



LAW OFFICE OF  
JENNIFER A. LIM LLC



February 17, 2023

**VIA ELECTRONIC MAIL & US MAIL:**

daniel.e.orođenker@hawaii.gov

Daniel Orođenker, Executive Officer  
Land Use Commission  
State of Hawaii  
State Office Tower  
Leiopapa A Kamehameha Building  
235 South Beretania Street, Suite 406  
Honolulu, HI 96813

Re: Annual Report: Docket No. A97-721 (Makena Resort)

Dear Executive Officer Orođenker:

On behalf of the ATC Makena Entities (defined below), we hereby submit this Annual Report for Docket No. A97-721.

**I. BACKGROUND**

On February 19, 1998, the Land Use Commission of the State of Hawaii (the “**Commission**”) filed its *Findings of Fact, Conclusions of Law, and Decision and Order* (the “**1998 D&O**”), which reclassified 145.943 acres of land in Makena, island of Maui, state of Hawaii from the State Land Use Agricultural District into the State Land Use Urban District (hereinafter, the “**LUC Reclassified Property**”). The LUC Reclassified Property consists of six non-contiguous areas of various sizes, adjacent to, and largely surrounded by, pre-existing Urban District land. At that time, the LUC Reclassified Property was owned by Makena Resort Corp.

The ATC Entities, consisting of 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, the “**ATC Entities**”, together with ATC Makena Hotel LLC, the “**ATC Makena Entities**”), acquired portions of the LUC Reclassified Property, and other properties, by three Commissioner's Deeds dated August 27, 2010. The three deeds are: (1) Document No. 2010-125618, which conveyed TMK No. (2) 2-1-005: 108; (2) Document No. 2010-125620, which conveyed TMK No. (2) 2-1-008: 090; and (3) Document No. 2010-125626, which conveyed TMK Nos. (2) 2-1-005: 086 (a portion of which is within the LUC Reclassified Property), and 125 (which is not within the LUC Reclassified Property).

The remaining portion of the LUC Reclassified Property (approximately 27.83 acres) is owned by H2R, LLC. Our understanding, based on public records, is that an entity called Hawaii Development LLC conveyed that property to H2R, LLC by deed recorded October 1, 2018. H2R, LLC is not affiliated with the ATC Makena Entities. The ATC Makena Entities never held title to that portion of the LUC Reclassified Property that is currently owned by H2R, LLC.

This Annual Report only covers those portions of the LUC Reclassified Property that are owned by the ATC Makena Entities, identified as TMK Nos.: (2) 2-1-005: 108 (por.), 2-1-008: 090 (por.), and 2-1-005: 086 (por.) (formerly TMK 2-1-007:004), collectively referred to herein as the “**Petition Area**.” This Annual Report does not address any properties owned by others, such as the portion of the Reclassified Property owned by H2R, LLC.

On August 27, 2012, the Commission filed an Order Granting With Modification Movant's Motion for Sixth Amendment to the Findings of Fact, Conclusions of Law, and Decision and Order, Filed on February 19, 1998, and for Release of Certain Conditions (the “**2012 Amendment**”), through which the Commission released the ATC Makena Entities from Conditions 4, 15, and 21, and amended Conditions 12 and 22 (thereafter renumbered to 11 and 19). An Amended and Restated Declaration of Conditions was recorded on September 7, 2012, in the Bureau as Doc. No. A-46330782.

## II. STATUS OF COMPLIANCE WITH LUC CONDITIONS

The following 19 conditions (in italics) are the conditions set forth in the 1998 D&O, as amended by the 2012 Amendment. ATC Makena Entities’ status of compliance is provided as a response after each condition.

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

**Response:** The ATC Makena Entities acknowledge that the Petitioner is subject to the provisions of said condition and will comply.

2. *Petitioner shall coordinate with the County of Maui Board of Water Supply to incorporate the proposed project into the County Water Use and Development Plan for the area. Prior to the granting of the first discretionary permit for the single-family and multi-family residential development described in paragraph 20 of the Decision and Order or the hotel described in paragraph 21 of the Decision and Order and by or before one year from the issuance date of this Decision and Order,*

*Petitioner shall furnish the Commission with a letter from the County of Maui Board of Water Supply confirming that (a) the potable water allocation that will be credited to Petitioner will be available to and sufficient for the proposed project as it is described in the Petition, (b) the availability of potable water will not be an obstacle or impediment to the development of the proposed project as described in the Petition and (c) the proposed project as it is described in the Petition has been incorporated into the County Water Use and Development Plan for the area and that this plan will prevent the continued overpumping of the sustainable yield of the Iao aquifer.*

**Response:** As provided in prior Annual Reports, this condition has been satisfied. Compliance was confirmed by letter from David Craddick, Director of the Department of Water Supply, County of Maui, dated February 18, 1999.

Additional letters regarding compliance with this condition, dated October 1, 2003, from Petitioner to the Department of Water Supply, and the response from George Tengan, Director of Water Supply, dated October 7, 2003, were attached to a prior Annual Report submitted in this Docket.

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

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

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

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

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

**Response:** This condition has been satisfied. Initially, at the request of the State Department of Defense (“DOD”), the ATC Makena Entities agreed to allow two emergency siren sites to be developed on land owned by the ATC Makena Entities. One at the Makena Wastewater Treatment Plant, and one near Makena State Park. As reported in the 15th Annual Report, the ATC Makena Entities executed Rights of Entry/License Agreements with the DOD in 2012. However, in December 2016, DOD informed the ATC Makena Entities that it intended for one of the two sirens to instead be located at Makena State Park and for the second siren to be located on the ATC Makena Entities wastewater treatment plan property. That siren was installed and completed in 2017.

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

**Response:** The ATC Makena Entities acknowledge that the Petition Area is subject to the provisions of said condition and will comply.

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

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

**Response:** The ATC Makena Entities acknowledge that the Petition Area is subject to the provisions of said condition and will comply prior to any grading, clearing, grubbing or other land alteration in these areas.

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

**Response:** The ATC Makena Entities acknowledge that the Petition Area is subject to the provisions of said condition and will comply at the appropriate time, starting prior to commencement of construction.

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

**Response:** The ATC Makena Entities continue to implement and fund a nearshore water quality monitoring program. This program initially collected base line water samples and analyzed the same to determine turbidity, chemical compound contents and biota sampling. This monitoring program continues with at least semi-annual sampling at four separate nearshore sites.

Enclosed is the Marine Water Quality Quarterly Monitoring Report prepared by AECOS Inc. dated November 28, 2022, for the quarterly tests performed in September of 2022. A copy of this report was sent to the Department of Health in December.

The ATC Makena Entities acknowledge that the Petition Area is subject to the provisions of said condition and will comply.

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

**Response:** ATC Makena Entities understand that this condition has been satisfied. As described in prior Annual Reports, a TIAR was prepared and submitted for State Department of Transportation (DOT) and County of Maui review as part of the change in zoning application. Following certain comments by DOT, revisions were made to the TIAR which DOT agreed with as set forth in a letter from Kazu Hayashida, Director of Transportation, dated May 2, 2000, a copy of which was provided to the Commission with a prior Annual Report in this Docket.

In addition, as set forth in prior Annual Reports, the Petitioner prepared and submitted a Makena Resort Master Traffic Study, dated June 6, 2003 (Revised September 14, 2003), which was submitted to the SDOT and County of Maui, and approved by the County on September 26, 2003. See also the ATC Makena Entities Response to Condition 11, below, regarding a future traffic impact assessment report (“**TIAR**”).

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

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

This condition has been partially satisfied, in so far as the ATC Makena Entities and the DOT have now formally agreed in writing that the ATC Makena Entities’ pro rata share to satisfy this Condition, Conditions 10 and 14, and other related conditions imposed in County-level entitlements, shall be based upon a TIAR to be prepared by the ATC Makena Entities. The TIAR will identify the impacts of ATC’s proposed development, the corresponding mitigation measures to address those impacts, a schedule for satisfaction, and appropriate schematic figures showing transportation improvements. The parties anticipate that the current letter agreement will be supplemented and/or superseded by a subsequent and more definitive memorandum of agreement in due course. Moreover, as noted in prior Annual Reports, partial satisfaction of this condition was achieved through the “Agreement for Planning and Design of Piilani Highway Expansion” between Makena Resort Corp. (the original Petitioner), and DOT in 2001. Under this Agreement, Petitioner agreed to fund the planning and design of the restriping and other improvements to Piilani Highway from Mokulele Highway to Kilohana Drive, to increase it from two lanes to four lanes. This work was substantially completed by July 2003, at a total estimated cost of \$400,000.00, which amount DOT agreed would be credited as partial payment in

satisfaction of the LUC's conditions of approval.

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

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

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

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

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

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

**Response:** The ATC Makena Entities acknowledge that they are subject to the provisions of said condition and will comply. Traffic improvements required by DOT will be addressed pursuant to Condition 11.

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

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

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

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

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

**Response:** The ATC Makena Entities acknowledge that they are subject to the provisions of said condition and will comply. The submittal of this Annual Report by the ATC Makena Entities is in compliance with this condition.

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

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

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

**Response:** This condition has been satisfied and the ATC Makena Entities acknowledge that they are subject to the provisions of said condition in the event of any amendments. The ATC Makena Entities recorded an Amended and Restated Declaration of Conditions Applicable To An Amendment to District Boundary From Agricultural to Urban, in the Bureau on September 7, 2012 as Document Number A-46330782, a copy of which was provided to the Commission as part of a prior Annual Report transmittal.

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Daniel Orodener, Executive Officer  
Land Use Commission  
February 17, 2023  
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If you have any questions or require any further information, please feel free to contact me or Mr. Ka'imi Judd Vice President of Development, Mākena Golf & Beach Club, at 808-640-6023.

Sincerely,



LAW OFFICE OF JENNIFER A. LIM, LLLC

cc: State of Hawaii, Office of Planning and Sustainable Development, *via US Mail*  
County of Maui, Department of Planning, *via US Mail*

Encls. Marine Water Quality Quarterly Monitoring Report prepared by AECOS Inc. dated November 28, 2022 for the quarterly tests performed in September of 2022.

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# Mākena Golf & Beach Club quarterly water quality monitoring report

## September 2022

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November 28, 2022

**Final**

AECOS No. 1535S

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## Introduction

The State Land Use Commission requires that Mākena Golf and Beach Club (MG&BC; called “Project” herein) submit water quality monitoring reports to the Hawaiʻi Department of Health (HDOH) in compliance with Condition No. 10 in the “Declaration of Conditions”, a document that pertains to the Amendment of the MG&BC District Boundary, dated April 17, 1998. The monitoring report must also ensure compliance with Condition 19 of the County of Maui, Zoning Ordinance 3613. The goals of the monitoring program established to comply with Condition No. 10 and Ordinance 3613 are: (1) assess degree to which fertilizers, as well as other nutrient sources used on land to enhance golf course turf growth and resort landscaping, leach to groundwater and subsequently reach nearshore waters; (2) establish evidence of delivery of these nutrients into the nearshore environment; and (3) determine if subsequent water quality has any measurable impacts on biological community structure in the nearshore marine environment (see annual water quality reports: AECOS, 2019a,b, 2021, 2022)

Water quality parameters of particular interest for the purposes of our monitoring program are termed nutrients<sup>1</sup>. Nutrient enrichment can enhance nuisance algae production in aquatic environments (HDLNR, 2014). Nutrient enrichment can also negatively impact corals and other biological components in Hawaiʻi coastal waters (Laws et al., 2004; MRC, 2011; AECOS, 2016). A

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<sup>1</sup> “Nutrients” are nitrogen and phosphorus compounds that promote plant growth, including algal growth in the marine environment. These chemicals are the main ingredients in applied fertilizers.

separate program monitors nearshore biological assemblages off the MG&BC resort to determine if marine water quality is impacting the biota extant there (see *AECOS*, 2020).

Tables and figures throughout this quarterly report compare the most recent (September 1, 2022) water quality monitoring results with means calculated from 17 previous monitoring events undertaken quarterly between June 2018 and June 2022.

## Background

Waters south from Nahuna Point—including Mākena Bay and Maluaka Bay (Figure 1)—to Pu‘u Ola‘i are designated as “Class A, open coastal waters” in State of Hawai‘i water quality standards (HDOH, 2021). These waters are included on the HDOH 2020 list of impaired waters in Hawai‘i prepared under Clean Water Act §303(d) as impaired for nitrate+nitrite, ammonium, total nitrogen, turbidity, and chlorophyll  $\alpha$  (HDOH, 2022). These waters are listed as “Category 2” (meaning that some designated uses are attained), “Category 3” (meaning that insufficient data and/or information exist to make use-support determinations), and “Category 5” (meaning that available data and/or information indicate that at least one designated use is not supported or is threatened). These results indicate that a Total Maximum Daily Load<sup>2</sup> study may be needed.

Marine waters from Pu‘u Ola‘i south are designated as Class AA “open coastal waters” in State of Hawai‘i water quality standards (HDOH, 2021) and included on the HDOH 2022 list of impaired waters in Hawai‘i for nitrate+nitrite, ammonium, and turbidity (HDOH, 2022). These waters are also listed under Categories 2, 3 and 5.

## Methods

The September 1, 2022 quarterly monitoring event was conducted along three monitoring transects in nearshore waters adjacent to MG&BC (Transects M-1, M-2, and M-3) and at a control site located well south of Pu‘u Ola‘i (Transect M-4) (Figure 1). Sampling stations were set at 2-m, 10-m, 50-m, and 100-m

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<sup>2</sup> Total Maximum Daily Load (TMDL) studies are done to establish limits on point-source discharges of substances causing impairments to water quality in aquatic environments. The term “needed” in the HDOH document actually means “has not been done”. A TMDL for any particular location is undertaken by HDOH and is unrelated to this monitoring effort as no point-source discharge is existing or contemplated at Mākena.

distance from shore along each transect and water samples were collected from near the surface at each station. Water quality samples were also obtained from four source water wells: Mākena Well 1, Mākena Well 3, Mākena Well 4 and Mākena Well 6 (see Fig. 1).



**Figure 1. Location of water quality monitoring transects M-1, M-2, M-3, and M-4) and irrigation water supply wells at MG&BC.**

Temperature, salinity, pH, and dissolved oxygen (DO) were measured *in situ* at each station. Collected water samples were immediately chilled and returned to the AECOS laboratory (AECOS Log No. 46025) for laboratory analyses. The following parameters were measured from these samples: salinity, turbidity, ammonium, nitrate+nitrite, total nitrogen (total N), ortho-phosphate, total phosphorus (total P), and chlorophyll  $\alpha$ . Table 1 lists the instruments and analytical methods used for these field measurements and laboratory analyses.

The predicted tide on the September 1, 2022 event was high at 0708 hours (+1.38 ft), falling to a low of +0.62 ft at 1226 hours (Station 1615202, Mākena; NOAA, 2022). Winds were mild (1.6 to 2.6 mph) from the northeast to southeast and nearshore surf was minimal (0 to 1.0 ft). Water quality samples were

collected at all stations along each of the four transects between 0800 and 0915 hours, followed by sampling at the MG&BC wells and storage pond.

**Table 1. Analytical methods and instruments used for water quality analyses reported herein.**

Analysis	Method	Reference	Instrument
Temperature	SM 2550B	SM (2017)	YSI Model 550 DO meter thermistor
Salinity	SM 120.1	SM (2017)	Accument AB200
pH	SM 4500H+	SM (2017)	pH pHep HANNA meter
Dissolved Oxygen	SM 4500-O G	SM (2017)	YSI Model 550 DO meter
Turbidity	EPA 180.1	USEPA (1993b)	Hach 2100Q Turbidimeter
Ammonium	EPA 349	USEPA (1997a)	Lachat Quickchem 8500
Nitrate + Nitrite	EPA 353.2	USEPA (1993a)	Lachat Quickchem 8500
Silicates	EPA 360.0	USEPA (1997c)	Lachat Quickchem 8500
Total Nitrogen	EPA 353.4	USEPA (1993a)	Shimadzu TNM-1
Ortho-Phosphate	EPA 365.5	USEPA (1997b)	Lachat Quickchem 8500
Total Phosphorus	EPA 365.5	USEPA (1997b)	Lachat Quickchem 8500
Chlorophyll $\alpha$	SM-10200H(M)	SM (1998)	Turner Fluorometer

## Results

Water quality results displayed in Tables 2 and 3 are compared with long-term historic mean values. On September 1, 2022, salinities were high compared to long-term means along all four transects. Salinity values did not increase with distance from shore as shown for historic values. Temperature values were high and consistent along Transects M-1 through M-3 due to late summer conditions. The lowest temperatures occurred along Transect M-4. pH means decreased from Transect M-1 to Transect M-4 and were reasonably close to historic means, except along Transect M-4. DO saturation means were low compared with historic means: the lowest values occurring at Transect M-3 and the highest at Transect M-1. Turbidity means were low along all four transects compared with historic means probably due to calm nearshore water conditions. Chlorophyll  $\alpha$  mean values were also low at Transect M-1 through Transect M-3 compared with historic data.

**Table 2. Physical/chemical water quality and chlorophyll  $\alpha$  means for June 2018 through June 2022 ( $n = 17$ ) compared to September 2022 results.**

Transect	DFS <sup>†</sup> (m)	Salinity (ppt)		Temperature (° C)		pH		DO (% Sat.)		Turbidity‡ (NTU)		Chl. $\alpha$ ‡ ( $\mu\text{g/L}$ )	
		Historic	Sept. 2022	Historic	Sept. 2022	Historic	Sept. 2022	Historic	Sept. 2022	Historic	Sept. 2022	Historic	Sept. 2022
<b>M-1</b>	2	34.01	35.10	26.6	27.1	8.17	8.23	102	98	1.58	1.78	0.70	0.44
	10	34.12	35.05	26.3	27.2	8.21	8.21	104	100	0.92	0.66	0.50	0.39
	50	34.26	35.07	26.3	27.1	8.21	8.18	100	93	0.77	0.50	0.39	0.20
	100	34.43	35.10	26.3	27.1	8.19	8.17	97	89	0.50	0.56	0.28	0.18
	<b>Means</b>	<b>34.20</b>	<b>35.08</b>	<b>26.4</b>	<b>27.1</b>	<b>8.19</b>	<b>8.20</b>	<b>101</b>	<b>95</b>	<b>0.94</b>	<b>0.88</b>	<b>0.47</b>	<b>0.30</b>
<b>M-2</b>	2	34.17	35.05	26.4	26.9	8.18	8.21	98	91	2.02	0.42	0.42	0.28
	10	34.17	35.19	26.4	27.2	8.19	8.20	95	91	1.36	0.63	0.34	0.26
	50	34.27	35.15	26.4	27.1	8.19	8.17	95	91	0.86	0.43	0.28	0.29
	100	34.47	35.13	26.4	27.3	8.18	8.18	95	89	0.54	0.24	0.23	0.22
	<b>Means</b>	<b>34.27</b>	<b>35.13</b>	<b>26.4</b>	<b>27.1</b>	<b>8.18</b>	<b>8.19</b>	<b>96</b>	<b>91</b>	<b>1.20</b>	<b>0.43</b>	<b>0.32</b>	<b>0.26</b>
<b>M-3</b>	2	34.02	35.15	26.4	26.9	8.18	8.11	105	88	0.73	1.42	0.52	0.38
	10	34.34	35.03	26.4	27.2	8.17	8.11	101	81	0.57	0.26	0.38	0.24
	50	34.53	35.18	26.4	27.2	8.17	8.15	99	88	0.44	0.26	0.28	0.25
	100	34.62	35.22	26.4	27.2	8.18	8.17	96	86	0.41	0.24	0.22	0.18
	<b>Means</b>	<b>34.38</b>	<b>35.15</b>	<b>26.4</b>	<b>27.1</b>	<b>8.18</b>	<b>8.14</b>	<b>100</b>	<b>86</b>	<b>0.54</b>	<b>0.55</b>	<b>0.35</b>	<b>0.26</b>
<b>M-4</b>	2	34.28	34.97	26.0	26.3	8.13	8.09	101	95	1.21	0.84	0.56	0.71
	10	34.33	35.10	26.0	26.4	8.14	8.08	100	94	0.98	1.05	0.45	0.45
	50	34.60	35.05	26.1	26.5	8.13	8.06	98	88	0.63	0.32	0.30	0.32
	100	34.72	35.15	26.1	26.6	8.08	7.92	95	84	0.44	0.36	0.22	0.24
	<b>Means</b>	<b>34.48</b>	<b>35.07</b>	<b>26.0</b>	<b>26.5</b>	<b>8.12</b>	<b>8.04</b>	<b>99</b>	<b>90</b>	<b>0.82</b>	<b>0.64</b>	<b>0.38</b>	<b>0.43</b>
<b>Dry Standard</b>		<b>+/- 10%</b>		<b>+/- 1C°</b>		<b>7.6-8.6</b>		<b>≥75%</b>		<b>≤0.20 NTU</b>		<b>≤0.15 <math>\mu\text{g/L}</math></b>	
† distance from shore		‡ geometric mean		<i>Values in italics exceed standard</i>									



Mean nitrate+nitrite concentrations on September 1, 2022 (Table 3, above) were low along all four transects compared with historic means. There were no onshore-offshore gradients in nitrate+nitrite concentrations in September 2022, whereas historic data demonstrate a distinct reduction in nitrate+nitrite concentrations with distance from shore along all four transects. Ammonium means concentrations, on the other hand, were somewhat high along all four transects. The highest ammonium mean occurred at Transect M-4. Ammonium means showed no trend relative to distance from shore. Total nitrogen mean concentrations were low compared with historic means along all four transects. Ortho-phosphate means were slightly elevated compared with long-term means and decreased from a high mean along Transect M-1 to a low mean along Transect M-4. Total Phosphorus mean concentrations were low along Transects M-1 through Transect M-3 and somewhat elevated along Transect M-4 compared with historic means. Silicate mean concentrations were similar with historic means at Transects M-1 and M-2 and elevated at Transect M-3 and M-4.

Using the PacIOOS Regional Ocean Modeling System (ROMS) we can display approximated water current movements off the southwestern coast of East Maui that occurred just prior to and during our September 1, 2022 sampling event (Figure 2). Water flows were moving into the Mākena vicinity from the northwest before and during this sampling event.



**Figure 2. Approximated current flow off Mākena coast during morning hours (0200 to 1100 hours) of September 1, 2022 (PacIOOS, 2022).**

## Discussion

Salinities along nearshore stations (2-m distance from shore) on September 1, 2022 were elevated along all four transects; nitrate+nitrite concentrations were low along all four transects (Table 3). These conditions suggest that water flowing into the Makena area was from offshore and this is supported by the flow results in Figure 2 above. Nearshore ammonium concentrations are generated within these nearshore waters from natural biological processes. Ammonium subsidies are generally not related to groundwater seepage in Mākena nearshore waters. The elevated ortho-phosphate concentrations noted along all four transects on September 1 are not typical of elevated salinity values in Mākena nearshore waters and the source is unknown.

Tables 4 and 5 present estimates of groundwater nitrate+nitrite and ortho-phosphate subsidies in nearshore marine waters calculated for the September 1 sampling event. Indications of nitrate+nitrite subsidies were not apparent at any of the 2 m stations: nitrate+nitrite concentrations were low at all 2 m stations compared with historic data.

<b>Table 4. Estimated nitrate+nitrite subsidies at nearshore (2-m) stations on September 1, 2022.</b>				
<b>Location</b>	<b>Measured</b>		<b>Estimated</b>	<b>Subsidy</b>
	<b>NO<sub>3</sub>+NO<sub>2</sub></b>	<b>Salinity</b>	<b>NO<sub>3</sub>+NO<sub>2</sub></b>	<b>NO<sub>3</sub>+NO<sub>2</sub></b>
	(µgN/L)	(PSU)	(µgN/L)	(µgN/L)
<b>Wells</b>	1702	1.32	---	---
<b>M-1</b>	3	35.10	63	0
<b>M-2</b>	6	35.05	63	0
<b>M-3</b>	10	35.15	63	0
<b>M-4</b>	5	34.97	63	0
Standard Dev.†	173	0.06	---	---
Range†	1400-1980	1.20-1.44	---	---

† Standard Dev. and Range are for the well data mean.

Ortho-phosphate concentrations were elevated at all stations along all four transects compared with long-term means (Table 3). Ortho-phosphate concentrations from groundwater seepage into coastal waters would be associated only with low salinity values but occurred at elevated values along all four transects during this sampling event. Thus, the ortho-phosphate subsidies given in Table 5 can be presumed to be from a source other than Mākena groundwater seepage.

**Table 5. Estimated ortho-phosphate subsidies at nearshore (2-m) stations on September 1, 2022.**

Location	Measured		Estimated	Subsidy
	PO <sub>4</sub>	Salinity	P04	P04
	(µgP/L)	(PSU)	(µgP/L)	(µgP/L)
<b>Wells</b>	60	1.32	---	---
<b>M-1</b>	4.0	35.10	2	2
<b>M-2</b>	5.0	35.05	2	3
<b>M-3</b>	4.0	35.15	2	2
<b>M-4</b>	5.0	34.97	2	3
Standard Dev. †	16	0.06	---	---
Range †	18-88	1.20-1.44	---	---

† Standard Dev. and Range are for the well data mean.

An estimate of the limiting nutrient (nitrogen or phosphorus) can be estimated by comparing molar ratios (N:P ratios) of dissolved inorganic nitrogen (DIN: nitrate, nitrite, and ammonium) to dissolved inorganic phosphate (DIP: ortho-phosphate). N:P ratios for 20 Hawaiian algal species range from 15:1 to 44.1 with an average of about 29:1 (Atkinson and Smith, 1983). High N:P ratios (>29.1) are potentially related to DIP limitation, whereas low N:P ratios (<29.1) are likely related to DIN limitation.

Analyses using accumulating data averages can be useful to decipher trends. Because we’re still gathering data, sufficient nutrient and chlorophyll α data are not presently available to make statistical inferences regarding actual limiting nutrient determinations in Mākena waters. Data presented in Table 6 are based on our 17 historic sample sets and September 2022 sampling data and N vs. P limitation will vary from place to place along the coast and over time as additional monitoring results are added to the data set. For example, during the present sampling event, N:P values for monitoring stations along Transects M-1 through Transect M-3 were potentially DIN limited at all but one station (50 m station along Transect M-2) due to high DIP concentrations along these transects compared with DIN concentrations. Historically, however, DIP was typically limiting at most stations in Transects M-1 through M-3.

Since different algal species present a wide range of N:P requirements (Atkinson and Smith, 1983), constantly changing nutrient levels in these waters tend to prevent excessive algal growth by preventing favoring growth of just one or a few species.

**Table 6. A summary of average DIN and DIP values for for June 2018 through June 2022 ( $n = 17$ ) compared to September 2022 results.**

Transect	DFS <sup>†</sup> (m)	DIP ( $\mu\text{M/L}$ )		DIN ( $\mu\text{M/L}$ )		DIN:DIP ratio		N/P Limited potential	
		Historic	Sept. 2022	Historic	Sept. 2022	Historic	Sept. 2022	Historic	Sept. 2022
<b>M-1</b>	2	0.09	0.13	4	0	49	3	P	N
	10	0.08	0.13	4	3	52	25	P	N
	50	0.08	0.13	3	1	41	5	P	N
	100	0.06	0.16	3	3	52	21	P	N
<b>M-2</b>	2	0.12	0.16	3	3	23	19	P	N
	10	0.11	0.13	3	2	24	12	P	N
	50	0.10	0.10	2	3	26	30	P	P
	100	0.08	0.13	2	2	28	17	P	N
<b>M-3</b>	2	0.11	0.13	4	4	35	28	P	N
	10	0.09	0.10	3	1	30	10	P	N
	50	0.08	0.13	3	4	39	27	P	N
	100	0.06	0.06	2	1	26	21	N	N
<b>M-4</b>	2	0.09	0.16	2	3	19	20	P	P
	10	0.09	0.03	2	6	28	188	P	N
	50	0.06	0.10	2	1	33	14	N	P
	100	0.06	0.10	2	4	27	42	P	N

<sup>†</sup> distance from shore

## Conclusions

The September 1, 2022 monitoring event provided a different picture of water quality off MG&BC compared with most previous monitoring events. This difference was the somewhat rare occurrence of a mixture of salinities and elevated ortho-phosphate concentrations at all stations along each of the four transects and presumed related to the origin of the water mass from northwest of the Mākena area. As a result, DIN appeared to be the limiting nutrient at all stations along transects M-1 through M-3. Elevated ortho-phosphate concentrations along all four transects occurred at various salinities suggesting

no influence from Mākena area groundwater input. Also evident is a lack of a decreasing silicate concentration gradient out from the shore.

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