AQUAWASTE TEAM

Aquarium of the Pacific

2020 - 2021 STUDENT RESEARCH TEAM

UCLA INSTITUTE OF THE ENVIRONMENT & SUSTAINABILITY

Final Report

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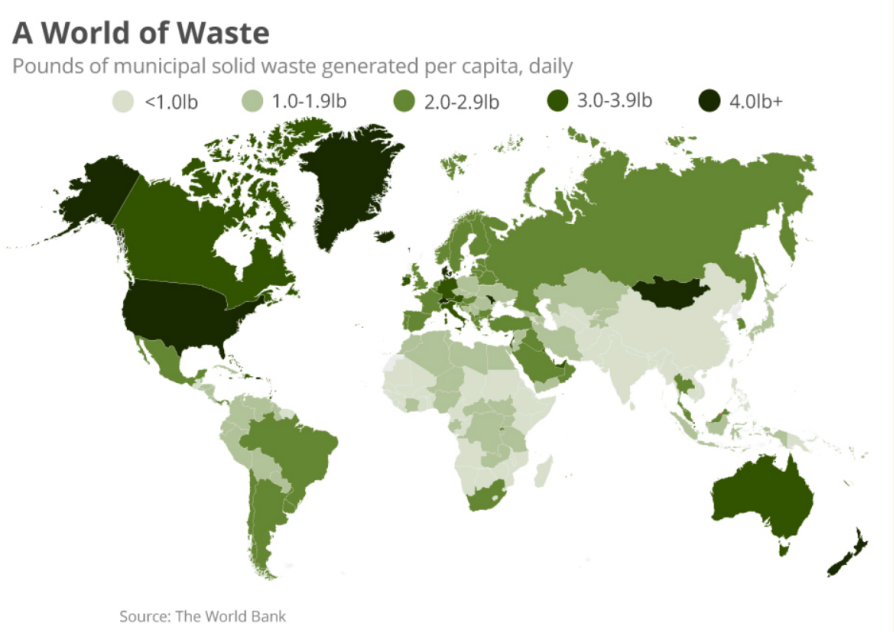
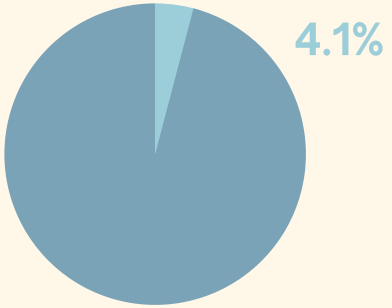
THE UNITED STATES IS THE GREATEST CONTRIBUTOR TO A GLOBAL LANDFILL CRISIS

More than 2 billion tonnes of municipal solid waste (MSW) is generated globally each year, with only 16% recycled, and most of the remainder being dumped into landfills. The planet is running out of room, and on top of that the waste generates harmful pollutants and greenhouse gas emissions. Reducing organic waste, which currently represents more than 50% of landfill volume in the United States, is especially important. This is because when organic waste decomposes in a landfill, it releases methane, which has a global warming potential ~30 times that of CO_2.

In this report we focus on reducing organic waste at the Aquarium of Pacific. This is not only good sustainability practice, it is also mandated by two recent California laws.



If everyone in the world produced as much solid waste as we do in the United States per capita, then the global waste load would be tripled.



If we represented all U.S. organic waste as a "pie", the sliver of that pie that is composted is tiny.

CALIFORNIA LEGISLATION FOR REDUCING ORGANIC WASTE

CA Assembly Bill 1826 (2014): *Mandatory Commercial Organics Recycling*

Implementation: Commercial businesses must subscribe to an organic waste collection service, recycle organic waste on-site, or sell/donate generated organic waste.

At the Aquarium: Reduce organic waste disposal by subscribing to composting services or implement on-site composting.

CA Senate Bill 1383 (2016): *California's Short-Lived Climate Pollutant Reduction Strategy*

Implementation: Every jurisdiction must instill organic waste collection services to all residents and businesses and edible surplus food must be donated to food recovery organizations.

At the Aquarium: Reduce organic waste disposal by subscribing to composting services or implement on-site composting. Work with local food recovery organizations such as food pantries.

THE ESSENTIALS

The Team
8 senior UCLA students

The Goal
Minimize amount of Aquarium waste going to landfills

The Deliverable
A sustainable waste management plan

The Methods
Informational interviews, literature reviews, & aquarium waste audits

WASTE AUDIT METHODOLOGY

1. Divide team into groups of 2.
2. Remove large landfill bags from dumpster and weigh as a singular unit.
3. Sort contents of each bag into the categories listed on the data entry sheet.
4. Weigh each category of sorted waste separately.

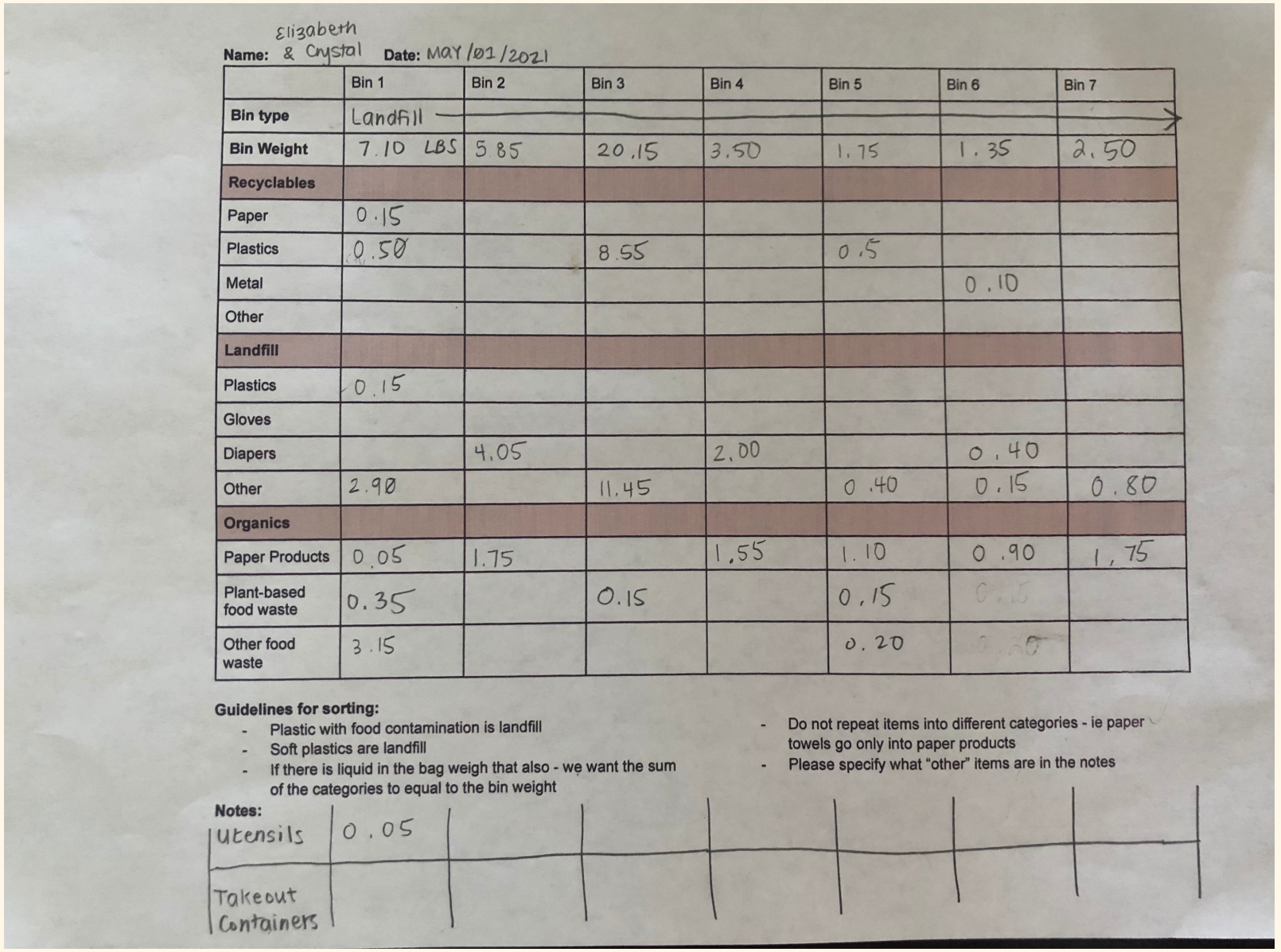
WASTE AUDIT DATA FORM

Name: **Date:**

	Bin 1	Bin 2	Bin 3	Bin 4	Bin 5	Bin 6	Bin 7
Bin type							
Bin Weight							
Recyclables							
Paper							
Plastics							
Metal							
Other							
Landfill							
Plastics							
Gloves							
Diapers							
Other							
Organics							
Paper Products							
Plant-based food waste							
Other food waste							

This is the data form we used as we sorted the waste samples from the dumpsters.

COMPLETED WASTE AUDIT DATA FORM



Name: Elizabeth & Crystal Date: MAY/01/2021

	Bin 1	Bin 2	Bin 3	Bin 4	Bin 5	Bin 6	Bin 7
Bin type	Landfill →						
Bin Weight	7.10 LBS	5.85	20.15	3.50	1.75	1.35	2.50
Recyclables							
Paper	0.15						
Plastics	0.50		8.55		0.5		
Metal						0.10	
Other							
Landfill							
Plastics	0.15						
Gloves							
Diapers		4.05		2.00		0.40	
Other	2.90		11.45		0.40	0.15	0.80
Organics							
Paper Products	0.05	1.75		1.55	1.10	0.90	1.75
Plant-based food waste	0.35		0.15		0.15		
Other food waste	3.15				0.20		

Guidelines for sorting:

- Plastic with food contamination is landfill
- Soft plastics are landfill
- If there is liquid in the bag weigh that also - we want the sum of the categories to equal to the bin weight
- Do not repeat items into different categories - ie paper towels go only into paper products
- Please specify what "other" items are in the notes

Notes:

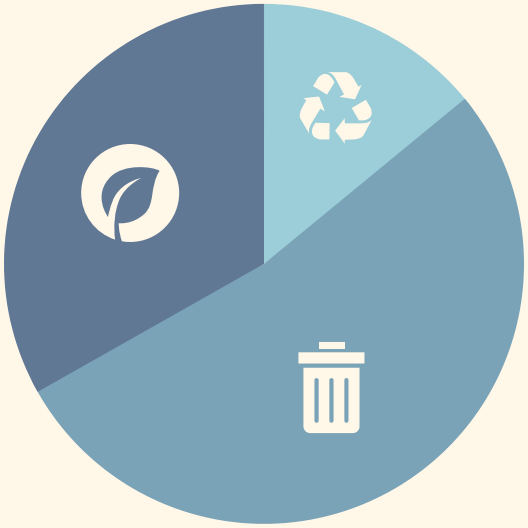
Utensils	0.05						
Takeout Containers							

WASTE AUDIT RESULTS

Audit 1

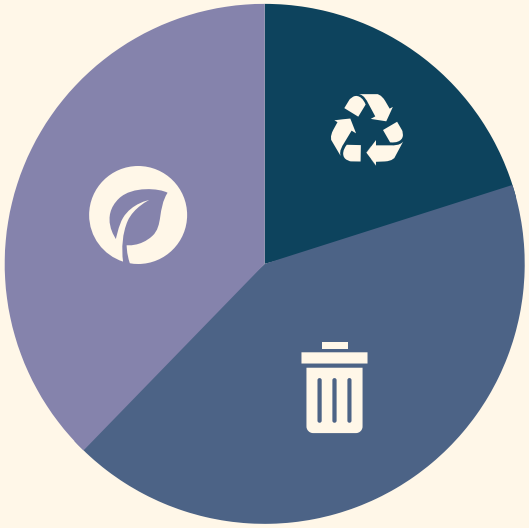
Organic: 48.4%
Recycle: 10.1%
Landfill: 41.5%

Audit 2



Organic: 33.2%
Recycle: 14.1%
Landfill: 52.8%

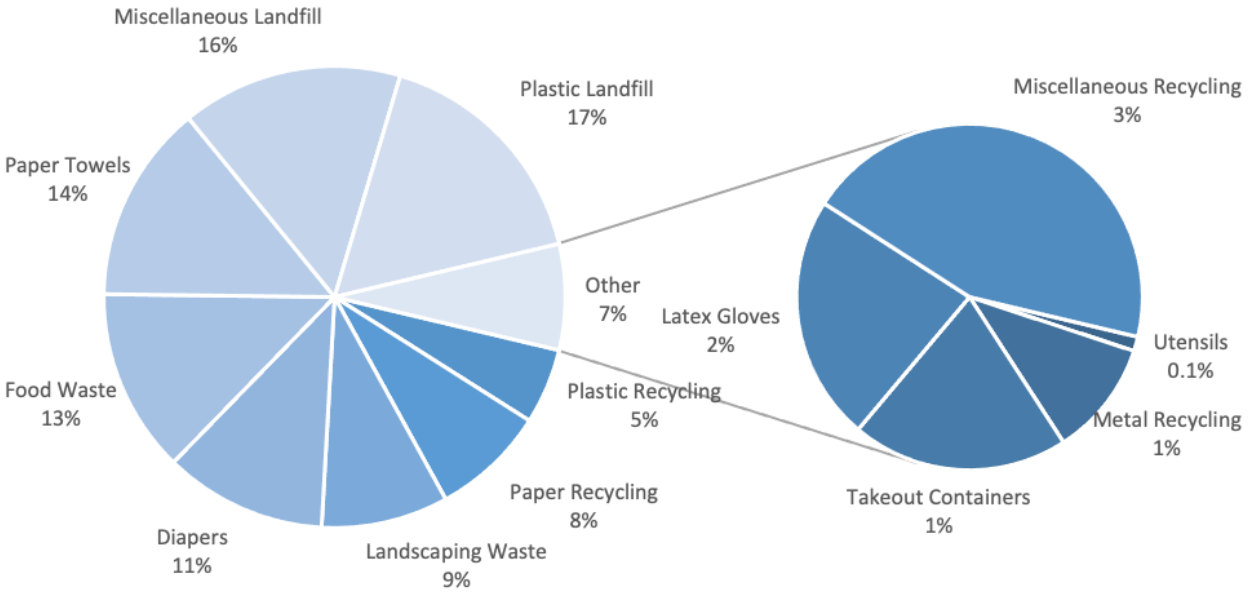
Audit 3



Organic: 37.7%
Recycle: 20.1%
Landfill: 42.2%

Although there was variation from sample day to sample day, organic and landfill waste consistently dominated by weight, with potential recyclable waste holding at 20% or less.

KEY WASTE AUDIT FINDINGS



PAPER TOWELS

Paper towels made up 14% of total weight

BOTTLES AND CANS

Thrown in landfill instead of recycling because emptying remaining liquids is a hassle

GIFT SHOP

Receipts, cardboard packaging, and soft plastics make up a large percent of waste

HUSBANDRY

Husbandry, included in the food waste category, should be composted

INFORMATIONAL INTERVIEWS

NAME	POSITION/ROLE
Allen LaPointe	Vice President of Environmental Operations at the SHEDD Aquarium
Andrew Green	Managing Director at Global Composting Solutions Ltd (HotRot)
Christy Serrano	Waste Diversion Analyst for the City of Long Beach
Erin Fabris	Sustainability Manager for UCLA Housing and Dining
Erin Rowland	Waste Diversion Analyst for the City of Long Beach
Jenifer Burney	Aquarist and Compost Enthusiast at the Aquarium of the Pacific
Jennifer McBride	Universal Waste Systems
Joanie Burns	Compost Enthusiast at Amgen
Jun Yang	CEO at Ecovim USA
Karen Erickson	Ecovim 250 Customer at Wrigley Marine Science Center
Ken Kim	Corridor Recycling
Ken Stuart	Head Chef at the Aquarium of the Pacific
Kikei Wong	UCLA Zero Waste Coordinator
Mandi Mckay	HotRot Customer at Sierra Nevada Brewing Co.
Nick Smith-Sebasto	CEO of FOR Solutions Composter
Sarah Adams	Recycling Specialist for City of Long Beach
Sean Devereaux	Director of Volunteer & Engagement at the Aquarium of the Pacific

LESSONS FROM THE EXPERTS

From waste haulers and composting specialists to various organizations and institutions, a diverse variety of perspectives were widely considered. Here are a few that really stood out to our team:

PRIORITIZE REDUCE > REUSE > RECYCLE

"Reduce, reuse, and recycle" is the mantra for sustainable waste management, **but reduce should always be the highest priority.** Reducing methods include: metal utensils, reusable water bottles, and tote bags for groceries. Due to the COVID-19 pandemic, the Aquarium has seen an increase in single-use plastic use, however, a return to reusable items post-pandemic can greatly reduce Aquarium waste.

INCORPORATE COMPOSTING

Compost technologies have been steadily improving, and companies such as **HotRot** and **FOR Solutions** provide clean and efficient in-vessel composting that turns organic waste into nutrient dense humus within weeks. Compost technology customers that we interviewed were generally delighted with their large compost machines.

LESSONS FROM THE EXPERTS

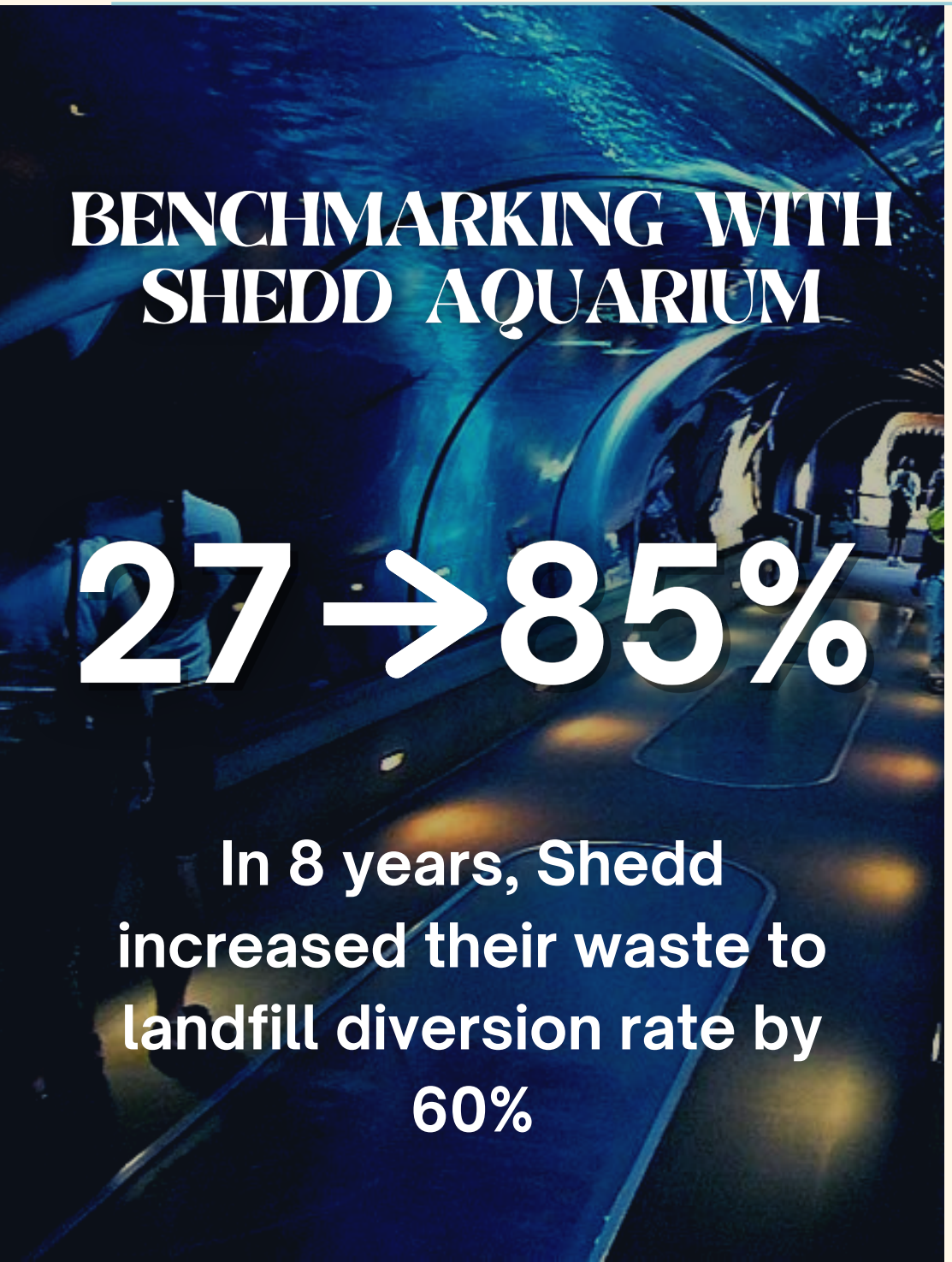
AVOID BIOPLASTICS

Bioplastics are plastics derived from renewable biomass sources such as sugar cane and corn starch. The starch-based biopolymers used in these products have a high heat resistance, making them **very difficult to compost and biodegrade**. Our interview experts emphasized that bioplastics were not the environmentally friendly solution they are often promoted as. They do replace petroleum-based polymer plastics, but they have their own waste disposal problems that should be avoided.

BEHAVIOR CHANGE

"The challenge is not the solution; it is to market it and normalize it." - Erin Rowland

A majority of our experts emphasized the importance of making it easy for visitors and staff to know how to sort their trash. Ways to do this include: adding signage, color coding bins and liners, as well as by "marketing" and better telling the story of waste streams. The importance and impact of diverting trash, especially organic waste, away from landfills should also be included.



BENCHMARKING WITH SHEDD AQUARIUM

27 → 85%

In 8 years, Shedd increased their waste to landfill diversion rate by 60%

Here's What They Do:

Separate waste on-site to send to different collectors (gloves, ink cartridges, light bulbs, clothes/textiles)

Put multi-stream bins in a high-traffic hallway

Send compost to off-site collector because they have no room on-site

Place compost bins by every staff member's desk

PROMISING COMPOST TECHNOLOGIES

Out of the various technologies on the market, our team found 2 promising in-vessel systems that might be great additions to the Aquarium's operations: The HotRot Comet and the Ecovim 250.

Since the Aquarium has limited space, the maximum end-product volumes were calculated for the HotRot and Ecovim based on their percent reduction values.*

HOT ROT

Pre-Pandemic (2019)
Annual Max Load: 22,596 lbs
Weekly Max Load: 435 lbs

Intra-Pandemic (2020)
Annual Max Load: 11, 858 lbs
Weekly Max Load: 228 lbs

ECO VIM

Pre-Pandemic (2019)
Annual Max Load: 10,660 lbs
Weekly Max Load: 200 lbs

Intra-Pandemic (2020)
Annual Max Load: 5,600 lbs
Weekly Max Load: 100 lbs

	HOTROT	ECOVIM
TYPE	In-vessel Composter	Food Dehydrator
SIZE	122 x 47 x 75 inches	80 x 75 x 80 inches
MAX LOAD	110-165 lbs	250 lb load
PROCESS TIME	10-14 days/cycle	12 hours
% REDUCTION	30% reduction	67% reduction
MAINTENANCE	Very manageable, 1-2 hours/day	Very manageable and easy to use
PRICE	~ $55,000	~ $32,300
LIMITATIONS	End product needs curing time, which requires additional space	For food and occasionally paper towels

**The maximum load will not be entirely used by either compost technology since the end-product quality is highly dependable on the composter's specific input load characteristics and conditions, such as carbon to nitrogen ratios and possible bulking agents.*

RECOMMENDATIONS

ENHANCE ON-SITE COMPOSTING

Three composting technologies had the greatest potential to be the most effective and suitable for the Aquarium of the Pacific: ECOVIM 250, HotRot COMET, and FOR Solutions. The three technologies vary in dimension, acceptable input load, installation requirements, and purchasing costs. Our team and external experts agreed that both the ECOVIM 250 and the HotRot COMET would be great additions to the Aquarium's on-site waste operations. Because of the diversity of organic waste it accepts, we recommend the HotRot Comet as the first installation.

EXPLORE REUSABLE / COMPOSTABLE FOOD PACKAGING

Due to the COVID-19 hygiene protocols, the Aquarium has seen a rise in single-use plastic utensils, takeout containers, sauce packets, and other disposable restaurant supplies. Though it is still unclear when a return to reusable materials will be most feasible, doing so is highly recommended as the Aquarium already has the infrastructure to handle it and there exists no sustainable substitute for reusable foodservice ware. Also, the Aquarium could enact further sustainable habits such as:

- Using compostable wooden utensils during big events
- Using compostable paper straws with a thin PLA lining inside
- Using condiment dispensers with paper condiment cups
- Replacing food label stickers with compostable ink stamps
- Replacing paper towels with hand dryers in bathrooms

RECOMMENDATIONS

ADD COMPOSTING + LIQUID DISPOSAL BINS

All Aquarium waste stations currently only have two streams: recycling and trash (landfill).This resulted in our team finding much compostable waste in landfill bags during waste audits, in addition to half-full plastic bottles and cans, as guests and staff found emptying bottles before recycling them to be too inconvenient. Thus, we recommend purchasing additional 2-stream bins with a composting stream and a liquid disposal stream, to be placed alongside the existing recycle/landfill bins in the Aquarium - especially along dining areas. We recommend purchasing these bins from Max-R, a waste bin company which has sold waste bins to the Aquarium in the past. Max-R offers the option for liquid disposal bins, and their bins are highly customizable to meet Aquarium needs. This way, new bins will easily blend into existing Max-R bins at the aquarium.

IMPROVE CLARITY OF BIN SIGNAGE

Signage is a necessary tool for educating guests and staff on proper waste sorting. Current bins at the Aquarium do NOT break down the different types of goods that go into each bin. More thorough signage can be customized and appended onto the Aquarium's current Max-R bins to teach guests to properly divert waste. In addition, graphics about the Aquarium's waste management goals and an exhibit on how poorly managed waste affects marine life can teach guests on the importance of proper diversion habits.

FUTURE STEPS, OBSTACLES, & COMPLICATIONS

OBSTACLES

Accommodations for COVID-19 led to a higher volume of waste, due to hygienic products like paper towels and gloves, and single-use food service ware such as takeout containers, plastic utensils, and sauce packets. This did not negatively affect our data or recommendations.

Our team struggled with finding organizations or individuals who would help take some of the end-product from the compost technology, since the Aquarium has limited space.

- Options include using it on-site as landscape purposes, habitat bedding, or free samples at the Aquarium's gift shop
- Off-site options include donating to individuals, organizations, or agricultural farms
- Selling the end-product is a possibility, but rules and regulations regarding compost end-product must be applied

FUTURE STEPS

Redo the waste audit in three years. This way, the Aquarium can assess progress in waste diversion.

Reduce retail waste. Our waste audits found a significant portion of waste coming from plastic packaging, receipts, and more from retail functions.

Increase plant-based food options on menus. The Aquarium currently has a wide variety of plant-based food on their menu. However, there is opportunity for expansion in sustainable options, which can also serve an educational purpose for guests.

Form partnerships to recycle specific waste streams, similar to Shedd Aquarium's partnership with a waste hauler that recycles only gloves.

Consider food recovery for SB-1383, by donating surplus food to local food recovery groups and shelters.

SOURCES FOR PAGE 3

Percentage of Food Waste Composted:
EPA: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#:~:text=In%202018%2C%20the%20rate%20of,2018%20(2.6%20million%20tons). Accessed May 10, 2021.

Global Waste Generation in U.S. Perspective:
EPA: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials. Accessed May 14, 2021.

4.9 pounds/day x 365 days/year = 1788.5 pounds/year x 7,800,000,000 people = 1.4x10^13 pounds/year = 6,975,150,000 tonnes/year

Global Municipal Solid Waste:
Verisk Maplecroft: https://www.maplecroft.com/insights/analysis/us-tops-list-of-countries-fuelling-the-mounting-waste-crisis/. Accessed May 10, 2021.

Percentage of Organic Waste in Landfill Waste:
EPA: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#:~:text=In%202018%2C%20about%20146.1%20million,less%20than%2010%20percent%20each. Accessed May 16, 2021.

Methane Global Warming Potential:
UNECE Sustainable Development Goals: https://unece.org/challenge. Accessed May 10, 2021.

SOURCES FOR PAGE 15

PRE-PANDEMIC (2019)

HotRot Comet: 30% volume reduction

Annual Max Load:
16.14 ton * 0.3 = 4.84 ton reduction
16.14 - 4.84 = 11.3 ton * 2000 lb/ton = **22,600 lbs**

Weekly Max Load:
22,600 lbs/ 52 weeks = **434.6 lbs**

Ecovim Food Dehydrator: 67% volume reduction

Annual Max Load:
16.14 ton * 0.67 = 10.81 ton reduction
16.14 - 10.81 = 5.33 ton * 2000 lb/ton = **10,660 lbs**

Weekly Max Load:
10,660 lbs/ 52 weeks = **205 lbs**

INTRA-PANDEMIC (2020)

HotRot Comet: 30% volume reduction

Annual Max Load:
8.47 ton * 0.3 = 2.54 ton reduction
8.47 - 2.54 = 5.93 ton * 2000 lb/ton = **11,860 lbs**

Weekly Max Load:
11,860 lbs/ 52 weeks = **228.1 lbs**

Ecovim Food Dehydrator: 67% volume reduction

Annual Max Load:
8.47 tons * 0.67 = 5.67 ton reduction
8.47 - 5.67 = 2.8 ton * 2000 lb/ton = **5,600 lbs**

Weekly Max Load:
5,600 lbs/52 weeks = **108 lbs**

SOURCES FOR PAGE 18

How Shedd Recycles Their Gloves:
Valutek and Terracycle: https://www.valutek.com/collections/gloves/products/zero-waste-box-for-disposable-gloves. Accessed June 6, 2021.

APPENDIX I - MEET THE TEAM

CRYSTAL MARIE CHACON

POLICY EXPERT + RESEARCHER

Crystal Chacon will be graduating from UCLA with a Bachelor of Science in Environmental Science with a concentration in Geography/Environmental Studies in June 2021. She has been involved with the Community Programs Office (CPO), which provides basic needs such as food and support to students in peril. Through her work with UCLA's CPO office she has contributed to programs that improve the access of underserved high school students to institutions of higher education. Crystal has volunteered at her hometown's urban garden for years and hopes to continue to advocate for expanding urban gardens in vacant city spaces.

ANNALISE EDER

PROJECT MANAGER + RESEARCHER

Annalise Eder will be graduating from UCLA with a B.S. in Environmental Science in 2021. She is passionate about environmental justice, policy, and education. She currently works as an operations volunteer for Misha's Kind Foods. She is also a manager and a competitive team member for the UCLA equestrian team. Annalise has previously assisted the non-profit organization the Assistance League of Greater Placer by creating and launching their online stores. After graduation she intends to pursue a master's in Environmental Policy.

DESIREE FELIX

PROJECT MANAGER + RESEARCHER

Desiree Felix is a graduating senior with a major in Environmental Science and minors in Environmental Systems and Society and Food Studies. Of Mexican and Salvadoran roots, she hopes to one day own a small farm and grow the crops her father traditionally grew and cooked. Her commitment stems from shadowing local doctors in Panama and Nicaragua, from serving as a caseworker for people experiencing homelessness in West Hollywood, and from travelling internationally and seeing the suffering caused by food insecurity. For Desiree, a fair and sustainable world depends on secure and sustainable food supplies, public health systems that reach everyone, and a recognition that global warming is an immediate threat.

APPENDIX I - MEET THE TEAM

ELIZABETH IGNACIO

DESIGN LEAD + RESEACHER

Elizabeth will graduate from UCLA in June 2021 with a Bachelor of Science in Environmental Science, concentrating in Geography/Environmental Studies. She is a leader of Sustainability Action Research's Green Games Team and a member of the Aquawaste Practicum Team, Elizabeth dedicated her time at UCLA to researching practical methods of waste diversion in locations ranging from sporting arenas to university campuses to aquariums. Outside of the classroom, Elizabeth exercised her creative skills as a member of the UCLA Bruin Marching Band and University Catholic Center's choir. Post-graduation, she hopes to pursue her passions for sustainable design.

ANNA JAFFE

PROJECT MANAGER + RESEARCHER

Anna Jaffe is a fourth year student and is part of the Institute of Environment and Sustainability at the University of California, Los Angeles. She is majoring in Environmental Science and minoring in Civil and Environmental Engineering. She has participated in several environmental activism programs such as UCLA's CALPIRG, an organization that works on solving issues such as food insecurity, voter registration, and climate change. In 2020, Anna's project for CALPIRG entailed the Plastic Free Seas Campaign, which urged UCLA and Los Angeles to ban single use plastics. Anna has a passion for horseback riding and other outdoor activities such as hiking, running, and snorkeling. She plans on pursuing a future career in renewable energy and plans on attending graduate school to advance her education on the topic. Anna hopes to one day help lead the necessary transition from fossil fuel and natural gas extraction to renewable energy.

MELISSA PERRIN

EDITOR + RESEARCHER

Melissa is studying for a Conservation Biology minor. In the future, she intends to help cities better integrate green spaces into the urban landscape. Outside of academics, Melissa is an involved member of the UCLA marching band. Her commitment to giving back to the surrounding community she loves so much, led her to the honorary band sorority, Tau Beta Sigma, where she currently holds the position of Vice President. When she is not engrossed in academics or marching, she loves reading, art, and brain games with her friends. She went on her first camping trip last year and is excited to make a hobby out of it.

APPENDIX I - MEET THE TEAM

JOYCE LEE

OUTREACH + RESEARCHER

Joyce Lee will graduate June 2021 from UCLA with a degree in Environmental Science and minor in Environmental Systems and Society. She has extensive experience working on sustainability practices in everything from building infrastructure, to corporate practices and supply chains. She participated in the 2019 EPA Campus Rainworks Challenge where her team won first place in the Demonstration Category. Currently, she is involved in UCLA's International Urban Sustainability Student Corps at UCLA under the energy division, the UCLA LEED Lab, and the Corporate Partners Program in the Institute of the Environment and Sustainability. She hopes to continue down a career path related to sustainability where she can focus her passion and help foster a better future of environmental stewardship.

RONALD THOMPSON III

OUTREACH + RESEARCHER

Ronald (Ronnie) Thompson III will graduate from UCLA in June 2021 with a Bachelor of Science in Environmental Science, minoring in Conservation Biology. Raised in Sacramento California, Ronnie enjoys discovering new musical artists, working on art projects, and learning about bees and other pollinators. During his time at UCLA, he was involved in a number of research projects and research labs, in addition to leading the mentorship program for the Environmental Student Network organization. As a part of the Aquarium of the Pacific Waste Management practicum, he is tasked with overseeing community outreach, community projects, and advertising the project. Ronnie is currently interested in studying pollinator behavior, sustainable beekeeping practices, and protecting native bees. In the future, he hopes to work to conserve native bees, while also establishing his own beekeeping and education program of his own.