



ZERO WASTE REVOLUTION

2014-2015 School Year



Zero Waste is a philosophy that encourages the redesign of resource life cycles so that all products are reused. No trash is sent to landfills and incinerators. The process recommended is one similar to the way that resources are reused in nature.

The internationally recognized definition of ZERO WASTE adopted by the Zero Waste International Alliance is:

“Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use.

Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.

Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.”

Project implementation and
preparation of this report provided by



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Photos courtesy Parker Sawyer

Phase 1 ZERO WASTE • 1st & 2nd Trimesters

Getting started with vermicomposting

History

Lanikai 6th graders dabbled in vermicomposting in 2005 – and even produced an award-winning animated film about the process – but never expanded beyond a few residential Can-O-Worms units. Kokua Hawaii Foundation’s AINA program at Lanikai School provides basic information about composting for 3rd graders but does not attempt food waste processing except as small-scale demonstration.

Aware of the extensive Resource Recovery program in place at Pearl City High, STEM and 6th grade teacher Parker Sawyer saw greater potential at Lanikai for processing food waste on campus to create compost and fertilizer for use in the school garden. Mr. Sawyer contacted Mindy Jaffe of Waikiki Worm Company in July of 2014 to see what could be accomplished with funds available through the Holoholo Farms CSA.*

Big Blue moves to Lanikai

At about the same time we learned that a departing teacher at Alvah Scott Elementary was looking for someone to adopt their worm bin, as no one else at Scott was interested in taking on the responsibility.

Serendipity! A 10-foot Pipeline worm system dubbed Big Blue was transferred from Scott to Lanikai, just in time for the opening of the school year on August 4th. The worm colony was already robust, well-established, and ready to process at full capacity on Day One.



The One Love advantage

Lanikai has a great advantage for successful food waste management: an outstanding lunch program. Because One Love Cafe prepares locally-sourced, fresh, organic, delicious school lunches instead of horrible processed mainland Federal lunch program meals, waste is both minimal and of excellent nutritional quality. Daily lunch prep generated plenty of vegetable trimmings, fruit rinds, skins and peels, all of which were bucketed and stored in the cafeteria fridge by Mr. Sawyer. Mindy was contracted to come every Wednesday morning to feed the Big Blue worm colony; they were watered daily by Mr. Sawyer.

* Holoholo farms began with a strong passion to make Hawaii more food sustainable, and improve the health of communities by making local produce more accessible. Holoholo returned 8% of the revenue from the Lanikai School CSA participants back to Lanikai for the 2013-2014 school year. Owner Jill Norby meets with the Lanikai School Garden club at times during the year to discuss business and entrepreneurship.

Participation with Environmental Protection Agency

A waste audit was conducted the first week of school so that Lanikai could be registered with the EPA's Food Waste Reduction Challenge. This competitive national program tracks food waste diversion across the U.S. and gives awards for reaching waste reduction goals. Hawaii schools are unique because our climate allows us to compost all year round. The on-campus Resource Recovery program at Pearl City High processed 40 tons annually and put Hawaii on the map. The EPA took notice. Lanikai is well positioned to win both national attention and awards as the program is developed.

Our modest beginning – vermicomposting with a weekly feeding of prep waste – was very successful: 1,421 pounds. **Zero Waste Phase 1 ran from Aug. 7, 2014 through Feb. 20, 2015.**

FOOD WASTE RECOVERY LOG

Vermicomposting 1st & 2nd Trimesters

<u>Date</u>	<u>Food recovered/processed per week</u>	<u>Percentage of total waste</u>
8/7/2014	60 pounds	15%
8/14/2014	60 pounds	15%
8/22/2014	65 pounds	16%
8/29/2014	59 pounds	15%
9/5/2014	63 pounds	16%
9/12/2014	56 pounds	14%
9/19/2014	60 pounds	15%
9/26/2014	63 pounds	16%
10/3/2014	62 pounds	16%
10/17/2014	40 pounds	10%
10/24/2014	70 pounds	18%
10/31/2014	68 pounds	17%
11/7/2014	57 pounds	14%
11/14/2014	55 pounds	14%
11/21/2014	58 pounds	15%
12/5/2014	55 pounds	14%
12/12/2014	44 pounds	11%
12/18/2014	44 pounds	11%
1/16/2015	29 pounds	7%
1/23/2015	56 pounds	14%
1/30/2015	75 pounds	19%
2/6/2015	65 pounds	16%
2/13/2015	82 pounds	20%
2/20/2015	75 pounds	19%

TOTAL: 1,421 pounds

Phase 2 ZERO WASTE • Going for 100%

Cafeteria Separation Station and Sort-It-Out Sam

The Pearl City High program was discontinued at the end of the year, so Mindy was free to bring full-on Resource Recovery to Lanikai PCS. Plans were made to expand the vermicomposting system and add hot composting and bokashi fermentation to the mix. In order to generate adequate input for these technologies, it was imperative that the collection and sorting operation begin immediately. Our motto: *Don't dump on Hawaii- sort it out!*



Capturing food waste is key

On the first day of the third trimester we set up a cafeteria Separation Station. Organizing and implementing the sorting of waste materials is fundamental to all waste reduction programs. This seemingly simple operation is what stops most schools dead in their tracks. On the surface, it looks easy: on 4-foot tables, set up clearly labeled buckets for leftover milk, post-consumer waste (plate scrapings), a container for HI-5 cans and bottles, a place to stack trays and other containers, and a rubbish can for non-recyclable items. Students learn within a few days what goes where, and are largely willing to take the time to sort out their lunch trays.



Lanikai started lunchtime sorting on February 23, 2015.

We ran two stations at the cafeteria; the kindergarten had their own separation station at the LC, with milk and food buckets that were switched out daily toward the end of the lunch period.

Whose job is it, anyway?

Because the Separation Station intersects with facilities operations – food service and custodial – there is a strict time frame and procedures and protocols that must be followed every single day without fail.

The big challenge is determining *who* is going to set up, monitor the stations, break down, switch out the kindergarten buckets, measure and record data, and clean up. Initially, the six original Zero Heroes were trained to run the operation as part of their duties, but it soon became apparent that this was too much responsibility for 5th graders on their own. After seven weeks of generously giving up their recess and meal time to help sort lunch trays, the Zero Hero group was replaced by two 6th grade helpers daily. Mr. Sawyer made it mandatory for his students to perform lunch duty for a least one day – after that it was voluntary, and the positions were not hard to fill since it's a fun job. Either Mr. Sawyer or myself was on hand to supervise daily.

We learned that more than one monitor per station just encourages goofing off, and that students immediately enter a slow-motion time warp after lunch to avoid going back to class and need to be pushed hard to finish.

Sort-It-Out events

Separation stations were set up and staffed for every non-lunch occasion where food waste was generated, including Career Day, the Health and Wellness Fair, and First Grade Play Night. We also sorted and separated at the Annual Volunteer Breakfast and Mrs. Fong’s Retirement Luncheon. We encouraged teachers to let us in on classroom Pizza Parties and birthday celebrations.

Mr. Sawyer’s 6th graders even took “To Be Composted” buckets with them to collect buffet leftovers at their Promotion party at Secret Island at Kualoa Ranch!

Sort-It-Out Sam debuts

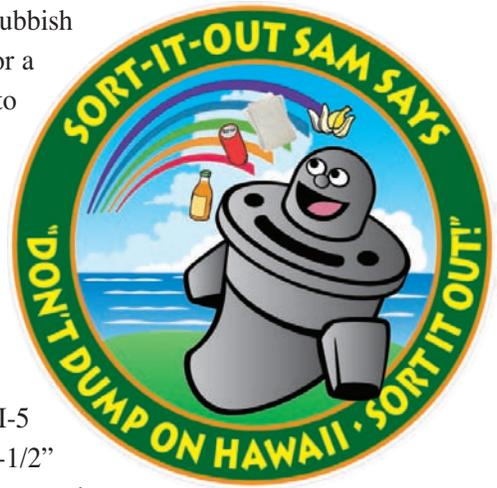
Digging around the fifteen 35-gallon classroom/campus Rubbermaid bins revealed that quite a lot of snack food was being disposed of in general-waste rubbish cans. It conveyed a mixed message to insist that students sort and separate their food waste at the cafeteria, but it was OK to trash it during classtime or recess. We gave each classroom a plastic ice cream tub for disposal of food waste to be picked up daily, but it got lost in the classroom clutter. It was clear that more compelling technology was needed.



To specifically address the snack waste issue, we introduced Sort-It-Out Sam, a cute recycling apparatus with a goopy smile, swing-open mouth, a couple of arms and a packaging-waste belly. Sam was engineered by Edwin Souza, Jr. of Pacific Industrial Projects, (who also developed our Pipeline worm system equipment and Bokashi Blasters), with graphic design and signage by Steve Underwood of Underwood Graphics and Kelly Fukuhara of Identity Signs and Graphics. Financing for ten units came from the LSO. Each Sam unit cost approximately \$250.

The plan was to assign each classroom a Sam to adopt. At the end of the school day, each room’s designated Sort-It-Out Samurai would gather up Sam’s collection and deliver it to a receiving station set up at the foot of A Building. The idea was to shift the responsibility of recycling from “someone else” to each teacher and student in the Lanikai community. Just like at lunchtime, this recycling ritual was to become a daily practice.

On April 22 – Earth Day – eleven Sams replaced ten large rubbish cans in A Building, with one for the 1st graders in the LC for a six-week Beta test, which would reveal the flaws, allow us to correct them over the summer, and start fresh when the 2015-2016 school year started up. Initial training was quick and minimal. The Beta test was very successful – all the problems were immediately apparent.



Sort-It-Out Sam soon came to clarify the challenges shifting from a rubbish to a recycling mentality. In addition to snack waste, Sam could also accommodate HI-5 cans and bottles which were collected for redemption and 8-1/2” x 11” copy or lined paper which was collected for shredding to make worm bin bedding. Sam was not a meant to be a fancy rubbish can, but a Recycling Guy, a totally distinct species.

Because Sam stood in the exact same location of big rubbish cans that had been there for 50+ years, it was very hard to people NOT to treat Sam as a rubbish can. They squeezed in everything through the slots meant only for small snack packaging, and even disassembling him to dump in all manner of regular rubbish.

In addition, despite repeated explanation, teachers and students also did not understand Sam’s pickiness regarding recyclable paper. Understandably, it is confusing that post-it notes, paper plates, paper towels, torn up or wadded up paper, cardboard, etc. – even though these are biodegradable and recyclable materials – were not acceptable. Due to our limitations on time, space, manpower and equipment to deal these various items, we could not take them but teachers and kids loaded Sam up with all of it anyway, making quite a mess.

The collection of food waste worked out best. Prior to Sam, remote food waste collection averaged five pounds daily. Once Sam was deployed, efficiency increased so much that average volume doubled to ten pounds. While this doesn’t seem like much, it amounts to a whopping 1,800 pounds per school year. Snack waste is roughly 15% of total food waste generated daily at Lanikai.

Classroom compliance to daily clearing out of Sam was spotty at best, around 60%. Teachers forgot, assigned kids left early, etc. We will work on a better way to make this happen next year.

Sam reduces use of plastic trash liners 95%

A monumentally important benefit of Sort-It-Out Sam is the reduction of the 35-gallon trash can plastic liners that are routinely discarded and replaced daily. A Building alone generated 50 discarded plastic liners per week x 40 weeks = 2,000 liners each school year. Sam’s corn polymer biodegradable liner was replaced only once a month to equal only 100 liners used annually – a reduction of 95 percent!

Phase 2 ZERO WASTE • Composting Operations

Worm system expansion, hot composting & bokashi

Installation of the Mulberry Gang

Five Pipeline POD units were installed by the cafeteria around the mulberry tree after sheet mulching the area. After the winter break small colonies were introduced to the bins and gradually expanded. There were initial common start-up problems with Black Soldier Fly infestation.



The production of mulberries was dramatically improved due to increased fertility created by mulch, vemicast, and daily watering. The mulberries attracted Red-Rumped Bulbuls who feasted on the fruit. Although they pooped messily all over the bins, they also ate any female BSFs in the area and kept the larvae under control. Happily, natural bulbul predation resolved the BSF issue within a few months.

Worms at full capacity

By May, the Mulberry Gang worm colonies had reached their processing capacity of 100-125 pounds of prep waste (fruit, veggie, grains) per week. The original Pipeline colony, Big Blue, continued to break down 30-50 pounds per week. The Mulberry Gang will be harvested in June; Big Blue is due the first of August. We can anticipate over 400 pounds of finished, commercial-grade vermicast from this first cycle.

Hot composting for post-consumer waste

In the nick of time, our tree-trimmer friend George from H.T.M. Contracting showed up with a truckload of mulch so that our hot (a.k.a. thermal) composting operation could begin right on schedule. **Our first pile was started on February 27, 2015.** The capacity for storage in the stainless steel refrigerator in the caf made it possible for us to save and consolidate post-consumer lunch waste a over a few days. After trying various days and times, we settled on Wednesdays and Fridays after school for composting.



Color-coded static aerated piles work perfectly, look great

We hot compost using *static aerated piles* which require no turning. After setting down a foundation of branches for drainage and aeration, several inches of mulch is added alternated with a couple of inches of food waste in layers like a lasagna. Every few layers, handfuls of soil or finished compost is incorporated



as inoculate. Water is hosed on continually as the pile is built. The combination of mulch (the carbon component, “brown”) and food waste (the nitrogen component, “green”), in the presence of moisture and oxygen create an environment favorable to thermophilic, or heat-loving, bacteria that begin the breakdown process on the molecular level. The energy released from the breaking of molecular bonds is released as heat, measured with a special compost thermometer.



Within 48 hours, our piles reached 130-160 degrees and maintained those temperatures for at least several weeks. This is called the thermophilic or active phase. During this time, any pathogens, phytotoxins and weed seeds are killed off and the materials are softened similar to cooking in an oven. This method is perfectly safe for decomposing meat, dairy, and virtually everything else. Each pile was wrapped with burlap bags and weighted down with colorful painted bricks to color-code our mounds and add a pleasing look to the garden area.



Particularly rich compost is created in piles containing a minimum of 500 pounds of food waste. We weighed and logged this data on a white board outside the library each time we added food to each of our piles, built out over three months. On the last day of school – teachers’ day, June 5th – we reached the finish line, with a total of 2,552 pounds of food waste incorporated in five piles: Pink, Yellow, Turquoise, Purple, and Green.

Challenges to participation

Initially we thought the Zero Heroes would be assisting with both vermicomposting and hot composting, but it did not work out. The core issue is that feeding worms and building compost piles are not group activities. At most, two people can feed worms, and at most, three people can compost. The Mon/Fri 45-minute morning time slot for Zero Heroes was not sufficient time for a hot composting taking turns, and that strategy just encouraged goofing off and was abandoned after a couple of tries. With these limitations, hot composting – taking at least an 1-1/2 hour including preparation and clean-up – was scheduled instead for after school Wed/Fri and was accomplished by myself and Mr. Sawyer with some help from an occasional student. Kaimi was interested and helped several times (the others were not interested or had other afterschool activities) but once soccer season got under-



way, he bailed. We did get some nice media in the *MidWeek Voice* showing the Zero Heroes helping with the compost piles, but it was just for show. They all did get enough experience and knowledge to perform perfectly for the reporter, but this participation did not continue.

The third issue is quality control. No matter how much you harp at them, elementary kids – in my experience – are sloppy, distracted, and forgetful. Because hot

composting is a very exacting biological process, piles must be perfectly constructed every single time or you will encounter problems with anaerobic conditions, odor, flies, rats and other pests. This is the reason most people are turned off by composting! I'm sure Mr. Sawyer would concur that the hot compost operation requires skilled adult management.

Curing the compost takes six months

Over the summer, the piles will start to cool down to around 100° and enter the mesophilic or curing stage, which we count as six months from the last day food is added. The mesophilic organisms such as various fungi, earwigs, isopods, soil roaches, millipedes, beetles, mites, springtails, earthworms, etc., will shred, grind, chew, tear, spit, suck, and otherwise rip apart and poop out the softened material – you can't call it compost until it has been through the gut of critters. To keep this activity going, each pile will be “soaked and poked” – watered and perforated with a pitchfork – weekly. The piles will shrink to half their size. By mid-November, the transformation is complete and harvesting will begin.

Once we begin this process, harvesting will be an on-going activity. We'll also start new piles right away when school starts up again in July so there will be piles in every stage of decomposition and it will make much more sense to both kids and adults who just couldn't grasp what was going on. Composting is, after all, practically magic, and certainly unfamiliar science to most people. Next year hot composting will be far more meaningful and interesting.

Keep the compost on campus

Once fully built out to nine or ten continually active piles, the hot compost program will be extraordinarily productive and valuable. I propose sending samples to CTAHR and even possibly to the mainland for nutrient and biota analysis. We will measure the volume extracted from each pile so we have the exact data (I have been only eyeballing this until now), and Mr. Sawyer is planning science projects that will quantify our accomplishment. Lanikai School will likely use all of the compost on campus to the benefit of both current and future gardening projects. Early harvested material can be incorporated into beds for the January 2016 planting of garden beds, the rest will likely be stored for the next round of major soil amending in August of 2016.

HISTORY of our HOT COMPOST PILES



PINK



YELLOW



TURQUOISE



PURPLE



GREEN

START DATE: **2/27/15**

Date	Pounds	Food	Temp
2/27	145		80°
3/4	+90		
	235		148°
3/11	+23		
	258		152°
3/27	+20		
	278		120°
4/8	+42		
	320		120°
4/15	+38		
	358		140°
4/22	+40		
	398		142°
4/29	+15		
	413		144°
5/15	+87		
	500		130°

HARVEST DATE: **11/15/15**

START DATE: **3/6/15**

Date	Pounds	Food	Temp
3/6	146		76°
3/11	+78		
	224		148°
3/27	+28		
	252		142°
4/8	+39		
	291		120°
4/15	+44		
	335		136°
4/22	+42		
	377		140°
4/29	+15		
	392		140°
5/15	+57		
	449		126°
5/20	+53		
	502		144°

HARVEST DATE: **11/20/15**

START DATE: **3/13/15**

Date	Pounds	Food	Temp
3/13	119		76°
3/25	+132		
	251		134°
4/10	+35		
	286		142°
4/17	+69		
	355		144°
4/24	+61		
	416		150°
4/29	+35		
	451		140°
5/19	+53		
	504		134°

HARVEST DATE: **11/19/15**

START DATE: **4/2/15**

Date	Pounds	Food	Temp
4/2	119		80°
4/10	+79		
	198		146°
4/17	+79		
	277		160°
4/24	+73		
	350		164°
4/29	+38		
	388		146°
5/22	+126		
	514		140°

HARVEST DATE: **11/22/15**

START DATE: **5/4/15**

Date	Pounds	Food	Temp
5/4	107		76°
5/6	+80		
	187		132°
5/8	+84		
	271		144°
5/13	+92		
	363		148°
5/28	+137		
	500		154°
6/5	+32		
	532		158°

HARVEST DATE: **12/5/15**

TOTAL food waste processed in hot composting operation 2/27 thru 6/5/2015:

2,552 pounds

Bokashi fermentation – a third way to process food waste

Bokashi is an ancient Japanese method of processing food waste using a consortium of bacteria to anaerobically ferment organic matter so that it can be quickly assimilated into the soil by the soil biota. In other words, we pickle food waste in a sealed container, then bury it to break down in the dirt.

There are many advantages to this method: It is enclosed and compact, you can safely include all food waste including meat and dairy, and only minimal greenhouse gases are produced. It is much faster than either hot or worm composting, taking a few weeks instead of many months, and because no nutrients are lost to the ground or atmosphere, together with the huge load of beneficial microorganisms, bokashi makes a super duper rich organic soil amendment.

Another advantage – unlike campus-scale vermicomposting and hot composting – part of the bokashi making process is a group activity that a whole classroom of kids can enjoy. We did this twice with the Zero Heroes, and they really liked doing it. Educationally, bokashi breakdown is so different from the aerobic methods we are used to, it provides an interesting contrast. Decomposition takes many forms.

Making bokashi starter

To kick off bokashi composting, you need to make an inoculate called bokashi starter. It's impossible to find the ingredients in small quantities so typically we whip up 50 pounds at once. You take four pounds of mill run – the waste from milling flour – mix it with one quart of water, two tablespoons of molasses and two tablespoons of EM-1. (This is a commercially available mixture of lactic acid bacteria, purple non-sulfur bacteria (PNSB) and yeasts.) Long story short, these guys will ferment in an anaerobic environment anything that was once alive, breaking critical cell structure but not rotting it as is the case when oxygen is present.

Mix the liquid ingredients with the bran, smishing it with your fingers like you would if you were mixing cookie dough. Then tightly pack each pound in a quart container and seal the lid down tight. When you pack it, it will smell like

Christmas cookies. Give it two weeks to sit and ferment. When you unpack it, it will smell like beer. Use it right away or spread it out to dry and repack it for later use. We dried it out in K-Mart wading pools and repacked it.

Packing the Bokashi Blaster

We saved our bokashi composting to the last week of school to accommodate whatever food waste was left after we maxed out the hot compost piles at around 500 pounds each. I have four Bokashi Blasters with a capacity of around 150 pounds – we used two, packing a in total of 287 pounds of food waste



with 26 pounds of bokashi starter mixed throughout. Sited at the end of the compost area semi-circle, these were sealed and covered with silvery tarps – they look sharp and techie. There is no maintenance except to turn their spigots to drain every few days.

Bokashi pre-compost

At the point at which the organic material is fully fermented, it is called bokashi pre-compost. This takes a minimum of two weeks but can go longer – even as long as years. We will decant our pre-compost in four weeks, sometime in July.

Processing is easy and pleasant so far but at the point of decanting and burial bokashi definitely loses its charm. It looks like vomit – pretty yucky. Scoop it out, dig some deep trenches in the garden bed, mix it with the soil and bury under at least a few inches.

Let it sit at least two weeks before planting. The plan is to bury one Blaster's worth of bokashi in two of the current garden plots. Cover crops (green manure) will be planted in the other beds and the experiment will be to see which – bokashi or cover crop enhanced soil – will produce hardier plants with greater yields.

Guarantee the bokashi results will be spectacular.

Bokashi pre-compost can also be used successfully between existing plantings, so simply buried in a mulch pile to add to the biota of the mulch or more methodically composted the usual layered way.

Promoting bokashi

While the more visible and glamorous technologies of vermicomposting and hot composting are preferred choices for school campus food waste recovery, bokashi enjoys high popularity for residential use. It may be a perfect fit for Lanikai teachers, staff, and especially parents because you don't much space, equipment, tools, experience, consistent management or time. Later in this report, I propose bokashi as a 4th grade Zero Hero activity, and a bokashi workshop for interested parents, and a bokashi-related service the Garden Club can offer as a fundraiser.



Composting is King

Whatever other initiatives we implement at Lanikai to achieve our Zero Waste goals, none will be as important and as deeply rooted in core values as our composting operations – our unique on-site organics processing.

It can not be overstated how lucky we are to live in a climate that allows schoolyard composting during the entire school year. Participation in the full extraordinary cycle – from lunchtime food waste collection to using the compost, vermicompost, or bokashi you have helped made yourself to create a robust, productive food garden – is a privilege very few modern kids get to experience.

Composting teaches children more about how the earth works and deepens their understand about how people and their actions fit into this world better than any app ever devised.

It is unfortunate that Oahu’s current public policy does not value or encourage recycling and waste reduction practices prominent on the Mainland, Europe, Canada, Japan, Australia, and elsewhere. In the eyes of most of civilized society, our government-sanctioned lazy and ignorant “just trash it” mentality is baffling.

We seek to elevate Lanikai students to become young citizens of the world. When they embrace Zero Waste concepts and practices they align themselves with higher worldwide cultural standards. Any Hawaii kid who composts and understands why earns a seat at the table in any national or international forum.



The most unusual item found discarded was this frozen fish pulled from the rubbish can in the Teachers’ Lounge. It landed in the Turquoise compost pile. Our compost piles also contain a higher percentage of chocolate than most!



*This summer, compost piles are cooking down, worms are processing, bokashi is fermenting, and our garden plots are seeded with cover crops, all getting ready for the first planting in August. **This will be the first time 100% of Lanikai’s garden, lawn, and landscaping inputs will come from recycling our own valuable waste resources.***

FOOD WASTE RECOVERY LOG
3rd Trimester Weekly Summary • 14 weeks

<u>Week of</u>	<u>Vermicomposting</u>	<u>Hot Compost</u>	<u>Bokashi</u>	<u>Weekly Total</u>
2/23/2015	58 pounds	145 pounds	0	203 pounds
3/2/2015	75 pounds	236 pounds	0	311 pounds
3/9/2015	76 pounds	220 pounds	0	296 pounds
3/23/2015	95 pounds	182 pounds	0	277 pounds
3/30/2015	110 pounds	119 pounds	0	229 pounds
4/6/2015	112 pounds	195 pounds	0	307 pounds
4/13/2015	130 pounds	230 pounds	0	360 pounds
4/20/2015	145 pounds	218 pounds	0	363 pounds
4/27/2015	121 pounds	103 pounds	0	224 pounds
5/4/2015	146 pounds	271 pounds	18	435 pounds
5/11/2015	132 pounds	236 pounds	0	368 pounds
5/18/2015	123 pounds	232 pounds	0	355 pounds
5/26/2015	183 pounds	133 pounds	85	401 pounds
6/1/2015	155 pounds	32 pounds	184	371 pounds
3rd Trimester TOTAL	1,661 pounds	2,552 pounds	287 pounds	4,500 pounds

2014-2015 School Year Summary • 40 weeks

1st & 2nd Trimester TOTAL	1,421 pounds	0 pounds	0 pounds	1,421 pounds
2014-2015 School Year TOTAL	3,082 pounds	2,552 pounds	287 pounds	5,921 pounds

- Average pounds of food waste processed weekly at 100% diversion rate: 321.4 pounds.
- Average pounds of food waste generated daily: 68.2 pounds.
- Based on a school year of 180 days, approximately 12,272 pounds of food waste is generated annually at Lanikai – over 6 tons.
- Because the first two trimesters employed only limited vermicomposting, Lanikai School’s diversion rate was 51% this year.
Next year we can anticipate a diversion rate of 100%.

**TOTAL FOOD WASTE
processed at
Lanikai PCS during the
2014-2015 School Year**

**5,921 pounds
(2.96 tons)**

Phase 2 ZERO WASTE • Cellulose Recycling

Paper, cardboard, green waste & scrap wood

Worm systems absorb mountains of paper and cardboard

In addition to the food waste assimilated by large worm colonies, an extensive lateral-flow worm system the size of Lanikai's utilizes hundreds of pounds of soft cardboard and shredded paper for semi-annual bedding and weekly covering. During the first two trimesters, this material was donated by Pearl City High and Palolo Elementary. By late February, thanks to librarian Cynthia Fong who sourced a hard-to-find strip shredder from Cosco Online, Lanikai began producing its own worm bin bedding, shredded personally by Mrs. Fong. A second large shredder was purchased for back-up. Mr. Sawyer contributes additional material from his small classroom strip shredder.

Paper recycling is – unfortunately – strictly limited at this time

As with every recycling initiative, we are limited to what we can handle based on our available space, time, manpower, and equipment. We accepted for recycling only 8-1/2" x 11" sheets of notebook, office, or construction paper that could be stacked and fed easily through the shredder. Any torn bits, wadded-up homework, glossy or laminated paper, post-it notes, poster-board, paper bags, paper towels, newspaper, etc. – even though these items are indeed biodegradable and recyclable – were rejected. The biodegradable paper trays used at lunch were also delgated to the rubbish since they also take too much space, time, manpower, and equipment to process.



Soft cardboard recovered for worm bedding

Although only a portion of paper was recycled, every piece of light corrugated cardboard generated all year was diverted from the dumpster, cut up and hand shredded. This considerable collection was stored all over campus and elsewhere until a 6' x 12' storage shed was vacated in May and repurposed as the Resource Recovery Room. We have enough material for our own use as well as surplus to export to other schools. A five-pound bag of mixed worm bin bedding sells for \$5.

Heavy cardboard recovered for lawn restoration

Heavy cardboard or cardboard with glossy laminate was collected and used for sheet mulching. Early in the year we sheet-mulched under the worm bins to mitigate mud and weeds. At the end of the year, the big boxes from the new SmartTVs have inspired a much more ambitious sheet mulching project to restore the soil and eventually rehabilitate the lawn around the picnic table area. This project will get underway over the summer.

Keep valuable green resource on campus

DOE custodial procedure customarily requires green waste – grass, leaves, trimmings, etc. – to be disposed of in the dumpster. This is senseless, anachronistic, and totally out of alignment with basic environmental practices. To make matters worse, much of this material is packed in 35-gallon, nonbiodegradable, toxic plastic bags. Even the City recognizes that green waste should be recycled (composted) not buried in a landfill or burned in an incinerator. In addition, these bulky items quickly fill a dumpster that is costly to pick up and transport.



Discussions with custodial staff Mary and Jeff did alter this practice about 80% of the time, although substitute custodians never did comply – it could be that they were not informed of the new policy. (This can easily be corrected.)

Jeff dumped much of the grass, leaves, and sweep-ups on the mulch pile, as well as some of the palm fronds and other big trimmings, although it was misunderstood that these had to be placed in a separate pile, rather than dropped on top of the ground mulch. (This, too, can be easily corrected.)

The dumpster offers by far the highest degree of convenience, time- and location-wise. Both custodians understand why we need to recover the value of our green waste, but it will take time to break old established union-supported habits.

As incentive, it has been suggested that the school purchase a really cool nice new compact chipper/shredder on wheels with a trailer hitch so that our custodians can easily drive out to the mulch pile and shred the bigger green waste.



Tree trimmings recovered

H.T.M. tree trimmers were more than happy to leave us with 100% of the ground-up mulch from our own annual campus tree trimming, as well as from other jobs around the neighborhood. We will move around much of this mountain of mulch in our composting, soil restoration, and gardening projects this upcoming year. Whatever is not used will simply decompose to soil that is rich in nutrients, fungal, microbial, and invertebrate life which enhances moisture retention, sequesters carbon and increases ecosystem complexity.

Biochar – recycle waste wood, enrich soil

Creating biochar is an exciting way to recycle waste wood, the ultimate cellulose material. We had the opportunity to learn about pyrolytic decomposition – breakdown using high temperatures – from Mr. Chris Fiezter, one of the few practicing biochar makers on Oahu. Biochar is used by organic gardeners and farmers to help improve soil moisture retention and provide habitat for microbial life. Since we release a lot of carbon into the atmosphere with our hot composting process (that’s why the piles shrink), biochar gives us a way to counter this and become more carbon neutral. Biochar sequesters carbon in the soil for thousands of years. It has a fascinating history going back to the early agarian civilizations of South America.

Chris visited Lanikai twice with his equipment and knowledge to work us through the process. He was a terrific teacher and will be a wonderful resource person as we acquire our own equipment and build our experience and expertise.

Recycling shipping pallets

It’s not a waste issue at Lanikai School, but to thousands of businesses on Oahu where everything is imported and practically nothing is exported, wooden shipping pallets are a huge problem. Our friends at Hardware Hawaii were more than happy to give us as many as we would take. Mr. Sawyer picked up ten pallets.

We ordered some special tools from the mainland that allowed us to easily rip them apart, then parent Scott Gaylord cut them into 6” pieces. Then we stuffed them in a 20-quart cooker and lit it up. The firing took one hour and 15 minutes. The fire was smothered and the charcoal was left to cool.



On our next session we ground the pieces with a heavy tool called a tamper and used a magnet-on-a-stick tool from Home Depot to sort out the nails. For a nice appearance, we then screened the charcoal through a 1/4 inch screen to yield two gallons of finished, ground charcoal. When it is intended to be buried in soil or organic material is added, it is called **biochar**. We decided we would infuse our biochar with our own vermicast tea.



Biochar production viable, fun, educational.

The ripping, burning, smashing charcoal-making process was of great interest to all the boys, especially Mr. Sawyer, who acquired his own DIY unit to test out this summer. We submitted a national Organic Farming grant for \$1,000 (to be awarded this August) to request funds for additional equipment and tools.



Mr. Sawyer is interested in setting up trial plots to test our biochar's efficacy as part of the project-based learning format he will be exploring at a mainland conference this summer. Most of the use of biochar on Oahu is anecdotal – we will be collecting original data and source material for Science Fair projects.

Because biochar is not available except shipped from the mainland, production could lead to sales opportunity for Lanikai. It is used extensively by Oahu's large Master Gardener community, several members with whom I spoke said they would prefer to buy it locally.

Phase 3 ZERO WASTE • School Year 2015-2016

Integrating waste-based curriculum

There are two key components that frame the journey to Zero Waste: the first is technological, the second is social. In the first year, we set up the technology, the systems. We found a good place to start in Phase 1, then in Phase 2 came up with the equipment, tools, procedures and protocols to power our operation. Separation stations, Sort-It-Out Sams, worm bins, compost piles, bokashi blasters, biochar cookers – all this was relatively easy.

In the upcoming year Phase 3 kicks in, the social piece, the cultural component. In this phase we focus on integrating knowledge, understanding, cooperation, and behavioral adjustments that will involve all teachers, staff, students and families. Phase 3 is all about humans and communication, so of course it is much more of a challenge!

Below are some ideas – subject to much discussion and change – that I see as a blueprint on how to proceed.

Restructure Zero Heroes

The original Zero Heroes idea with six 5th graders was too limited and didn't work very well as a stand-alone Lei Kukui program. The Zero Hero concept should evolve to be fully inclusive and integrated into every school day. Essentially, every Lanikai student is a Zero Hero when they mindfully separate their lunch trays and use Sort-It-Out Sam correctly. Let's take that another step further by structuring Zero Hero Service activities as well as developing academic units designed to increase understanding of the Resource Recovery practices at Lanikai.

Zero Hero Service & Waste-Based Learning

A school Resource Recovery operation requires a substantial investment of time and energy, creating meaningful opportunities for student involvement. Specific Zero Hero Service activities are age-appropriate and can be assigned by grade level and scheduled to fit with other class projects or related units. Each activity requires mastering procedures and protocols as well as absorbing academic content.

Kindergarten

Service: Make worm bin bedding

Learning: An introduction to composting worms

All of the soft cardboard on campus is collected to make worm bin bedding to re-bed Big Blue and the Mulberry Gang twice a year at harvest time – we also sell prepared bedding to other schools. Little kids are developing fine motor skills so this is a perfect activity for them as well as a substantial contribution to our vermicomposting operation.

I conduct a scheduled session about creating an appropriate habitat, or home, for our special worms, showing them how we rip up cardboard and how they can create a big batch in their classroom. Then we take a field trip to Big Blue, introduce the worms and provide some explanation for separating food waste – to feed our worms. When we re-bed, the kindergartners are invited to help by adding the bedding they made into the bin.

Ist Grade

Service: Make worm bin bedding, advanced

Learning: An introduction to garden worms

First graders can continue the worm bin bedding production, although they can add to ripping-up participation by learning to soak, drain, and dry the cardboard themselves.

Mr. Sawyer is planning to start up the LC gardens, so this would be a good time for a scheduled lesson on garden worms, who have a completely different habitat and function than the composting variety. Kids would get hands-on time with the worms and learn general anatomy, vocabulary and other facts before they release the worms into their garden plots.

2nd Grade

Service: Water Big Blue daily, assist with worm bin harvests

Learning: An introduction to invertebrates

Because of their proximity to Big Blue, A-1 and A-2 can take over the watering duties currently provided by Mr. Rocky. Two kids at a time can water daily. They will learn and practice hose handling skills, follow instructions as the bin goes through its harvest cycle and use judgement – how much watering is just right.

Big Blue harvesting will take place in August and February. This is a fun group activity that 2nd graders traditionally enjoy.

Picking through the vermicast at harvesting provides an excellent opportunity to learn and identify the vast community of decomposer invertebrates, including not only the worms, but millipedes, isopods, blatterians, earwigs, mites, beetles, etc. We'll make flashcards and learn the FBI song.

3rd Grade

Service: Harvesting hot compost piles

Learning: Classroom worm bin with AINA

Since both hot composting and vermicomposting is the subject of AINA 3rd grade curriculum, we can dovetail with them, adding a bit more depth to their current lessons.

We will begin to harvest our hot compost piles in November. Four 3rd grade students at a time can do this with supervision – two to shovel, two to screen. The process will be on-going. They will once again encounter the community of invertebrates, reinforcing and adding to their prior expertise.

AINA establishes a classroom worm bin with each class to include set-up, care and feeding, and hand-harvesting. While they will have been included in some aspects of the school's major worm systems, this will allow them participate in the full experience close hand. By the end of 3rd grade, students should be fully familiar with all the worm information on the facing page.

4th Grade

Service: Making bokashi starter, eco-sales enterprises

Learning: Bokashi composting

We anticipate that bokashi fermentation will become the composting method of choice for Lanikai parents. We will also do some bokashi on campus from time to time, since it provides a much quicker turnaround time for nutrient breakdown in soil compared to hot composting or vermicomposting.

Bokashi starter is made up in 50-pound batches, so it is an excellent group activity for 4th graders that involves several exacting steps. Most home users use an average of a pound a month and purchase it as needed from Whole Foods or online. Lanikai students can periodically produce, package, and label it for sale to families or other community members.

Fourth grade might also take on the responsibility of packaging and selling our other eco-products such as worm bin bedding, vermicast and biochar. They will need a scale and appropriate packaging materials. Ms. Kristi has agreed to design our exclusive label. Our first order in August of 200 pounds of vermicast to AINA – already confirmed – will net \$600. It is anticipated that funds raised by sales of our recovered projects will easily cover costs of equipment, supplies and materials.

The academic topic will be bokashi fermentation and the role of bacteria in this and other composting technologies. Fourth graders will test out bokashi decomposition as a science project.

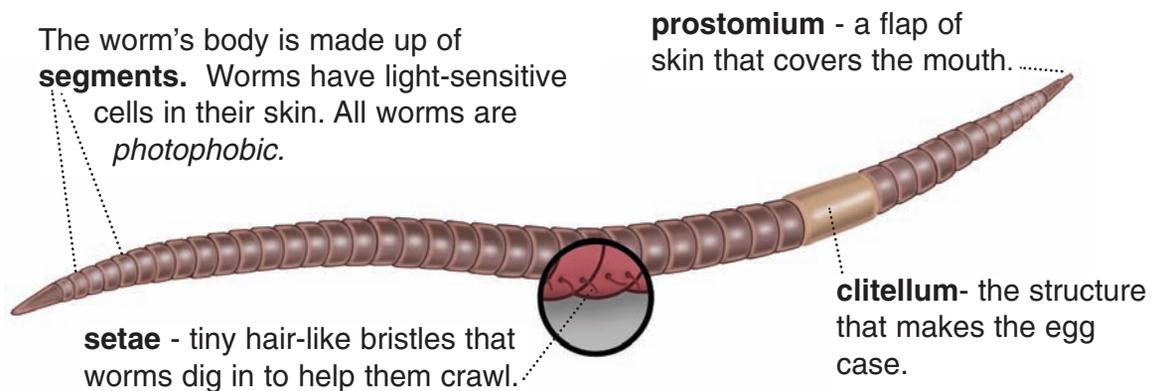
5th & 6th Grade

Service: Cafeteria Separation Station

Learning: Biochar, various field trials, science projects

After tweaking and experimentation this past year, we settled on assigning two 6th grade students daily to set up and run the daily Separation Stations at lunchtime. For 2015-2016, we would like to try assigning two kids from 5th and 6th grade classes for this important community service, which they would perform for an entire week. There are 40 weeks, so, presuming some absenteeism and substitutions, 80-100 students would serve.

WORM ANATOMY



TYPES of WORMS at LANIKAI SCHOOL



GARDEN (or topsoil) WORMS

Endogeic worms make tunnels as they move through the earth in search of decaying organic matter to eat; they loosen and *aerate* the soil. They are big and muscular and have a tough skin. The worms in our gardens are named *Amyntas gracilis*.

Eisenia has a stout body build and laid back manner. Its clitellum is located low on its body and puffs out.



Perionyx is long, thin and active with a clitellum located near its head like a collar.

COMPOSTING WORMS

Epigeic worms are small, delicate worms that are housed in large worm bins at our school. They live in soft bedding made of recycled shredded paper and cardboard. We feed them fruit, veggie, and grain waste which they process into a rich fertilizer called *vermicast*.

The two species of epigeic worms in our vermicomposting system are named *Eisenia fetida* and *Perionyx excavatus*.

For the academic component, Mr. Sawyer will design and implement project-based learning focusing on biochar production and application, field trials testing different soil amendments, and other science related to our Resource Recovery operation.

In addition, **FIRST® LEGO® League** is promoting the 2015/2016 Trash Trek Challenge – Finding Better Ways to Manage Our Trash – inviting 290,000 students from 80 countries to choose and solve a real-world trash problem that includes collection, sorting, smart production and reuse. Lanikai School has been active participants in Lego League for many years, but the timing couldn't be better on this one! We already have a head start thinking about waste, a clear vision, and some practice under our belts. Mr. Sawyer will register our team – the competition begins in August. The competition emphasizes science, technology, engineering and math skills. This opportunity imparts solid structure and credibility to what we are working to achieve.

Afterschool, Green Team, Garden Club participation

By necessity, most hot composting will take place after school hours and students of every grade level are welcome to transport mulch, assist to build compost piles, log data or help in any way they wish. Any media projects that describe our activities and transmit our ideas to the community will be encouraged.

Our goal is to give each student a piece of the overall operation to perform at every grade level during their Lanikai career. By also presenting related academic information incrementally over time they will not only participate but come to fully understand the processes and the science involved.



Phase 3 ZERO WASTE • School Year 2015-2016

Family participation, looking beyond next year...

No, you cannot dump your garbage here

Both school staff and parents have slipped their home slops into our operation – at times up to 50 pounds/week – which validates our stunning success in raising awareness of food waste recycling! While it doesn't seem fair that we take on the responsibility (time, labor, etc.) of being the LSO recycling center, we can certainly take advantage of this awareness to expand our project further into the larger community. Composting at home is fun and educational and will reinforce the values the kids are practicing at school.

Compost College

I propose a FREE Compost College course – that could be offered afterschool or on a weekend day – for parents and interested staff members that would introduce them to the art and science of composting, show how these technologies can be modified for home use, and set them up to get started.

The course would include a tour of our campus vermicomposting, hot composting, and bokashi operations. We can take a look at popular home tumblers, residential worm bin options, and commercially available bokashi buckets. These can be on hand and be for sale, so they can make a choice and start ASAP.

Bokashi will be #1

My guess is that most families/teachers will opt for bokashi buckets. These take up the least amount of space and take the least amount of time, energy, and care. Bokashi buckets cost \$80 and include a pound of bokashi starter that will need to be replaced monthly. Fill the bucket with food waste mixed with the starter, then bury the fermented material in the garden, raised bed, or pot, where it breaks down and is absorbed into the soil. A fresh pound of starter is available from the 4th graders for \$5.

Since burying bokashi is the part that no one likes – unless they are avid gardeners – I propose that Lanikai Green Team or Garden Club offers a paid service to families who return their filled bokashi buckets on a designated day, say Wednesdays. (It will take the average family 3-4 weeks to fill a bucket.)

We have endless gardens, landscaping, and mulch piles in which to bury bokashi, all to our benefit. Wash out the bucket, include a fresh container of starter, and have it ready for pick-up on Thursday, all for a \$10 fee. For convenience, participating parents could pre-purchase a \$125 subscription – unlimited drop-offs – for the year.

Teacher/parent co-op compost pile

Should teachers/parents not want to make the investment in the bokashi bucket project, Mr. Sawyer and I would be very willing to train and monitor a parent/teacher co-op hot compost pile on the school campus. Participants could save up their food waste at home, bring it on a designated day after school to layer into the pile.

All kinds of parental help welcome

Whether parents chose to compost or not, parental participation in our Zero Waste initiatives would be most welcome. There are many families who have lived on the mainland and elsewhere in the world where Zero Waste is the norm, who may have great ideas to share and time to volunteer. Those parents who are great committee organizers or have experience in grant writing or researching sources of funding could take us far.

Schoolyard restoration

This summer we plan to initiate a sheet mulching project to bring back to robust health the lawn (now just dirt, pictured here) to the picnic area outside the cafeteria. A thick layer of rich soil can be created using waste cardboard, mulch, biochar, and compost tea. Within a year, this area can be re-seeded and fully restored. (See attached article about Harvard's lawn). We believe this is a far better – and less expensive – resolution than pouring concrete or installing artificial turf as has been suggested. Hopefully, the entire property can be treated over the next few years.



Making a movie

On May 22, 2015, we were visited by Josh Stanbro, Environment and Sustainability Program Director of the Hawaii Community Foundation and several of his guests. Josh has been following (and occasionally funding) Waikiki Worm Co. projects for the last ten years, but never actually saw any of this stuff in person – he just got to read these long, boring reports! The group enjoyed a terrific One Love Cafe lunch and a tour of our operations and were very impressed. I had requested funding for making a video of Lanikai’s Zero Waste project and Josh verbally approved the money pending confirmed continuation of our program. The details for this media project will be worked out once the school year starts.

Josh also suggested that we submit an entry for a \$4,000 prize from the Cooke Foundation for environmental projects and apply to other national and international competitions.

We can get even better – wish list for future projects, improvements

- Wheels for all the Sort-It-Out Sams
- Compost tea brewer
- Chipper/shredder for campus green waste
- Re-useable, washable food service trays and utensils for cafeteria
- Re-usable, washable party sets for classroom use
- High tech solar powered dishwasher/sterilizer with gray water irrigation capacity
- Hand dryers in the restrooms to eliminate paper towels
- Establishment of Juice/Snack Bar at recess to eliminate packaging and optimize portions

YOU WILL NEVER SEE THIS AGAIN!!!

Before we started the Lanikai Zero Waste Revolution, this stinking, oozing, overflowing RollOffs dumpster was a common sight. By eliminating the disposal of food and milk waste, much of the paper, and all of the bulky cardboard and green waste this year, we decreased dumpster volume from a full load daily to a full load weekly. As we move forward on creatively reducing, re-using, and recycling even more of our school rubbish, we plan to call RollOffs and cancel – our biweekly waste will fit in a City gray bin.

This is not an academic exercise or passing fad. Lanikai School’s Zero Waste commitment is to develop and establish permanent and progressive changes that will benefit students, school, and community.



Mahalo to Lanikai's Zero Waste pioneers!



The six original **Zero Heroes** fearlessly tried and tested all our ideas so that we could introduce recycling projects and practices throughout Lanikai School and make everyone a Zero Hero! These intrepid trailblazers are, from left to right: **Judah Walker, Henry Cullison, Anela Kerber, JoLee Hopkins, Kaimi Victor, and Carissa Glenn.**

This picture appeared in a feature spread in the *MidWeek Windward Voice*. Mahalo to reporter **Nicole Kato** for the excellent article and for permission to use her photo.