

# Broadland Flood Alleviation Project

Protecting



## Land Survey with use of GPS Technology

Broadland

### WHAT IS GPS?

The Global Positioning System (GPS) is a world-wide radio-navigation system formed from a constellation of 24 satellites and their ground stations.

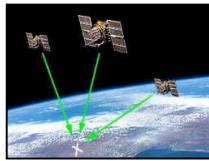
It was built in 90's by U.S. Department of Defence to provide a super precise positioning system for its military for just \$12 billion.

"Man-made stars" are the reference points to calculate positions accurate to within 10 millimeters.



### HOW GPS WORKS?

The whole idea behind GPS is to use satellites in space as reference points for locations here on earth. By very, very accurately measuring our distance from at least three satellites we can "triangulate" our position anywhere on earth.



To "triangulate", a GPS receiver measures distance using the travel time of radio signals to satellites. To measure travel time, an accurate timing is the key.

Satellites are extremely accurate because they all have atomic clocks on board. Receiver clocks on earth do not have to be as accurate because an extra satellite range measurement can remove errors.

Along with distance, we need to know exactly where the satellites are in space. The basic orbits are constantly monitored by the U.S. Department of Defense who use precise radar to check each satellite's altitude, position and speed.

The errors are caused by gravitational pulls from the moon and sun and by the pressure of solar radiation on the satellites. These are usually very slight but if we want great accuracy they must be taken into account.

Finally a correction is made for any delays the signal experiences as it travels through the atmosphere.

### DIFFERENTIAL GPS

Differential GPS involves the co-operation of two receivers, one that is stationary and another that is roving around making position measurements.

The stationary receiver is the key. It ties all the satellite measurements into a solid local reference.



Trimble Base Station at Haddiscoe Island

The satellites are so far out in space that the little distances we travel here on earth are insignificant.

So if two receivers are fairly close to each other, say within a few kilometers, the signals that reach both of them travel through virtually the same slice of atmosphere, and so have virtually the same errors.

### HOW DIFFERENTIAL GPS WORKS?

The idea is simple. We have to put the reference receiver on a point that has been very accurately surveyed and keep it there.

This reference station receives the same GPS signals as the roving receiver but instead of working like a normal GPS receiver it attacks the equations backwards.

Instead of using timing signals to calculate its position, it uses its known position to calculate timing. It figures out what the travel time of the GPS signals should be, and compares it with what they actually are. The difference is an "error correction" factor.

Since the reference receiver has no way of knowing which of the many available satellites a roving receiver might be using to calculate its position, the reference receiver quickly runs through all the visible satellites and computes each of their errors.

The receiver then transmits this error information to the roving receiver so it can use it to correct its measurements.



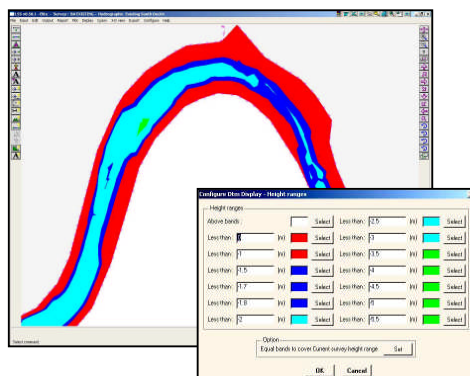
Trimble Roving Station

## PRACTICAL APPLICATIONS OF GPS TECHNOLOGY - HYDROGRAPHIC SURVEY

A full hydrographic survey of the Broads Rivers has been carried out in partnership with the Broads Authority.

This information will allow monitoring sediment transfer when sheet piles are removed as part of setting back the banks.

The Broads Authority are using the information as part of their sediment management strategy to identify areas and assess quantities for river dredging.



Hydro survey



Hydro-boat



Hydro-kit

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## Land Survey and Floodbank Design

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