St.Agnes Qualitative Dye Survey
22 August 1995

TWQ/95/17

Tidal Water Quality

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St. Agnes - Qualitative Dye Survey - 22/8/95 - Neap Tide

1.0 Introduction

This survey was carried out as part of the NRA's assessment of the application by SWWSL to discharge sewage via a new outfall 600m west of the EC bathing water of Trevaunance Cove. This survey was undertaken on a neap tide with the predicted tidal times at Perranporth (4 km NE of St. Agnes) being:

22 August 1995		
	Time (BST)	Height (mAOD)
HW	3:21	5.3
LW	9:43	2.3
HW	15:48	5.6
LW	22:18	2.1

Table 1 shows the programme of events undertaken during this survey which was defined by Tidal Water Quality and carried out by Cornwall Investigations in association with Tidal Water Quality.

Dye (both flourescein and rhodamine) was syphoned down a long tube from the cliff top to the base of the cliffs at the outfall location. The end of the tube was weighted to ensure injection sub-surface, and supported approximately 0.75m above by a buoy.

Initial dye injection commenced at HW+4 (the approximate beginning of the easterly [flood] tide). Each dye injection consisted of 2 litres of flourescein or rhodamine diluted with fresh water to make up 20 litres of dye solution.

Enough dye solution was made up to undertake an injection every hour from HW-4 to HW+2, (approximate flood tide) although dye advection in the vicinity of the outfall was slow and fewer dye injections were necessary. (See Table 1 for actual injection times).

The dye patches were to be fixed with differentially post processed data from the Global Positioning System (GPS) backed up by a photographic chronology of each patch from the cliff top. Due to equipment malfunction during the survey, the dye patches were fixed at points via non-differential GPS. A picture of dye movement was then built up although not with the sub-5m accuracy of the Differential GPS system.

3.0 Results and Discussion

Table 2 shows the wind observations made during the survey with Table 3 showing temperature and salinity profiles. The salinity measurements made are higher than the salinities known to exist in this area. It is suggested that the measurements are inaccurate (too high). However, they can be used comparatively to determine salinity trends and compare spatial and temporal variability.

Individual dye releases are described below.

HW+4 Release (Fluorescein)

This dye release initially headed west, with the leading edge reaching a point 100m west and 150m offshore of the discharge point by HW+5. Around LW the dye patch (still coherent and concentrated) became static. Movement eastward, indicating the commencement of the flood tide, began at approximately HW-5:50.

Shortly after the eastward movement began the leading eastern edge of the patch began to break up. By HW-4:50 a small patch had broken away from the main body and moved offshore (as well as eastward). This patch comprised of very diluted fluorescein which was soon invisible to the naked eye. The main patch moved east along the base of the cliffs reaching Polberro Cove at HW-4:50 (Plate 1) and the old discharge point at HW-4. The trailing edge of the fluorescein was just moving away from the discharge point at this stage.

At HW-3:40 the visible dye was at its furthest easterly position, 200m or so past the western headland of Trevaunance Cove. The dye was moving across Trevaunance Cove, not into it. The dye at this position was difficult to see and disappeared from sight around HW-3:30, still moving across the bay. Dye was still visible along the cliffs between the discharge point and the old outfall position.

HW-4 Release (Rhodamine)

This release dispersed in a mainly offshore direction, initially with a small easterly component (Plate 2). The offshore dye quickly sunk but was still visible indicating that the dye had not sunk more than a couple of metres. The dye still near the outfall was buoyant however. A temperature and salinity profile taken at HW-2:15 (see Table 2 and Fig 3) shows significant stratification due to both a strong halocline and thermocline. It is possible that the dye encountered this less dense water mass (probably originating from the present Trevaunance Cove outfall) and was subducted beneath it. This feature was either transitory or of a small, local scale as no other profiles identified this water mass during the survey.

By HW-2 a secondary arm was developing in a northerly direction, as opposed to the main transport NNW (Plate 3). Soon after this occurred the whole patch began to move westerly, very slowly, at approximately HW-1:45. This shows the onset of the ebb tide. A fairly strong offshore dispersion was prevalent concurrent with the westerly transport.

HW-0:50 Release (Fluorescein)

This release confirmed that the ebb tide had commenced as the dye moved westwards immediately it became visible in the waters at the base of the cliffs. A small offshore component was also present acting on the dye.

4.0 Conclusions

The dye releases showed the onset of the flood tide to occur around HW-5:50 with the ebb beginning around HW-1:45. The duration of the flood tide was therefore approximately 4 hours 5 minutes.

The early flood tide dye discharge reached the edge of Trevaunance Cove but no visual tracking was possible any further than this. It is therefore not possible to say if the Trevaunance Cove Bathing Water was impacted by the dye on the succeeding ebb.

5.0 Reference

1) South West Water Services Ltd., St.Agnes Site Specific Survey, Nov 1994.

Table 1: Trevaunance Cove Survey Work - Programme Of Events, 22 August 1995.

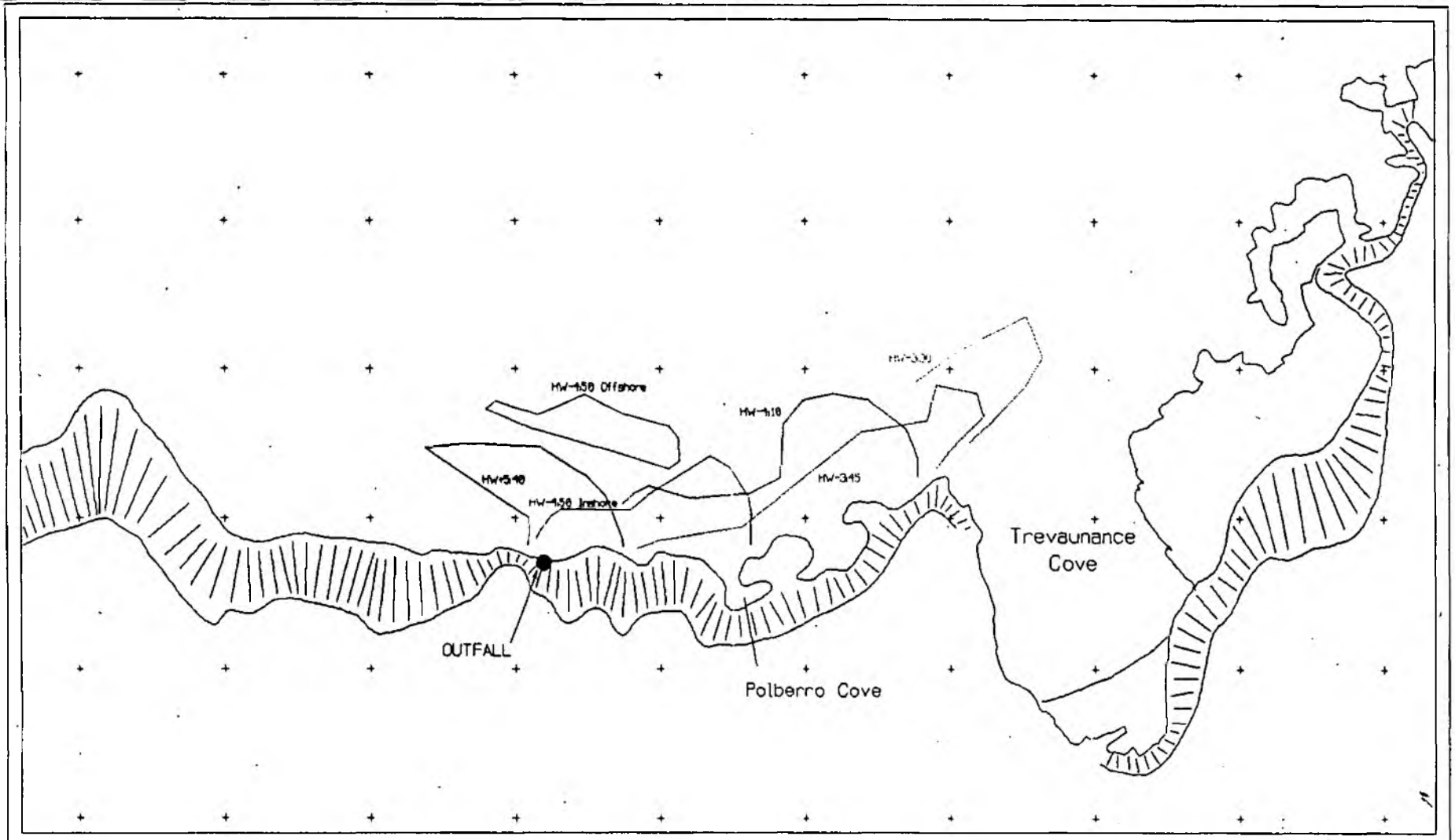
Location	Task	BST and Tidal Times wrt Perranporth								
		07:20	08:20	09:20	10:50	11:50	12:50	13:50	14:50	15:50
		HW+4		HW+6		HW-4		HW-2		HW
Outfall Site	Dye Patch Injections (Alternate rhodamine & fluorescein)	*				*			*	
Offshore	Patch Delimitation (Including Temp & Salinity profiling)									
Clifftop	Photography									

Table 2: Meteorological Observations

Time (BST)	Location	Direction (Deg)	Speed (m/s)
07:20	Cliff Top	-	0
07:40	Offshore	-	0
09:20	Offshore	315 - 360	<1
09:25	Cliff Top	315	<1
10:30	Offshore	315 - 360	<1
11:20	Offshore	315	<1
14:00	Offshore	315	2
14:02	Cliff Top	315	2
16:15	Offshore	270	2 - 4

Table 3: Temperature and Salinity Profiles

Time (BST)	Time (wrt HW)	Easting	Northing	Depth (m)	Temperature (Deg C)	Salinity (ppt)
08:10	HW+4:49	171441.7	51794.3	0.1	18.26	36.1
				1	18.16	36.1
				2	18.09	36.1
				3	18.11	36.2
09:49	LW	171538.2	51833.9	0.1	18.78	35.9
				1	18.33	36.1
				2	18.30	36.1
				3	18.23	36.2
11:20	HW-4:28	171706.6	51882.5	0.1	18.92	36.1
				1	18.78	36.1
				2	18.41	36.2
				3	18.26	36.2
				6	17.96	36.3
13:33	HW-2:15	171578.9	51813.8	0.1	20.01	35.1
				1	19.04	35.8
				2	18.56	36.0
				3	18.41	36.0
				4	18.05	36.0
				5	17.96	36.1
15:04	HW-0:44	171575.2	51866.1	0.1	19.64	36.0
				1	19.32	36.0
				2	18.34	36.2
				3	18.06	36.2
				4	18.01	36.2



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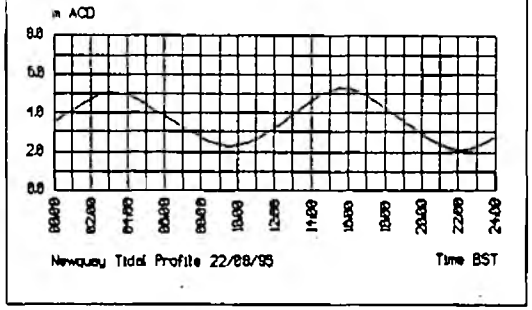
Dye Tracing Survey

22nd August 1995

09:00 to 12:15 BST

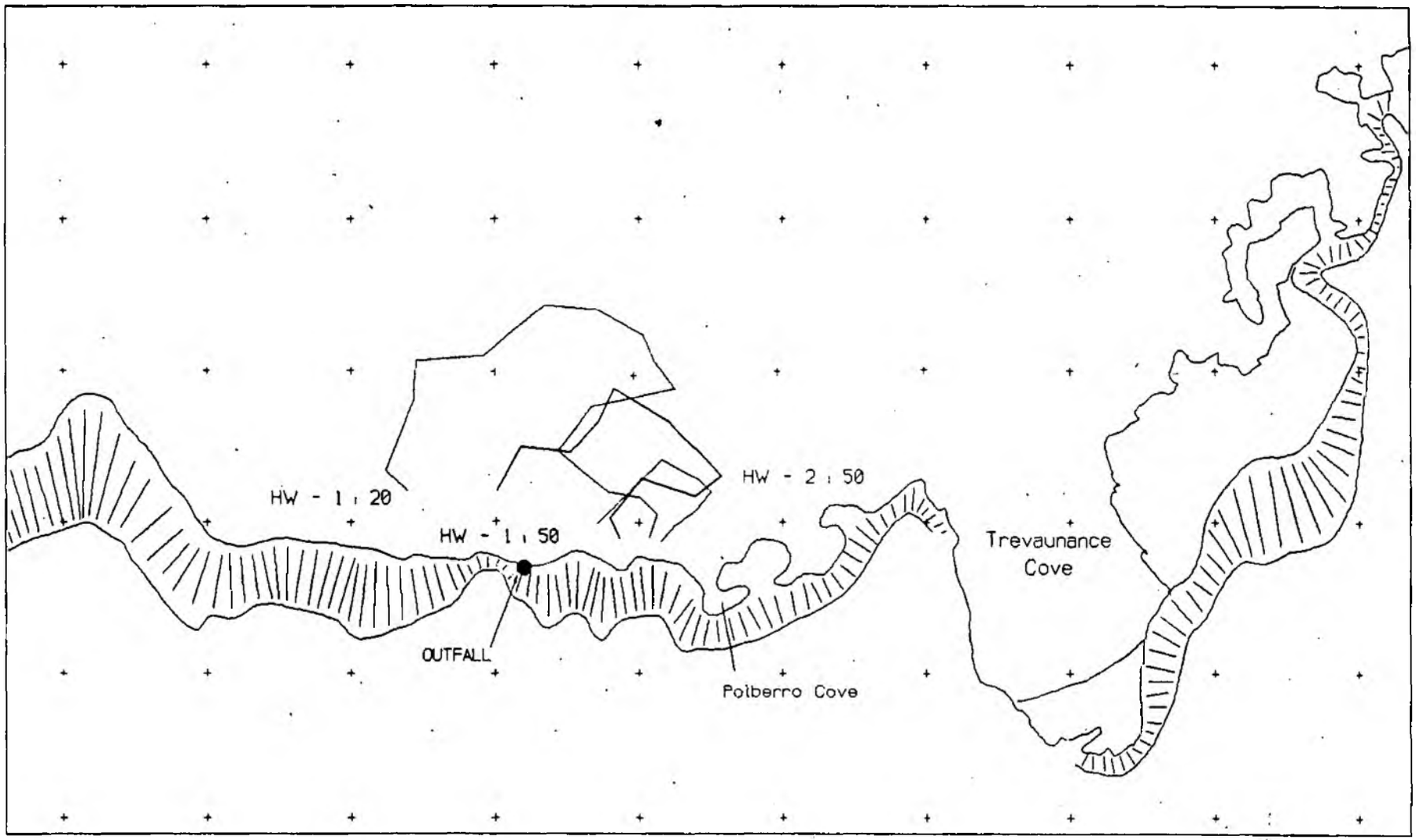
HW+4 Release



Dye Patch Positions

Delimited By GPS

Figure 1



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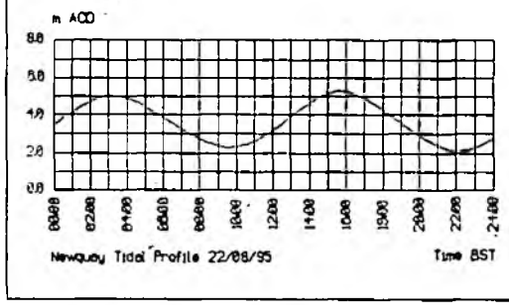
Dye Tracing Survey

22nd August 1995

11:47 to 14:25 BST

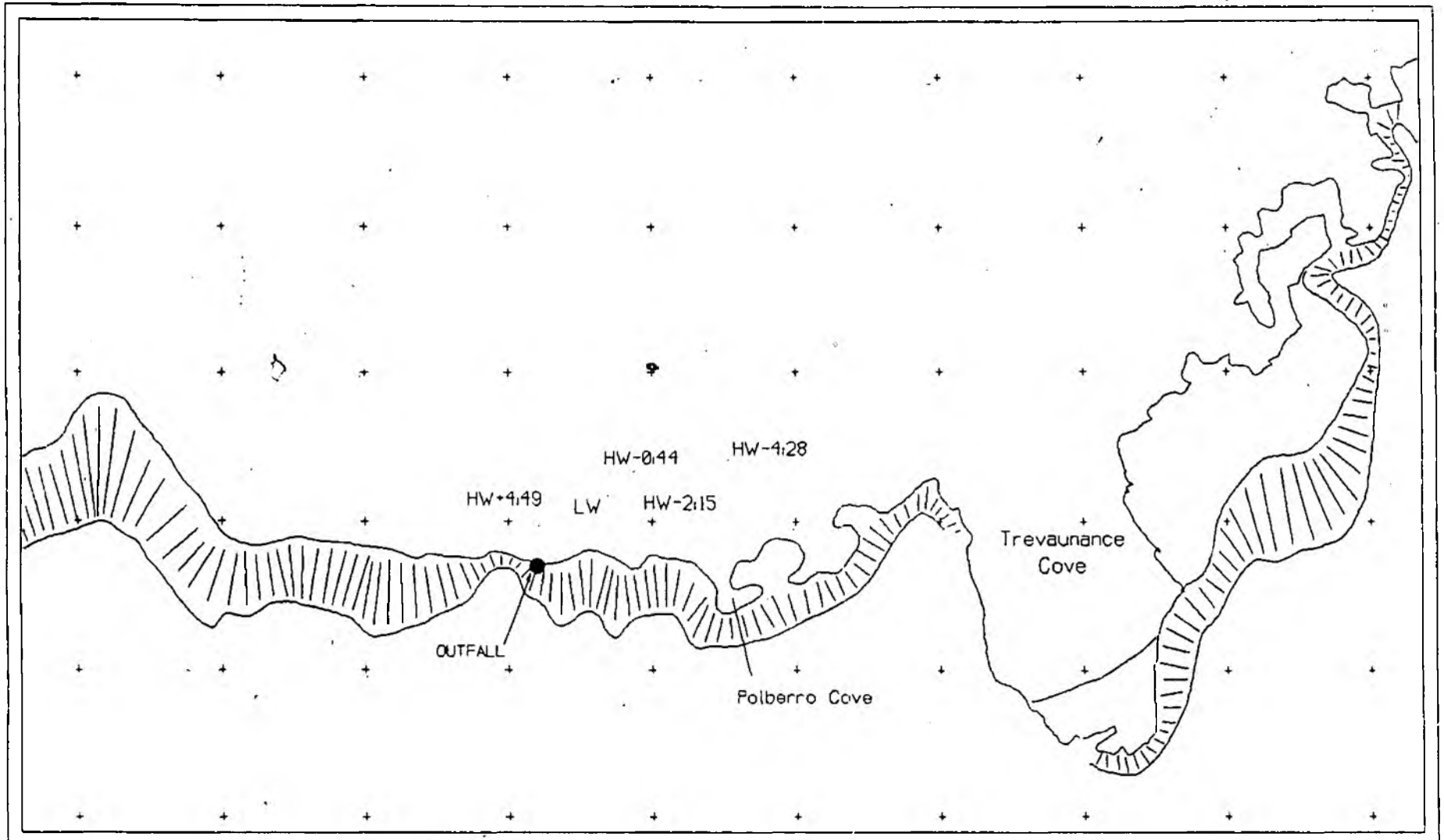
HW-4 Release



Dye Patch Positions

Delimited By GPS .

Figure 2



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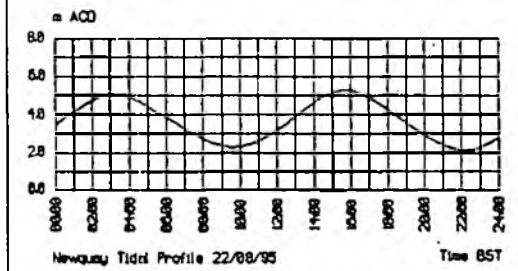
Profiling Locations



Positions Defined by GPS

Figure 3

Plate 1 : HW + 4 release (fluorescein) at HW - 4:51. Dye extends east of discharge location to Polberro Cove.

Plate 2 : HW - 4 release (rhodamine) at HW - 2:35. Dye extends from discharge location offshore NE. Fluorescein from the HW + 4 release can be seen in the bottom left in Polberro Cove

Plate 3 : Rhodamine from the HW - 4 release at HW - 2:03