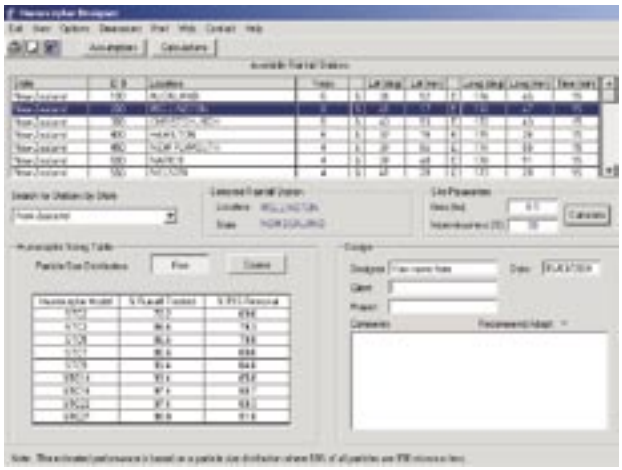
Model Selection and Performance

Hume*ceptor*™ Design Software

The **Hume***ceptor*™ product is designed and specified using a calibrated continuous rainfall/runoff pollutant export model supplied by Humes. The software operates similar to commercially available models such as MUSIC[2] (CRC for Catchment Hydrology, 2002) and XP-AQUALM[1] (WP Software, 1992). **Hume***ceptor*™ is sized to achieve a water quality outcome as reflected by the percentage of total suspended solids (by mass) that is retained. This approach allows a more direct comparison of the performance from the various **Hume***ceptor*™ units with the water quality outcomes required by regulatory authorities. The product may be designed to achieve up to 98% retention of the total suspended solids load, but generally, regulators worldwide are targeting the removal of 75-85% of the total suspended solids load. **Hume***ceptor*™ is not sized using hydraulic design event considerations such as treatment flow rates, since this parameter provides little nexus with water quality outcomes.



Hume*ceptor*™ Design Software is simple to use and comes complete with historical rainfall records from throughout New Zealand.

The adoption of a continuous simulation approach is the recommended approach for the modelling of water quality and stormwater management systems as reflected in the commercially available modelling packages. The software is packaged with historical rainfall data from locations throughout New Zealand covering the major metropolitan and regional centres and may be updated with site-specific rainfall data (for example from a mine site) if available.

The software parameters (hydrology andpollutant export) have been calibrated against field data generated from typical **Hume***ceptor*™ applications. Across all monitoring sites, the correlation coefficient between the software results and the field data is 95%. Consultants, local authorities and customers can therefore proceed with development proposals with a high degree of confidence regarding the likely water quality outcomes from the **Hume***ceptor*™ product.

Hume*ceptor*™ Performance

The performance of the **Hume***ceptor*™ product to deliver a water quality outcome has been extensively verified under field conditions and in many cases certified by regulatory authorities under Environmental Technology Verification (ETV) programs. These conditions implicitly take into consideration the varying hydrologic, hydraulic and pollutant export conditions that exist in the real world. (Note: **Hume***ceptor*™is marketed across North America as Stormceptor®.)


Environmental Technology Verification Program

The Stormceptor® System

Canada

Certification of **Hume***ceptor*™ Performance by Environment Canada in Accordance with the Canadian Environmental Technology Verification (ETV) Program.

Total Suspended Solids

Hume*ceptor*™ is primarily designed using total suspended solids (TSS) as an indicator of overall ecological health. Regulators that have specified the mass removal of TSS are generally targeting the retention of 75-85% of the total suspended solids load. It is important to note that TOTAL Suspended Solids considers all particle sizes as noted below. Caution should be exercised where data is presented that only considers a certain range of particle sizes, since this is not a true measure of total suspended solids, nor is it a true measure of the water quality outcomes desired by regulators.

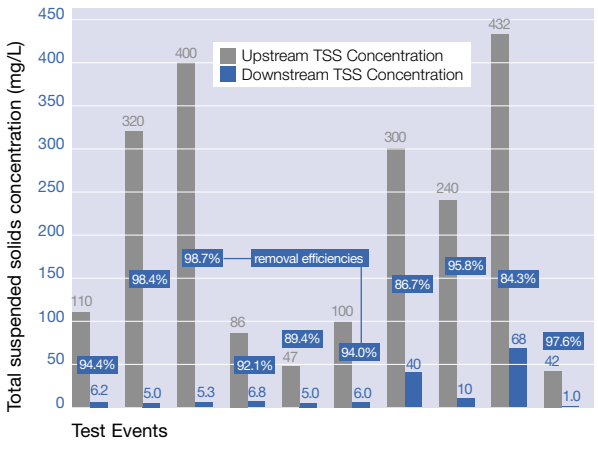
The performance of **Hume***ceptor*™ across a wide range of hydrologic conditions is indicated in the following graph, which shows the concentration of total suspended solids upstream and downstream of various **Hume***ceptor*™ units during rainfall events, sampled using automatic samplers. The mass removal efficiency is also indicated, which demonstrates the ability of the product to deliver a superior water quality outcome.

Total Suspended Solids

The performance of **Hume***ceptor*™ is primarily based on retaining TOTAL Suspended Solids over a long term period across a range of hydrologic conditions. The term total suspended solids refers to the total mass of particulate matter which may be removed from solution by filtration, usually specified as the matter which is retained on a 0.45 µm pore-diameter filter. Total suspended solids is therefore a measurement of all particle sizes that are present within the sample.

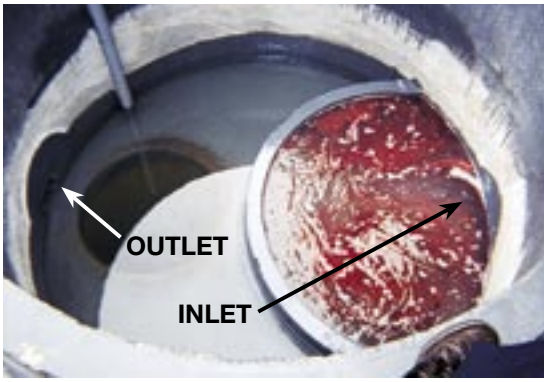
In order to achieve high removal efficiencies of TSS, products must be able to capture and retain fine particles less than 60 µm in diameter, since these generally comprise the majority of the mass load in stormwater runoff. Products marketed on the ability to remove a certain percentage of material down to 150 µm (say) will not perform in terms of a Total Suspended Solids measure. All monitoring data for **Hume***ceptor*™ reports true Total Suspended Solids and for this reason will out perform many other products.

Performance of Hume*ceptor*™ to retain total suspended solids during field validation testing by regulatory authorities



Oil/Total Petroleum Hydrocarbon Capture

The performance of the **Hume***ceptor*™ product to capture and retain floating oils and petroleum/ hydrocarbon products has been demonstrated under both full scale/full flow laboratory verification testing and data collected by regulators under field conditions. **Hume***ceptor*™ is the only product available that can demonstrate the capture of total petroleum hydrocarbons (TPH) under field conditions during wet weather events.



Total Petroleum Hydrocarbon Capture at Full Treatment Flow Rate at Coventry University in Accordance with the European Standard EN 858-1:1994.

Dry Weather Capture Versus Hydrocarbon Removal During Rainfall Events

An important distinction exists between the capture of petroleum hydrocarbons during dry weather and during wet weather events. Dry weather capture reflects the ability of products to capture emergency spills under no flow conditions (i.e. no rainfall occurring at the time of the spill) as opposed to retaining hydrocarbon products being flushed from a catchment during rainfall. In general, it is relatively easy to capture dry weather spill events provided sufficient storage capacity has been provided. However, the removal of oils and petroleum hydrocarbons during rainfall and from runoff is more difficult and requires careful attention to operational velocities and turbulence generated within proprietary devices.

Several proprietary devices are marketed on the ability to capture oils and petroleum hydrocarbons from data generated during dry weather spill events. However, the majority are unable to replicate this capture performance during rainfall, since excessive operational velocities will emulsify collected oils and transport/export them out of the unit.

Humeceptor™ will catch and retain dry weather emergency spills of oils and hydrocarbon/petroleum products and may be configured for highway/freeway and industrial applications to provide capture of products from tanker incidents and other emergency spill situations with capacities to cater for spills ranging between 20,000-60,000 litres.

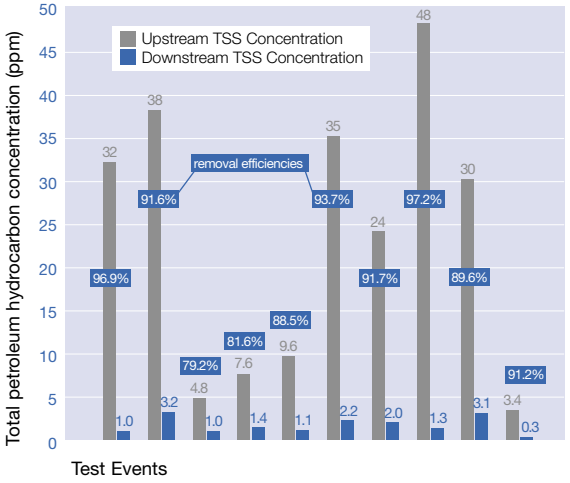
Capture and Retention of Oils/Petroleum Hydrocarbons During Wet Weather

Unlike many alternative solutions, **Humeceptor**™ will also capture oils and petroleum hydrocarbons during wet weather events and retain this material within a protected storage zone until subsequent cleaning of the unit. This ability is primarily the result of carefully controlled flow rates, very low operational velocities and the provision of the secure storage zone removed from the active flow path through the unit, where oils and petroleum hydrocarbons will be retained under quiescent conditions.

The following graph shows a range of field verifications where regulators have tested the performance of the **Humeceptor**™ product to capture and retain oils and petroleum hydrocarbons during rainfall events. As shown, **Humeceptor**™ has the ability to limit the outlet concentrations under 10 ppm for "normal" concentrations exported from urbanised land uses. Where influent concentrations reduce below 10 ppm, **Humeceptor**™ will further retain sufficient hydrocarbons to achieve an outlet concentration generally below 1 ppm. Duncan (1999)[3] reports concentrations of hydrocarbons (oil and grease) from various land uses ranging from 0.5 ppm to 200 ppm, with the higher concentrations being generated from transportation activities.

Minton (2002)[4] further reports mean concentrations ranging from 0.57 ppm to 69 ppm. As shown below, under these "normal" influent concentrations, **Humeceptor**™ will limit the outlet concentrations below 10 ppm retaining in excess of 90% of the total hydrocarbon load during wet weather events.

Performance of Humeceptor™ to retain total petroleum hydrocarbons during field validation testing by regulatory authorities



The following chart shows the performance of **Humeceptor**™ to retain hydrocarbons in situations containing very high influent concentrations.As shown, up to an influent concentration about 2000 ppm, **Humeceptor**™ will continue to limit the outlet concentrations below 10 ppm and achieve very high retention efficiencies around 99%. The last two results also indicate very high retention efficiencies around 98% from a full-scale laboratory test. These results were generated with a very high hydrocarbon influent concentration as shown, introduced to the unit constantly with a continuous full (maximum) treatment flow rate, which reflects relatively extreme field conditions.

Performance of Humeceptor™ to retain high concentrations of total petroleum hydrocarbons during field validation testing by regulatory authorities