s), and if applicable, in the capacities shown, having been duly authorized to execute such instrument in such capacities.

ANDREA MCINTOSH NOTARY PUBLIC No. 16-326 STATE OF HAWAII

Andrea McIntosh

Print Name: Andrea McIntosh
Notary Public, State of Hawaii.

My commission expires: September 18, 2020

Date of Doc: Undated # Pages: 14

Name: Andrea McIntosh First Circuit

Doc. Description: Declaration of Restrictive Covenants for Park Purposes

Andrea McIntosh March 9, 2017
Notary Signature

ANDREA MCINTOSH NOTARY PUBLIC No. 16-326 STATE OF HAWAII

NOTARY CERTIFICATION (Seal)

EXHIBIT "A"

[See attached]

EXHIBIT A

EASEMENT P-1
(FOR PARK PURPOSES)

Being a portion of Lot 2 of the Seibu Makena Hotel Subdivision, II and Lot 3 of the Maui Prince Hotel Subdivision and all of Lot 4 of the Maui Prince Hotel Subdivision, being also a portion of Grant 835 to Mahoe and Grant S-15,029 to Ulupalakua Ranch, Inc.

Situate at Maluaka, Honuaula, Maui, Hawaii.

Beginning at the Northeast corner of this easement, also being a point along the Northwest boundary of Lot 1 of the Makena Aina-Golf Corp. Subdivision, the coordinates of said point of beginning referred to Government Survey Triangulation Station "PUU OLAI" being 3,216.69 feet North and 1,950.10 feet East thence running by azimuths measured clockwise from true South:

1.	29° 20′	124.40 feet	along Lot 1 of the Makena Aina-Golf Corp. Subdivision, also along Grant 1441, Apana 3 to L.L. Torbert;
2.	124° 42′	107.24 feet	along Lot 1-A of The Parcel H-1 Consolidation, also along remainders of Grant S-15,029 to Ulupalakua Ranch, Inc. and Grant 835 to Mahoe;
3.	101° 04′	28.00 feet	along along Lot 1-A of The Parcel H-1 Consolidation Subdivision, also along the remainder of Grant 835 to Mahoe;
4.	91° 12′	6.00 feet	along same;
			Thence along same, on a curve to the left with a radius of 25.00 feet, the chord azimuth and distance being:
5.	65° 13′ 30″	21.90 feet;	
6.	39° 15′	20.00 feet	along same;
7.	305° 15′	9.00 feet	along same;
8.	39° 40′	16.00 feet	along same;

9.	137°	57′		13.00	feet along same;
10.	76°	00′		49.00	feet along same;
11.	47°	49′		100.05	feet along same;
12.	133°	04′		26.75	feet along remainder of Lot 3 of the Maui Prince Hotel Subdivision, also along the remainder of Grant 835 to Mahoe;
13.	154°	28′		16.02	feet along same;
14.	161°	42′		13.86	feet along same;
15.	145°	44′		11.42	feet along same;
16.	138°	31′		11.39	feet along same;
17.	129°	51′		20.70	feet along same;
18.	108°	18′		12.98	feet along same;
19.	74°	17′		43.56	feet along same;
20.	107°	44′		3.36	feet along same;
21.	16°	05′		4.14	feet along same;
					Thence along same, on a curve to the right with a radius of 8.00 feet, the chord azimuth and distance being:
22.	31°	01′	30″	4.13	feet;
23.	45°	58′		2.40	feet along same;
					Thence along same, on a curve to the right with a radius of 35.00 feet, the chord azimuth and distance being:
24.	54°	15′	30″	10.10	feet;
25.	62°	33′		11.73	feet along same;
26.	65°	00′		18.04	feet along same;

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS
501 SUMNER STREET, SUITE 521
HONOLULU, HAWAII 96817-5031
1871 WILI PA LOOP, SUITE A
WAILUKU, MAUI, HAWAII 96793
100 PAUAHI STREET, SUITE 213
HILO, HAWAII 96720

27.	68°	37′		24.65 feet along same;
28.	64°	25′		50.53 feet along same;
29.	79°	03′		8.75 feet along same;
30.	66°	05′		17.17 feet along same;
31.	62°	01′		18.24 feet along same;

Thence along same, on a curve to the left with a radius of 20.00 feet, the chord azimuth and distance being:

32.	48°	15′		9.52 feet;
33.	34°	29′		50.73 feet along same;
34.	39°	01′		24.09 feet along remainder of Lot 2 of The Seibu Makena Hotel Subdivision, also along the remainder of Grant 835 to Mahoe;

Thence along same, on a curve to the right with a radius of 45.00 feet, the chord azimuth and distance being:

35.	47°	18′		12.97 feet;
36.	55°	35′		27.17 feet along same;
37.	58°	26′		52.00 feet along same;
38.	149°	41′		28.87 feet along same;

Thence along the shoreline as certified on February 11, 2016, for the following nine (9) courses, the direct azimuth and distance between points on said shoreline being:

39.	237°	49′	17″	100.20 feet;
40.	209°	46′		73.45 feet;
41.	248°	21′		64.16 feet;

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS
501 SUMNER STREET, SUITE 521 HONOLULU, HAWAII 96817-5031
1871 WILI PA LOOP, SUITE A WAILUKU, MAUI, HAWAII 96793
100 PAUAHI STREET, SUITE 213 HILO, HAWAII 96720

42. 293° 38' 8.46 feet;

43. 239° 41' 66.60 feet;

44. 274° 44' 32.99 feet;

45. 182° 19' 112.65 feet;

46. 300° 46' 84.97 feet;

47. 229° 39' 53.65 feet;

Thence along the shoreline as certified on July 12, 2000, for the following ten (10) courses, the direct azimuth and distance between points on said shoreline being:

48. 228° 50' 20.02 feet;

49. 263° 46' 55.21 feet;

50. 284° 41' 45.55 feet;

51. 217° 09' 27.35 feet;

52. 135° 54' 15.09 feet;

53. 216° 13' 17.00 feet;

54. 299° 46' 47.78 feet;

55. 307° 54' 12.40 feet;

56. 253° 31' 12.10 feet;

57. 228° 14' 77.05 feet;

58. 311° 36' 15" 146.16 feet along Lot 5 of The Maui Prince Hotel Subdivision, also along the remainders of Grant 835 to Mahoe and Grant S-15,029 to Ulupalakua Ranch, Inc., to the point of beginning and containing an area of 1.500 acres more or less.

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS
501 SUMNER STREET, SUITE 521
HONOLULU, HAWAII 96817-5031
1871 WILI PA LOOP, SUITE A
WAILUKU, MAUI, HAWAII 96793
100 PAUAHI STREET, SUITE 213
HILO, HAWAII 96720

JUSTIN H. LAPP
LICENSED PROFESSIONAL LAND SURVEYOR
No. 12964
HAWAII U.S.A.

Description Prepared By:

EXP 04/18

JUSTIN H. LAPP
Licensed Professional Land Surveyor
Certificate No. 12964

Maui, Hawaii
May 10, 2016

TMK: (2) 2-1-006: Por. 036, Por. 057 and 111

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

501 SUMNER STREET, SUITE 521
HONOLULU, HAWAII 96817-5031

1871 WILI PA LOOP, SUITE A
WAILUKU, MAUI, HAWAII 96793

100 PAUAHI STREET, SUITE 213
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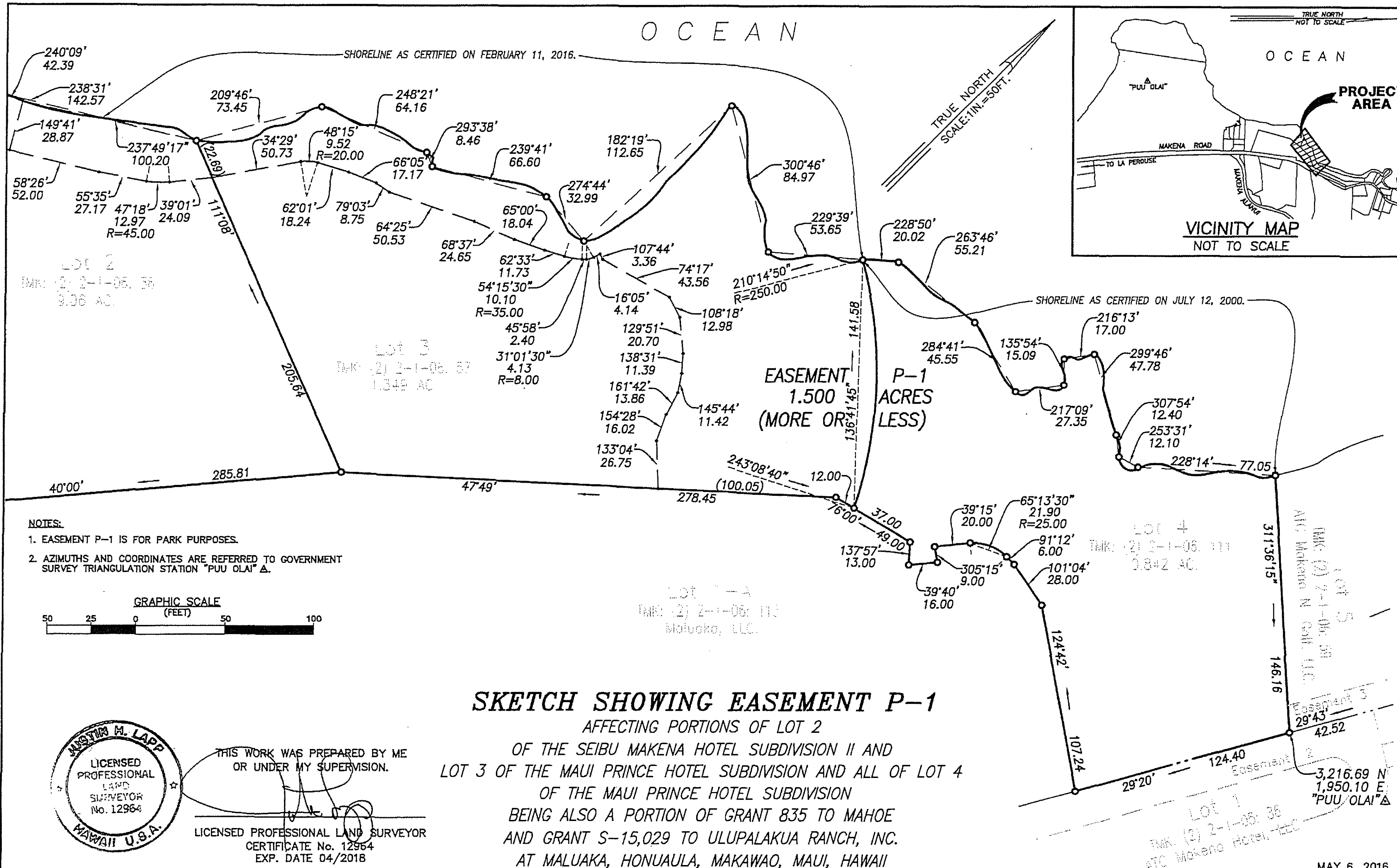


NOTES:

1. EASEMENT P-1 IS FOR PARK PURPOSES.
2. AZIMUTHS AND COORDINATES ARE REFERRED TO GOVERNMENT SURVEY TRIANGULATION STATION "PUU OLAI" △.

GRAPHIC SCALE
(FEET)
50 25 0 50 100

SKETCH SHOWING EASEMENT P-1

AFFECTING PORTIONS OF LOT 2
OF THE SEIBU MAKENA HOTEL SUBDIVISION II AND
LOT 3 OF THE MAUI PRINCE HOTEL SUBDIVISION AND ALL OF LOT 4
OF THE MAUI PRINCE HOTEL SUBDIVISION
BEING ALSO A PORTION OF GRANT 835 TO MAHOE
AND GRANT S-15,029 TO ULUPALAKUA RANCH, INC.
AT MALUAKA, HONUAULA, MAKAWAO, MAUI, HAWAII

AUSTIN H. LAPP
LICENSED PROFESSIONAL LAND SURVEYOR
No. 12964
HAWAII U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

LICENSED PROFESSIONAL LAND SURVEYOR
CERTIFICATE No. 12964
EXP. DATE 04/2018

MAY 6, 2016

Z:\2015\15-527\SURVEY\K- PARK EXPANSION ADDITIONAL WORK\EASEMENT P-1.DWG

TMK: (2) 2-1-006: POR. 036, POR. 057 AND 111

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
1871 WILI PA LOOP SUITE A • WAILUKU, MAUI, HAWAII 96793

JOB NO.: 15-527(K)

CONSENT AND SUBORDINATION OF SPT TLB BB HOLDINGS, LLC, AS COLLATERAL AGENT ON BEHALF OF THE LENDERS

SPT TLB BB HOLDINGS, LLC, a Delaware limited liability company, as collateral agent on behalf of the Lenders (as defined below), having an address at 591 W. Putnam Avenue, Greenwich, Connecticut 06830 (the "Mortgagee"), is the holder of the mortgagee's rights under the Mortgage (as defined below), which Mortgage, by mesne assignments, was assigned to the Mortgagee by that certain unrecorded assignment dated September 10, 2015, such unrecorded assignment being referenced in that certain Memorandum of Assignment of Security Documents dated September 10, 2015, recorded in the Bureau of Conveyances of the State of Hawaii (the "Bureau"), as Document No. A-57420899. As used herein, "Mortgage" shall mean that certain Mortgage, Assignment of Leases and Rents, Security Agreement and Fixture Filing dated September 11, 2014, recorded in the Bureau as Document No. A-53710126. As used herein, "Lenders" shall mean the holders of the Note (as defined in the Mortgage) and their successors and assigns.

The Mortgagee hereby consents and subordinates the lien of the Mortgage to the foregoing Declaration of Restrictive Covenants for Park Purposes, provided that this consent and subordination shall not be deemed to be a release or waiver of any of the rights of the Mortgagee under the Mortgage or under any of the Loan Documents (as defined in the Mortgage), which rights are hereby expressly reserved.

SPT TLB BB HOLDINGS, LLC,
a Delaware limited liability company,
as collateral agent on behalf of the
Lenders

By: ______________________________
Name: ANDREW J. SOSSEN
Its: Authorized Signatory

STATE OF Connecticut)
) ss. Greenwich
COUNTY OF Fairfield)

I, Vernice Briggs, a Notary Public for the said County and State of Connecticut, do hereby certify that Andrew S. Gossen, Authorized Signatory of SPT TLB BB HOLDINGS, LLC, a Delaware limited liability company, as collateral agent on behalf of the Lenders, personally appeared before me this day and acknowledged the due execution of the foregoing instrument on behalf of the limited liability company.

WITNESS my hand and official stamp or seal, this 13th day of February, 2017.

VERNICE BRIGGS
NOTARY PUBLIC
State of Connecticut
My Commission Expires
October 31, 2017

Notary Public

[SEAL]

My commission expires:

EXHIBIT D.

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

BUREAU OF CONVEYANCES

DOCUMENT NO. Doc A – 65200824A thru A – 65200824C

DATE - TIME November 07, 2017 1:00 PM

LAND COURT SYSTEM	REGULAR SYSTEM

Return by Mail ( ) Pickup ( ) To:

Sullivan Meheula Lee
745 Fort Street, Suite 800
Honolulu, Hawaii 96813
Attn: Barry A. Sullivan

Tax Keys: (2) 2-1-006: 057 (por.), 036 (por.) and 111;
2-1-007: 068 (por.) and 094

Total No. of Pages: 20

UNILATERAL MAINTENANCE AGREEMENT FOR EXPANDED MALUAKA PARK, NORTH MALUAKA AND MAKENA LANDING

This Unilateral Maintenance Agreement for Expanded Maluaka Park, North Maluaka and Makena Landing ("Agreement") is made as of this 21st day of February, 2017, 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 Land U1 LLC, ATC Makena Land B1 LLC, ATC Makena Land MF4 LLC, ATC Makena Land SF2 LLC, ATC Makena Land AH1 LLC** (collectively, the "TICs") and **ATC Makena Hotel LLC** ("Hotel"), all of which are Delaware limited liability companies and whose mailing address is c/o ATC Makena Holdings, LLC, 1100 Alakea Street, 27th Floor, Honolulu, Hawai'i 96813 (the TICs and Hotel are hereinafter collectively called "ATC Makena").

RECITALS:

A. The TICs, as tenants in common, are the fee simple owners of land comprising portions of the Makena Beach & Golf Resort as follows:

(i) Lot 4 of the "Maui Prince Hotel Subdivision", described as Tax Map Key No. (2) 2-1-006: 111, located at the south end of Maluaka Beach. Lot 4 is also known as and referred to herein as "Maluaka Park";

(ii) Lot 3 of the "Maui Prince Hotel Subdivision", described as Tax Map Key No. (2) 2-1-006: 057 ("Lot 3"), abutting Maluaka Park on the south;

(iii) Lot 2 of the "Seibu Makena Hotel Subdivision II", described as Tax Map Key No. (2) 2-1-006: 036 ("Lot 2"), abutting Lot 3 on the south;

(iv) Lot 1 (0.603 acre) and Lot 2 (0.403 acre) of the "Makena Farms Subdivision", collectively described as Tax Map Key No. (2) 2-1-007: 068 (total 1.006 acres). A parking lot for beach access, public comfort station and shower are located upon a portion of this parcel depicted as Lot 1-A on the map attached hereto as Exhibit "A" and incorporated by reference herein. Lot 1-A is referred to herein as "North Maluaka"; and

(v) Parcel 70 (1.298 acres) of Registered Map 4132, described as Tax Map Key No. (2) 2-1-007: 094, and depicted on the map attached hereto as Exhibit "B" and incorporated by reference herein. Said parcel is also known as and referred to herein as "Makena Landing".

B. ATC Makena has expanded Maluaka Park, as more particularly described in that certain Declaration of Restrictive Covenants for Park Purposes of even date herewith ("Declaration"), affecting Lot 4 and portions of Lots 2 and 3, described and depicted as Easement P-1 in Exhibit "C" attached hereto and incorporated by reference herein, and referred to herein as "Expanded Maluaka Park".

C. Maluaka Park and Makena Landing historically have been used by the public for beach access and general recreational purposes under long-standing formal and informal agreements with the County. A public comfort station and shower are currently located at each of Expanded Maluaka Park, North Maluaka and Makena Landing. A parking lot for beach access is currently located at North Maluaka.

D. The prior owner of Makena Beach & Golf Resort (then known as the Maui Prince Resort) and its affiliates entered into formal and informal agreements with the County of Maui with respect to the public use of Maluaka Park including, but not limited to: (i) the Special Management Area (SMA) approval dated November 21, 1990 (86/SMA-010), Sections 11, 12, 13 and 17; (ii) Letter of Understanding Concerning Maintenance of Beach Access Restrooms at Public Beach Right of Way at Makena, Maui dated September 14, 1992; Temporary Right of Entry Agreement dated September 14, 1992 recorded in the Bureau of Conveyances of the State of Hawaii as Document No. 92-162242; (iii) Land Exchange Agreement dated November 27, 1985, recorded in the said Bureau of Conveyances in Liber 19136, Page 18; and (iv) the Landscaping and Maintenance Agreement dated August 9, 1984, recorded in the said Bureau of Conveyances in Liber 18301, Page 210 (collectively referred to as the "Prior Commitments").

F. Maui County Ordinance No. 3613, effective on January 7, 2009 (the "Rezoning Ordinance") changed the zoning applicable to some of the Makena Beach & Golf Resort lands. Condition No. 36 of the Rezoning Ordinance (the "Maintenance Condition") requires ATC Makena to "maintain Makena Landing (TMK: 2-1-007: 094), North Maluaka (TMK: 2-1-007: 068) . . . and all future parklands within the Makena Resort Area."

G. ATC Makena desires to set forth its understanding with the County of Maui (the "County") regarding the maintenance and operation of Expanded Maluaka Park, North Maluaka and Makena Landing, in satisfaction of the Prior Commitments (as to Expanded Maluaka Park) and the Rezoning Ordinance.

AGREEMENT:

NOW, THEREFORE, ATC Makena, as the respective owners of the aforementioned properties, agrees as follows:

1. Maintenance of Expanded Maluaka Park, North Maluaka and Makena Landing. ATC Makena accepts and confirms the Maintenance Condition and shall perform the Maintenance Condition in accordance with the terms thereof. ATC Makena shall be responsible, as its sole expense, for the care and maintenance of Expanded Maluaka Park, North Maluaka and Makena Landing.

2. Operation. The County shall have no obligation to maintain or operate Expanded Maluaka Park, North Maluaka or Makena Landing, said responsibilities being assumed entirely by ATC Makena. ATC Makena shall provide written notice to the County, in advance to the extent possible, if the services it provides pursuant to this Agreement are, or will be, interrupted.

3. Rules and Regulations. Expanded Maluaka Park, North Maluaka and Makena Landing shall be open to the public for recreational use and beach access subject to reasonable restrictions on such use and access which may be established by ATC Makena, or any of them from time to time, in their reasonable discretion, for the health, safety, welfare and enjoyment of park users and the protection of the lands and shoreline including, but not limited to: closing the lands during non-daylight hours; adopting and enforcing rules with regard to littering, noise, pets and illegal activities; prohibition of or restriction on commercial uses; and regulations on the use of motorized vehicles, bicycles, watercraft and other equipment. Prior to the establishment of any restrictions on use and access, ATC Makena shall consult the Director of the County Department of Parks and Recreation and shall incorporate all reasonable requests of the Director.

4. Recreational Use. Any person using Expanded Maluaka Park, North Maluaka or Makena Landing for recreational, non-commercial purposes shall do so without charge. Such person shall be deemed to be a permittee for recreational purposes or "recreational user" as defined in Hawaii Revised Statutes ("HRS"), Chapter 520, relating to Landowners' Liability. Nothing in this Agreement shall amend, qualify or otherwise limit: (i) the liability protections given to ATC Makena, and their respective members, managers, officers, employees, agents and affiliates under HRS Chapter 520, including, without limitation, HRS Section 520-4, as the same may be amended from time to time; or (ii) the liability protections given to the owners or operators of any businesses providing recreational activities to the public who obtain voluntary written release waivers from their patrons pursuant to the provisions of HRS Section 663-1.54 relating to Recreational Activity Liability, as the same may be amended from time to time.

5. Term. This Agreement shall become effective upon its recordation in the Bureau of Conveyances of the State of Hawaii and shall continue in effect as to each of the properties affected by this Agreement unless and until: (i) a written release of this Agreement by the County as to such property is recorded in said Bureau; or (ii) such property is dedicated to and accepted by the County.

6. Runs With Land. This Agreement shall run with, and be binding upon, the land comprising Expanded Maluaka Park, North Maluaka and Makena Landing and all persons having or who acquire any right, title or interest in and to Expanded Maluaka Park, North Maluaka and/or Makena Landing, without the execution, delivery or recordation of any further instrument, document, agreement or declaration by ATC Makena, its successors or assigns, or the County. Upon the transfer of any right, title or interest in or to Expanded Maluaka Park, North Maluaka or Makena Landing, or any portion thereof, the transferee shall be bound by and shall assume, observe and perform all of the terms of this Agreement as it pertains to such land.

7. Assignment to Master Association. ATC Makena is expressly permitted to assign its rights and obligations under this Agreement to a master owners association for the Makena Beach & Golf Resort to be created by ATC Makena, in its sole discretion.

8. Satisfaction of Prior Commitments. This Agreement satisfies the requirements of the Prior Commitments and, in the event of any inconsistency between the terms of this Agreement and the terms of the Prior Commitments, the terms of this Agreement shall control.

9. Definitions. The terms "TICs" and "ATC Makena" as used herein, and any pronoun in reference thereto, shall mean and include each entity included by definition in such term and its respective successors and assigns.

10. Integration; Amendment. This Agreement and all exhibits to this Agreement constitute the entire agreement between ATC Makena and the County with respect to the subject matter hereof and supersede any and all prior negotiations, understandings, representations and agreements, oral or written. Any amendment of this Agreement shall be in writing and executed by ATC Makena and approved by the County.

11. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Hawaii.

[No Further Text On This Page]

IN WITNESS WHEREOF, the undersigned have executed this instrument as of the day and year first written above.

APPROVAL RECOMMENDED:

By: ____________________
Butch Ka`ala Buenconsejo
Director, Parks and Recreation
County of Maui

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, ATC Makena Land AH1 LLC, and ATC Makena Hotel LLC

By: ____________________

Their Authorized Signatory

APPROVED AS TO FORM AND LEGALITY:

By: ____________________

Deputy Corporation Counsel
County of Maui

"ATC MAKENA"

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

On this 9th day of March, 2017, before me personally appeared Sean Hehir, to me personally known, who, being by me duly sworn or affirmed, did say that such person(s) executed the foregoing instrument as the free act and deed of such person(s), and if applicable, in the capacities shown, having been duly authorized to execute such instrument in such capacities.

ANDREA MCINTOSH NOTARY PUBLIC No. 16-326 STATE OF HAWAII

andrea mcintosh
Print Name: Andrea McIntosh
Notary Public, State of Hawaii.

My commission expires: September 18, 2020

Date of Doc: undated # Pages: 20

Name: Andrea McIntosh First Circuit

Doc. Description: Unilateral Maintenance Agreement for Expanded Maluaka Park, North Maluaka, and Makena Landing

andrea mcintosh march 9, 2017

Notary Signature

ANDREA MCINTOSH NOTARY PUBLIC No. 16-326 STATE OF HAWAII

NOTARY CERTIFICATION (Seal)

EXHIBIT "A"

North Maluaka

[See attached]

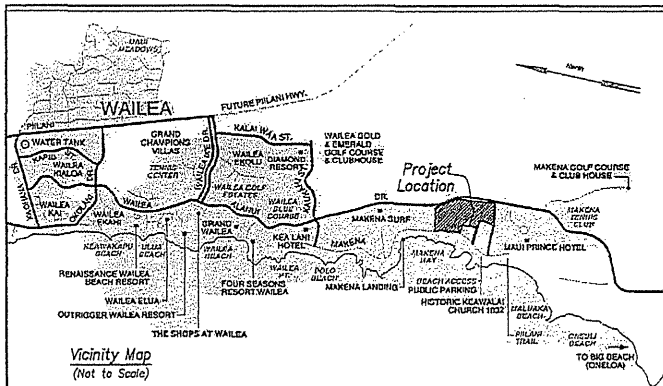
Consolidation of Lot 1–C of Land Court Application 1846 (Map 5) and Lot 2–A of Seibu Makena Hotel Subdivision, Being a Portion of Grant 835 to Mahoe and Resubdivision into Lots 1–C–1 and 2–A–1 and Cancellation of Access and Utility Easement and Designation of Easements A–1 and S–1

At Makena, Maui, Hawaii

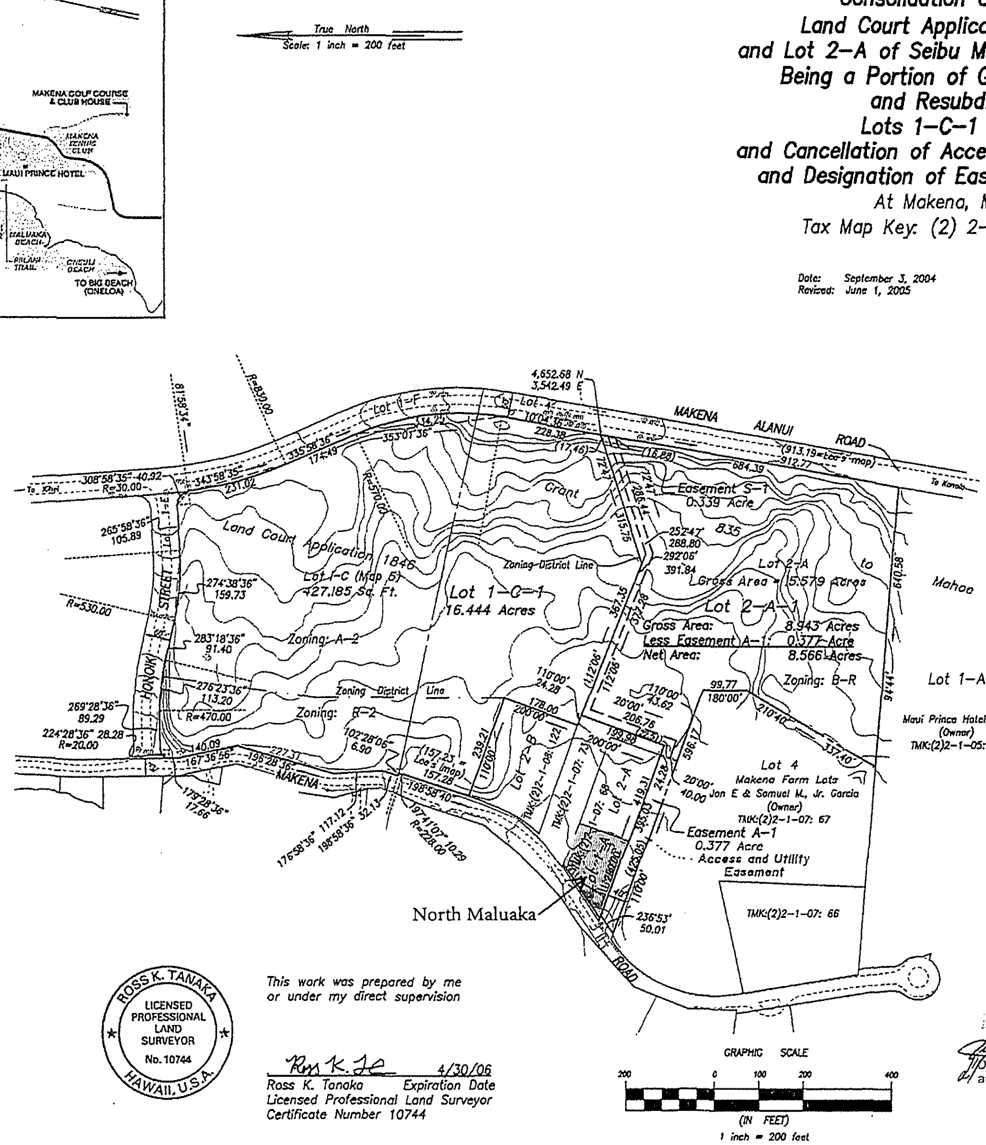
Tax Map Key: (2) 2–1–08: 80 and 99

Date: September 3, 2004
Revised: June 1, 2005

Owner: Makena Aina Corp.
5415 Alanui Road
Kihei, Maui 96753



Vicinity Map
(Not to Scale)



ROSS K. TANAKA
LICENSED PROFESSIONAL LAND SURVEYOR
No. 10744
HAWAII, U.S.A.

This work was prepared by me or under my direct supervision

Ross K. Tanaka — 4/30/06
Ross K. Tanaka — Expiration Date
Licensed Professional Land Surveyor
Certificate Number 10744

Notes:

1. Coordinates and azimuths are referred to Government Survey Triangulation Station "Puu Olai" △.
2. Easement A–1 (40 feet wide) for Access and Utility Purposes affecting Lot 2–A–1 and in favor of Lots 2–A and 4 of the Makena Farms Lots (LUCA File No. 2.1696) = 0.377 Acre.
3. Easement S–1 for Sewerline Purposes affecting Lot 2–A–1 and in favor of Makena Wastewater Corp. = 0.339 Acre.
4. Pursuant to Maui County Code Section 3.44.015(C), the County of Maui is not responsible for any park, roadway, easement (including but limited to drainage, sewer, access, reclaimed water, or avigation easement), or any other interest in real property shown on this map or shown on these plans, unless the Maui County Council has accepted its dedication by a resolution approved by a majority of Council's members at a regular or special meeting of the Maui County Council.
5. All boundary corners are marked with 1/2" pipes.
6. Elevations are based on Mean Sea Level (MSL). Five (5) ft. contour intervals.
7. "Lee's map" denotes Seibu Makena Subdivision Map, Subdivision File Number 2.1994.
8. Flood Zone C, Community–Panel Number 150003 0330 B, dated June 1, 1981.

SUBDIVISION APPROVAL
...VAL BASED UPON SECTION 18.04.020.C., M.C.C.)

...ivision File Number: 2.2869
...roved for Recordation with the Bureau of ...onveyances and Department of Taxation, ...tate of Hawaii.

[signature] — 2/9/06
Director of Public Works and Environmental Management — Date

Subdivision File No. 2.2869

RMTC Ref. No.: 1–19878–0–S
F.N.: Makena–1C.Dwg

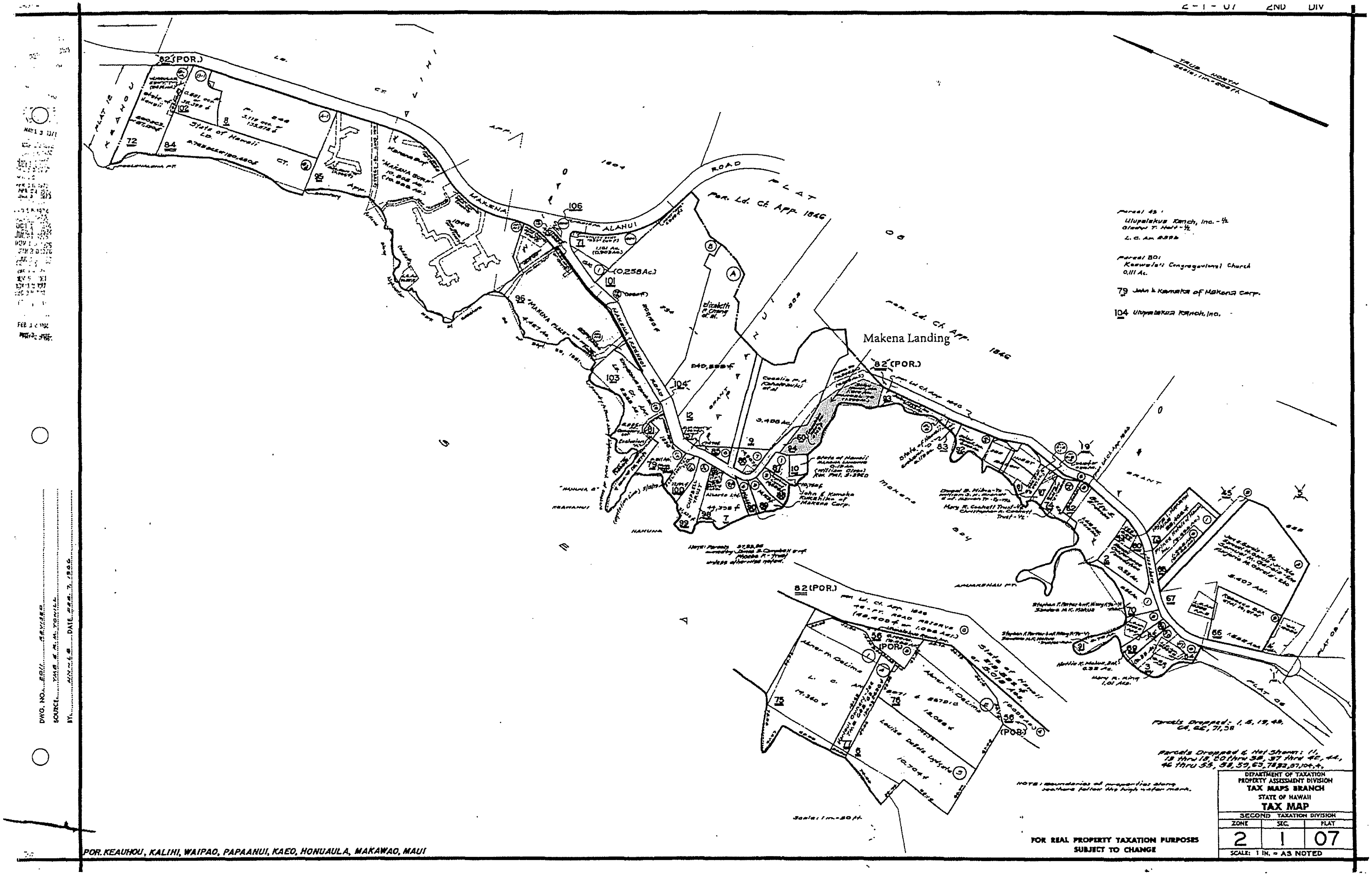
R. M. TOWILL CORPORATION

420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
September 3, 2004

EXHIBIT "B"

Makena Landing

[See attached]



2-1-07 2ND DIV
TRUE NORTH
Parcel 43: Ulupalakua Ranch, Inc. - ½ Gladys T. Holt - ½ L.C. Aw. 8395
Parcel 80: Keawala'i Congregational Church 0.111 Ac.
79 John & Kamaka of Makena Corp.
104 Ulupalakua Ranch, Inc.
Makena Landing
82 (POR.)
MAKENA ROAD
ALAHUI
Por. Ld. Ct. App. 1846
PLAT 08
PLAT 12
PLAT 06
(0.258Ac.)
"MAKENA PLACE"
Elizabeth P. Chang et al.
John & Kamaka Kukahiko of Makena Corp.
Abner H. DeLima
Louise DeSoto Igtalo
Parcels Dropped: 1, 5, 19, 49, 64, 66, 71, 38
DEPARTMENT OF TAXATION
PROPERTY ASSESSMENT DIVISION
TAX MAPS BRANCH
STATE OF HAWAII
TAX MAP
SECOND TAXATION DIVISION
ZONE SEC. PLAT
2 1 07
SCALE: 1 IN. = AS NOTED
FOR REAL PROPERTY TAXATION PURPOSES SUBJECT TO CHANGE
POR. KEAUHOU, KALIHI, WAIPAO, PAPAANUI, KAEO, HONUAULA, MAKAWAO, MAUI

EXHIBIT "C"

Expanded Maluaka Park

[See attached]

EASEMENT P-1
(FOR PARK PURPOSES)

Being a portion of Lot 2 of the Seibu Makena Hotel Subdivision, II and Lot 3 of the Maui Prince Hotel Subdivision and all of Lot 4 of the Maui Prince Hotel Subdivision, being also a portion of Grant 835 to Mahoe and Grant S-15,029 to Ulupalakua Ranch, Inc.

Situate at Maluaka, Honuaula, Maui, Hawaii.

Beginning at the Northeast corner of this easement, also being a point along the Northwest boundary of Lot 1 of the Makena Aina-Golf Corp. Subdivision, the coordinates of said point of beginning referred to Government Survey Triangulation Station "PUU OLAI" being 3,216.69 feet North and 1,950.10 feet East thence running by azimuths measured clockwise from true South:

1.	29°	20′		124.40	feet	along Lot 1 of the Makena Aina-Golf Corp. Subdivision, also along Grant 1441, Apana 3 to L.L. Torbert;
2.	124°	42′		107.24	feet	along Lot 1-A of The Parcel H-1 Consolidation, also along remainders of Grant S-15,029 to Ulupalakua Ranch, Inc. and Grant 835 to Mahoe;
3.	101°	04′		28.00	feet	along along Lot 1-A of The Parcel H-1 Consolidation Subdivision, also along the remainder of Grant 835 to Mahoe;
4.	91°	12′		6.00	feet	along same;
						Thence along same, on a curve to the left with a radius of 25.00 feet, the chord azimuth and distance being:
5.	65°	13′	30″	21.90	feet;	
6.	39°	15′		20.00	feet	along same;
7.	305°	15′		9.00	feet	along same;
8.	39°	40′		16.00	feet	along same;

9.	137°	57′		13.00 feet along same;
10.	76°	00′		49.00 feet along same;
11.	47°	49′		100.05 feet along same;
12.	133°	04′		26.75 feet along remainder of Lot 3 of the Maui Prince Hotel Subdivision, also along the remainder of Grant 835 to Mahoe;
13.	154°	28′		16.02 feet along same;
14.	161°	42′		13.86 feet along same;
15.	145°	44′		11.42 feet along same;
16.	138°	31′		11.39 feet along same;
17.	129°	51′		20.70 feet along same;
18.	108°	18′		12.98 feet along same;
19.	74°	17′		43.56 feet along same;
20.	107°	44′		3.36 feet along same;
21.	16°	05′		4.14 feet along same;
				Thence along same, on a curve to the right with a radius of 8.00 feet, the chord azimuth and distance being:
22.	31°	01′	30″	4.13 feet;
23.	45°	58′		2.40 feet along same;
				Thence along same, on a curve to the right with a radius of 35.00 feet, the chord azimuth and distance being:
24.	54°	15′	30″	10.10 feet;
25.	62°	33′		11.73 feet along same;
26.	65°	00′		18.04 feet along same;

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

CIVIL ENGINEERS • SURVEYORS

501 SUMNER STREET, SUITE 521
HONOLULU, HAWAII 96817-5031

1871 WILI PA LOOP, SUITE A
WAILUKU, MAUI, HAWAII 96793

100 PAUAHI STREET, SUITE 213
HILO, HAWAII 96720

27.	68°	37′		24.65 feet along same;
28.	64°	25′		50.53 feet along same;
29.	79°	03′		8.75 feet along same;
30.	66°	05′		17.17 feet along same;
31.	62°	01′		18.24 feet along same;

Thence along same, on a curve to the left with a radius of 20.00 feet, the chord azimuth and distance being:

32.	48°	15′		9.52 feet;
33.	34°	29′		50.73 feet along same;
34.	39°	01′		24.09 feet along remainder of Lot 2 of The Seibu Makena Hotel Subdivision, also along the remainder of Grant 835 to Mahoe;

Thence along same, on a curve to the right with a radius of 45.00 feet, the chord azimuth and distance being:

35.	47°	18′		12.97 feet;
36.	55°	35′		27.17 feet along same;
37.	58°	26′		52.00 feet along same;
38.	149°	41′		28.87 feet along same;

Thence along the shoreline as certified on February 11, 2016, for the following nine (9) courses, the direct azimuth and distance between points on said shoreline being:

39.	237°	49′	17″	100.20 feet;
40.	209°	46′		73.45 feet;
41.	248°	21′		64.16 feet;

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
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501 SUMNER STREET, SUITE 521
HONOLULU, HAWAII 96817-5031
1871 WILI PA LOOP, SUITE A
WAILUKU, MAUI, HAWAII 96793
100 PAUAHI STREET, SUITE 213
HILO, HAWAII 96720

42.	293°	38′		8.46 feet;
43.	239°	41′		66.60 feet;
44.	274°	44′		32.99 feet;
45.	182°	19′		112.65 feet;
46.	300°	46′		84.97 feet;
47.	229°	39′		53.65 feet;

Thence along the shoreline as certified on July 12, 2000, for the following ten (10) courses, the direct azimuth and distance between points on said shoreline being:

48.	228°	50′		20.02 feet;
49.	263°	46′		55.21 feet;
50.	284°	41′		45.55 feet;
51.	217°	09′		27.35 feet;
52.	135°	54′		15.09 feet;
53.	216°	13′		17.00 feet;
54.	299°	46′		47.78 feet;
55.	307°	54′		12.40 feet;
56.	253°	31′		12.10 feet;
57.	228°	14′		77.05 feet;
58.	311°	36′	15″	146.16 feet along Lot 5 of The Maui Prince Hotel Subdivision, also along the remainders of Grant 835 to Mahoe and Grant S-15,029 to Ulupalakua Ranch, Inc., to the point of beginning and containing an area of 1.500 acres more or less.

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS
501 SUMNER STREET, SUITE 521 HONOLULU, HAWAII 96817-5031
1871 WILI PA LOOP, SUITE A WAILUKU, MAUI, HAWAII 96793
100 PAUAHI STREET, SUITE 213 HILO, HAWAII 96720

JUSTIN H. LAPP
LICENSED PROFESSIONAL LAND SURVEYOR
No. 12964
HAWAII U.S.A.

Description Prepared By:

EXP 04/18

JUSTIN H. LAPP
Licensed Professional Land Surveyor
Certificate No. 12964

Maui, Hawaii
May 10, 2016

TMK: (2) 2-1-006: Por. 036, Por. 057 and 111

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

501 SUMNER STREET, SUITE 521
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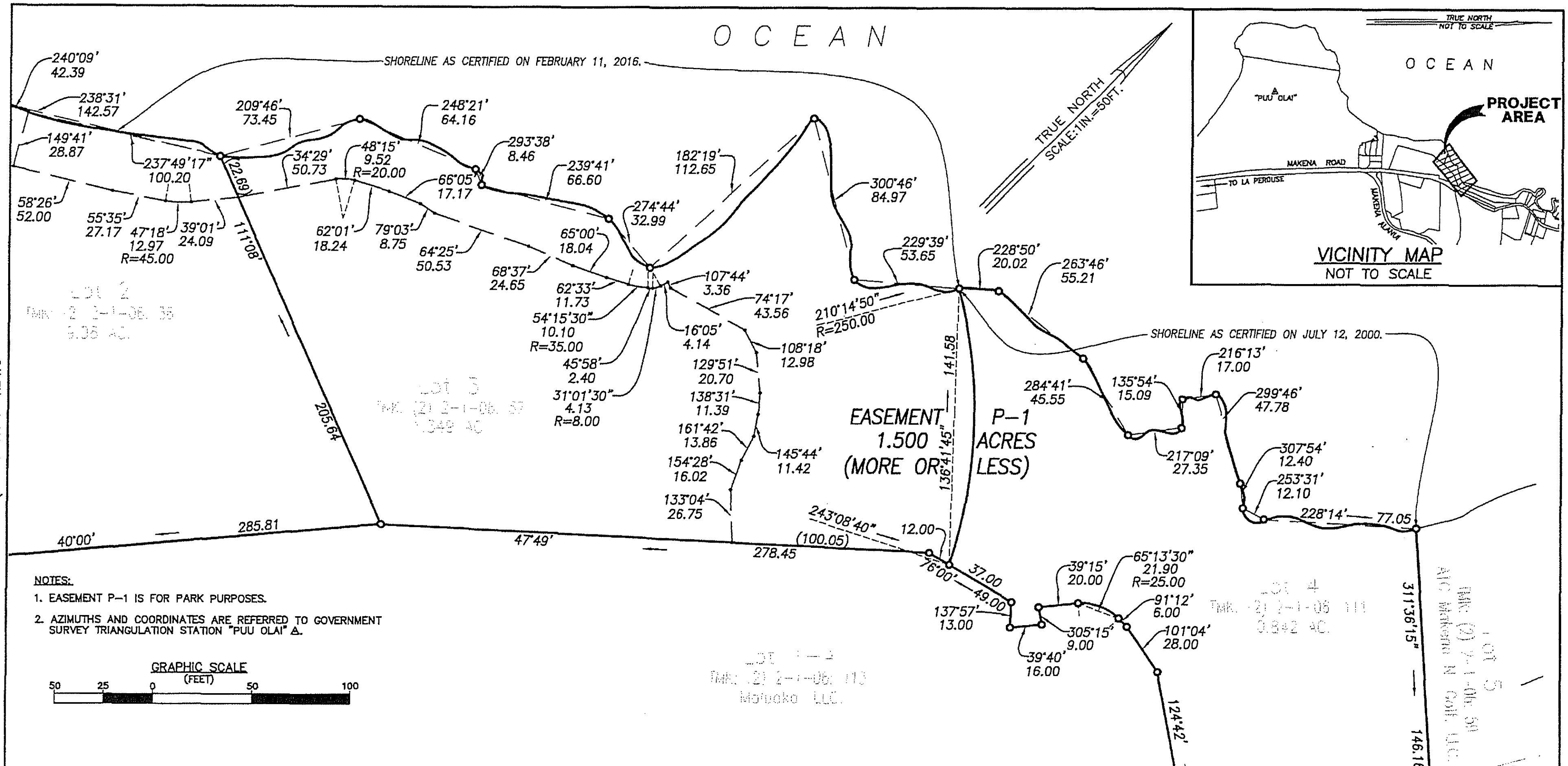

NOTES:

1. EASEMENT P-1 IS FOR PARK PURPOSES.
2. AZIMUTHS AND COORDINATES ARE REFERRED TO GOVERNMENT SURVEY TRIANGULATION STATION "PUU OLAI" Δ.

SKETCH SHOWING EASEMENT P-1

AFFECTING PORTIONS OF LOT 2
OF THE SEIBU MAKENA HOTEL SUBDIVISION II AND
LOT 3 OF THE MAUI PRINCE HOTEL SUBDIVISION AND ALL OF LOT 4
OF THE MAUI PRINCE HOTEL SUBDIVISION
BEING ALSO A PORTION OF GRANT 835 TO MAHOE
AND GRANT S-15,029 TO ULUPALAKUA RANCH, INC.
AT MALUAKA, HONUAULA, MAKAWAO, MAUI, HAWAII

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

LICENSED PROFESSIONAL LAND SURVEYOR
CERTIFICATE No. 12964
EXP. DATE 04/2018

AUSTIN H. LAPP LICENSED PROFESSIONAL LAND SURVEYOR No. 12964 HAWAII U.S.A.

MAY 6, 2016

JOB NO.: 15-527(K)

TMK: (2) 2-1-006: POR. 036, POR. 057 AND 111

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
1871 WILI PA LOOP SUITE A • WAILUKU, MAUI, HAWAII 96793

Z:\2015\15-527\SURVEY\K- PARK EXPANSION ADDITIONAL WORK\EASEMENT P-1.DWG

CONSENT AND SUBORDINATION OF SPT TLB BB HOLDINGS, LLC, AS COLLATERAL AGENT ON BEHALF OF THE LENDERS

SPT TLB BB HOLDINGS, LLC, a Delaware limited liability company, as collateral agent on behalf of the Lenders (as defined below), having an address at 591 W. Putnam Avenue, Greenwich, Connecticut 06830 (the "Mortgagee"), is the holder of the mortgagee's rights under the Mortgage (as defined below), which Mortgage, by mesne assignments, was assigned to the Mortgagee by that certain unrecorded assignment dated September 10, 2015, such unrecorded assignment being referenced in that certain Memorandum of Assignment of Security Documents dated September 10, 2015, recorded in the Bureau of Conveyances of the State of Hawaii (the "Bureau"), as Document No. A-57420899. As used herein, "Mortgage" shall mean that certain Mortgage, Assignment of Leases and Rents, Security Agreement and Fixture Filing dated September 11, 2014, recorded in the Bureau as Document No. A-53710126. As used herein, "Lenders" shall mean the holders of the Note (as defined in the Mortgage) and their successors and assigns.

The Mortgagee hereby consents and subordinates the lien of the Mortgage to the foregoing Unilateral Maintenance Agreement for Expanded Maluaka Park, North Maluaka and Makena Landing, provided that this consent and subordination shall not be deemed to be a release or waiver of any of the rights of the Mortgagee under the Mortgage or under any of the Loan Documents (as defined in the Mortgage), which rights are hereby expressly reserved.

SPT TLB BB HOLDINGS, LLC,
a Delaware limited liability company,
as collateral agent on behalf of the Lenders

By: ______________________________
Name: ANDREW J. SOSSEN
Its: Authorized Signatory

STATE OF Connecticut)
) ss.: Greenwich
COUNTY OF Fairfield)

I, Vernice Briggs, a Notary Public for the said County and State of Connecticut, do hereby certify that Andrew J. Sossen, Authorized Signatory of SPT TLB BB HOLDINGS, LLC, a Delaware limited liability company, as collateral agent on behalf of the Lenders, personally appeared before me this day and acknowledged the due execution of the foregoing instrument on behalf of the limited liability company.

WITNESS my hand and official stamp or seal, this 13 day of February, 2017

Notary Public

VERNICE BRIGGS
NOTARY PUBLIC
State of Connecticut
My Commission Expires
October 31, 2017

[SEAL]

My commission expires: