An editorial oversight meant the following article did not run in the November 2012 issue of Water – Ed.

New Stormwater Management Product Aims to Prevent Plastic In Our Oceans

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Introduction

There is an increasing awareness that plastic and gross pollutants are killing our oceans . Once viewed as unsightly yet non toxic, gross pollutants were considered more a nuisance rather than the major and growing environmental degrader that it is. Recent research has shown that the volume of gross pollutants in our ocean is killing millions. Further the persistent and buoyant nature of the man-made compounds such as plastics and Styrofoam contained in gross pollutants have a cumulative effect accumulating in the environment. Man-made compounds in marine pollution can also leach containments such as estrogen like chemicals and heavy metals contaminating marine bio and travelling up the food train into humans.

Environmental cleanup organizations are horrified by the amount of material on our islands beaches and coast lines but this is only a small percentage of of what is being discharged into our coast environment. Stormwater360 leaders in stormwater innovation have redeveloped its successful EnviroPod catchpit filter to target gross pollutants in an effective manner. . The new Enviropod LT (Litter Trap) has been developed to target plastics and gross pollutants. The Enviropod LT starts in addressing the problem at the source.

What We Do in New Zealand is Affecting Animals Across the Pacific

Over 80% of marine pollution comes from land-based activities. (WWF). With the majority of these being discharged through storm sewers and rain flushes and impermeable surfaces through catch pits into the reticulation system where it eventually reaches our oceans.

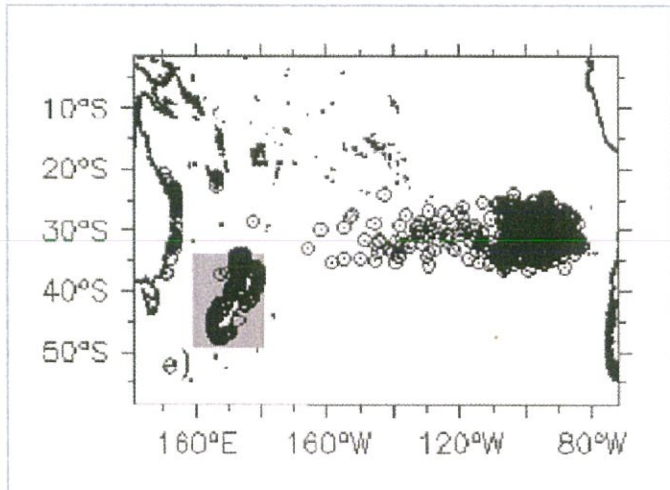
Once waterborne and in the ocean some gross pollutants settle to the ocean floor, some break down quickly (organic material), however a considerable amount can be blown by the wind, or follow the flow of ocean currents, and in time often ending up in the middle of oceanic gyres where currents are weakest. The Great Pacific Garbage Patch is one such example of this, comprising a vast region of the North Pacific Ocean rich with anthropogenic wastes. Estimated to be double the size of Texas, the area contains more than 3 million tonnes of plastic.

While the evidence of the North Pacific seems far away for New Zealand there is evidence that the same phenomena is occurring in the Southern ocean and New Zealand is a source. Young and Adams of Unitec undertook a study in 2008 where they trawled the parts of the Waitemata harbor and the inner gulf with plankton net. The plastic concentration was found to be as high as 16626 items/km² of ocean trawled. While this is not as high as the Great Pacific Garbage Patches 334,271 items/km², it is still a considerable and concerning amount.

This figure below is an extract from Martinez et al research paper "Floating marine debris surface drift: Convergence and accumulation toward the South Pacific subtropical gyre". Her modeling shows that Land based marine pollution originating from New Zealand (gray box) often ends back up on our own shores of a much large amount accumulates in the in the center of south pacific gyre.

Figure 1 – Sample of seawater from the great pacific garbage patch Source: Scripps Oceanography

Figure 2 – Final destination of plastics originating from New Zealand Source – Floating marine debris surface drift: Convergence. Martinez



The Size of the Problem

Gross pollutants are large pieces of litter, debris, and sediment. The litter component mainly comprises of paper, plastic and cigarette butts. The percentage of litter can vary greatly from location but on average is approximately 30% of the gross pollutant load.

While the discharge of total suspend solids is regulated in Auckland and in other regions of New Zealand – gross pollutant discharge is not and there has been little effort to control them. That is apart from the heroic efforts of some individuals and community groups such as Island Care Trust and Sustainable Coastlines which annually pick up tones of gross pollutants from our beaches

The volume of gross pollutants that discharge from urban areas into the marine environment is significant. In 1995 the Island Care Trust of New Zealand estimated 28,000 piece of litter a day were discharging from Auckland cities stormwater drain into the Waitemata Harbor.

Island Care study found industrial catchments contribute more plastics and commercial catchments contribute more paper.

Allison's research estimated the gross pollutant load for Melbourne to be 230,000 cubic meters per year. Which is almost the same as a super tanker (300,000m³) of gross pollutants a year. Research by Hannah in 2005 on retained material from Enviropods in Auckland and Sydney estimated a loading rate of 1.6m³ of particles over 1mm per heater where entering the stormwater drain in urban areas. Applying this to the urban area of Auckland (482km²) would equate to over 75000m³ or over 1100 40ft shipping containers being dumped into Auckland's marine environment every year. Another study in Hobart with the EnviroPod found that nearly 10,000 cigarette butts and over 500 pieces of plastic per hectare where being washed down Hobart stormwater drains and into the southern ocean.

The Effects of Gross Pollutants in the Marine Environment

Gross Pollutants in our waterways and on our beaches are unsightly and unattractive. Tourism is worth 23 billion dollars to the New Zealand economy

First the share volume of gross pollutants is a concern. This volume tends to settle out in our receiving water bodies smothering and clogging them. The organic component is also a considerable source of nutrients (phosphorous and nitrogen) into ours waterways. Excess nutrients effect dissolved oxygen levels in the water bodies and can lead to algal blooms.

The entanglement by and ingestion of, marine litter by organisms, are the most noticeable short-term impacts. Plastic litter in particular, is estimated to lead to the world wide mortality either directly or indirectly of one million seabirds, 100,000 marine mammals (including 30,000 seals) and 100,000 turtles globally every year either through entanglement or ingestion.

Figure 3 - Oystercatcher found with ingested plastic in Colville Harbour NZ. Source: Sustainable Coast Lines

Long-term impacts are usually associated with the fate and interaction of contaminants over a long period of time. Ecosystem deterioration can result from a combination of these impacts, such as habitat damage, reduced population size and biodiversity loss.

Gersberg even with a small amount of un-burnt tobacco clinging to it, a single cigarette butt soaked for a day is enough to turn a liter of water a sickly yellow brown and kill 50 percent of fish swimming in it. Without tobacco, it takes about 4 smoked filters to do the same job.

Research has shown photo-degradation of plastics causes estrogenic compounds to leach into the surrounding water. A study in Germany has shown that plastic packaging material was capable of leaching Estradiol into water and into the New Zealand mud snail. Estradiol is Estrogen like chemical – it has a critical impact on reproductive and sexual functioning. Estrogen mimics, like those released from the photo-degradation of plastics and magnified up the food chain into our seafood. In our bodies, they attach themselves to estrogen receptors in cells and mimic the action of the body's natural estrogen, or they may block the action of natural estrogen and are thus called estrogen antagonists.

Ministry of Science and Innovation Grant

With knowledge and understanding the effect plastic and gross pollutants are having on the world marine life, the team at Stormwater360 decided to do something about it.

Stormwater360 started in 1996 by developing the Enviropod Catchpit filter. In 2010 Stormwater360 successfully applied to the Ministry of Science and Innovation for a technology development grant to redevelop the EnviroPod filter. The MSI grant enabled extensive lab and field testing, engineering materials design, modeling and industrial design

The goal was to come up with a low cost solution for gross pollutants that could be applied anywhere, handle the volume of gross pollutants washing into our drain and be easy to maintain. The redesign objectives were as follows:

- Low Cost
- Dry Capture
- High Flow Capacity
- Hand Maintainable

The original Enviropod (the EnviroPod 200) was designed to target sediment as well as gross pollutants. It utilised a 200 micron screen with a galvanised or stainless steel frame. Suspended sediment is usually the contaminant of concern as heavy metals attached to sediments are transported into the marine environment with them. The Enviropod 200 was tested at Auckland University for Auckland Council and shown to remove more than 95% of particle above 100 micron (0.1mm). Since then over 7,000 Enviropods 200's have been installed throughout New Zealand. These Enviropods have been installed in city centres, shopping centres and commercial properties and when properly managed have removed significant amounts of sediment and gross pollutants. Stormwater 360 estimate 480 tonne of contaminants have been prevented from entering New Zealand waters by the Enviropod since its inception in 1996.

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By removing large volumes of sediment the EnviroPod 200 required cleaning by Induction Truck. Induction trucks are expensive to operate ($200 + hour). All waste removed from inductor trucks is required to be treated as special waste. Further by focusing on sediment the serviceability of the EnviroPod 200 was high i.e. the system needed to be maintained every 2–4 months.

The EnviroPod 200 is a very effective tool, however feedback from the market was that there needed to be a lower spec option The EnviroPod LT is modified to only focus on the gross pollutants, this increases the serviceability and allows the system to be hand maintained not dissimilar to emptying a curb-side rubbish bins therefore removing the need for the induction truck.

Figure 4 - EnviroPod LT

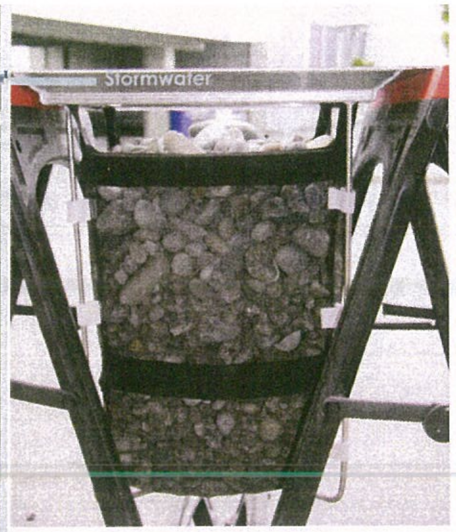
Figure 5 - Hand maintenance

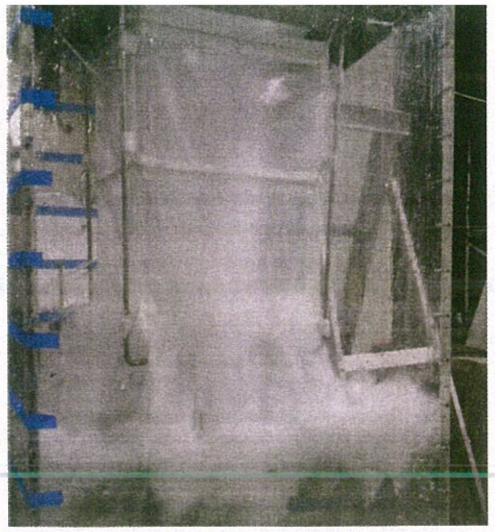
The design of the Enviropod LT is based around a self supporting bag, removing the need for a support frame. As the system sets loaded with gross pollutants the bag gets heavier causing the sidewalls of the original bag to get stiffer. This feature allows the removal of the frame which was a costly yet essential element to the original design.

The effective bag design enables a large surface area bag to be constructed. The large surface area allows the device to convey a high amount of flow through the screen with low head loss. The photo below show the system being tested at the Auckland University hydraulics lab. The photo shows the small amount of head loss through the system as a flow of 12 l/sec passes through the bag. The photo also shows very little turbulence in the sump under the Enviropod LT as the bag dissipated the incoming flows energy. This energy dissipation enhances sediment settling in the sump of the catchpit.

The Allison study in Melbourne revealed that approximately 20% of gross pollutants were floating. There is also a large amount of gross pollutants that travel in the water column i.e. they are neutrally buoyant. The only way effective to capture floating or neutrally buoyant material is by screening it. A standard catchpit has no means to stop neutrally buoyant material. Some standard catch pits are installed with half siphons – this has only a limited effect on capturing truly floating material. By screening the flow the EnviroPod LT can effectively capture and retain all gross pollutants in the flow.

The EnviroPod LT uses a fiberglass burn proof fabric that captures all particles over 1mm that enter the catchpit The retained trash





Left to right: Figure 6 – Load Testing of Self Supporting Bag; Figure 7 – Head Loss and Energy Dissipation @ 12 l/sec; Figure 8 – Dry Capture

and debris are held dry in the system, preventing break down in the catchpit sump or in the receiving environment. Allowing excess water to drain from the retained material lowers the disposal costs.

> "The EnviroPod LT uses a fiberglass burn proof fabric that captures all particles over 1mm that enter the catchpit The retained trash and debris are held dry in the system, preventing break down in the catchpit sump or in the receiving environment. Allowing excess water to drain from the retained material lowers the disposal costs."

During the development process over 40 prototypes were manufactured and installed in various catch pits around Auckland and a few in Sydney. Trail locations where chosen specifically to test the functional aspects of the design, these included: concrete yard, steep streets and ultra urban catchments. Removal rate was between 550–1800kg/ha/or 2.3–7.5m³/ha/yr.

The EnviroPod LT is now available. It intended to start mass production of the product in the New Year with a view to export the product to Australia, USA and abroad. Further information is available at www.stormwater360.co.nz

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Figure 9 – Example of gross pollutants caught in during development of the EnviroPod LT