

Chessel Bay, England

Chronic Plastic Pellet Loss Case Study

Key Facts

Date:	First reported in 2011 – Ongoing (2023)
Location:	Chessel Bay Nature Reserve Southampton, England, Europe
Cause:	Suspected loss from plastic manufacturers
Quantity lost:	Unknown
Quantity removed:	~4,680 kg (~234 million microplastic fragments)

Location and habitat

Chessel Bay is an estuarine bay located in Southern England, on the eastern bank of the River Itchen in Southampton¹. The River Itchen is approximately 45 km long and passes through two cities within the county of Hampshire, Winchester and Southampton². The river is widely used for a range of recreational activities such as sailing and fishing, and there is a variety of industries located in proximity to the river, with the highest density of these being at the river's mouth in Southampton.

Chessel Bay is the only remaining long stretch of undeveloped natural shoreline of the lower Itchen, and at low tide provides feeding and nesting grounds for wading birds and wildfowl such as egrets, oystercatchers, and Brent Geese¹. This site was designated as a Nature Reserve in 1989³ and is of national importance due to its natural salt marshes and mud flats classified as a Site of Special Scientific Interest (SSSI). It is also part of the Southampton Water and Solent Marshes Special Protection Area (SPA) protected under European legislation⁴, and is an internationally important Ramsar Site⁴ (Figure 1).

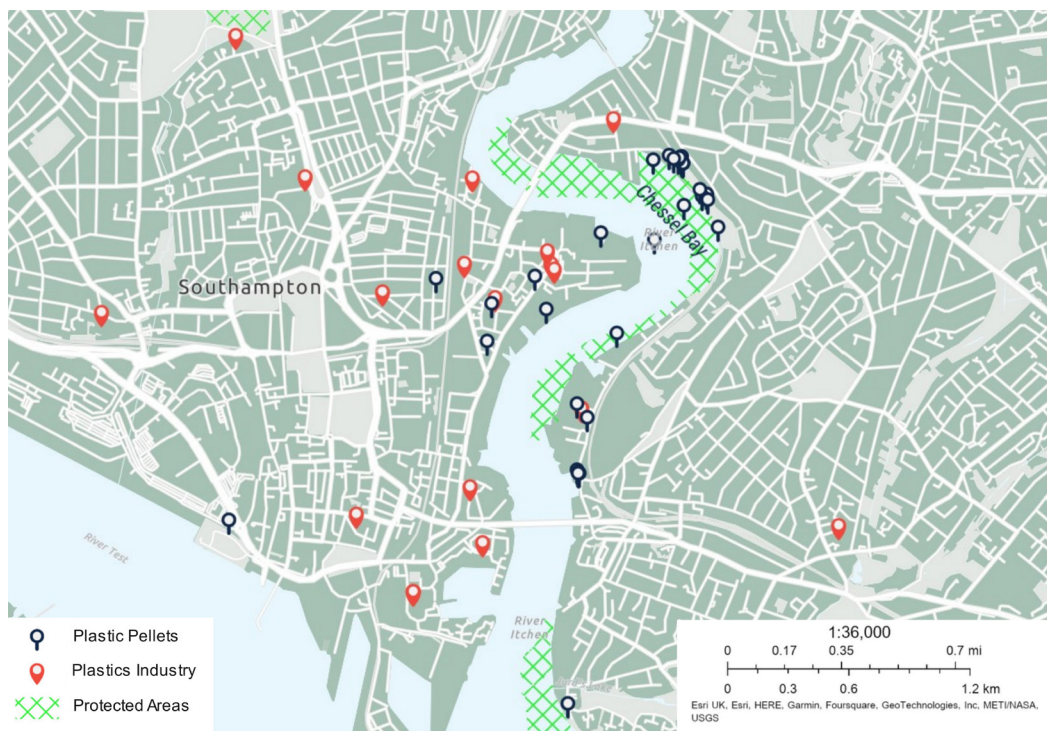


Figure 1: Map of the River Itchen and Chessel Bay illustrating the environmental designation areas, recorded pellets from Fidra Nurdle Hunt data¹¹, and registered plastic industries within the surrounding area

The nature reserve is adjacent to a residential area and is accessible to the public year-round. The Bay is managed by Southampton City Council and Natural England which allow bi-annual beach cleans to be carried out by local volunteers. The site itself is under environmental pressure from background marine pollution due to the heavy industrial setting, and the effects of climate change and sea level rise reducing the available habitat. The Bay has been subject to management issues, including illegal fly tipping, and large accumulations of general and industrial litter,



Figure 2: Chessel Bay, facing south towards the River Itchen at high tide and nearby marinas and industrial areas⁷

including plastic pellets^{1,3,5}. Due to the unique double high water of the Solent that influences the water levels within the Itchen⁶, and it being located on an outside bend of a meander in the river, the bay is an accumulation zone for river bound debris. The shoreline substrate is a mixture of shingle beach, dense salt marsh, and natural vegetation debris (Figure 2), meaning the plastic debris and pellets mix into the substrate and are difficult to recover.

Extent of plastic pellet impact

Plastic pellets, along with miscellaneous microplastic fragments and polystyrene, have been recorded in the Bay since 2011 by Southampton Urban Wildlife Centre and Friends of Chessel Bay⁸. A report on the impact from this group illustrated the variety of pellet shapes and colours found indicating multiple sources and varying stages of weathering, which suggests **a chronic release of pellets over a long period of time**. High concentrations of pellets have been seen to accumulate on the upper shoreline (Figure 3).

There are a large number of plastic manufacturers in the area (Figure 1), however, none have taken responsibility for the pellet pollution along the River Itchen. Without transparency within the sector, it is hard to identify who is responsible, making it difficult to make the relevant companies liable for the chronic spill. Mismanagement of pellets during transport, handling and storage can result in pellets reaching the environment through inadequate spill management procedures, therefore leading to direct input into the river from surface runoff, or into surface water drainage which can be exacerbated in windy or rainy conditions as they are easily transported due to the pellets' small size and weight⁹.



Figure 3: Photo of the floating material on the water surface downstream from Chessel Bay, showing the volume of plastic pollution from pellets, polystyrene, macroplastics, and microplastic fragments, amongst the natural debris¹⁴

Pellet pollution was reported to the regulator, the Environment Agency (EA), in 2012, and again in 2019, following further beach cleans, citizen science surveys, and along with collaboration with the charity Surfers Against Sewage (SAS) and the University of Southampton's Marine Conservation Society. These surveys identified that the pellet pollution in the Bay was consistent and identified recent losses due to the lack of discolouration which is seen when plastics are exposed to UV radiation over time. Data was also reported to the Fidra Great Nurdle Hunt, which has 15 recorded entries within the nature reserve of pellet concentrations from 101 to greater than 1000 pellets between 2017 and 2022¹¹(Figure 1).

Assessment of the surrounding area and downstream riverbanks also identified thousands of plastic pellets had washed up on beaches between Chessel Bay and within the Royal Victoria Country Park (7 km from Chessel Bay), following high tides and storms in 2019³.

Response to plastic pellet pollution – Prevention

Across a 2.5 km length of the river, there are nine industrial areas and eight registered plastic manufacturers under Standard Industrial Classification (SIC) code 22290 – 'manufacture of other plastic products', all within 800 m of the water's edge (Figure 1). The EA reported that since the issue was first reported to them in 2012, they had undertaken pollution prevention visits to the manufacturing companies along the Itchen that have had a history where spillages were common. This was to encourage better practices including, the installation of drainage grates, border walls, and spill kits to improve clean up procedures¹¹. The EA reported that following repeat visits in 2018, improvement and prevention techniques had been implemented by the relevant companies.

Table 1 Plastic manufacturers surrounding the River Itchen where details on product produced could be identified

Manufacturer	Products Produced	Pellet Pollution	Year & Source
Plastic polythene manufacturer, located in Northam Industrial Estate	Bags and covers, films and sheeting, disposable aprons, shrink and stretch films, refuse sacks, horticultural and agriculture, and bio-compostable plastics.	Pellets were found on the pavement, gutter and drains on public highways surrounding the manufacturer's premises. Pellets covered the company's yard, most of the drains did not have capture traps, and the ones that did were damaged and leaking pellets.	Feb 2020 ³
Plastic polythene manufacturer, located in Millbank Industrial Area	Bags and covers, films and sheeting, disposable aprons, shrink polythene, refuse sacks, agricultural, and specialised (biodegradable, UV resistant, flame-retardant) including in-house reprocessing machinery.	Pellets in the gutters and drains as well as accumulations on the driveway and neighbouring areas.	Feb 2020 ³
Plastic polyethylene manufacturer, located in Spitfire Quay	Lamination, blown film extrusion, flexographic printing, slitting & finishing and food packaging.	Pellets within the drains without any capture traps, and pallets of plastic pellets stored outside near the quayside with pellets scattered across the road.	Feb 2020 ³
Aircraft Seal & Polymer Engineer, located in Mount Pleasant Industrial Estate	Polyurethane, fluorosilicone, natural rubber products, polymer hybrids and blends, polychloroprene, silicone, fluorocarbon and Ethylene Propylene Diene Monomer.	No reported pollution or investigations undertaken.	N/A
Thermoformed plastic packaging manufacturer, located in Millbank Industrial Area	Electronic (packaging for Electro Static Discharge (ESD)-sensitive components), pharmaceutical (blister packs, handling trays, clamshells), medical (packaging for syringes, scalpels, catheters, cannulas and needles), aerospace and nautical, construction (cavity trays, roof tile sealant).	No reported pollution or investigations undertaken.	N/A



Figure 4: Image of the storage and movement of plastic pellets within tonne bags (image credit: Shutterstock)

Inland surveys were undertaken on the western side of the River Itchen in 2020 where a number of the plastic manufacturing facilities are located in a further attempt to identify the source of the plastics³. This was again reported to the EA and recorded on the Great Nurdle Hunt database. The world's first pellet handling specification (PAS 510) was published in 2021¹² by British Standards Industry (BSI) to mitigate the loss of pellets from organisations within the plastic supply chain. PAS 510 is a publicly available specification that sets out requirements for the handling and management of plastic pellets, as well as flakes and powders, throughout the supply chain to prevent spills, leaks and losses to the environment. The observations from these surveys are evidence that despite EA intervention, **pellet management guidance is not being followed by plastic industry in the area or is ineffective, leading to continued pellet losses** within close proximity to Chessel Bay (Table 1). Furthermore, none of the plastic manufacturers are listed as signatories for the voluntary Operation Clean Sweep (OCS)¹³.

Response to plastic pellet pollution – Clean up

A not-for-profit company '[Nurdle.org](https://www.nurdle.org)' (partnered with cleaning suppliers Karcher) has been involved in trials and clean ups along the shoreline of Chessel Bay. This has been undertaken using specifically designed vacuum equipment in agreement with the EA, Natural England and local authorities to avoid times of migratory birds and nesting seasons. An initial clean up trial was undertaken in August 2021 along with an impact and biodiversity survey. From this, it was concluded that the equipment was effective in the recovery of all types of plastic pollution. The plastic collected was found to cover the ground to such an extent that it restricted the growth of certain grasses, preventing the creation of suitable habitats for wildlife to thrive. Subsequently '[Nurdle.org](https://www.nurdle.org)' reattended throughout January to April 2023 along with SAS, Friends of Chessel Bay, The Final Straw Foundation and other public volunteers to undertake a mass clean up along the nature reserve for five days at a time. They claim to have removed over 234,000,000 pieces of microplastic, cleaning 90% of the pollution in some areas of the nature reserve⁵. **The local industry has been approached to take part in clean up at Chessel Bay, however, to date, they have not been involved.** The EA have since reached out to the relevant parties to begin to form a coalition and stakeholder groups to tackle the pollution³.



Figure 5: Use of vacuum recovery equipment to remove plastic pollution from an intertidal section of the River Itchen, downstream from Chessel Bay, that has also been impacted by the chronic pellet pollution¹⁴

Current research at the University of Southampton¹⁵ has also been conducted in the Bay to understand a) what, if any, positive and negative impacts the clean up has on the Nature Reserve and b) if there is an increased input of pellets identified following the clean up works. This can determine if they are 'fresh' virgin pellets potentially from ongoing losses from the plastic manufacturers, or if it is residual background legacy pollution being re-mobilised from the surrounding areas.

In recent years, the pellet pollution and clean up efforts at Chessel Bay have received media attention^{7,9,16}. Despite this, the unknown **perpetrators of pellet mismanagement have not been held to account**. The chronic accumulation of pellet pollution is unlikely to be stopped without regulatory measures and sanctions in place to hold those accountable. **The reliance on NGO's and community volunteers to clean up the Bay contravenes the 'polluter pays principle' of the UK Government¹⁷ and is not a viable management plan**. In the absence of data on the source of the pellets, any outcomes of research on the impacts of pellet pollution to Chessel Bay and the surrounding area is likely to provide further evidence to support the application of the precautionary principle to stop pellet pollution.

Summary & Conclusions

- There is sufficient evidence to infer that the **pellet pollution at Chessel Bay is chronic**, and is potentially from the local plastic manufacturing industry based on the series of incidences of logged nurdles between 2011 to 2023. However, the exact source is still unknown due to a lack of reporting and transparency from the industry.
- The **pellet pollution is having an impact on nationally important habitats and the seascape**, however the environmental, chemical and health risks associated with this are unclear.
- Regulators and governing authorities are aware of the chronic pollution in this area. However, **attempts to enforce prevention measures have been voluntary and ineffective based on the ongoing pollution**.
- Despite media attention, academic research and community group efforts, the lack of industry transparency has meant it is unclear what prevention and mitigation measures are in place to stop pellet loss at source.
- **Industry have not met the costs of clean up to date**. The prevention and polluter pays principle¹⁶ are not being adhered to in preventing pellets from impacting the environment nor in the clean up of pellets lost. Mandatory measures are needed to ensure zero pellet loss in the first instance, and where there is evidence of chronic pollution the cost of clean up efforts are met by polluters.
- None of the plastic manufacturers within an 800 m radius of the River Itchen are registered as signatories to the voluntary OCS scheme. Nationally, out of the 5851 registered plastic manufacturers in the United Kingdom, only 185 are registered signatories of OCS. **Without mandatory standards (such as PAS510:2021)¹² verified by third parties, chronic pellet loss is likely to continue resulting in severe pollution**.

Chronic pellet pollution sites around the world

- Similar **chronic pellet pollution sites have been identified worldwide** such as Limekilns in Scotland, Antwerp in Belgium and Corpus Christi & Point Comfort in the US where there is a large concentration of plastic manufacturers, commonly near a river or shoreline, that are contributing to severe pellet pollution. Due to the lack of industry reporting on pellet losses and volunteers being unable to undertake surveys in some regions, there is underreporting of chronic pellet pollution sites across the globe. **Further sites will be at risk if the plastic industry expands further.**
- With the identification and recorded quantity of pellets associated with chronic losses being underreported, it is hard to quantify the current extent of the chronic issue. In 2018 it was estimated that the loss from chronic spills in Europe is ~145,150 tonnes annually, which is equivalent to 7.3 billion pellets lost¹⁸. To add to this issue, plastic production is expected to triple 2060¹⁹ and if there is no change in behaviours towards pellet loss this could result in severe quantities being lost each year.
- Current voluntary efforts to address pellet loss are insufficient resulting in ongoing pollution from industry and chronic accumulations of pellets, many in environmentally sensitive locations. This is evidenced by the correlation of pellet finds and plastic industry locations highlighting the ongoing chronic pollution around these sites. Pellet loss is preventable with a legislated mandatory supply chain approach, where all actors in the process are required to meet rigorous standards that are externally verified and communicated along the supply chain. This can be supported by strong enforcement and compliance should actors in the supply chain fail to follow through with preventative measures, ensuring the costs of clean up are met polluters. **Implementing a mandatory supply chain approach should be the first step in stopping chronic pellet loss, to turn the tap off from the source.**

Chronic Plastic Pellet Loss Case Study: References

- 1 Friends of Chessel Bay. Chessel Bay Local Nature Reserve. Available at: <https://www.chesselbay.org.uk/> [Accessed on 27/07/23]
- 2 Visit Hampshire. River Itchen. Available at: <https://www.visit-hampshire.co.uk/explore/rivers-and-canals/river-itchen> [Accessed on 27/07/23]
- 3 Surfers Against Sewage. (2020). Reps Case Study: Southampton Nurdle Campaign. Published on 30/07/20. Available at: <https://www.sas.org.uk/updates/reps-case-study-southampton-nurdle-campaign/> [Accessed on 27/07/23]
- 4 Department for Environment, Food & Rural Affairs (DEFRA). (2022). Magic Map. Available at: <https://magic.defra.gov.uk/MagicMap.aspx>
- 5 Nurdle. (2023). The Chessel Bay Clean. Available at: <https://nurdle.org.uk/the-great-chessel-bay-clean/> [Accessed on 28/07/23]
- 6 Associated British Ports. Southampton Tides. Available at: https://www.southamptonvts.co.uk/Port_Information/Navigation/Hydrography/Southampton_Tides/ [Accessed on 28/07/23]
- 7 Photo credit © Malcom Hudson. Daily Echo. (2014). Chessel Bay is set to undergo an autumn cleanup next month. Available at: <https://www.dailyecho.co.uk/news/11544348.chessel-bay-is-set-to-undergo-an-autumn-cleanup-next-month/> [Accessed on 28/07/23]
- 8 Southampton Urban Wildlife Centre, & Friends of Chessel Bay. (2011). Plastic Pellets – Chessel Bay, Southampton (SU4412). Available at: <http://www.chesselbay.org.uk/Chessel%20Bay%20-%20Plastic%20Pellets.pdf> [Accessed on 28/07/23]
- 9 Fidra. The Great Nurdle Hunt – The Problem. Available at: <https://www.nurdlehunt.org.uk/the-problem.html> [Accessed on 27/07/23]
- 10 Friends of Chessel Bay, & Environment Agency. (2019). Letter to Environment Agency March 2019 and their Response. Available at: <https://www.chesselbay.org.uk/Nurdles%20in%20Chessel%20Bay%20LNR%20-%20Environment%20Agency%20Response%202019.pdf> [Accessed on 28/07/23]
- 11 Great Nurdle Hunt. Nurdle Finds. Available at: <https://www.nurdlehunt.org.uk/nurdle-finds.html> [Accessed on 28/07/23]
- 12 PAS 510:2021. Plastic pellets, flakes and powders – Handling and management throughout the supply chain to prevent their leakage to the environment. British Standards Institution. Available at: <https://www.bsigroup.com/en-GB/standards/pas-5102021/>
- 13 Operation Clean Sweep. Signatories Available at: <https://www.opcleansweep.eu/signatories> [Accessed on 28/07/23]
- 14 Photo credit © Joshua Doran (Oracle Environmental Experts Ltd.)
- 15 Rose, D., Hudson, M.D., Bray, S., Gaca, P. (2023, in review) Assessment of the estuarine shoreline microplastics and mesoplastics of the River Itchen, Southampton (UK) for contaminants and for their interaction with invertebrate fauna. Environmental Science and Pollution Research
- 16 Stafford, S. (2023). Clean up of nurdle-polluted Southampton Chessel Bay nature reserve. BBC News. Published on 18/03/23. Available at: <https://www.bbc.co.uk/news/uk-england-hampshire-64867719> [Accessed on 28/07/23]
- 17 Department for Environment, Food & Rural Affairs (DEFRA). (2022). Environmental principles policy statement. Available at: <https://www.gov.uk/government/publications/environmental-principles-policy-statement> [Accessed on 28/07/23]
- 18 Rethink Plastic. (2023, June 23). European Parliament to Take Urgent Action to Reduce Microplastic Emissions from Tyre Abrasion. Available at: https://rethinkplasticalliance.eu/news_type/news/ [Accessed on 27/07/23]
- 19 Organisation for Economic Cooperation and Development (OECD). (2022). Global Plastics Outlook: Policy Scenarios to 2060. Available at: <https://www.oecd-ilibrary.org/sites/aa1edf33-en/index.html?itemId=/content/publication/aa1edf33-en> [Accessed on 28/07/23]

- 29 WWF. Green Sea Turtle. Available at: <https://www.worldwildlife.org/species/green-turtle> [Accessed on 28/07/23]
- 30 Hong Kong Government. Press Release – Progress of cleaning plastic pellets scattered on beaches, in fish culture zones and at sea after the typhoon. Available at: <https://www.info.gov.hk/gia/general/201208/14/P201208140531.htm> [Accessed on 28/07/23]
- 31 Doyle, J. (2022). Nurdle Apocalypse: Plastic on the Loose. Pop History dig. Available at: <https://pophistorydig.com/topics/nurdle-apocalypse-plastic-pollution/#:~:text=More%20than%20a%20month%20following,of%20the%20Hong%20Kong%20islands> [Accessed on 28/07/23]
- 32 CEDRE. (2018). Information Bulletin. Available at: https://wwz.cedre.fr/en/content/download/9234/file/bulletin37_EN-web.pdf [Accessed on 28/07/28].
- 33 Saliba, M., Frantzi, S., & van Beukering, P. (2022). Shipping spills and plastic pollution: A review of maritime governance in the North Sea. *Marine Pollution Bulletin*, 181, 113939. <https://doi.org/10.1016/j.marpolbul.2022.113939>
- 34 Lee, A., & Chi-Fai, C. (2014). Compensation deal struck for clean-up of plastic pellets spilled in typhoon. SCMP. Available at: <https://www.scmp.com/news/hong-kong/article/1470007/compensation-deal-struck-clean-plastic-pellets-spilled-typhoon> [Accessed on 25/07/23]
- 35 Seneviratne, S. I., X. Zhang, M., Adnan, W., Badi, C., Dereczynski, A., Di Luca, S., Ghosh, I., Iskandar, J., Kossin, S., Lewis, F., Otto, I., Pinto, M., Satoh, S. M., Vicente-Serrano, M., Wehner, & Zhou, B. (2021). Weather and Climate Extreme Events in a Changing Climate. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, & Zhou, B. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1513–1766, doi: 10.1017/9781009157896.013