

Plastic Pollution in the River Thames



RESULTS FROM CITIZEN SCIENCE SURVEYS:
JANUARY 2015 TO DECEMBER 2019

A.J McConville, Alice Hall, Emma Harrington, Kirsten Downer





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Our rivers, oceans and wildlife are being overwhelmed by plastic waste, and microplastic is entering our food and water. Up to 12.7 million tonnes of plastic enter our oceans every year, and it's estimated that 80% comes from land, likely from rivers¹.

Here in London, Thames21 and the Port of London Authority (PLA) remove at least 200 tonnes of waste from the Thames each year, much of it plastic. A recent survey found large amounts of microplastic in the Thames². Yet there is no statutory monitoring of the impact plastic is having on UK rivers.

Thames21 launched the Thames River Watch citizen science programme in 2014 to help close this gap. The programme trains Londoners to monitor plastic pollution and identify the most common plastic items, to help understand pollution sources and identify solutions. This report reviews that people-powered data, as well as rapid appraisal data and bathymetric foreshore surveys of the riverbed.



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KEY FINDINGS AND RECOMMENDATIONS

KEY FINDINGS

1. **Over the past 20 years, the PLA and Thames21 annual 'rapid appraisal' boat surveys³ reveal a significant decrease in large immobile waste items** (such as tyres, metal, bicycles) due to the huge Thames21 volunteer effort to clean up the river. These items return at a slow rate and are hence within the capacity of volunteer clean-up efforts.
2. **Over the same period, there has been a discernible increase in plastic consumer items and packaging in the river.** Volunteer effort alone cannot address the problem. The flow dynamics of the river mean that these items are deposited in particular areas of foreshore with two main types noticed: sites that collect lightweight items which float on the surface of the water (such as food wrappers and drink bottles) and those that collect sinking items (such as wet wipe products and bags filled with sediment).

1 Ocean Conservancy (2015) Land-based strategies for a plastic-free ocean. [Online]. [Accessed December 2019]. Available at: <https://oceanconservancy.org/wp-content/uploads/2017/04/full-report-stemming-the.pdf>

2 Bangor University and Friends of the Earth. 2019. Microplastic pollution widespread in British lakes and rivers - new study. [Press release]. [Accessed March 2019]. Available from: www.bangor.ac.uk/news/latest/microplastic-pollution-widespread-in-british-lakes-and-rivers-new-study-40043

3. Thames21 and PLA (unpublished data). Results of Rapid Appraisal Boat surveys



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3. **Wet wipe products, most of which contain plastic, are by far the most common item recorded on the tidal Thames foreshore in London. These products are physically changing the shape and sediment type of the foreshore.** This phenomenon is found on at least six sites inside river bends in west London and has only been observed in the past six years. Wet wipe products occur in very large densities at these sites – typically between 50 and 200/m² on the surface of the mounds. In Barnes, one mound has grown in height by 1.4m between September 2014 and May 2019 and covers approximately 1,000m² (equivalent to four tennis courts).
4. **Single-use plastic items make up 83% of all counted items on the foreshore** (excluding glass fragments)
5. **Just five items represent nearly two-thirds of all lightweight identifiable plastic found, more than 64% of the total.** In order of abundance, these are: food wrappers, cotton bud sticks, drink bottles and their lids, cups and takeaway containers. Preventing these items and wet wipe products from entering the river would significantly reduce river pollution.
6. **A total of 97,019 drink bottles were recorded and removed between April 2016 and December 2019.** These counts do not include bottles from the large Kent saltmarsh sites which also accumulate large numbers of bottles. Many more are removed by Southend Council, which further masks their true plastic burden on the river.
7. **Water bottles represent almost half of all the drink bottles found in the Thames,** making it the single most common type of drink bottle. More people choosing tap water over bottled water would significantly reduce the plastic burden in the river.
8. **Precious intertidal habitats to the east of London bear the brunt of lightweight plastic such as bottles and polystyrene.** Of the total bottles recovered, 65% were found on saltmarsh and reedbed habitats outside the city, compared to 33% from slipways and beaches in London (see Figure 1). These reedbed habitats are key nursery grounds for fish and already suffer from other pressures.
9. **Micro (< 0.5cm) and meso-plastics (<2.5cm) are widespread and common on the Thames.** Of 21 sites surveyed, 20 reported the presence of microplastics at least once. This hidden plastic is difficult to remove via river clean-ups and is likely to persist in the tidal Thames. Some of these items are as manufactured, such as pre-production pellets (known as nurdles or nibs). Others originate from the breakdown of larger items: food wrappers, caps from drink bottles, plastic cups and polystyrene takeaway containers which are particularly prone to breaking up.
10. **Storms – characterised by low pressure, high tides and heavy rainfall – are likely depositing greater quantities of lightweight items on the saltmarsh and reedbed habitats on the Thames.** More data are needed to definitively prove this.

Figure 1. The main distribution of two important plastic items across the estuary
(April 2016 to December 2019)

Wet wipes and lightweight plastic characterise two key areas of the river



RECOMMENDATIONS

Much of the conversation around reducing plastic pollution has focused on how members of the public should change what they buy or better dispose of waste products. But the overarching regulatory framework has the biggest impact on reducing the scale of the plastic problem, from setting manufacturing parameters to establishing a coherent waste management strategy.

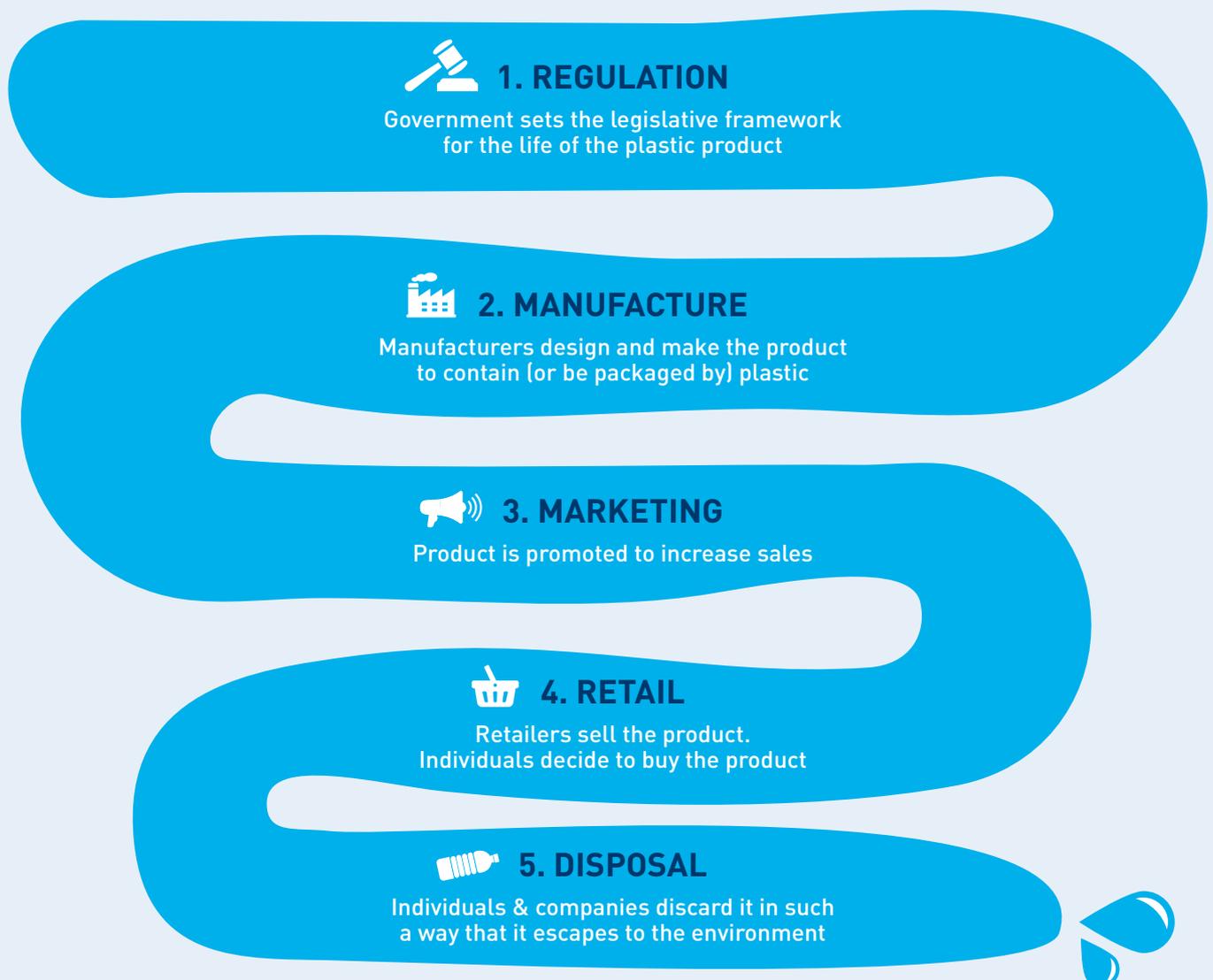
Efforts to reduce plastic pollution should not detract from the need to first prevent waste generation, as dictated by the waste hierarchy.⁴ All materials have environmental consequences and it's vital that in our efforts to tackle the plastic

issue we don't create new problems by simply substituting one damaging material for another.

We need to revolutionise the packaging system as a whole, eliminate non-essential single-use packaging and transition to a circular economy. Demand-management measures should be part of the overall solution.

Thames21 has adopted a framework in order to understand and communicate the process whereby items collect in the river and to establish where interventions are most effective (see Figure 2). In general, the higher up this chain an intervention takes place, the more effective it will be.

**Figure 2. The plastic waste pathway to the river:
Early intervention has most impact**



⁴ Prevention, Re-use, Recycle, Other recovery, Disposal: see European Union (2010) Being Wise with Waste: the EU's approach to waste management. [Online]. [Accessed March 2020]. <https://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf>



With these principles in mind, we propose the following recommendations for key stakeholders:

The UK Government should:

- **Establish standardised protocols for data collection from litter picking events** on coasts, estuaries and rivers to provide reliable statistics on trends over time, focusing on the quantity, composition and source of litter items. This can build on work that is already underway by the Rivers Trust, the Port of London Authority and Thames21 to standardise data collection
- **Introduce statutory monitoring of rivers and coasts** to establish the success rate of measures to reduce plastic pollution
- **Set legally binding waste reduction targets** to phase out non-essential waste items
- **Give councils sufficient funding** to collect street refuse and enforce existing laws
- **Introduce strict standards on labelling** to require all single-use wet wipe products containing plastic to indicate this clearly on the packaging; and to ensure that a 'flushable' label cannot be applied to wet wipe products that contain plastic or persistent chemicals
- **Introduce an 'all-in' Deposit Return Scheme for bottles and cans** paid for by manufacturers
- **Eliminate polystyrene packaging** by moving to recyclable plastic supported by a comprehensive recycling system.

Manufacturers should:

- **Improve labelling** voluntarily on wet wipe and sanitary products to highlight that it is damaging to flush them

- **Innovate to reduce food wrapper packaging**, which is particularly prone to breaking into microplastic, and make more of it recyclable.

Retailers (including bars/pubs) should:

- **No longer sell wet wipe products and instead stock reusables**, following the lead of companies including Holland & Barrett and Selfridges
- **Switch away from single-use plastic cups to reusable ones** following the example of Putney Business Improvement District
- **Join the #OneLess campaign** to help London become single-use plastic water bottle free.

NGOs and agencies should develop campaigns to:

- **Better communicate the link between street litter, drains and our rivers** to tackle the lack of awareness amongst the public about the link between drains and local rivers
- **Drive consumer behaviour towards waste reduction, recycling and sustainable alternatives.**

Individuals can help by:

- **Not flushing any products down the toilet, even if the label claims it to be flushable:** abide by the 3Ps (flush only pee, paper, poo)
- **Downloading the Refill app** to find their nearest refill point rather than buying water in single use plastic bottles
- **Carrying cigarette butt pouches** to carry butts until they can be disposed of properly
- **Joining their local campaign groups**, such as Thames21's River Action Groups⁵
- **Joining Thames21's Thames River Watch** to help monitor plastic and learn how to lobby for change.⁶

⁵ <https://www.thames21.org.uk/thames21-river-action-group/>

⁶ <https://www.thames21.org.uk/thames-river-watch/>



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BACKGROUND

Over the past six decades, since the tidal Thames was declared “biologically dead” in 1957 by the Natural History Museum, the river has undergone extraordinary change, recovering from that low point to having 125 species of fish recorded in its waters.⁷ Once the Tideway Tunnel is operational and intercepting the majority of London’s sewage overflows, river water quality should improve. But public perceptions of the river are poorly informed, and many Londoners are unaware of the biodiversity recovery underway. Meanwhile new threats have emerged which are poorly understood, particularly that of plastic pollution.

The Thames River Watch programme is funded by Tideway, the company constructing the Thames Tideway Tunnel and has been recognised by the Lord Mayor’s Dragon Awards and the Evening Standard’s Business Awards for its support of local volunteers to tackle these issues.

WASTE ITEMS IN THE TIDAL THAMES

Since historic times, the tidal Thames has been used by Londoners to dispose of waste. But to this day whilst it is illegal to dump litter, there is no statutory authority with responsibility for removing waste items from the river or other water bodies throughout London. In 1994, the Port of London Authority (PLA), Thames Water, the City of London Corporation, the Environment Agency and Keep Britain Tidy came together to tackle the tidal Thames waste issue by supporting Londoners to take part in clean-ups. This partnership developed into Thames21, which became an independent charity in 2004.

In the early days, volunteers focused on removing the most obvious waste items, mainly large immobile objects (such as tyres, shopping trolleys, metal work, large shipping ropes, motorbikes etc). Since the early 2000s, the PLA and Thames21 have carried out annual ‘rapid appraisal’ boat surveys to document the occurrence of these items which, along with photographic evidence, reveal a significant decrease in immobile waste items, due to the huge concerted volunteer effort delivered year after year. These items return at a slow rate and now appear to be within the capacity of volunteer groups to remove them.

⁷ <https://www.pla.co.uk/Environment/Main-Biodiversity-Resources-in-the-Tidal-Thames-Species>

GROWTH IN SINGLE-USE PLASTIC PACKAGING WASTE

While many sections of foreshore are now free of waste thanks to Thames21 volunteer efforts over the past two decades, there are certain sites which have proven impossible to keep clean on a permanent basis by volunteer effort alone. The waste at these sites is overwhelmingly plastic, often single-use products or packaging. We refer to these sites as “waste hotspots” and have created a map of known hotspot sites (see Figure 6). There are two types of waste hotspots, which differ considerably from each other. These are:

- **Floating waste hotspots:** these are slipways, beaches or vegetated intertidal sites that collect lightweight (floating) waste (for example plastic bottles, food wrappers, polystyrene). A strandline is deposited by a receding high tide and composed of

both organic and plastic material (see Figure 3). The larger plastic items can be removed by volunteers during a clean-up, but the waste quickly returns with the next high tide. The strandline is laced with micro-plastics, frequently pieces of plastic broken down from larger original pieces, and is often impossible to remove via a clean-up.

- **Sinking waste hotspots:** these collect heavier mobile items (e.g. wet wipe products, plastic shopping bags filled with sediment) which come out of suspension where the water moves more slowly. On the tidal Thames this takes place inside river bends. From Vauxhall Bridge westwards, sinking waste hotspots mostly consist of wet wipe products and sanitary products (see Figure 4); east of Vauxhall Bridge, we mostly find submerged plastic bags, which fill up with mud and become embedded in the river bed (see Figure 5).

Figure 3. Floating waste hotspot at Queen Caroline Drawdock, Hammersmith

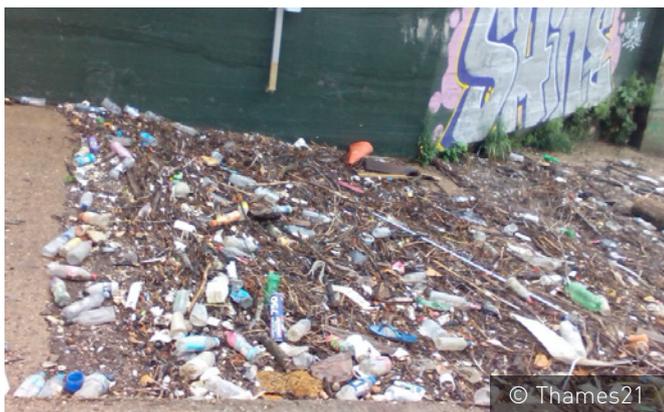


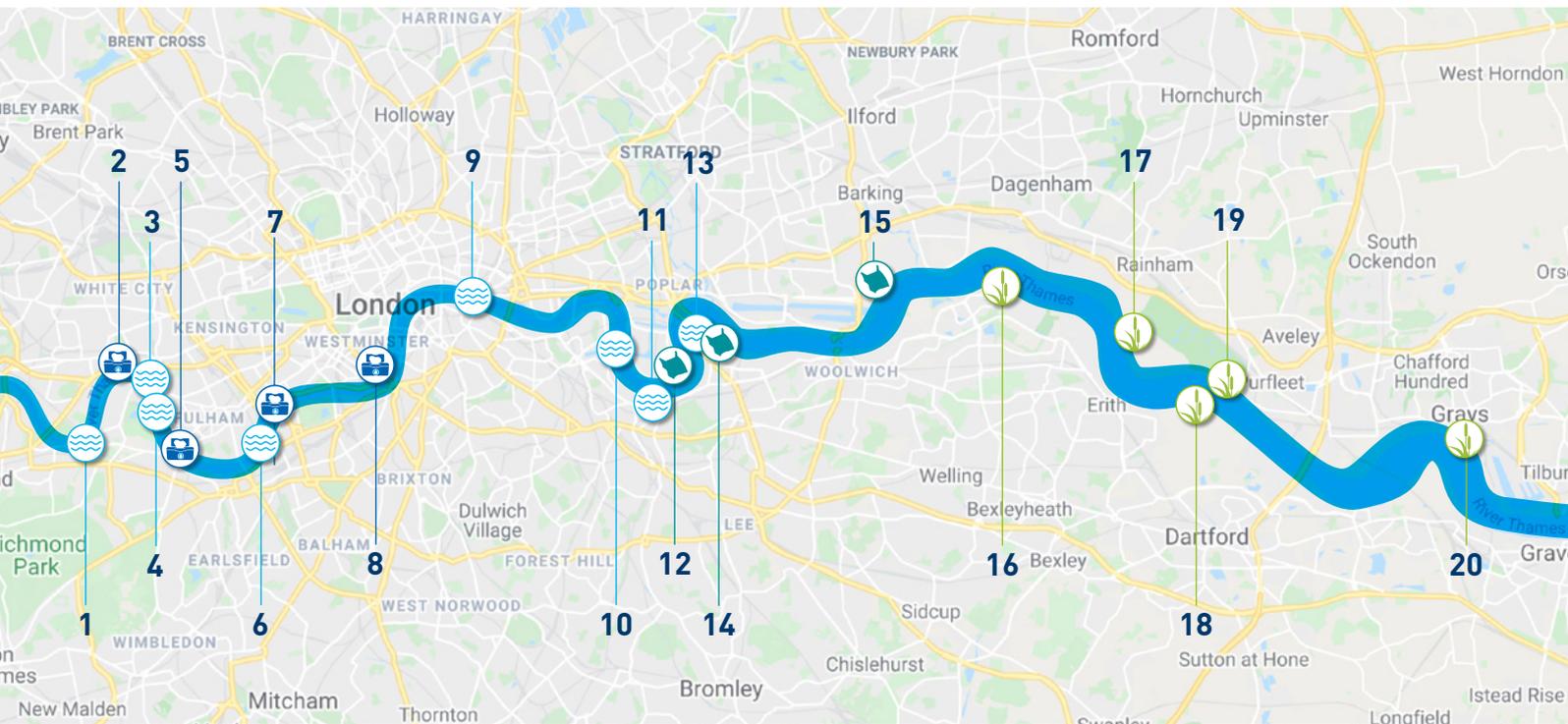
Figure 4. Sinking wet wipe hotspot in west London, by Hammersmith Bridge Southside



Figure 5. Sinking plastic bag hotspot in east London, Newcastle Drawdock, Isle of Dogs



Figure 6. Some of the key plastic hotspots on the tidal Thames



- 1. Small Profits
- 2. Hammersmith Bridge Southside
- 3. Queen Caroline Drawdock
- 4. Crabtree Wharf
- 5. Fulham Football Club
- 6. Old Swan Wharf
- 7. Battersea Bridge
- 8. Vauxhall Bridge
- 9. Queenhithe
- 10. Millwall Drawdock

- 11. Cutty Sark
- 12. Newcastle Drawdock
- 13. Point Wharf
- 14. O2 Flats
- 15. Galleons Point
- 16. Thamesmead (Redbourne Drive)
- 17. Concrete Barges
- 18. Erith Marshes
- 19. Purfleet RSPB Rainham
- 20. Grays Beach

Key:

- Floating waste on slipways or beaches
- Floating waste on saltmarsh or reedbeds
- Wet wipe sinking site
- Plastic bag sinking site



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'I volunteer for Thames River Watch and Thames21 because I love the Thames and its tributaries. They are a small piece of nature surrounded by an urban environment and a lifeline for many creatures, from tiny riverflies to seabirds'
 Claire Cheeseright, Greenwich hub volunteer



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SURVEY METHODOLOGIES ADOPTED TO RECORD PLASTIC ITEMS

Data in this report comes from three main sources:

- **Transect plastic waste surveys**
- **Regular bottle counts**
- **Data from plastic clean-ups**

TRANSECT SURVEYS OF THE FORESHORE

In 2015, Thames River Watch developed a waste monitoring methodology to identify the most common waste items on the Thames. The classification of items was based on the system used by the Marine Conservation Society, which in turn is based on the system used by OSPAR.⁸

Thames River Watch surveys with transects to identify waste from the top of the shore to the river's edge (see Figure 7). The steps are as follows:

- A measuring tape is laid starting at the top of the shore running towards the river
- A 1m x 1m square quadrat is laid alongside the tape measure and volunteers identify, count and record all the waste that is found in each square

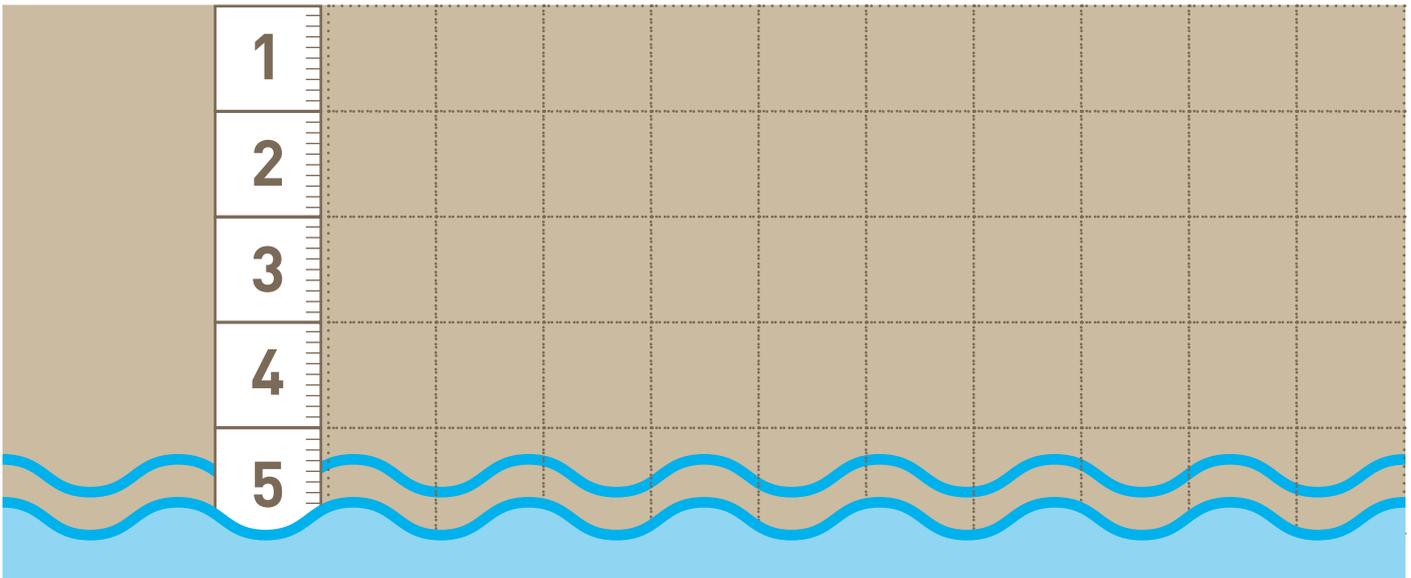
- Every piece of an identifiable object is counted as one of those items before being removed and disposed of
- Pieces of unidentifiable plastic < 2.5cm in size are excluded, as they are too numerous. An estimation of the numbers on a logarithmic scale is recorded (that is, in factors of 10; we chose the following categories 1-9, 10-99, 100-999 and greater than 1000).

Our surveys take place on the foreshore of the river (i.e. riverbed that is revealed when the tide recedes): excluded from our data is waste on the riverbed not revealed at low tide, waste suspended in the water column or on the surface floating direct out to sea without being deposited along the river. The transect survey data applies to London, where our citizen science effort has been, and not to the wider estuary in Essex or Kent. The surveys cover a small amount of area in detail and are well suited to plastic waste hotspot sites where the majority of waste is to be found. However some transect surveys were carried out on non-hotspot sites; these are identified as 'general foreshore' surveys.

⁸ OSPAR is the mechanism by which 15 Governments & the EU cooperate to protect the marine environment of the North-East Atlantic.

Figure 7. Our waste monitoring transect

Volunteers lay a measuring tape from the sea wall at the top of the foreshore down towards the river, then count all items found in each 1m² using a square frame.



Thames River Watch data are gathered by volunteers who are trained in our monitoring methodologies or directly supervised by Thames21 staff. Two separate teams of volunteers have been established at Hammersmith and Greenwich respectively, and surveys are carried out once a month. Opportunistic surveys have also been carried out at other sites and the data from these sites is included in the results described below.

The survey has worked well to help us determine the key waste items in the river. This has provided us with a clear prioritisation list to tackle plastics entering the Thames.

Given that all identifiable items are counted, the time taken to complete a single quadrat can be high: some quadrats could take a group of 4 citizen scientists up to 40 minutes to complete. This limits the number of quadrats that can be surveyed between tides. With the intention to move towards detecting trends, as of January 2019, we started to focus only on ten key plastic waste items, enabling us to cover much greater areas in our surveys and providing the most useful data for identifying plastic waste solutions (see Box 1).

In addition to our regular monitoring we also carry out repeat surveying through our Big Count initiative. This event occurs twice a year, engaging a large number of people from the general public in a specific task that does not require prior training. This enables us to collect much more data than we would be otherwise

Box 1. Key items now being surveyed

- Drink bottles
- Drink bottle tops
- Single-use plastic cups
- Straws
- Cotton bud sticks
- Takeaway containers (polystyrene)
- Takeaway containers (plastic)
- Cable ties
- Tile spacer crosses (from construction sites)
- Cigarette butts
- Wet wipe products (surveyed differently as it is a type of sinking waste, see below)

able to do with our regular monitoring. In spring 2017 we started our Big Wet Wipe Count which focuses on just one site in Barnes by Hammersmith Bridge, where a huge amount of wet wipe products accumulate. During this event we used our linear transect method to record the quantity of wet wipes-based products on the foreshore. The Count is limited to those wipes found within 4cm of the surface and removed by using a standardised hoof pick to scrape the surface.

In 2019, we adapted the Big Wet Wipe Count method to work on a grid rather than a transect system to allow us to focus on the mounds where the wet wipe products accumulate with a view to tracking their change in size as well as the density of wet wipe products over time.

Through the transect waste surveys, Thames River Watch citizen scientists monitored 1,805m² of Thames foreshore between 2015 and December 2018, with an additional 717m² surveyed between January and December 2019 using the new ten key waste items list. These sites are all within Greater London.

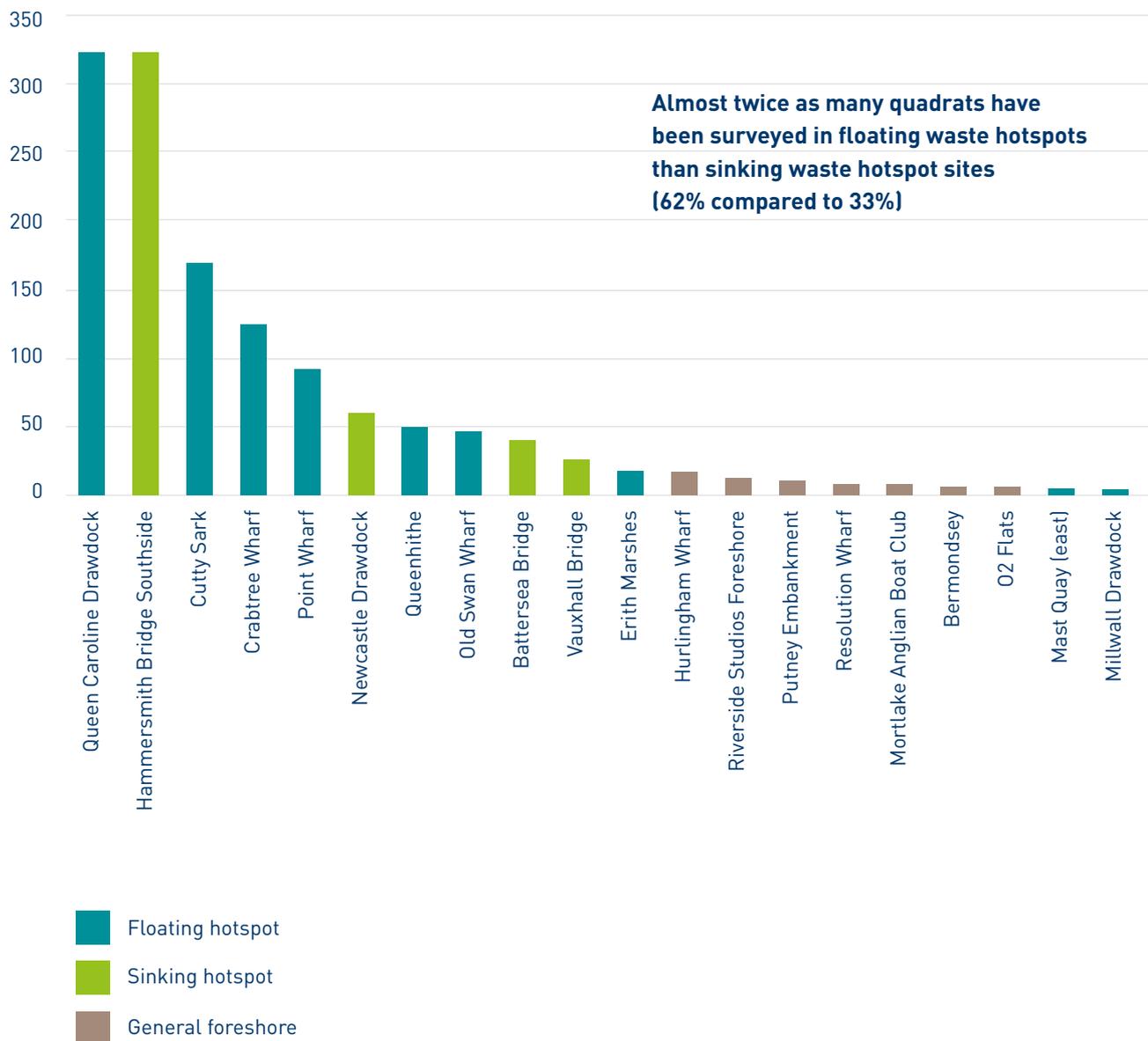
In total, floating waste sites represent around 62% of all quadrats surveyed, with sinking waste sites representing 33% and general foreshores (i.e. not known to be waste hotspots) representing 5% (see Figure 8).

Sinking sites are not as easily surveyed as the waste mostly accumulates at the bottom of the foreshore and is only accessible at low tides, thus restricting the opportunities for surveys. Most of the sinking site data comes from Hammersmith Bridge Southside during

the annual 'Big Count' events. As this event invites the general public to take part, more data can be gathered from the survey over a short period of time. Floating waste sites, on the other hand, can be accessed an hour either side of high tide and therefore surveys occur more frequently. These are mostly carried out by trained citizen scientists in groups independently of Thames21 staff.

'Floating waste' and 'sinking waste' sites are very different in terms of the types of waste that they collect and the area that they cover, as discussed above. Therefore, it is necessary to analyse the two data sets separately to present an overall picture of the most common items on the foreshore. For the purposes of this report we analyse the data from the two site types separately.

Figure 8. Number of quadrats surveyed at different types of sites





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BOTTLE COUNTING AT KEY SITES

Since April 2016, Thames21 has partnered with the #OneLess campaign and Thames Estuary Partnership to count the total number of bottles collected at our clean-ups to better understand the scale of London’s plastic bottle problem. Since April 2018, bottle counts have been carried out on a fortnightly basis on a neap tide⁹ at five key floating plastic waste hotspot sites.¹⁰ These sites are Queen Caroline Drawdock, Crabtree Wharf, Old Swan Wharf, Queenhithe and Point Wharf.

During bottle count surveys, trained citizen scientists collect the single-use plastic bottles that have accumulated at a predefined area at sites on the Thames foreshore. The collected bottles are then sorted into four categories based on their bottle type and counted: bottles of still water, bottles of flavoured or fizzy drinks, milk bottles and unknown (for any bottles where it was not possible to determine type).

In addition to the regular bottle counts, in the autumn of 2016, Thames21 and #OneLess launched an annual ‘Big Bottle Count’ event. During this one-day mass bottle count event, surveys are carried out at multiple floating waste hotspot sites along the Thames. The purpose of this event is to further our understanding of the distribution of plastic bottles in the River Thames and to raise awareness of London’s single-use plastic bottle pollution problem, by encouraging volunteers across London to take part in this mass bottle count event.

RECORDS FROM WASTE CLEAN-UPS

Waste clean-ups are carried out by multiple organisations across the Thames estuary. Thames21, #OneLess, the North Thames Estuary Litter Picking Group and Thames21-supported River Action Groups (such as the Barnes and Putney Tidy Tow Path groups) collaborate to collate data on the quantities of waste and the number of bottles that are collected.



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⁹ A neap tide refers to a tide just after the first or third quarters of the moon when there is the least difference between low and high tides. This is normally when the most bottles and lightweight items are found on the foreshore.

¹⁰ #OneLess (2019) The River Thames: Plastic bottle pollution. [Online]. [Accessed December 2019]. Available from: https://www.onelessbottle.org/wp-content/uploads/sites/14/2019/06/ZSL00085_OneLess_MonitoringReport_FINAL.pdf



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WHAT WE FOUND

WET WIPE PRODUCTS ARE THE MOST COMMON ITEM RECORDED

Wet wipe products, most of which contain plastic, are by far the most common item recorded on the tidal Thames foreshore in London. These products are changing the shape and sediment type of the foreshore at particular sites.

Since 2013, Thames21 has been aware that wet wipe products are depositing in huge numbers in west London, with six large sites identified between Isleworth Eyot and Vauxhall Bridge. This phenomenon only occurs on the inside bends of the river, where a slower current creates insufficient energy to keep the wet wipe products in suspension. Wet wipe products enter the river via the sewage overflows during periods of high rainfall. No wet wipe sites have been recorded in east London despite the largest sewage overflow being in Greenwich; this raises the question of where these wet wipe products might be deposited.

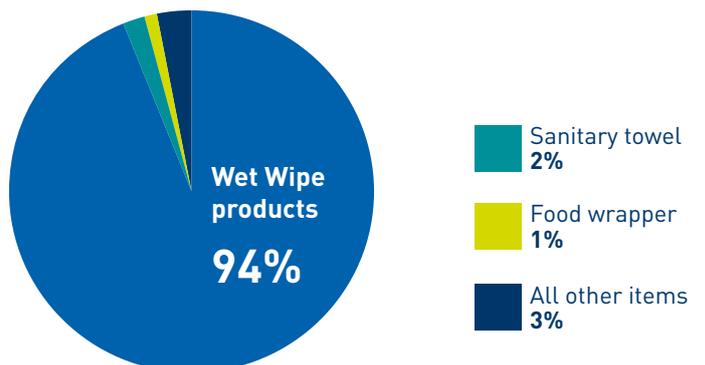
The wet wipes are depositing in mounds that are changing the shape and sediment type of the foreshore. Mounds probably form due to wipes becoming snagged on an uneven surface (e.g. rocks or twigs), creating turbulence that encourages other wipes and sediment to come out of suspension. As the mound grows, it

creates more turbulence and the process becomes self-reinforcing. We suspect that the wipes help to bind the sediments together and reduce the chances of erosion.

Waste surveys conducted at sinking sites show that wet wipe products are overwhelmingly the most common item at these locations, accounting for 94% of what is found (see Figure 9).

Figure 9. Items found at Hammersmith Bridge Southside: March 2018

Of all the items found at the sinking site, 94% were wet wipe products



The site we have studied in most detail is Hammersmith Bridge Southside, which runs from Hammersmith Bridge to the slipway by St Paul's School, where there are multiple mounds created by deposited wet wipe products.

Bathymetric surveys, carried out by the PLA on behalf of the company building the west section of the Tideway

Tunnel, have shown that the mounds are growing in height. In just under five years, the largest of these mounds grew nearly 1.4m in height; half of this growth (70cm) occurred in the eight months between September 2018 and May 2019 (see Figure 10 and Figure 11). This growth occurs despite frequent large clean-ups at the site over the past two years.

Figure 10. Wet wipe products are dramatically changing the shape of the foreshore at Barnes south of Hammersmith Bridge

(a) This cross-section of the change in the height of the riverbed shows one mound grew by 70cm in four years (between September 2014 - September 2018)

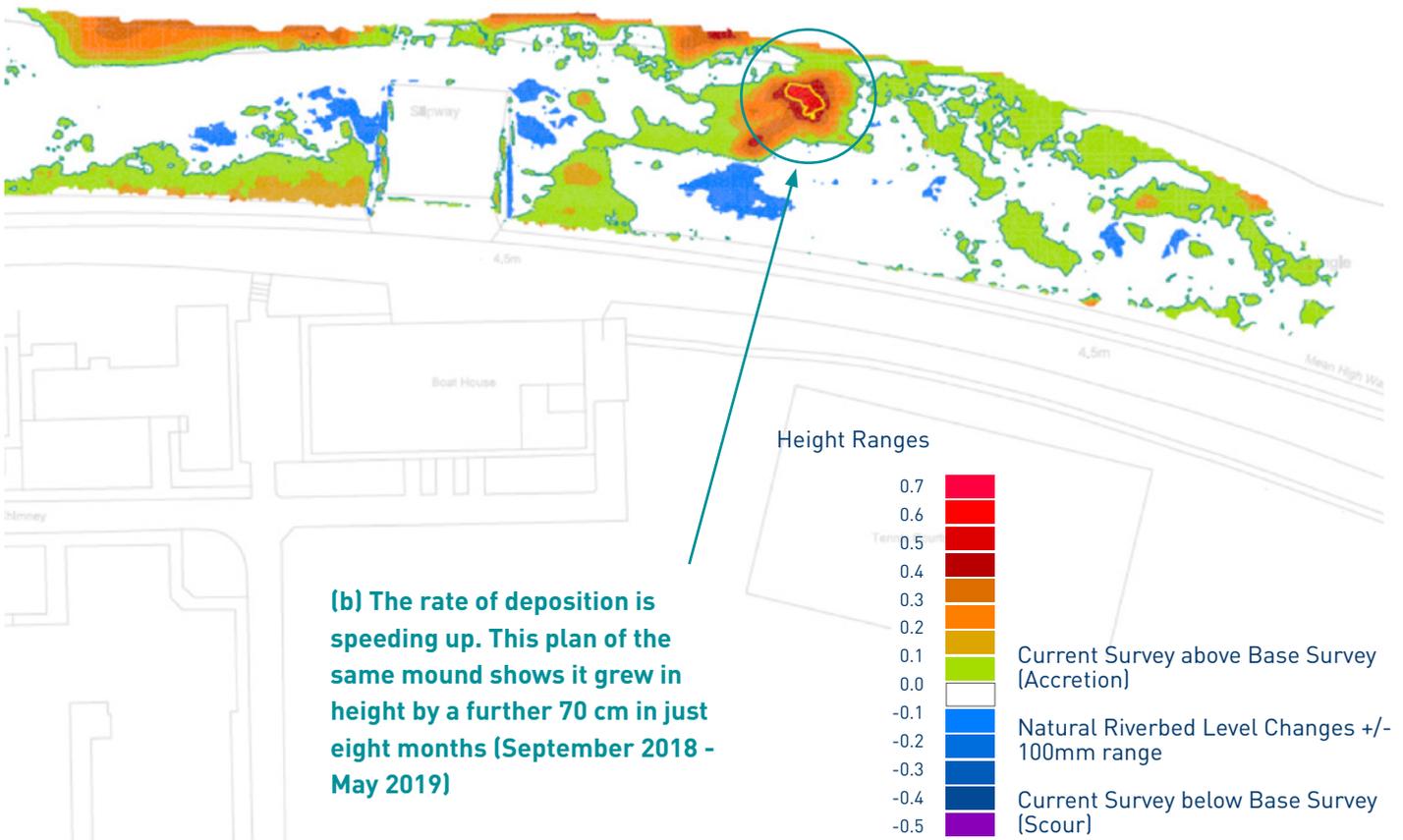
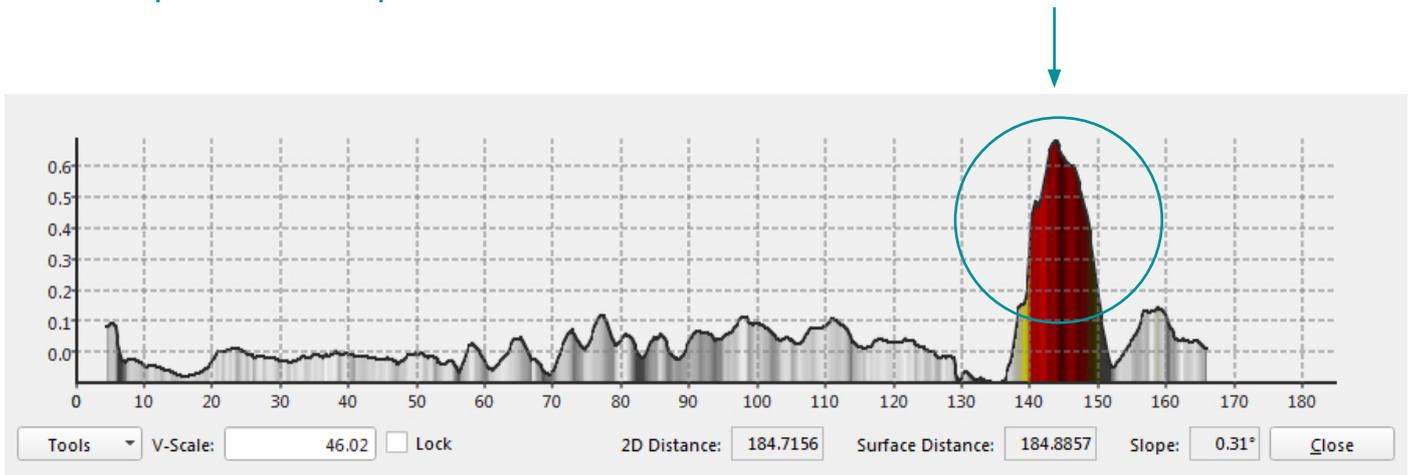
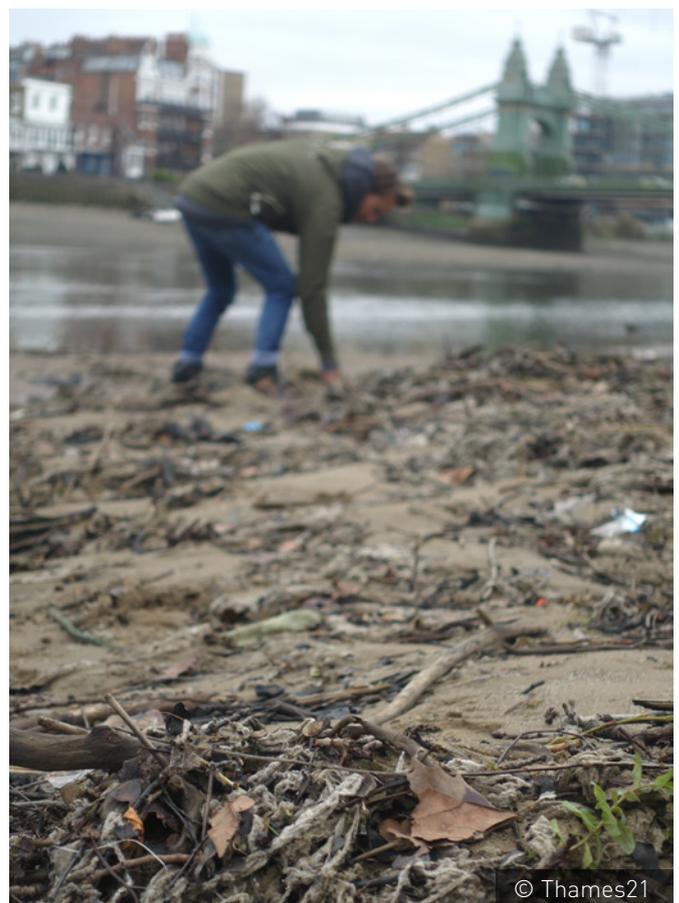


Figure 11. Image of the largest mound by St Paul's Boys School (taken 21 February 2019).



During the Big Wet Wipe Count 2019, we surveyed the mounds on a grid system with the aim of identifying change in size and density of mounds over time (see Figure 12). The biggest mound was not surveyed by our citizen scientists as it is too large to survey effectively within the time available at low tide. Four smaller mounds were selected and groups of volunteers counted the wet wipe products found per square metre. Typically, between 50 and 200 wet wipe products per square metre were found when surveying these mounds.



'I like going to the same location throughout the year to see how it changes. But it's frustrating to see litter every time we go after clearing it the previous time. To stop this problem, we need to know the sources and our regular surveys help collate relevant information to help'

Clare Cheeseright, Greenwich hub volunteer

SINGLE- USE PLASTIC ITEMS MAKE UP 83% OF ALL COUNTED ITEMS, EXCEPT GLASS FRAGMENTS

JUST FIVE ITEMS REPRESENT NEARLY TWO-THIRDS OF ALL LIGHTWEIGHT IDENTIFIABLE PLASTIC FOUND

The top five identifiable lightweight items recorded make up 64% of the total lightweight plastic items. When wet wipes are included in the total, single-use plastic items represent 83% of all the counted items, excluding glass fragments. A concerted effort to ensure these specific items are recycled and returned to the circular economy could significantly reduce the amount of plastic pollution.

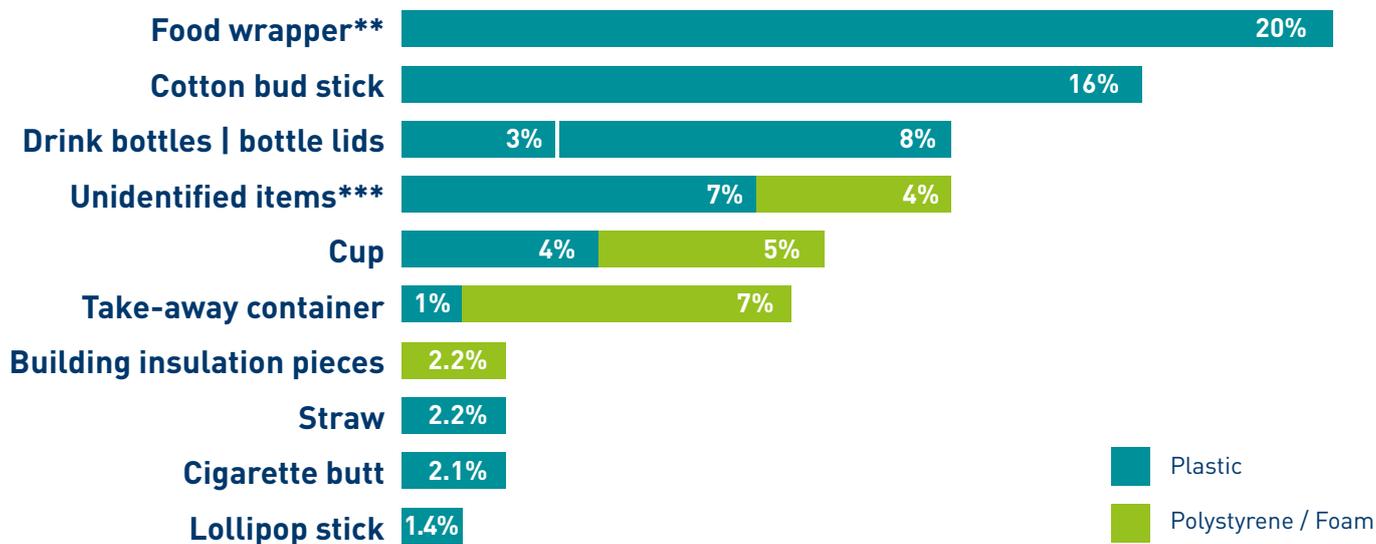
Lightweight items, i.e. those that float on the surface of the water and can become stranded at the top of the shore when the high tide retreats, impact slipways, beaches and intertidal vegetated habitats across the

estuary. These represent the most visible fraction of the plastic waste in the tidal Thames.

The top five identifiable items at these sites are food wrappers, cotton bud sticks, plastic drink bottles and their lids, plastic cups and takeaway containers (see Figure 13).

Almost three times as many bottle lids than bottles themselves were recorded in our surveys. There are a number of possible reasons for this result. Firstly, bottle lids are often found in the river in fragments which would increase their representation in our data whereas we normally find drink bottles in one piece.¹² Bottle lids are likely to have more routes to enter the river (e.g. via storm water drains) due to their small size. It has also been observed by our volunteers that bottles with no lids tend to sink. It is therefore possible that there are bottles without lids at the bottom of the river and are under-represented in the counts. However, more research is needed here to further understand this result.

Figure 13. The top lightweight (floating) waste items found on the foreshore (2015-2018) by number of items counted in the litter surveys*



* These are not the overall top items on the foreshore; items from sinking sites are considered separately

** Food wrappers: almost exclusively polypropelene packaging of chocolates and biscuits

*** Includes foam pieces but excludes plastics <2.5cm and unidentified polystyrene, which are too numerous to count.



© Thames21

'I go back to the fifties when childhood days were spent cockling, crabbing, swimming in the creeks at low tide and having picnics on the beach. Then, the beaches were clean and the water was dirty, so we avoided swimming on the outgoing tide. Now, the water is relatively clean and the beaches are littered, so have we really progressed?' Clive Webster, Grays Beachcombers

WATER BOTTLES MAKE UP NEARLY HALF OF ALL PLASTIC DRINK BOTTLES FOUND

Water bottles represent almost half of all the drink bottles found in the Thames, making it the single most common type of drink bottle. Given that UK tap water is safe to drink and one of the most highly regulated drinking water systems in the world, more people replacing bottled water with tap water would make a significant contribution to reducing the plastic burden in the river.

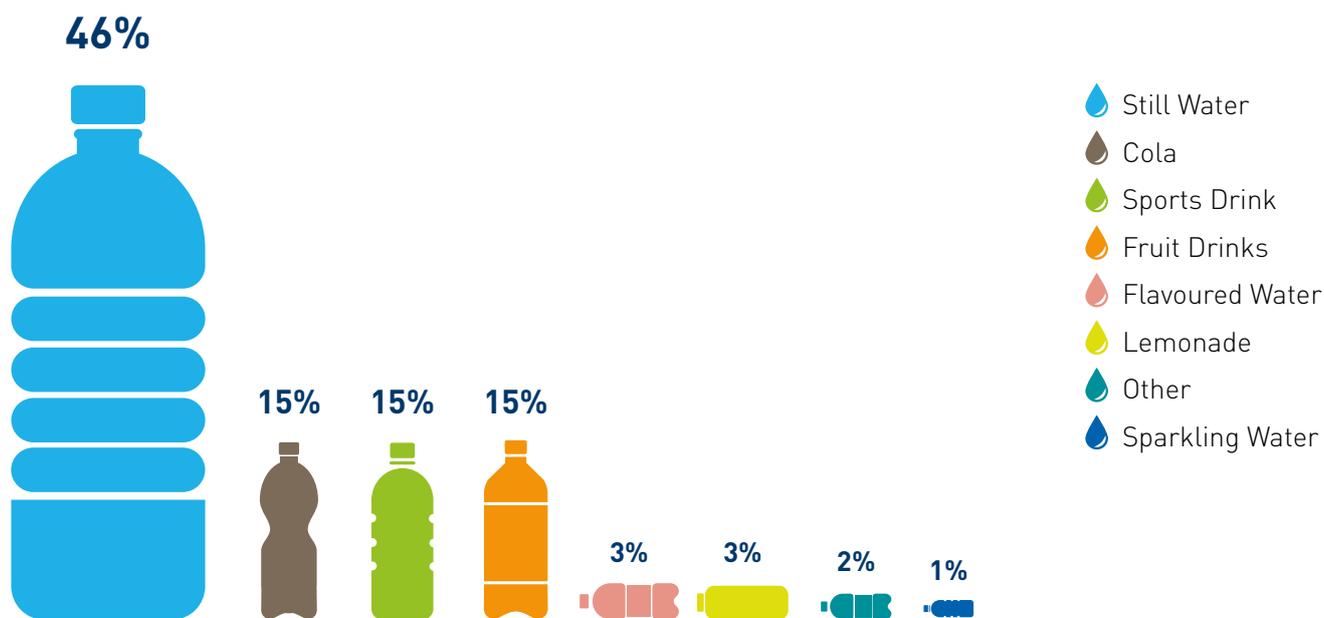
Overall the proportion of still water bottles recorded in the Thames is around 46% of all drink bottles that were identified (see Figure 14).

This ratio does not remain constant throughout the year. The ratio of still water to fizzy or flavoured drinks seems to increase in the period of July to September, likely due to hot weather. A longer time series will be necessary to prove this over time, but it flags up the growing need to provide Londoners with this basic resource through free water fountains and refill points, especially with more heatwaves predicted due to climate change.

Figure 14. Proportion of bottles of different drink types found in the Thames

Water bottles are the most common type of plastic bottle found: almost 50% of all bottles

Water bottles are far more common than any other type of drink bottle found



PRECIOUS INTERTIDAL HABITATS EAST OF LONDON BEAR THE BRUNT OF LIGHTWEIGHT PLASTIC SUCH AS BOTTLES AND POLYSTYRENE

A total of 97,019 drink bottles were recorded and removed between April 2016 and the end of December 2019. These counts do not include bottles from the large saltmarsh sites in Kent which are known to also accumulate large numbers of bottles. Furthermore, many more are being cleaned up by Southend Council during the summer months, which further masks the true plastic burden on the river generated by these items.

Plastic bottles accumulate in huge amounts on precious intertidal habitats. Of the total bottles recovered, 67% were found on saltmarsh and reedbed habitats outside the city compared to 30% from slipways and beaches in London. These habitats are key nursery grounds for fish and are already suffering from other pressures.

A total of 97,019 bottles have been recorded and removed between April 2016 (when bottles began to be counted) and December 2019. Since 2018, when bottle counting effort was significantly increased, an average of 3,000 bottles have been recovered every month. Due to insufficient data, we are not able to say whether the overall number of bottles has increased or decreased over this period; this will be addressed in our next report in 2021.

The total numbers and averages of sites in Essex are considerably higher than equivalent counts in London (see Figure 15). This is partly because the areas of land exposed to high tides are much larger. It is also likely due to the fact that the vegetation traps the bottles more readily and allows them to accumulate over time.

It should be noted that counts from estuarine areas in Kent have not been included, with the exception of six Thames21 led events at Erith Marshes between April 2018 and July 2019 (which produced 7,512 bottles). However, it is known that very large areas of saltmarsh and reedbeds are inundated with floating plastic there as well.¹³

Figure 15. Waste accumulating on the saltmarsh and reedbeds at Concrete Barges, Havering. March 2017



© Clive Webster

MICROPLASTICS ARE WIDESPREAD AND COMMON ON THE THAMES

Micro and meso-plastics (smaller than 0.5 and 2.5cm respectively) including polystyrene pieces (from now on referred to as microplastic) are found in most of our 21 surveying sites. Of 21 sites surveyed, 20 reported the presence of microplastics at least once. This hidden plastic is difficult to remove via river clean-ups and is likely to persist in the tidal Thames; adding to the global microplastic issue.

The issue is particularly prevalent at floating waste sites – 76% of the quadrats surveyed contained unidentified microplastics. In comparison, just 1% of sinking and general foreshore quadrats reported microplastics.

Nurdles (or nibs) – i.e. small plastic pellets which are the raw material for the production of plastic products – have also been found at all of the floating waste sites except Queenhithe. Nurdles are about the size of a lentil and little is known about how they enter the environment during industrial processes. They are more commonly found on coastal beaches;¹⁴ it is unclear whether their presence in the Thames originates from land or sea based sources.

The presence of microplastic and polystyrene pieces is an issue in the Thames as smaller plastics are more likely to enter the food chain via ingestion by invertebrates, fish, mammals and birds. However, it is unclear how much of a risk these items pose to wildlife. The majority of plastic ingested by estuarine species in the Thames and Clyde as reported by McGoran et al. (2018) were plastic fibres, most likely originating from clothes.¹⁵



CLIMATIC FACTORS APPEAR TO INFLUENCE THE QUANTITY OF ITEMS FOUND

Storms – characterised by low pressure, high winds and heavy rainfall – are associated with greater quantities of lightweight items being deposited on Thames saltmarsh and reedbed habitats. This suggests that items are being flushed out from the wider catchment during storms in greater numbers than is usual. More data are needed to definitively prove this.

The number of bags collected per clean-up over a given area can be an important indicator of the trend of waste accumulation over time. Most of the clean-ups are opportunistic and not regular, which makes trends difficult to detect. However, Grays Beach in Thurrock has been cleaned on the first weekend of each month since March 2017 as well as twice in 2016. Plastic drink bottles were counted only once in 2017 but they have been counted consistently from January 2018. The site is a discrete 200m section of inter-tidal habitat of grasses and reeds running from Thurrock Yacht Club to Tilbury Docks.

Figure 16, which shows the number of bags of rubbish and drink bottles collected from Grays Beach since 2016, suggests two phenomena. Firstly, the highest number of black sacks collected was from the first clean-up carried out at the site; a high of 134 in one day. On only one other occasion has a clean-up at Grays Beach exceeded 80 bags. This suggests the rubbish had been accumulating at the site and not re-floating; possibly because of the vegetation.

Secondly, the other two major spikes in sacks and bottles occurred just after a storm: Storm Eleanor in early January 2018 or Storm Lorenzo in late September 2019. This is supported by anecdotal evidence by Grays Beachcombers who have noticed an increase in plastic waste after both storms.¹⁶

It is unclear why spikes in plastic waste occur after storms. Strong winds could increase the movement of waste from land to water. Furthermore, high rainfall means full rivers could be flushing waste out of freshwater environments and into the estuary.

'I like being useful, being outdoors, staying one step ahead of the weather, working with a diverse group of interesting people, talking to passers-by about our work, getting compliments from passers-by, and leaving a site looking a lot cleaner than it was when we started'

Michael Byrne, Hammersmith Hub volunteer

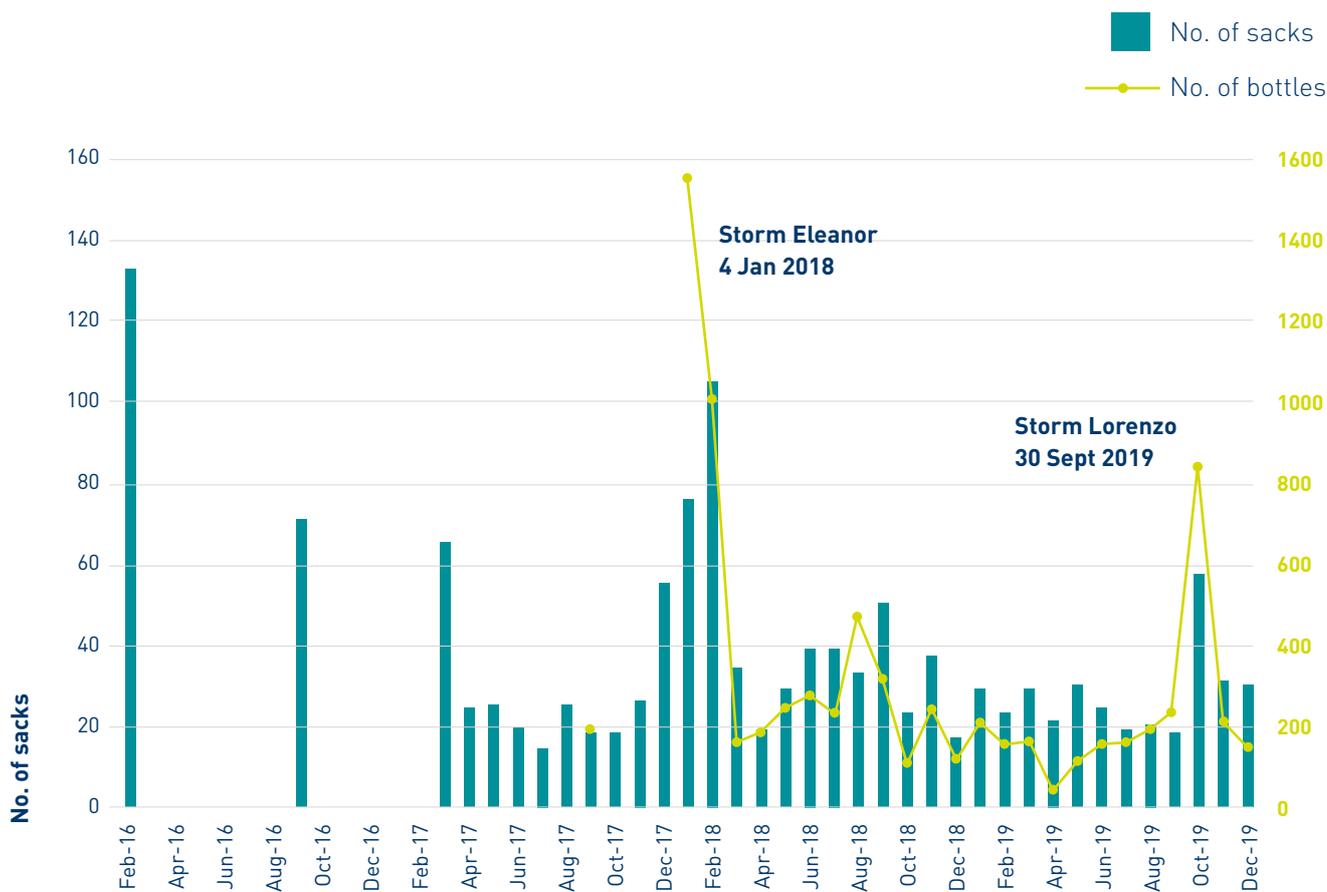
14 The Great Nurdle Hunt [Online]. [Accessed December 2019]. Available from: <https://www.nurdlehunt.org.uk/>

15 McGoran, A.R., Cowie, P.R., Clark, P.F., McEvoy, J.P. and Morritt, D. (2018) Ingestion of plastic by fish: A comparison of Thames Estuary and Firth of Clyde populations, Marine Pollution Bulletin, 137, pp 12-23.

16 Pers. Comm. Steve Catchpole and Clive Webster from North Thames Estuary Litter Picking Group

Figure 16. No. of bin bags of rubbish and plastic drink bottles recovered at Grays Beach at monthly clean-ups

Waste picked up at Grays Beach reduced after initial clean-ups took place but appeared to spike again after significant storms, suggesting they have an influence on plastic quantity





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GAPS IN KNOWLEDGE

The citizen science monitoring has built a good picture of the main plastic items on the foreshore of the tidal Thames in London. However, there are many key gaps in our knowledge with respect to plastic in the river.

It is unknown how many microplastic and polystyrene pieces are typically found on the foreshore. We have not counted these items in our surveys as there are frequently too many to count in one square metre. It is likely that these items would represent the most common items on the foreshore if they could be counted.

Very little data exist detailing the quantity of plastic bags found at sinking sites in east London. Our surveys from sinking sites come almost exclusively from wet wipe sites in west London. Although anecdotal accounts suggest the number of bags in east London has declined over the past 20 years, there has been insufficient coverage in our surveys to document this issue.

Of the floating litter items greater than 2.5cm in size, 10% could not be identified. There are a large number of plastic items for which no information is available and therefore it is not possible to identify how to stop them reaching the river.



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It has not yet been possible to determine trends in the number of specific items over time. There are a number of factors that influence the number of items that we detect in our surveys making it difficult to detect a trend from the data. These include:

- **Climatic factors:** wind direction could have a significant impact on the amount of floating plastic deposited at a given site by preventing the plastic from depositing at high tide. This means that an absence of plastic on a given survey may not in fact represent a reduction in the total in the river at that time. Similarly, high rainfall could result in the flushing of plastic items out of the tributaries creating a spike in items found in the tidal section of the river. However, the high flow of freshwater into the estuary could also result in the plastic being transported more quickly out to sea than usual.
- **Undocumented clean-ups:** with an increase in interest in this subject, there are more locally organised clean-ups occurring.
- **Variation in deposition across a site:** the transect surveys included in this report only include one transect and therefore don't give an indication of

how representative the survey is of the whole site. An understanding of the variation across the site is needed before we can refer to trends.

Very little is understood about the sources, pathways and fate of plastic waste in the river. With the exception of sewage-related items (such as wet wipe and sanitary products and cotton bud sticks) which are almost certainly transported to the river via combined sewage overflows, we don't have any means of identifying how most of the plastic gets to the river. Anecdotal evidence exists of fly-tipping and over-flowing bins next to the river but it is not known how significant these sources are. It is also unknown the extent to which plastic is transported to the river from its freshwater inputs compared to entering directly from land to the estuary.

'I volunteer with Thames River Watch because I was appalled at the huge amounts of litter and wanted to take concrete steps towards solving the problem. I see TRW as a perfect vehicle for this. Not only do we help practically through litter removal, we assist TRW in crucial data collection.'
Helen Stoddard, East Hub coordinator





PUTTING THE DATA TO USE – WHAT’S NEXT?

We collect this data for a number of reasons. First, to understand the issue better and identify ways to stop plastic waste before it gets to the river. Second, to help keep business, government, agencies and citizens accountable. Has enough action been taken to address the plastic crisis? The river data shows that so far, the answer is no.

Our vision for the next stage of the project includes:

- Supporting a thriving and funded academic Baseline and Evidence Group through the Thames Litter Forum to update monitoring methodologies and produce written reports on the state of the tidal Thames
- Identifying the plastic items that cause the most harm to the environment and map their pathways to the river
- Developing active riverside community groups that are effective spokespeople for the river, knowledgeable about the issues and trained to make the case for protection of the tidal Thames to local and national politicians, including the prevention of plastic waste entering the river
- Using the data to raise awareness in the media about the need to tackle overall waste generation, not just single-use plastic, mindful of the fact alternatives to plastic can also create significant environmental issues
- Using the data generated to create targeted campaigns alongside other NGOs and partners to reduce waste production at the local and national level and to introduce measures to prevent plastic reaching the river.

‘Data collection is the only way to speak with knowledge about the serious damage plastic waste causes to the planet; it is the only way we can clearly communicate the need for changes in our habits and laws on production and recovery to the government and the public.’

Kathy Stevenson, Hammersmith hub volunteer

‘Certain types of litter are obvious along the foreshore. But without hard evidence policy-makers can argue that the problem isn’t as extensive as is claimed. Aggregating data across multiple sites, dates, weather conditions, tidal conditions builds hard evidence for changes to policy and practice’

Michael Byrne, Hammersmith Hub Coordinator



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