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Beach Water Quality Forecast Index
Frequently Asked Questions

Project WATERMAN

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What is Beach Water Quality Forecast Index?

Swimming in sewage-contaminated water may result in gastrointestinal and skin illnesses. To protect public health, Project WATERMAN has developed a beach water quality forecast system by predicting the concentration of the sewage pollution indicator *Escherichia coli* (*E. coli*). Epidemiological studies of swimmers at Hong Kong beaches have demonstrated a strong relationship between the level of *E. coli* and the incidence rate of swimming-associated illnesses.

The beach water quality forecast index is a four-level index system indicating the risk in getting swimming associated gastro-intestinal and skin illnesses when swimming in the water.

Escherichia coli

Beach Water Quality Forecast Index?	Predicted *E. coli* Concentration (cnt/100ml)	Health Risk *
1	≤ 24	Negligible
2	25 - 180	Low
3	181 - 610	Moderate
4	> 610	High

* Health risk: Risk in getting swimming associated gastro-intestinal and skin illnesses.

How do we predict the beach water quality?

Beach water quality forecast model

The forecast model is developed from an integrated approach based on statistical methods, hydro-dynamic modeling and data-driven hydro-informatics tools. The model takes into account the most relevant environmental and hydro-meteorological parameters such as rainfall, solar radiation, onshore wind, tide level, to provide daily forecast of beach water quality.

What is the difference between Beach Water Quality Forecast Index and Environmental Protection Department's beach grading system?

Although they use similar grading scales, the Beach Water Quality Forecast Index and the EPD beach grading are two different systems. The EPD grading is based on the immediate past measurements of *E.coli*. The EPD monitors the beach water quality regularly, and uses the sampling results to grade the beach to reflect the recent bacteriological water quality status.

However, as beach water quality changes rapidly, the current state of water quality may deviate considerably from even the latest grading. In this regard, the Beach Water Quality Forecast Index predicts the most updated water quality status by applying the state-of-art mathematical model. Nevertheless, inherent uncertainty is associated with any forecast of future, and the forecast results should be considered a supplement to the beach grading by the EPD.

What are the factors affecting beach water quality?

Bacterial concentration varies dynamically with time in a complex way in response to pollution inputs and hydro-meteorological factors. The *E. coli* variation pattern is complex, and essentially affected by the following seven hydro-meteorological parameters: rainfall, solar radiation, onshore wind, tide level, salinity, water temperature, and the past *E. coli* level.

Rainfall - When there is a rain event, overflow of bacteria-laden sewage from septic tanks or soakaway pits may happen; bacteria may also be washed off from the land to the beach, deteriorating the beach water quality. Cumulative rainfall of the previous two to three days is generally found to have strong correlation with *E. coli* level.

Solar Radiation - Bacterial mortality increases with ultraviolet radiation. Hence *E. coli* level is negatively correlated with irradiance level. As a rule of thumb, water quality is usually good after a prolonged sunny period.

Onshore Wind - There is a strong correlation between bacterial level and onshore wind speed to the beach. Onshore wind may bring the effluent from a nearby submarine outfall to the beach, or prevent pollutants from dispersing from the beach.

Tide Level - Tidal current can bring the pollutants from the ambiance. Therefore, beaches with nearby submarine outfalls from sewage treatment plants may have strong correlation between *E.coli* level and tide level. In addition, when there is a high tide level, the swimming zone is moved onshore, where more human activities take place. Water closer to the beach shoreline are more likely to be polluted than the offshore area.

Salinity - Salinity is another indicator similar to rainfall, but with a more direct implication on freshwater impacts. While ambient marine water usually has a salinity around 33 ppt, after heavy rain beach salinity may drop to below 10 ppt. At beaches with polluted streams or storm drains in close proximity, a low salinity is usually associated with high bacterial level.

Water Temperature - Microbial activities increase with water temperature, and there is a positive correlation between *E. coli* level and water temperature at the beach. The seasonal variation of water quality also shows that *E. coli* concentration is typically higher in the summer.

Past *E. coli* level - It is observed that there is high temporal coherence in beach water quality variations. For instance, a beach with a good water quality record in the past is likely to stay clean in the near future.

What is the benefit of having the Beach Water Quality Forecast Index?

The WATERMAN system offers the daily Beach Water Quality Forecast Index to the public, with forecast models setup based on hydro-meteorological factors that will affect the *E. coli* concentration. It can supplement the existing weekly beach water quality grading system which shows only the general trend of the beach water quality over a long duration of recent past. The model also indicates days with good water quality so that bathers can gain confidence in going swimming in the beach.

Silver Mine Bay Beach in Lantau Island

Has any overseas region/country adopted similar kind of beach water quality forecast system?

In recent years, a number of overseas authorities have put in place some form of systems to forecast beach water quality, for instance, Huntington beach and Edgewater beach in Ohio, USA; the ocean and harbour beaches in Sydney, Australia; Islands Brygge beach and Amager Strand beach in Copenhagen, Demark and 11 bathing beaches (in the sea, inland lochs and rivers) in Scottland have some form of beach water quality forecast system.

The use of real-time system in predicting water quality deterioration, arising from adverse weather (especially heavy storm) conditions, to safeguard health of swimmers was recommended in the WHO's 2003 guidelines for bathing waters. The EC bathing directive 2006 also requires the EU Member States to inform and warn the public whenever short-term pollution was predicted or present. In addition, there is a growing global trend to adopt beach water quality forecasting systems, noting that they are particularly useful in predicting occasional deterioration of bathing water quality due to polluted surface run-offs after heavy storms. Such systems together with best management practices should be able to effectively reduce health risk to bathers.

If the beach water quality forecast index is sometimes different from the EPD grading, which one should we follow?

At present, the beach water quality forecast index should not be considered an official guidance for swimmers. During this pilot phase, the operational feasibility of the forecasting system will be tested, and the beach water quality forecast index will only be used as an intelligence of possible deterioration of beach water quality. Therefore, the forecast index should only be taken as a supplement to the existing EPD grading. Meanwhile, EPD will continue to advise bathers whether the water quality is suitable for swimming based on their beach water quality monitoring results.

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