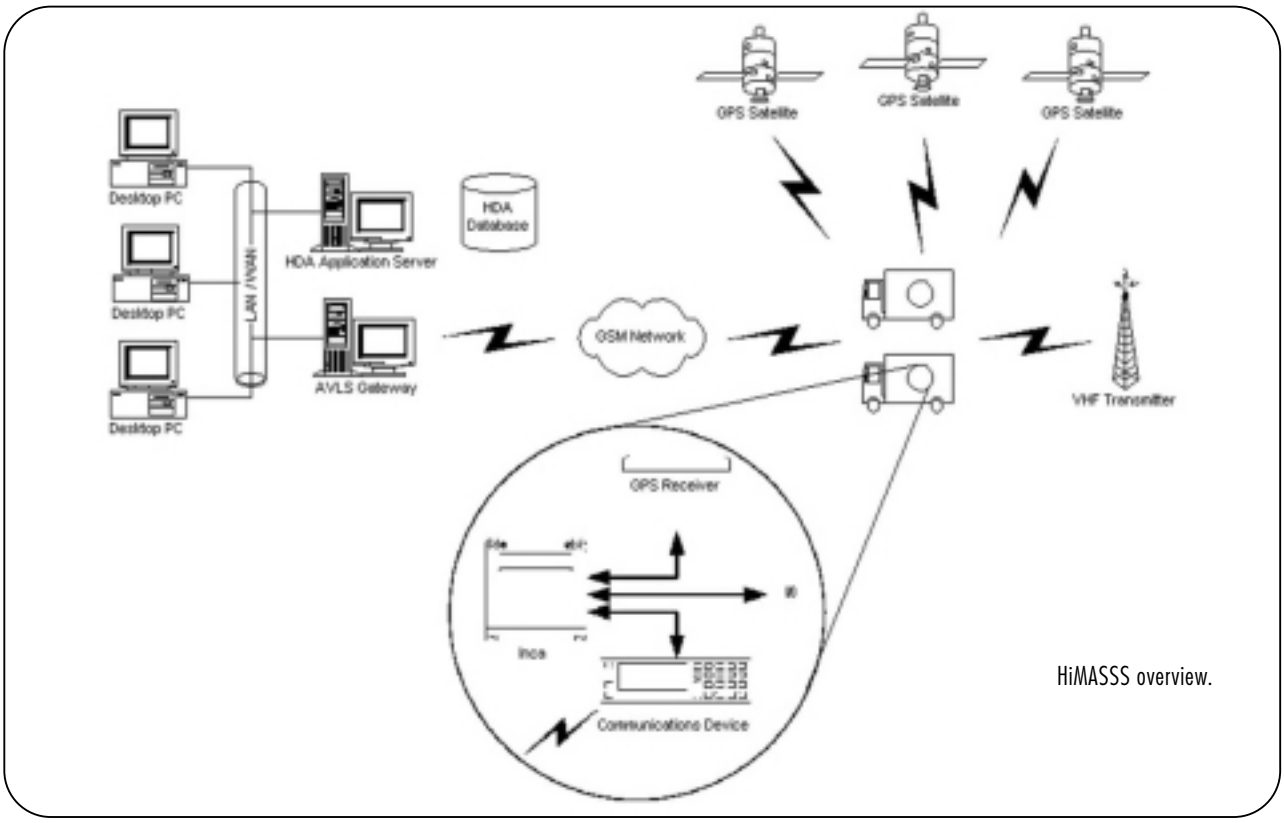
NETWORK MANAGEMENT NOTES

HIGHWAY MAINTENANCE SATELLITE SUPPORT SYSTEM (HIMASSS)



HiMASSS overview.

Highway maintenance has, and, is set to continue to experience the largest growth compared to any other sector of civil engineering in the UK, and as such is the most competitive. Winning new work is not the only priority to guarantee the future; renewing existing contracts is just as important. Today this can only be achieved by completing work to consistent high standards and providing the Client with services that competitors cannot offer.

Scope for procedural improvements in a number of highway maintenance operations has been indentified.

Gully Cleansing operations:

- More comprehensive reports and comments from production staff regarding work carried out and problems encountered;
- Verification of time taken for "dayworks";
- Proof of work carried out on site;
- Time to/from site and tip;
- Measure duration of cleansing activity at each unit, and
- Accurate recording of units which cannot be cleansed, in terms of location and state of repair.

Emergency Response operations:

- Improvement in the quality of information reported by production staff;
- Proof of attendance on site/at scene;
- Reduction in the need for supervision.

One supervisor to look after Client and Contractor interests;

By S Newell

Stewart Newell is a Director of RCS and has a strong career background in Local Authority highway maintenance. He is a firm believer in partnering and innovation to streamline client and contractor operations in the interests of Best Value.

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- A reliable measurement of the time taken to attend;
- A more efficient means of reporting to the client, and
- A reduction in the time taken to allocate a vehicle to an emergency.

Street Lighting operations:

- Vehicle tracking to verify operational use
- Measurement and recording of work achieved on site, both in labour terms and in material quantities
- Supply production staff with their work more efficiently and accurately

As a result of the identification of these criterion in partnership with APD Communications, RCS has developed HiMaSSS, a management tool for highway maintenance operations supported by the Global Positioning System (GPS).

How does it work?

At the heart of HiMaSSS is APD Communications' INCA product, a vehicle–installed intelligent GPS modem, comprising a GPS Receiver, Flash disk (data storage device), and Modem. According to the application, the modems are interfaced with devices, which monitor the vehicles' operational status, and dash–mounted MDT's (Mobile Data Terminals/touch–screen consoles), which allow staff to perform data entry. This is combined with a device similar to a mobile telephone, which facilitates communication with a fixed site via the global system for mobile communication (GSM) (Fig 1).

The intelligent modems utilised by the system continually monitor and record data relating to a vehicle's status derived from events generated when pre–programmed triggers are activated and conditions satisfied.

The Global Positioning System (GPS)

GPS comprises of 24 US Department of Defence maintained satellites orbiting the Earth at a height of about 11,000 miles. The orbital paths of the satellites ensure that every part of the Earth's surface can see them. Each of the satellites repeatedly transmits one of 32 different codes (these codes are built–in to every GPS receiver at the time of manufacture). By tracking at least three of these codes (ie, three different satellites) and calculating how long the signals have taken to travel to the receiver, the receiver's exact position on the Earth's surface can be determined. A GPS receiver calculates its position every second and can work out speed and direction of travel if appropriate.

In summary, a GPS receiver provides:

- Date/time
- Latitude/longitude (typically <10m error)*
- Speed
- Direction of travel (in degrees)

*With HiMaSSS the positional accuracy of the GPS information is enhanced to only ±m error by using "Differential GPS" or DGPS with a service provided by Focus FM.

This works by calculating the instantaneous difference between a GPS derived latitude/longitude and the "true" latitude/longitude of a previously surveyed location, such as a radio/TV broadcasting mast. By making this error value known to GPS receivers, adjustments to their calculations can be made accordingly, thus improving positional accuracy. Despite the relatively recent termination of Selective Availability (SA), which was the deliberate degradation in the quality of GPS by the US Department of Defence, the accuracy of GPS remains subject to inaccuracies resulting from natural degradation. DGPS is therefore still useful in position critical applications such as Gully Cleansing and Street Lighting.

INCA

With continuous one–second updates from its GPS receiver, INCA constantly knows the position, speed and direction of travel of the vehicle to which it is fitted. In addition to this it has "inputs" which can be wired to the vehicle's Ignition, Power Take Off (PTO), Doors, Panic Buttons, etc.

It also has its own memory, enough for over 10,000 records, allowing it to record accurately a vehicle's activity over time. These records can be later downloaded via the GSM network (or other wireless network).

At any time, a current position report can be requested from an INCA installed vehicle. If fitted with an MDT, text messages sent from the office via e–mail can also be displayed.

Where is it being used?

HiMaSSS is currently installed in a number of Emergency Response, Gully Cleansing, Routine Maintenance, Street Lighting, and Winter Maintenance vehicles operating in five of RCS's seven Term Maintenance Contracts in the UK.

Gully Cleansing

In Gully Cleansing activities, the vertical displacement of the Gully Emptier's boom or the activation of the PTO when cleansing automatically "logs" the position of the unit on the HiMaSSS Flash disk. When the position is "logged" the Operator is prompted by the MDT to enter:

1. The unit type attended
2. Its current state of repair
3. The nature of any work undertaken

In addition to this, further information can be added before moving on to the next unit.

A string of information is generated from a series of pre–programmed buttons shown in the table detailed opposite (where additional information is required an integrated keyboard can be used):

A typical string might be:

Gully/No Fault/Cleansed

The information derived from the switches and MDT's is supplemented by location and time data generated by GPS, which is then stored locally on the flash disk until it is reported to the office. Such reports can be self initiated by the operator, by a pre–programmed trigger, such as ignition off, or requested by a supervisor.

The management of the information

The system is currently being used in conjunction with the Gully Cleansing Contract with Hampshire CC to provide the council with an accurate inventory of its Gully type assets. As a result of this, it is possible to

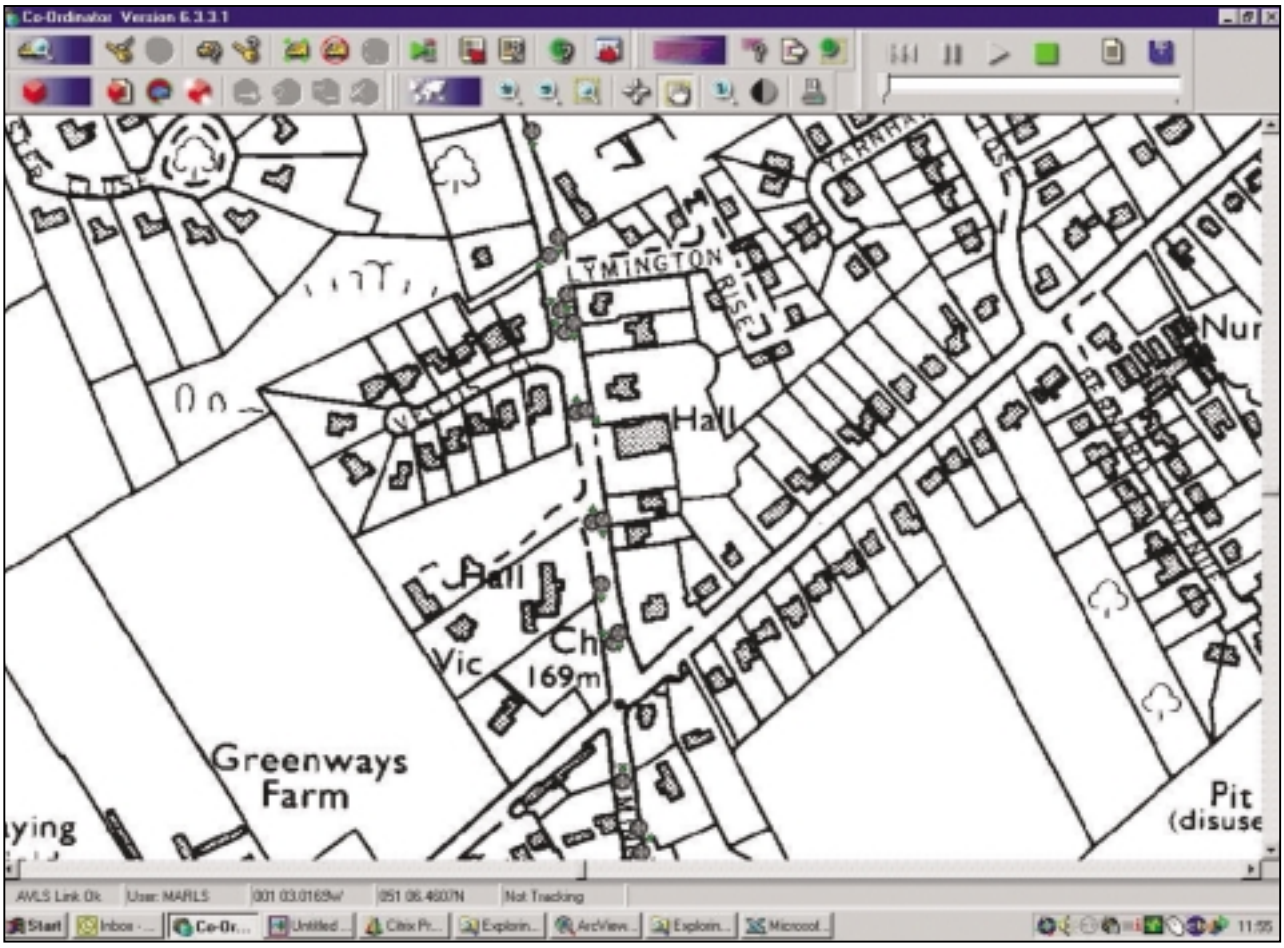
Unit Type	Current State of Repair	Work Undertaken	Comments
Gully	Broken Grid	Cleansed	
Double Gully	Blocked Connection	Not Cleansed	
Catch Pit	Brickwork Damaged		
Cattle Grid	Lid Jammed		
Linear Drainage	Dig Out		
Soakaway 0–2m^3	Obstruction		
Soakaway 2–4m^3	Vehicle Over		
Soakaway 4–8m^3	No Fault		

electronically report the precise location of defective drainage items, including their current state of repair (Fig 2). In addition to this, "whereabouts" or "output" reports can also be provided electronically to enable the operation to be closely monitored by both Contractor and Client (Fig 3).

Once the server's database has been updated, the information can be immediately interrogated via any connected PC, providing the PC has been installed with the supervision software. As well as revealing this information pictorially in relation to 1:250 000, 1:50 000 and 1:10 000 digital maps (Fig 4), the software presents the user with further tools, which for example can be used to determine the location of a Gully Emptier upon request.

EAST	Ref	Road Name	Easting	Northing	Unit	Fault	Action
9/28/00	76B3006AJ	STATION ROAD	477142	128636	Gully	VO	NC
9/28/00	76B3006AJ	STATION ROAD	477212	128432	Gully	LJ	NC
9/28/00	76B3006AJ	STATION ROAD	477624	127779	Gully	VO	NC
9/28/00	76B3006AJ	STATION ROAD	477225	128421	Gully	DO	NC
9/28/00	76C114AA	HOLLYWATER RD	473053	138757	Gully	BG	NC
9/28/00	76C114AA	HOLLYWATER RD	473290	138692	Gully	DO	NC
9/28/00	76C114AC	HOLLYWATER ROAD	475339	138047	Gully	DO	NC
9/28/00	76C114AC	HOLLYWATER ROAD	475393	138055	Gully	DO	NC
9/28/00	76C114AC	HOLLYWATER ROAD	475341	138057	Gully	LJ	NC
9/28/00	76C114AC	HOLLYWATER ROAD	475368	138052	Gully	DO	NC
9/28/00	76C86AP	FLEXCOMBE LINK OVERPASS	476750	126944	Gully	OB	C
9/28/00	76U211AA	WARREN ROAD	479314	128783	Gully	BD	NC
9/28/00	76U216PQ	HENWOOD DOWN (SPUR)	475360	123380	Gully	Vo	NC

Fig 2: An extract from a typical fault report (refer to key).



HiMaSSS screen shot. OS Licence No. WL 5612.

Ref	Road Name	Vehicle	Road	Date	Gullies		
EAST					R	V	C
76U211AC	MINT ROAD	HGC2	3	28/09/00	2	3	3
76U211AG	WYLD GREEN LANE	HGC2	3	28/09/00	4	3	3
76U211AJ	DUCKMEAD LANE	HGC2	3	28/09/00	5	3	3
76U211AA	WARREN ROAD	HGC2	3	28/09/00	2	1	0
76C86AJ	HATCH LANE	HGC2	3	28/09/00	6	4	4
76C86AP	FLEXCOMBE LINK OVERPASS	HGC2	3	28/09/00	20	1	1
76B3006AJ	STATION ROAD	HGC2	3	28/09/00	26	26	22
76B3006AN	FARNHAM ROAD (PART)	HGC2	3	28/09/00	15	10	10
76U216PP	HENWOOD DOWN (SPINE)	HGC3	5	28/09/00	5	4	4
76U216GS	MARDEN WAY	HGC3	5	28/09/00	8	12	12
76C70AL	ISINGTON FARM LANE	HGC4	2	28/09/00	5	11	11
76U216PQ	HENWOOD DOWN (SPUR)	HGC3	5	28/09/00	4	4	4
76B3004AE	CAKERS LANE	HGC4	2	28/09/00	65	57	55
76U216PT	BEPTON DOWN (N.SPUR)	HGC3	5	28/09/00	4	3	3
76U216PR	BEPTON DOWN (SPINE)	HGC3	5	28/09/00	5	5	5
76U216PS	BEPTON DOWN (W.SPUR)	HGC3	5	28/09/00	2	2	2
Sub–Total					**311**	**203**	**195**

Fig 3: An extract from an output report (refer to key).

Key:

VO	Vehicle Over
LJ	Lid Jammed
BG	Broken Grid
DO	Dig Out Required
OB	Obstruction, eg, overhanging foliage
BD	Brickwork Damaged
NC	Not Cleansed
C	Cleansed/Number cleansed
R	Number previously recorded/client inventory
V	Visited

A further tool converts the geographical information generated by HiMaSSS from Latitude & Longitude to GIS (Geographical Information System) friendly Ordnance Survey Grid Reference (OSGR) Eastings & Northings. Thus allowing immediate use of HiMaSSS derived information in the client's GIS.

What are the benefits?

With the information recorded and reported, improvements in efficiency and reductions in operational costs can be realised to the benefit of both Contractor and Client:

- Reduction in paperwork and removal of duplication. Information is recorded once only in an electronic format during completion of work on site
- Minimisation of direct supervision through the use of PC based supervision tools and geographically referenced reports
- Creation and maintenance of client asset inventory
- Improved service in terms of emergency response times and proof of attendance/work
- Reduction in administration, for example invoice processing time
- Improved accountability in terms of emergency response and waste management

Future development

Following the successes attained from the full implementation of the system in Gully Cleansing activities in particular, the system is currently being developed to support Emergency Response activities.

It is envisaged that hand held data capture systems will be integrated to enable a means of truly mobile data capture for production staff in activities less conducive to the current vehicle based solution.

Other developments include new touch screens to give greater flexibility to the operator and the integration of OSCAR (Ordnance Survey Centre Alignment of Roads) product with data processing which will enable roads visited to be identified from co–ordinates derived from HiMaSSS hardware.

List of Acronyms:

DGPS	Differential GPS
GIS	Geographical Information Systems
GPS	Global Positioning System
GSM	Global System for Mobile communication
HDA	HiMaSSS Data Analysis
HiMaSSS	Highway Maintenance Satellite Support System
MDT	Mobile Data Terminal
OSGR	Ordnance Survey Grid Reference
PTO	Power Take Off
RCS	Raynesway Construction Southern
SA	Selective Availability

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