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TO: Honorable Alice Lee,  
Council Chair  
Maui County Council  
County of Maui  
200 South High Street  
Wailuku, Hawai'i 96793

DATE: January 6, 2021

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

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Enclosed is/are:

Copies	Date	Description
1 (HC) + 1 (CD)	January 6, 2021	Annual Compliance Report

X	For your information For necessary action For your review For your files	For your use As requested For your signature Returning
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**REMARKS:** On behalf of Makena Golf & Beach Club Owners 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 (808)983-1233.

Signed: \_\_\_\_\_

Bryan K. Esmeralda, AICP  
Senior Associate

BKE:yp  
Copy to:

Kaimi Judd, Discovery Land Company (w/enclosure)  
Josh Circle Woodburn, Discovery Land Company (w/enclosure)

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www.munekiyo-hiraga.com

GENERAL COMMUNICATION NO. 21-3

# **Annual Compliance Report**

## **CHANGE IN ZONING CONDITIONS FOR MAKENA RESORT AREA**

**Prepared by**  
AREG AC Makena Propco LLC (doing business as Makena Golf & Beach Club Owners)  
**January 2021**

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## LIST OF EXHIBITS

<b>Exhibit A</b>	Transmittal and Water Quality Sampling Report Dated October 2020
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# 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 Entities"), acquired through foreclosure most, but not all, of the lands that are covered by Ordinance No. 3613.

Lands so acquired by ATC Makena Entities and that are covered by this Ordinance 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"). In early 2020, there was a change in ownership configuration whereby AREG AC Makena Propco LLC (doing business as Makena Golf & Beach Club Owners) ("Makena Golf & Beach Club Owners") acquired 100% of the membership interest of the entities that own the Zoned Parcels. This Annual Compliance Report is being submitted by Makena Golf & Beach Club Owners.

It is noted that Makena Golf & Beach Club Owners is currently in the process of planning the development of a resort residential project, the Makena Resort Land Plan, involving lands subject to above-noted Ordinance. The proposed development will be subject to environmental review under Chapter 343, Hawaii Revised Statutes (HRS), and that process is expected to be initiated in early to mid 2021.

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 for the Zoned Parcels.

*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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** It is noted that Makena Golf & Beach Club Owners does not own Lot 19. H2R, LLC is the owner of Lot 19. H2R, 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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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

Makena Resort Land Plan further develops and application(s) for SMA Use Permits are submitted.

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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition. Makena Golf & Beach Club Owners is pursuing an agreement with the State Department of Transportation (SDOT) that will address Makena Golf & Beach Club Owners' 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 Makena Golf & Beach Club Owners will have an agreement with SDOT 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:** Makena Golf & Beach Club Owners does not own the rights-of-way for a construction access road, but has initiated discussions with adjacent landowners to identify a possible location of a construction access road route for future construction within the Zoned Parcels 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, includes 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 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. Makena Golf & Beach Club Owners will work with applicable reviewing agencies to obtain approval of the CTMP. As appropriate, an updated CTMP will be prepared

for the Zoned Parcels in connection with the development of the Makena Resort Land Plan.

Makena Golf & Beach Club Owners 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 SDOT, DPW, and the 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. As noted above, as appropriate, an updated TMP will be prepared for the Zoned Parcels in connection with the development of the Makena Resort Land Plan.

**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:**

Satisfied. As previously reported, the ATC Makena Entities agreed to two (2) locations for emergency sirens - one at the Makena Resort Wastewater Treatment Plant (WWTP), and one near Makena State Park (as reported in the 2010 Annual Report). Final Right-Of-Entry and Non-Exclusive License Agreements dated May 25, 2012 with the State of Hawaii, Department of Defense (DOD) were submitted with the 2012 Annual Report. 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 Makena Golf & Beach Club Owners' WWTP property. The siren at Makena Golf & Beach Club Owners' WWTP property was completed in 2017.

**Estimate of Time for Compliance:**

Makena Golf & Beach Club Owners has complied with the provisions of this condition. DOD installed the siren at Makena Golf & Beach Club Owners' WWTP property 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:**

Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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 the Department of Land and Natural Resources, State Historic Preservation Division (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:**

Makena Golf & Beach Club Owners will comply with Chapter 6E, HRS, prior to any grading within the Zoned Parcels. In accordance with Chapter 6E, HRS, Makena

Golf & Beach Club Owners will prepare preservation/mitigation plans for each Zoned Parcel in compliance with SHPD requirements, and subject to the review and approval of SHPD and the Office of Hawaiian Affairs as appropriate. Makena Golf & Beach Club Owners has engaged the archaeological firm, Aina Archaeology in this regard.

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.*

**Status:** Makena Golf & Beach Club Owners retained the services of AECOS, Inc. for assistance with compliance with this condition. Included with this Annual Report is the latest quarterly monitoring report dated October 2020 (see **Exhibit A**). This report has been transmitted to the State DOH.

Allen Cattell, Ph.D. of AECOS, Inc. has confirmed that the AECOS' reports have been prepared to comply with this condition. The reports: (1) assess the degree that fertilizers, as well as other nutrient sources, used on land to enhance golf course turf growth and resort landscaping, leach to groundwater and subsequently discharge into nearshore waters; (2) establish whether there is delivery of these nutrients into the nearshore zone; and (3) determine if subsequent water quality has any measurable impacts on biological community structure in the nearshore marine environment. The nutrients that are monitored each quarter determine water quality, as well as the nature of the benthic and pelagic biologic communities.

**Estimate of Time for Compliance:** Water quality monitoring and assessment will continue to be conducted 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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** As documented in this Annual Report, Makena Golf & Beach Club Owners acquired 100% of the membership interest of the entities that own the Zoned Parcels subject to Ordinance 3613. However, title to the real estate holdings has not changed since the Zoned Parcels were acquired by the ATC Makena Entities in August 27, 2010. Makena Golf & Beach Club Owners will continue to comply with the provisions of said condition within the Zoned Parcels.

**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 through to the build out 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:** Makena Golf & Beach Club Owners 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:** Makena Golf & Beach Club Owners 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:**

Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:**

Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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 on July 27, 2009 and submitted with the 2010 Annual Report.

**Estimate of Time for Compliance:**

Makena Golf & Beach Club Owners has complied with the requirement to provide a WCP. Makena Golf & Beach Club Owners 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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition. It should be noted that H2R, LLC owns Lot 19 where the southern Maluaka beach parking is planned to be located.

**Estimate of Time for Compliance:** Within one year of issuance of any SMA permit relating to a Zoned Parcel. If H2R, LLC proceeds with development first, Makena Golf & Beach Club Owners 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:** Satisfied. As previously reported, the ATC Makena Entities, in coordination with Discovery Land Company, the Makena Cultural Focus Group, the Makena Community Advisory Group, and the Department of Parks and Recreation (DPR) 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. This expansion was formalized and documented 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 was submitted as part of the 2018 Annual Report.

**Estimate of Time for Compliance:** Makena Golf & Beach Club Owners 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, the ATC Makena Entities 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 15<sup>th</sup> 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:** Satisfied. The final Makena State Park Plan dated February 2013 was submitted to the State Department of Land and Natural Resources, the County DPR and the Oneloa Coalition in March 2013. The final plan document and associated transmittals were submitted to the County Department of Planning in March, 2013 in compliance with this condition. The 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:** Makena Golf & Beach Club Owners 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:** Makena Golf & Beach Club Owners 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). 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.

Various adjustments to the 2013 site plan to reflect input received from the Makena Community Advisory Group and the Makena Cultural Focus Group were made consistent with this input and authorized by the Department of Planning.

**Estimate of Time for Compliance:**

Some of the renovation and beautification work has begun, such as landscape improvements, and tree maintenance. In addition, the restroom fixtures have all updated and been replaced. Additionally, the restroom structure repainting is anticipated to be completed in 2021. Makena Golf & Beach Club Owners has engaged with an ADA consultant for recommendations on accessibility and also engaged with a mural painter for near term beautification of the bathroom facility. The work plan for additional measures is in the process of being clarified with the County DPR.

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 DPR for their approval on June 26, 2009. After working with the DPR 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 was submitted as part of the 2018 Annual Report.

Makena Golf & Beach Club Owners will continue to maintain Makena Landing, North Maluaka, and South Maluaka in compliance with said condition and Unilateral Maintenance Agreement.

**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:**

Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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. Robert Hobdy has been retained as part of the Makena Resort Land Plan project, which will require application(s) for SMA Use Permit(s).

**Estimate of Time for Compliance:**

Makena Golf & Beach Club Owners will continue to comply with this condition within the Zoned Parcels.

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:**

Makena Golf & Beach Club Owners 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:**

Makena Golf & Beach Club Owners acknowledges the provisions of said condition as it applies to hotel zoned lands subject to Ordinance 3613, which is limited to Parcel 19 that is owned by H2R, 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:**

Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners acknowledges the provisions of said condition. New dwelling units within the Zoned Parcels shall not exceed 800, excluding residential workforce housing.

**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:** Makena Golf & Beach Club Owners will comply with the provisions of said condition within the Zoned Parcels.

**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:** Makena Golf & Beach Club Owners 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.**

ATC Makena Hotel, LLC  
c/o Makena Golf & Beach Club

October 21, 2020

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

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

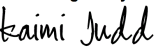
Dear Mr. Honda,

ATC Makena Holdings, LLC, in compliance with the above referenced conditions, respectfully submits the enclosed Marine Water Quality Quarterly Monitoring Reports prepared by AECOS Inc. dated October 6, 2020 for the quarterly tests performed in June of 2020 and dated October 15, 2020 for quarterly tests performed in July of 2020.

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 email at [kjudd@makenagbc.com](mailto:kjudd@makenagbc.com).

Sincerely,

Makena Golf & Beach Club,  
For ATC Makena Hotel, LLC

DocuSigned by:  
  
262B511CEA9548D...

Kaimi Judd  
Vice President of Development

Enclosures (2):

- a. PDF Copy of the June 2020 Quarterly Water Quality Sampling Report
- b. PDF Copy of the July 2020 Quarterly Water Quality Sampling Report

Cc:

Mark Roy, Munekiyo Hiraga  
Joshua Woodburn, Makena Golf & Beach Club



**ENCLOSURES**

**a.**

June 2020 Quarterly Water Quality Monitoring Report

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# Mākena Golf & Beach Club quarterly water quality sampling event

## June 2020

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September 16, 2020  
October 6, 2020, revised

<b><i>Final Report</i></b>
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AECOS No. 1535I

Allen Cattell, Ph.D.  
AECOS, Inc.  
45-939 Kamehameha Highway, Suite 104  
Kāneʻohe, Hawaiʻi 96744  
Phone: (808) 234-7770 Email: Cattell@aecos.com

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## Introduction

The State Land Use Commission requires that Mākena Golf and Beach Club (MG&BC) submit water quality monitoring reports to the Hawaiʻi Department of Health (HDOH) to ensure 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 requirements of 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 and (2) establish evidence of delivery of these nutrients into the nearshore environment (see AECOS 2019a,b).

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, 2016). 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 chemical compounds that promote plant growth, including algal growth in the marine environment.

separate program is monitoring 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 report compare this second quarter, 2020 water quality monitoring with means calculated from eight previous monitoring efforts undertaken quarterly between June 2018 and February 2020.

## 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, 2014) and included on the HDOH 2018 list of impaired waters in Hawai'i prepared under Clean Water Act §303(d) for nitrate+nitrite, ammonium, total nitrogen, and turbidity (HDOH, 2018). These waters are listed as a "Category 2" water body—meaning that some uses are attained; a "Category 3" water body—meaning that insufficient data and/or information exist to make use-support determinations—and as a "Category 5" water body—meaning that available data and/or information indicate that at least one designated use is not supported or is threatened, and a Total Maximum Daily Load (TMDL)<sup>2</sup> study is 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, 2014) and included on the HDOH 2018 list of impaired waters in Hawai'i for nitrate+nitrite, ammonium, turbidity, and chlorophyll  $\alpha$  (HDOH, 2018). These waters are also listed under Categories 2, 3, and 5. A TMDL study is needed.

## Methods

The June 9, 2020 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; see Fig. 1). Stations were sampled in the surface waters at 2-m, 10-m, 50-m, and 100-m distances from shore along each transect between 1000 and 1400 hours. Water quality samples were also collected at three irrigation source water wells: Seibu Well 1, Seibu Well 6, and Seibu Well 4 (Fig. 1).

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<sup>2</sup> TMDL studies are conducted to establish limits on discharges of substances causing impairments to water quality of aquatic environments.



Figure 1. Location of water quality monitoring transects (M-1 through M-4) and irrigation supply wells at MG&BC.

Temperature, salinity, pH, and dissolved oxygen (DO) were measured *in situ*. Water samples were collected, chilled, and returned to the AECOS laboratory for additional analyses (AECOS Log No. 40131). The following parameters were measured from these samples: salinity, turbidity, ammonium, nitrate+nitrite, total nitrogen (total N or TN), ortho-phosphate, total phosphorus (total P or TP), and chlorophyll *a*. Table 1 lists the instruments and analytical methods used for these field measurements and laboratory analyses.

On the June 9 event, cloud cover increased from about 5 percent in the morning to about 30 percent by afternoon. The tide was low at 0934 hours (+0.34 ft),

rising to a high of +0.78 ft at 1402 hours (Station161525, Mākena; NOAA, 2020). Winds were light (< 5 mph) from the southwest to north and nearshore surf was mostly calm (smooth to < 1 ft). Samples were collected between 1000 and 1400 hours.

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

Analysis	Method	Reference	Instrument
<b>Temperature</b>	SM 2550B	SM (2017)	YSI Model 550 DO meter thermistor
<b>Salinity</b>	SM 120.1	SM (2017)	Accument AB200
<b>pH</b>	SM 4500H+	SM (2017)	pH pHep HANNA meter
<b>Dissolved Oxygen</b>	SM 4500-O G	SM (2017)	YSI Model 550 DO meter
<b>Turbidity</b>	EPA 180.1	USEPA (1993b)	Hach 2100Q Turbidimeter
<b>Ammonium</b>	EPA 349	USEPA (1997a)	Lachat Quickchem 8500
<b>Nitrate + Nitrite</b>	EPA 353.2	USEPA (1993a)	Lachat Quickchem 8500
<b>Total Nitrogen</b>	EPA 353.4	USEPA (1993a)	Shimadzu TNM-1
<b>Ortho-Phosphate</b>	EPA 365.5	USEPA (1997b)	Lachat Quickchem 8500
<b>Total Phosphorus</b>	EPA 365.5	USEPA (1997b)	Lachat Quickchem 8500
<b>Chlorophyll α</b>	SM10200H(M)	SM (1998)	Turner Fluorometer

## Results

Water quality results are shown in Tables 2 and 3, compared with the long-term means (our quarterly monitoring results sampled between June 2018 and February 2020). In June 2020, temperatures were very close to long-term averages, lowest along Transect M-4. Salinities were also close to long-term averages at all stations, and showed a small increase southward from Transect M-1 to Transect M-4. pH values were slightly lower than the long-term means and demonstrated no particular horizontal trends. The lowest pH values occurred along Transect M-4. DO saturation in June 2020 were elevated compared with historic means along all four transects. The distribution of turbidity was variable between transects and under long-term means at all transects except M-1. Chlorophyll α concentrations were also variable in June 2020 and not close to long-term means.

Table 2. Physical water quality and chlorophyll  $\alpha$  means from June 2018 through February 2020 ( $n = 8$ ), compared to June 9, 2020 results.

Transect	DFS <sup>†</sup> (m)	Salinity (ppt)		Temperature (° C)		pH		DO (% Sat.)		Turbidity (NTU)		Chl. $\alpha$ ( $\mu\text{g/L}$ )	
		Means	June 2020	Means	June 2020	Means	June 2020	Means	June 2020	Means	June 2020	Means	June 2020
M-1	2	33.79	33.40	27.1	27.5	8.12	8.02	103	103	1.35	2.46	0.69	1.69
	10	34.08	33.81	26.9	26.7	8.19	8.20	109	115	0.79	0.59	0.46	0.41
	50	34.30	33.93	26.9	26.7	8.19	8.20	105	113	0.72	0.49	0.39	0.27
	100	34.49	34.23	26.9	26.5	8.17	8.13	101	104	0.49	0.54	0.31	0.21
	Means	34.17	33.84	27.0	26.9	8.17	8.14	104	109	0.84	1.02	0.46	0.65
M-2	2	33.92	34.16	26.8	27.4	8.13	8.11	97	119	2.78	1.14	0.69	0.37
	10	33.97	33.94	26.8	26.8	8.17	8.11	96	96	1.89	0.89	0.53	0.24
	50	34.06	34.11	26.7	26.9	8.17	8.13	97	108	1.21	0.32	0.36	0.27
	100	34.38	34.55	26.6	26.7	8.16	8.10	97	97	0.68	0.42	0.21	0.29
	Means	34.08	34.19	26.7	27.0	8.16	8.11	97	105	1.64	0.69	0.45	0.29
M-3	2	33.60	33.71	26.7	27.0	8.15	8.14	110	118	0.81	0.52	0.66	1.99
	10	34.10	34.01	26.6	26.8	8.17	8.14	108	115	0.71	0.32	0.48	0.40
	50	34.35	34.53	26.7	26.6	8.16	8.13	103	107	0.52	0.32	0.28	0.43
	100	34.42	34.62	26.7	26.7	8.16	8.12	99	104	0.43	0.31	0.21	0.22
	Means	34.12	34.22	26.7	26.8	8.16	8.13	105	111	0.62	0.37	0.41	0.76
M-4	2	34.00	34.54	26.4	26.4	8.11	8.05	100	115	1.48	1.31	0.76	0.54
	10	34.10	34.02	26.3	25.9	8.14	8.09	102	106	1.21	0.73	0.58	0.38
	50	34.41	34.46	26.4	25.9	8.15	8.05	103	100	0.86	0.46	0.32	0.24
	100	34.44	34.51	26.3	26.0	8.15	8.05	100	97	0.50	0.52	0.21	0.23
	Means	34.24	34.38	26.3	26.1	8.14	8.06	101	105	1.01	0.76	0.47	0.35
Dry Criteria		+/- 10%		+/- 1C°		7.6-8.6		≥75%		≤0.20 NTU		≤0.15 $\mu\text{g/L}$	

<sup>†</sup> distance from shore

<sup>‡</sup> geometric mean

Red exceeds standard

Nitrate+nitrite and ammonium concentrations from the June sampling event were elevated along Transect M-1 compared with historic means. Nitrate+nitrite concentrations tended to decrease with distance from shore on all transects and were notably under the long-term means on Transect M-2.

Ammonium concentrations, on the other hand, demonstrated little change with distance from shore. Total nitrogen concentrations were elevated along all transects in June. Ortho-phosphate concentrations were low and similar to historic means on all four transects. Total phosphorus concentrations were generally close to long-term values, slightly above on Transect M-1.

Table 3. Water quality nutrient concentration geometric means ( $n = 8$ ) from June 2018 through February 2020, compared to June 9, 2020 results.

Transect	DFS <sup>†</sup> (m)	NO <sub>3</sub> +NO <sub>2</sub> (µgN/L)		NH <sub>4</sub> (µgN/L)		TN (µgN/L)		PO <sub>4</sub> (µgP/L)		TP (µgP/L)	
M-1	2 10 50 100	Means	June 2020	Means	June 2020	Means	June 2020	Means	June 2020	Means	June 2020
		71	127	15	27	208	256	2.2	5.0	8	16
		54	71	15	20	168	186	2.0	2.0	6	6
		48	63	15	15	166	192	2.0	2.0	7	12
		32	62	19	22	140	203	1.2	2.0	6	5
M-2	Means	51	81	16	21	171	209	2	3	6	10
	2	41	26	11	3	134	124	4.0	3.0	43	41
	10	39	42	13	8	141	125	3.3	4.0	9	7
	50	36	24	11	3	124	177	3.3	2.0	7	7
	100	32	4	12	7	118	106	2.3	2.0	7	8
M-3	Means	37	24	12	5	129	133	3	3	16	16
	2	71	102	16	5	219	218	4.3	4.0	7	9
	10	49	48	12	3	159	146	4.1	2.0	6	5
	50	36	8	16	18	126	177	2.0	1.0	7	7
	100	20	19	14	5	121	123	2.0	2.0	6	13
M-4	Means	44	44	15	8	157	166	3	2	7	9
	2	20	28	14	10	103	123	2.3	4.0	8	6
	10	17	17	16	9	99	124	3.0	3.0	6	5
	50	13	5	15	45	98	132	1.6	2.0	8	3
	100	13	6	15	15	85	108	1.6	2.0	4	2
Dry Criteria		≥3.5 µgN/L		≥2µgN/L		≥110 µgN/L		ns		≥16µgP/L	
† distance from shore											
Red exceeds standard											
ns - no standard											



Generally, groundwater seepage into nearshore coastal waters will produce a reduction in salinity and an increase in nitrate+nitrite. Conditions further offshore, however, are more likely to reflect water moving into the MG&BC vicinity from points farther away and not influenced by groundwater influx along the Mākena shore. Using the PacIOOS Regional Ocean Modeling System (ROMS), we can display water current movements off the southwestern coast of East Maui that occurred prior to our sampling efforts.

The direction and position of a current marker on June 9, 2020 are shown in Figure 2 starting at 0200 hours and ending at 1100 hours. Water movement off the coast at this time was in a southerly direction and during the sampling event had flowed from off Wailea, about 1.3 nautical miles north of the MG&BC (PacIOOS, 2020).



Figure 2. Predicted current flows off southwest Maui during morning hours of June 9, 2020 (PacIOOS, 2020).

## Discussion

The slightly reduced salinities recorded on the June 9 at 2-m stations on transects M-1 and M-3 likely reflect nearshore groundwater seepage measured

during a low tide coupled with relatively calm wind conditions (breezier winds would enhance mixing of surface water down into the water column). Nitrate+nitrite concentrations were elevated along both transects at 2-m and then tended to decrease with distance from shore. Ammonium concentrations were somewhat elevated along transects M-1 and M-4, but low along both transects M-2 and M-3. Ammonium is not typically related to salinity, being generated within the nearshore waters from natural biological activities. Ortho-phosphate concentrations were typically present in low concentrations in the project area and demonstrate no correlation with salinity. Total nitrogen and total phosphorus concentrations were elevated at the 2-m stations for both transect M-1 and M-3.

### Nutrient Subsidies

Table 4 provides an overview of potential groundwater nutrient subsidies in nearshore marine waters on June 9, 2020. Using the 2-m stations—the most likely to reveal groundwater inputs—the nitrate+nitrite concentrations were elevated (measured concentration exceeded estimated concentration based on salinity) at transects M-1 and M-3. Nitrate+nitrite elevations were directly related to low salinities during this sampling event.

Table 4. Estimated nitrate+nitrite subsidy at nearshore stations (2-m), June 9, 2020.

Well	Measured		Estimated	Subsidy
Transect	NO <sub>3</sub> +NO <sub>2</sub>	Salinity	NO <sub>3</sub> +NO <sub>2</sub>	NO <sub>3</sub> +NO <sub>2</sub>
	(µgN/L)	(PSU)	(µgN/L)	(µgN/L)
<b>Seibu Wells</b>	1967	1.32	---	---
<b>M-1</b>	127	33.40	55	72
<b>M-2</b>	26	34.16	54	0
<b>M-3</b>	102	33.71	55	47
<b>M-4</b>	28	34.54	53	0

Table 5 shows there were no ortho-phosphate subsidies at any transect on June 9, 2020. The lack of subsidy at the 2-m station of Transect 1 occurs because the ortho-phosphate background concentration measured at 100-m station on Transect 4 (2 µgP/L) is subtracted from subsidy calculation. Ortho-phosphate is used only infrequently in fertilizing grounds at MG&BC

Table 5. Estimated ortho-phosphate subsidy at nearshore stations (2-m), June 9, 2020.

Well	Measured		Estimated	Subsidy
Transect	PO <sub>4</sub>	Salinity	PO <sub>4</sub>	PO <sub>4</sub>
	(µgP/L)	(PSU)	(µgP/L)	(µgP/L)
<b>Seibu Wells</b>	68	1.32	---	---
<b>M-1</b>	5	33.40	3	0
<b>M-2</b>	3	34.16	3	0
<b>M-3</b>	4	33.71	3	0
<b>M-4</b>	4	34.54	3	0

## Irrigation and Fertilizer Tracking

We track monthly turf and landscaping fertilization/irrigation rates, using monthly data provided by Jonathan Galicinao at MG&BC. Irrigation water nutrient concentrations are measured in several irrigation supply wells on each sampling event. Figures 5, 6, and 7 present a comparison of unused monthly nitrate+nitrite fertilizer with nitrate-nitrite subsidies calculated for 2-m stations at transects M-1, M-2, and M-3 on each sampling event since March 2018.

Potential fertilizer nitrate+nitrite residuals (blue bars) are estimates using 20% of application values (Johnson et al., 2018). Nitrate+nitrite excess or subsidy concentrations, calculated for the 2-m stations, are plotted as red dots. Note that the greatest applications of nitrate+nitrite fertilizer were in February and June 2019 and January 2020. Nearshore excess nitrate+nitrite concentrations were highest in March and August 2019 and February 2020 at Transect M-1—within one to two months after elevated fertilization. However, similar ‘peaks’ in excess nitrate-nitrite appeared only in March 2019 and February 2020 at Transects M-2 and a single peak at Transect M-3 in February 2020. A further complication is the fact that the December 2018 subsidy at M-1 is nearly as high as the peak in August 2019, but unrelated to any preceding high in application rate. Clearly, additional measurements over a longer period will be required to establish if any valid relationship exists between application of fertilizer at MG&BC and our salinity-based method<sup>3</sup> of estimating excess nitrate-nitrite off the Mākena shore. If needed and as these data accumulate, we should be able to recommend changes to fertilizer application methods that will meet Mākena

<sup>3</sup> Explained in detail in *AECOS*, 2018, p. 10-11.

golf course and landscaping requirements and minimize measureable effects on nearshore waters.

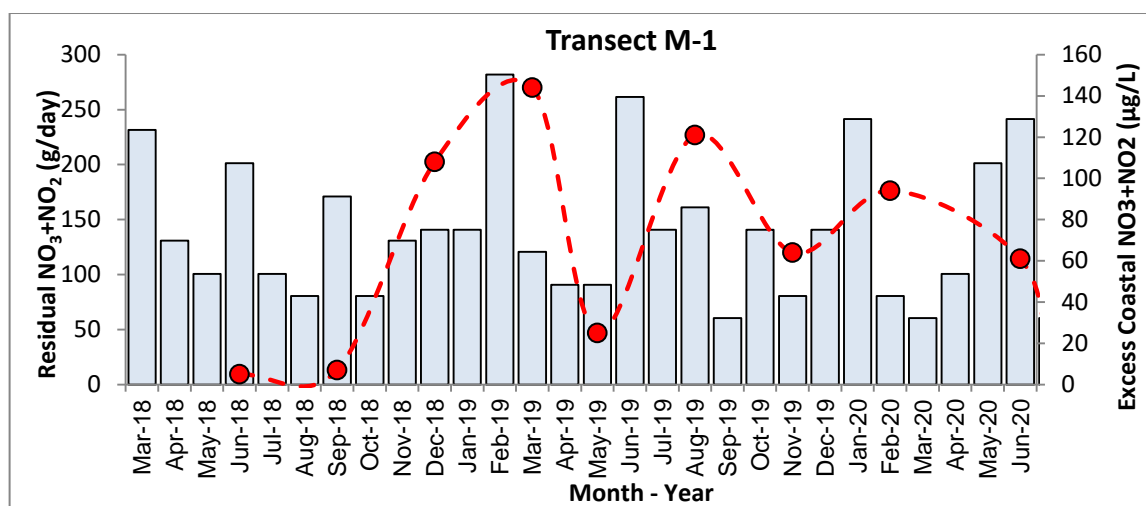


Figure 5. Mean daily application of nitrate+nitrite to golf course turf and landscaping (blue bars; g/day) and excess calibrated nitrate+nitrite (red circles  $\mu\text{g/L}$ ) at 2-m station on Transect M-1.

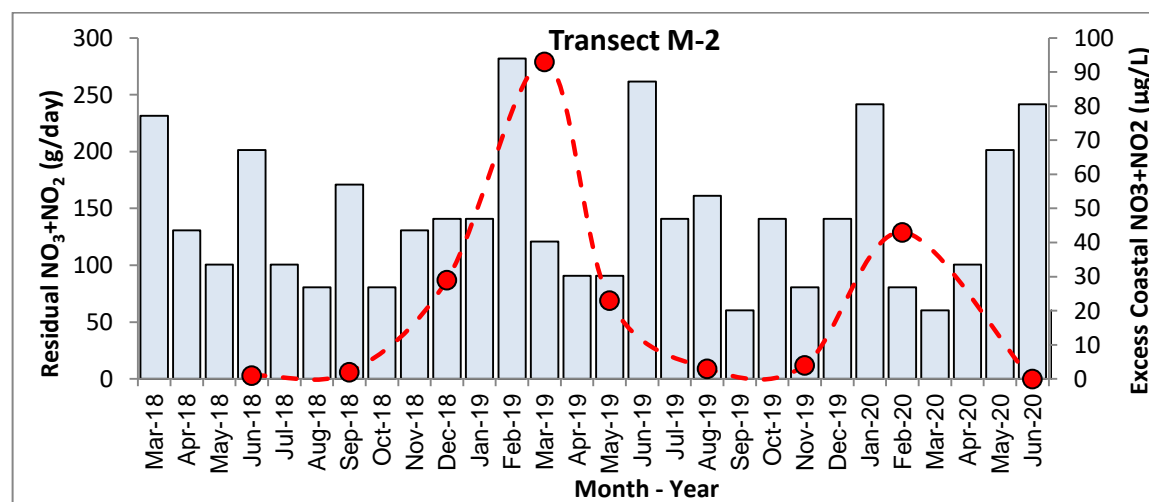


Figure 6. Mean daily application of nitrate+nitrite to golf course turf and landscaping (blue bars; g/day) and excess calibrated nitrate+nitrite (red circles  $\mu\text{g/L}$ ) at 2-m station on Transect M-2.

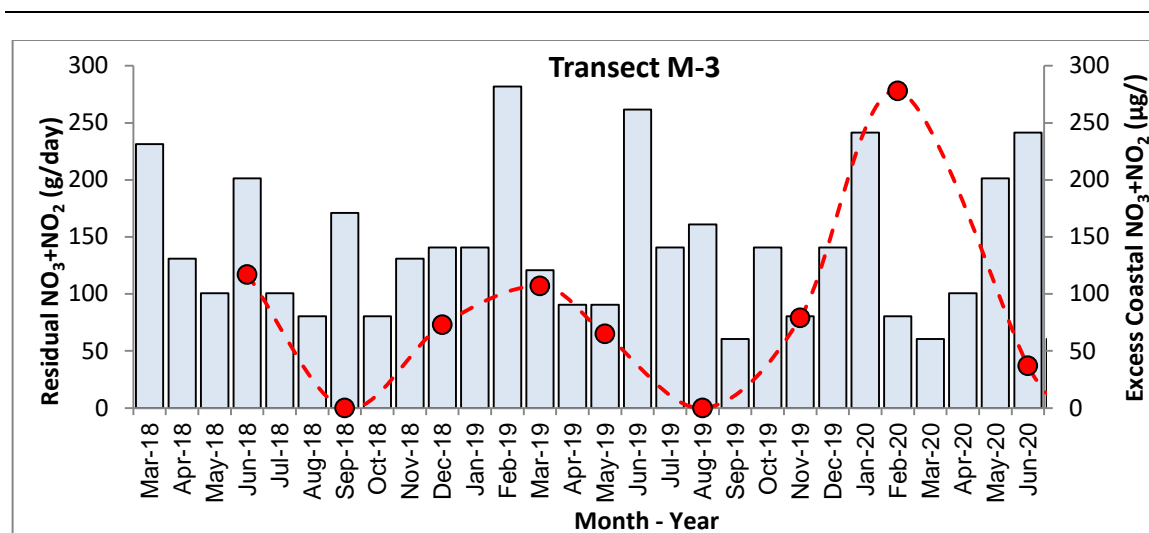


Figure 7. Mean daily application of nitrate+nitrite to golf course turf and landscaping (blue columns; g/day) and excess calibrated nitrate+nitrite (red circles  $\mu\text{g/L}$ ) at 2-m station on Transect M-3.

## Chlorophyll $\alpha$ and Nutrient Limitation

Inorganic nitrogen and phosphorus compounds are typically identified as potentially “limiting” nutrients in Hawaiian marine waters—phytoplankton and macroalgae require these nutrients for growth and photosynthesis. Increases in a limiting nutrient concentration can result in enhanced growth of phytoplankton and macroalgae. Excessive algal growth has happened in the coastal waters off Kīhei due to increased discharge of both nitrogen and phosphorus compounds from the Kīhei Wastewater Treatment Plant (Laws et al., 2004; Dailer et al., 2010). Thus, maintaining low limiting nutrient concentration is essential to maintaining a pristine biological community off Mākena.

We can estimate the limiting nutrient (nitrogen or phosphorus) 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 related to DIP limitation and low N:P ratios (<29.1) are related to DIN limitation.

Sufficient nutrient and chlorophyll  $\alpha$  data are not presently available to make statistical inferences regarding actual limiting nutrient determinations in

Mākena waters. However, analyses using averages of accumulating data can be useful to decipher trends. Data presented herein are based on the previous nine sample sets and will likely change as additional monitoring adds to the data set.

N:P ratios can vary as shown in Table 6 from place to place along the coast. For example, during the present sampling event, N:P values for monitoring stations along M-1 and M-3 transects were mostly DIP limited, due to the fact that DIN values were high along these transects. N/P limitation can also vary between stations along individual transects, as shown in Transect M-4.

Table 6. A summary of average DIN and DIP values for eight monitoring events (June, 2018 – February, 2020) and June 2020.

Transect	DFS† (m)	DIP (μM/L)		DIN (μM/L)		DIN:DIP ratio		N/P Limited potential	
		Means	June 2020	Means	June 2020	Means	June 2020	Means	June 2020
<b>M-1</b>	2	0.07	0.16	6	11	85	68	P	P
	10	0.06	0.06	5	7	79	101	P	P
	50	0.07	0.06	5	6	69	86	P	P
	100	0.04	0.06	4	6	95	93	P	P
<b>M-2</b>	2	0.13	0.10	4	2	29	21	?	N
	10	0.11	0.13	4	4	35	28	P	N
	50	0.11	0.06	3	2	32	29	P	?
	100	0.07	0.06	3	1	42	12	P	N
<b>M-3</b>	2	0.14	0.13	6	8	45	59	P	P
	10	0.13	0.06	4	4	33	56	P	P
	50	0.06	0.03	4	2	57	58	P	P
	100	0.06	0.06	2	2	38	27	P	N
<b>M-4</b>	2	0.07	0.13	2	3	32	21	N	N
	10	0.10	0.10	2	2	24	19	N	N
	50	0.05	0.06	2	4	37	55	P	P
	100	0.05	0.06	2	2	40	23	P	P

Since different algal species represent a wide range of N:P requirements (Atkinson & Smith, 1983), constantly changing nutrients tend to prevent excessive algal growth, preventing extensive growth of just one or a few species.

## Summary

June 2020 monitoring results included water temperatures close to long-term means. Salinity was low at Transect M-1 compared with historic means and increased progressively to Transect M-4. DO saturations were slightly elevated. Nitrate+nitrite and ammonium concentrations were elevated in comparison with historic means at Transect M-1 and for ammonium at Transect M-4. Orthophosphate concentrations were low and comparable with historic means.

Current tracking with the PacIOOS modeling indicates currents were moving in a southerly direction prior to and during the June 9, 2020 sampling event. Ocean water had travelled about 1.4 nautical miles from Wailea to Mākena project area by 1100 hours.

Subsidies for nitrate+nitrite concentrations occurred at the 2-m stations on two transects (M-1 and M-3) in the MG&BC area. There were no subsidies for orthophosphate at any transect. No nutrient subsidies were noted at Transect M-4.

An analysis of DIN to DIP ratios for this sampling event suggests that DIP was the presumptive limiting nutrient for algal growth along transects M-1 and M-3; DIN along Transect M-2; and both DIN and DIP along Transect M-4.

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**b.**

July 2020 Quarterly Water Quality Monitoring Report

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# Mākena Golf & Beach Club quarterly water quality sampling event

## July 2020

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September 11, 2020

***Final Report***

AECOS No. 1535J

October 6, 2020, revised

October 15, revised

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## Introduction

The State Land Use Commission requires that Mākena Golf and Beach Club (MG&BC) submit water quality monitoring reports to the Hawai'i Department of Health (HDOH) to ensure 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 to Condition 19 of the County of Maui, Zoning Ordinance 3613. The goals of the monitoring program established to comply with requirements of 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 and (2) establish evidence of delivery of these nutrients into the nearshore environment (see AECOS 2019a,b).

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, 2016). Nutrient enrichment can also negatively impact corals and other biological components in Hawai'i coastal waters (Laws et al., 2004; MRC, 2011; AECOS, 2016). A

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<sup>1</sup> "Nutrients" are nitrogen and phosphorus chemical compounds that promote plant growth, including algal growth in the marine environment.

separate program is monitoring 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 report compare the most recent (July 17, 2020) water quality monitoring results with means calculated from ten previous monitoring efforts undertaken quarterly between June 2018 and June 2020.

## 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, 2014) and included on the HDOH 2018 list of impaired waters in Hawai‘i prepared under Clean Water Act §303(d) for nitrate+nitrite, ammonium, total nitrogen, and turbidity (HDOH, 2018). These waters are listed as a “Category 2” water body—meaning that some uses are attained; a “Category 3” water body—meaning that insufficient data and/or information exist to make use-support determinations; and as a “Category 5” water body—meaning that available data and/or information indicate that at least one designated use is not supported or is threatened, and a Total Maximum Daily Load (TMDL)<sup>2</sup> study is 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, 2014) and included on the HDOH 2018 list of impaired waters in Hawai‘i for nitrate+nitrite, ammonium, turbidity, and chlorophyll  $\alpha$  (HDOH, 2018). These waters are also listed under Categories 2, 3, and 5. A TMDL study is needed.

## Methods

The July 17, 2020 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). Stations were sampled in the surface waters at a 2-m, 10-m, 50-m, 100-m distance from shore along each transect. Water quality samples were also collected at three irrigation source water wells: Seibu Well 1, Seibu Well 6, and Seibu Well 4 (see Fig. 1).

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<sup>2</sup> TMDL studies are conducted to establish limits on discharges of substances causing impairments to water quality of aquatic environments.



Figure 1. Location of water quality monitoring transects (M-1 through M-4) and irrigation supply wells at MG&BC.

Temperature, salinity, pH, and dissolved oxygen (DO) were measured *in situ*. Water samples were collected, chilled, and returned to the AECOS laboratory for additional analyses (AECOS Log No. 40370). The following parameters were measured from these samples: salinity, turbidity, ammonium, nitrate+nitrite, total nitrogen (total N or TN), ortho-phosphate, total phosphorus (total P or TP), and chlorophyll *a*. Table 1 lists the instruments and analytical methods used for these field measurements and laboratory analyses.

On the July 17 event, the tide was low at 0701 hours (-0.06 ft), rising to a high of +1.79 ft at 1459 hours (Station161525, Mākena; NOAA, 2020). Winds were

light (< 3 mph) from the north to northwest and nearshore surf was mostly calm (smooth to < 1 ft). Samples were collected between 0810 and 1145 hours.

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

Analysis	Method	Reference	Instrument
<b>Temperature</b>	SM 2550B	SM (2017)	YSI Model 550 DO meter thermistor
<b>Salinity</b>	SM 120.1	SM (2017)	Accument AB200
<b>pH</b>	SM 4500H+	SM (2017)	pH pHep HANNA meter
<b>Dissolved Oxygen</b>	SM 4500-O G	SM (2017)	YSI Model 550 DO meter
<b>Turbidity</b>	EPA 180.1	USEPA (1993b)	Hach 2100Q Turbidimeter
<b>Ammonium</b>	EPA 349	USEPA (1997a)	Lachat Quickchem 8500
<b>Nitrate + Nitrite</b>	EPA 353.2	USEPA (1993a)	Lachat Quickchem 8500
<b>Total Nitrogen</b>	EPA 353.4	USEPA (1993a)	Shimadzu TNM-1
<b>Ortho-Phosphate</b>	EPA 365.5	USEPA (1997b)	Lachat Quickchem 8500
<b>Total Phosphorus</b>	EPA 365.5	USEPA (1997b)	Lachat Quickchem 8500
<b>Chlorophyll α</b>	SM10200H(M)	SM (1998)	Turner Fluorometer

## Results

Water quality results, displayed in Tables 2 and 3, are compared with long-term means. On July 17, 2020, salinities were low at all stations along all transects but Transect M-4, where salinities were close to the long-term means. Temperatures along all four transects were higher, whereas pH values were lower. DO saturation along all four transects, were similar with historic means, although generally quite variable. The distribution of turbidity values varied between stations. The highest mean turbidity was noted at Transect M-1, the lowest at Transect M-3. Chlorophyll α concentrations were similar to long-term means except on Transect M-4, where chl. α was notably high during the July 17 event.

Nitrate+nitrite concentrations (Table 3) showed decreasing values in the waters southward from Transect M-1 to Transect M-4. Nitrate+nitrite concentrations along Transect M-1 were similar to long-term means, but concentrations along the other three transects were low compared with historic means, while ammonium concentrations on Transect M-1 and Transect M-3 were elevated

*Mākena Golf & Beach Club*

Mākena, Maui

compared to long-term means. Total nitrogen was low compared to historic means. Along all four transects, ortho-phosphate concentrations were similar to historic means, whereas total phosphorus concentrations were elevated along all transects except M-2; the highest mean TP occurred at Transect M-2.

Table 2. Physical water quality and chlorophyll  $\alpha$  means from June 2018 through June 2020 ( $n = 10$ ), compared to July 17, 2020 results.

Transect	DFS <sup>†</sup> (m)	Salinity (ppt)		Temperature (° C)		pH		DO (% Sat.)		Turbidity (NTU)		Chl. α (μg/L)	
M-1	2 10 50 100	Means	July 2020	Means	July 2020	Means	July 2020	Means	July 2020	Means <sup>‡</sup>	July 2020	Means <sup>‡</sup>	July 2020
		33.55	32.74	27.1	29.6	8.11	8.09	103	110	1.47	2.90	0.78	0.91
		33.66	32.10	26.6	27.1	8.18	8.14	108	106	0.74	0.85	0.47	0.57
		33.89	32.23	26.6	27.1	8.18	8.12	104	104	0.68	0.74	0.39	0.53
		34.15	32.48	26.6	27.1	8.16	8.10	100	95	0.49	0.43	0.27	0.27
	Means	33.81	32.39	26.8	27.7	8.16	8.11	104	104	0.85	1.23	0.48	0.57
M-2	2 10 50 100	33.79	32.40	26.9	27.6	8.12	8.07	99	101	2.14	2.45	0.39	0.05
		33.80	32.38	26.8	27.0	8.16	8.09	96	92	1.49	1.35	0.35	0.27
		33.89	32.32	26.7	27.0	8.16	8.09	98	96	0.83	0.46	0.27	0.30
		34.15	31.89	26.7	27.0	8.14	8.03	97	93	0.62	0.45	0.23	0.29
	Means	33.91	32.25	26.8	27.2	8.14	8.07	97	96	1.27	1.18	0.31	0.23
M-3	2 10 50 100	33.47	32.15	26.9	28.1	8.15	8.19	111	119	0.72	0.54	0.63	0.52
		33.92	32.40	26.7	27.1	8.16	8.08	108	97	0.57	0.54	0.45	0.41
		34.22	32.85	26.7	27.0	8.15	8.1	102	94	0.43	0.40	0.27	0.27
		34.29	32.81	26.7	26.9	8.15	8.11	101	108	0.41	0.36	0.22	0.31
	Means	33.97	32.55	26.7	27.3	8.15	8.12	105	105	0.53	0.46	0.39	0.38
M-4	2 10 50 100	34.05	33.97	26.4	26.9	8.10	8.11	102	108	1.36	1.87	0.64	1.87
		34.02	33.41	26.3	26.5	8.12	8.04	102	102	1.04	1.64	0.47	1.64
		34.41	34.36	26.4	26.8	8.13	8.05	102	95	0.65	0.69	0.30	0.69
		34.46	34.58	26.4	26.8	8.12	7.96	99	89	0.48	0.34	0.21	0.34
	Means	34.24	34.08	26.4	26.8	8.12	8.04	101	99	0.88	1.14	0.41	1.14
Hawai'i Dry Criteria		+/- 10%		+/- 1C°		7.6–8.6		≥75%		≤0.20 NTU		≤0.15 μg/L	
† distance from shore		‡ geometric mean		Red exceeds standard									

Generally, groundwater seepage into the nearshore will produce a reduction in salinity and an increase in nitrate+nitrite. Conditions further offshore likely reflect water moving into the survey area from points north or south along the coast. That is, water quality is not much influenced by groundwater influx at

Table 3. Nutrient concentration geometric means from June 2018 through June 2020 ( $n = 10$ ), compared to July 17, 2020 results.

Transect	DFS <sup>†</sup> (m)	NO <sub>3</sub> +NO <sub>2</sub> (µgN/L)		NH <sub>4</sub> (µgN/L)		TN (µgN/L)		PO <sub>4</sub> (µgP/L)		TP (µgP/L)	
M-1	2 10 50 100	Means	July 2020	Means	July 2020	Means	July 2020	Means	July 2020	Means	July 2020
		71	42	16	26	211	196	2.5	3	8	5
		57	61	18	78	170	168	2.1	4	5	4
		51	67	14	12	168	158	2.0	2	7	6
		35	43	19	17	145	140	1.2	1	6	23
M-2	Means	54	53	17	33	173	166	2	3	7	11
	2	37	22	11	7	131	115	3.8	4	41	30
	10	37	23	12	14	135	107	3.3	3	9	9
	50	35	49	11	18	131	147	3.0	2	7	12
	100	25	22	12	19	116	113	2.3	2	9	18
M-3	Means	34	29	11	15	128	121	3	3	17	17
	2	66	22	13	7	204	106	3.7	1	6	2
	10	49	50	10	11	156	138	3.5	2	6	17
	50	29	22	20	110	127	142	2.1	6	8	16
	100	20	17	13	17	119	99	2.0	2	8	18
M-4	Means	41	28	14	36	151	121	3	3	7	13
	2	18	4	11	3	103	85	2.3	1	8	13
	10	18	22	15	13	102	110	3.0	3	7	29
	50	10	3	17	25	98	73	1.6	1	6	2
	100	10	3	14	8	87	86	1.6	2	3	2
	Means	14	8	14	12	97	89	2	2	6	11
Dry Criteria		≥3.5 µgN/L		≥2µgN/L		≥110 µgN/L		ns		≥16µgP/L	
† distance from shore						Red exceeds standard			ns - no standard		



the shore. Using the PacIOOS Regional Ocean Modeling System (ROMS), we can display water current movements off the southwestern coast of East Maui that occurred prior to our sampling event (see Figure 2).

The direction and timing of current flow are shown in Fig. 2 starting at 0200 hours and ending at 1100 hours on July 17, 2020. In this time period, water currents off the coast were moving in a southeasterly to southerly direction. Current velocity estimates indicate that during the monitoring event, water had flowed from an area off Wailea, about 1.3 nautical miles north of the MG&BC (PacIOOS, 2020).



Figure 2. Predicted water movement during morning hours (0200 to 1100 hours) off East Maui on July 17, 2020 (PacIOOS, 2020).

## Discussion

Low salinity values, recorded during the July 17, 2020 sampling event (at all stations on Transect M-1 through Transect M-3) indicate that groundwater influx distant from the Mākena area and from the Mākena Resort vicinity influenced salinity values. Low nitrate+nitrite concentrations along Transect M-2 and Transect M-3, coupled with low salinity water, is not a usual occurrence, but could reflect a residence time of soluble nitrates in the water sufficient for phytoplankton uptake. Ammonium concentrations, generated from natural biological activities in the ocean, were somewhat elevated along Transects M-1 through M-3. Ammonium concentrations, however, are not typically related to salinity. Ortho-phosphate was present in low concentrations and had no correlation with salinity.

## Nutrient Subsidies

Table 4 illustrates no groundwater nitrate+nitrite subsidies in nearshore marine waters on July 17. Nitrate+nitrite concentrations (based on salinity calculations) were not elevated at the 2 m stations along any transects.

Table 4. Estimated nitrate+nitrite subsidies at nearshore stations (2-m), July, 2020.

Well	Measured		Estimated	Subsidy
Transect	NO <sub>3</sub> +NO <sub>2</sub>	Salinity	NO <sub>3</sub> +NO <sub>2</sub>	NO <sub>3</sub> +NO <sub>2</sub>
	(µgN/L)	(PSU)	(µgN/L)	(µgN/L)
<b>Seibu Wells</b>	1933	1.33	---	---
<b>M-1</b>	42	32.74	76	0
<b>M-2</b>	22	32.40	76	0
<b>M-3</b>	22	32.15	77	0
<b>M-4</b>	4	33.97	73	0

Table 5 illustrates no groundwater ortho-phosphate subsidies in nearshore marine waters on July 17. Ortho-phosphate concentrations (based on salinity calculations) were not elevated at the 2 m stations along any transects. There was no subsidy at Sta. 2 m on Transect M-2 as background ortho-phosphate concentration (2 µg/L at Sta. 100 m on Transect 4) was subtracted for subsidy estimate.

## Irrigation and Fertilizer Tracking

We track turf and landscape fertilization/irrigation data on a monthly basis (data provided by Jonathan Galicinao at MG&BC). Nutrient concentrations are measured in several irrigation supply wells on each sampling event. Figures 3, 4, and 5 present our comparison of unused fertilizer residual (blue bars) with

Table 5. Estimated ortho-phosphate subsidies at nearshore stations (2-m), July, 2020.

Well Transect	Measured		Estimated	Subsidy
	NO <sub>3</sub> +NO <sub>2</sub>	Salinity	PO <sub>4</sub>	PO <sub>4</sub>
	(µgN/L)	(PSU)	(µgN/L)	(µgN/L)
<b>Seibu Wells</b>	1933	1.33	---	---
<b>M-1</b>	3.0	32.74	3.0	0
<b>M-2</b>	4.0	32.40	3.0	0
<b>M-3</b>	1.0	32.15	3.0	0
<b>M-4</b>	1.0	33.97	3.0	0

actual sampling event nitrate+nitrite concentrations (red circles) at 2 m stations. For these plots, we assume that 80 percent of applied nitrate+nitrite fertilizer concentrations are absorbed by plant material or otherwise lost and do not reach the groundwater (Johnson et al., 2018).

In the figures that follow, our calculated nitrate+nitrite subsidies calculated for 2-m stations are plotted as red dots. Note that the greatest applications of nitrate+nitrite fertilizer occurred in February and June 2019, and January and June 2020. At Transect M-1, excess nitrate+nitrite concentrations were highest in March and August 2019, and February 2020, about one to two months after elevated fertilization application. However, in December 2018, Transect M-1 peaked as high as the August 2019 value, but without a preceding elevated fertilization. The apparent lack of response in July 2020 to the application spike preceding may be due to the short period of time between application and the monitoring event.

At Transect M-2 (Fig. 4), similar nitrate-nitrite peaks were recorded following February 2019 and January 2020 application peaks. but not following the June 2019 peak, perhaps because of the longer delay until the monitoring event. The situation at M-3 is identical to that demonstrated at M-2.

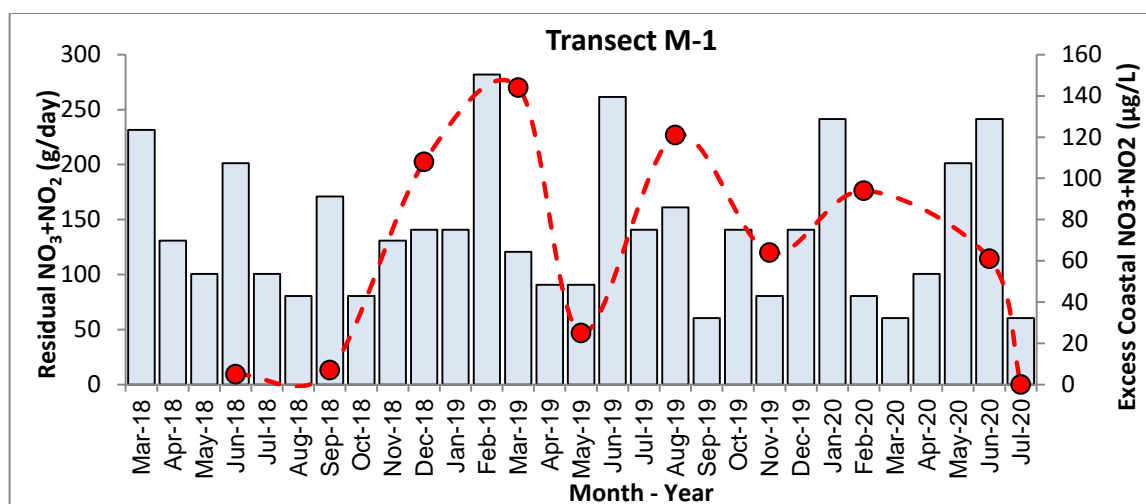


Figure 3. Mean daily application of nitrate+nitrite to golf course turf and landscaping (blue bars; g/day) and excess calibrated nitrate+nitrite (red circles  $\mu\text{g/L}$ ) at 2-m station on Transect M-1.

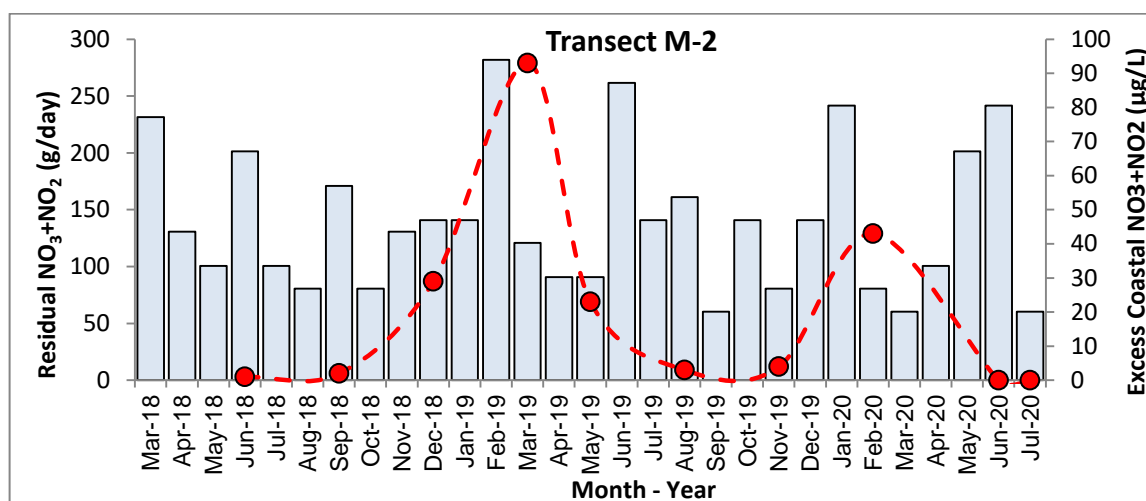


Figure 4. Mean daily application of nitrate+nitrite to golf course turf and landscaping (blue bars; g/day) and excess calibrated nitrate+nitrite (red circles  $\mu\text{g/L}$ ) at 2-m station on Transect M-2.

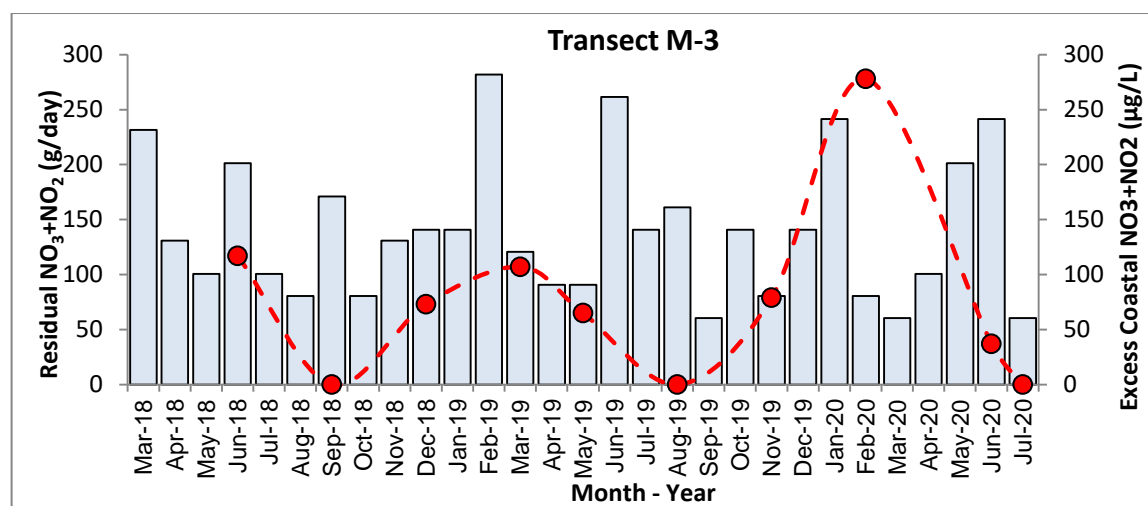


Figure 5. Mean daily application of nitrate+nitrite to golf course turf and landscaping (blue columns; g/day) and excess calibrated nitrate+nitrite (red circles  $\mu\text{g/L}$ ) at 2-m station on Transect M-3.

Our sampling protocol and the turf managers' fertilizer application schedule are not connected in any way. Therefore, additional water quality measurements over a long period will be required to establish if any valid relationship exists between fertilizer application amounts and our salinity-based method<sup>3</sup> of detecting "excess" nitrate+nitrite in the waters directly offshore. If needed and as additional data accumulates, we should be able to recommend changes to fertilizer application methods that will meet golf course and landscape requirements, while also minimizing measureable effects on nearshore water quality.

### Nutrient Limitation

Inorganic nitrogen and phosphorus compounds are typically identified as potentially "limiting" nutrients in Hawaiian marine waters. Increases in a limiting nutrient concentration can result in enhanced growth of phytoplankton and macroalgae. Excessive algal growth has happened in the coastal waters off Kīhei due to increased discharge of both nitrogen and phosphorus compounds from the Kīhei Wastewater Treatment Plant (Laws et al., 2004; Dailer et al., 2010). Maintaining low limiting nutrient concentrations is essential to maintaining a pristine and diverse marine biological community.

<sup>3</sup> Explained in detail in *AECOS*, 2018, p. 10-11.

We can estimate the limiting nutrient (nitrogen or phosphorus) 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 related to DIP limitation, whereas low N:P ratios (<29.1) are related to DIN limitation. Analyses using accumulating data averages can be useful to decipher trends and sufficient nutrient and chlorophyll  $\alpha$  data are not presently available to make statistical inferences regarding actual limiting nutrient determinations in Mākena waters.

Table 6. A summary of average DIN and DIP values for ten monitoring events (June, 2018 – June, 2020) and July 2020.

Transect	DFS <sup>†</sup> (m)	DIP ( $\mu$ M/L)		DIN ( $\mu$ M/L)		DIN:DIP ratio		N/P Limited potential	
		Means	July 2020	Means	July 2020	July 2020	July 2020	July 2020	July 2020
<b>M-1</b>	2	0.08	0.10	6	5	78	50	P	P
	10	0.07	0.13	5	10	79	77	P	P
	50	0.07	0.06	5	6	72	87	P	P
	100	0.04	0.03	4	4	98	133	P	P
<b>M-2</b>	2	0.12	0.13	3	2	27	16	N	N
	10	0.11	0.10	4	3	33	27	P	N
	50	0.10	0.06	3	5	35	74	P	P
	100	0.07	0.06	3	3	37	45	P	P
<b>M-3</b>	2	0.12	0.03	6	2	47	64	P	P
	10	0.11	0.06	4	4	37	68	P	P
	50	0.07	0.19	4	9	52	49	P	P
	100	0.06	0.06	2	2	36	38	P	P
<b>M-4</b>	2	0.07	0.03	2	0	28	14	N	N
	10	0.10	0.10	2	3	24	26	N	N
	50	0.05	0.03	2	2	38	62	P	P
	100	0.05	0.06	2	1	33	12	P	N

N:P ratios can vary, as shown in Table 6, from place to place along the coast. For example, during the present sampling event, N:P values for monitoring stations along M-1 and M-3 transects were DIP limited, due to the fact that DIN values were high along these transects. N/P limitation can also vary between stations along individual transects, as shown in Transects M-2 and M-4. different algal species represent a wide range of N:P requirements (Atkinson & Smith, 1983), Constantly changing ratios prevent extensive growth of just one or a few species, maintaining diversity (of algae and the food chain).

## Summary

The July 17, 2020 monitoring event revealed the somewhat unusual circumstance of low salinities and low nitrate+nitrite concentrations in these waters compared with historic means. Ortho-phosphate values were low but comparable to historic means.

Current tracking with the PacIOOS modeling system indicates currents were moving in a southeasterly to southerly direction prior to and during the July 17, 2020 sampling event. Ocean water had traveled about 1.3 nautical miles from Wailea area to Mākena by 1100 hours.

Subsidies for nitrate+nitrite concentrations were not present at any of the 2-m stations in the survey area. There were also no subsidies for ortho-phosphate at any transect.

DIN to DIP ratios indicate that DIP was the presumptive limiting nutrient for algal growth along transects M-1 and M-3. DIN was the limiting nutrient along transects M-2 and M-4 at the 2 m and 10 m stations.

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