

Environmental Protection Internal Report

REGIONAL WATER QUALITY MONITORING AND SURVEILLANCE PROGRAMME FOR 1992

OPERATIONAL INVESTIGATION PROGRAMME AT WHEAL JANE TIN MINE, CORNWALL

June 1992

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Author: R M Hamilton

Regional Environmental Scientist

C.V.M. Davies
Environmental Protection Manager



NRA

*National Rivers Authority
South West Region*

REGIONAL WATER QUALITY MONITORING AND SURVEILLANCE PROGRAMME FOR 1992

OPERATIONAL INVESTIGATION PROGRAMME AT WHEAL JANE TIN MINE, CORNWALL.

Technical Report No. OI/92/001

Summary

The monitoring and investigation programmes associated with the Wheal Jane mine project are described, in so far as they generate samples which are analysed in NRA laboratories.

The programme includes elements for the assessment of groundwater quality, treatment effectiveness, and impact on both fresh and tidal waters. Due to the changing nature of the problem, the investigative content of the programme is necessarily flexible. Only estimated numbers of sampling points, samples and Analysis Required Groups are given.

A summary of the estimated numbers of samples, by type and material is given below:

ESTIMATED NUMBER OF SAMPLES

TYPE	MATERIAL			
	WATER	SEDIMENT	BIOACCUMULATION	BIOLOGY
Groundwater	276			
Treatment System	365	50		
River	646	50		42
Tidal Waters	832	101	70	70

R. M. Hamilton
Regional Environmental Scientist
June 1992

ENVIRONMENT AGENCY



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1. Introduction

This report describes the monitoring and investigation programmes for 1992/93 which are part of the Wheal-Jane Project.

2. Description of Programme

The abandoned tin mine at Wheal Jane in West Cornwall began to overflow in November 1991. A contingency plan was put into operation, but this failed in January 1992, leading to a major pollution event which affected the River Carnon and the tidal waters of Restronguet Creek, Carrick Roads and Falmouth Bay. Subsequently, pumping water from the mine and treating it before discharge to the Clemows Stream has reduced the polluting discharge. This system is being operated whilst a long term solution is sought.

The mine water contains high concentrations of cadmium, an EC List I dangerous substance, and of many EC List II metals. EC Dangerous Substances Directives and UK legislation indicate the need to monitor and report on the discharges of such substances, and to introduce proposals to eliminate List I or reduce List II substances.

Use-related Environmental Quality Objectives have been adopted and Environmental Quality Standards have been identified against which compliance can be assessed.

The programme contains a number of elements. These are shown below, together with the materials sampled and analysed, in parentheses.

- * assessment of groundwater quality (water)
- * assessment of treatment method effectiveness (water, sediment)
- * assessment of impact on River Carnon (water, sediment, biology)
- * assessment of impact on tidal waters (water, sediment, biota, biology)

A variety of investigations are being undertaken to assist in the development of a long term solution. Due to the changing nature of the problem, the investigative content of the programme is flexible. It is appropriate, therefore, to give only estimated numbers of sampling points, samples and Analysis Required Groups (ARGs).

3. Programme Information

The table below shows, in summary, the estimated number of sampling points and samples, and the ARGs.

Wheal Jane Programme 92/93 Summary

Sampling Point	Estimated Number of Samples	ARG	Estimated Numbers
<u>Groundwaters</u>			
No. 2 shaft	52	S 473	52
		S 102	12
Nangiles	52	S 473	52
		S 102	12
County Adit	52	S 473	52
		S 182	12
Wellington Adit	12	S 473	12
		S 182	12
Other shafts	108	S 325	108
<u>Treatment System</u>			
Tailings Dam	50	WJSD	50
Polishing Lagoon	365	S 481	365
		S 473	52
		S 182	12
<u>River Carnon</u>			
Twelveheads	52	S 473	52
		S 182	12
d/s Wellington Adit	52	S 473	52
		S 182	12
Points Mill	52	S 473	52
		S 182	12
Hicks Mill	12	S 473	12
		S 182	12
u/s Clemows Stream	12	S 473	12
		S 182	12
Clemows Stream	52	S 473	52
		S 182	12
d/s Clemows Stream	12	S 473	12
		S 182	12
Devoran Bridge	52	S 473	52
		S 182	12
<u>General</u>			
Pollution	250	S 481	250
River	100	N.D.	N.D.
Sediment	50	WJSD	50

N.D. = Not determined.

River Biology

Chacewater Viaduct	3	}	All biology samples
d/s Chacewater STW	3	}	will be analysed to
Twelveheads	3	}	family level with
d/s Wellington Adit	3	}	estimates of abundance.
Bissoe Bridge	3	}	Calculations will
Devoran Bridge	3	}	include numbers of
Clemows Stream	3	}	families, BMWP, ASPT
Hicks Mill	3	}	and RIVPACS.
Perranwell	3	}	Habitat data will be
Kennal at Tregolls	3	}	collected to allow the
Kennal at Ponsanooth	3	}	calculation of RIVPACS.
Kennal at Sticken	3	}	
Stithians at Seauragh	3	}	
St. Day at Twelveheads	3	}	

Tidal Waters

Devoran	4	TWO 1	4
	4	Contract	4
Tallack	8	TWO 1	8
	8	Contract	8
Point	12	TWO 1	12
	12	Contract	12
South of Penpol	20	TWO 1	20
	20	Contract	20
Restronguet FS	120	TWO 1	120
	120	Contract	120
Loe Beach	16	TWO 1	16
	16	Contract	16
Greatwood	24	TWO 1	24
	24	Contract	24
Mylor	24	TWO 1	24
	24	Contract	24
Turnaware	12	TWO 1	12
	12	Contract	12
Messack	32	TWO 1	32
	32	Contract	32
Carrick North	24	TWO 1	24
	24	Contract	24
North of Restronguet	24	TWO 1	24
	24	Contract	24
King Harry No. 4	8	TWO 1	8
	8	Contract	8
East of Weir	28	TWO 1	28
	28	Contract	28
Carrick mid	16	TWO 1	16
	16	Contract	16
Penarrow	32	TWO 1	32
	32	Contract	32
Gyllingrase	4	TWO 1	4
	4	Contract	4
Swan Pool	4	TWO 1	4
	4	Contract	4

Tidal Waters (continued)

Maen Pool	4	TWO 1	4
	4	Contract	4
Mylor Old Quarry	1	Sed. Contract	1
Mylor 1	8	Sed. Contract	8
Site 14	1	Sed. Contract	1
Messack Buoy	8	Sed. Contract	8
Site 10A	1	Sed. Contract	1
Loe Beach	8	Sed. Contract	8
N Site 11	1	Sed. Contract	1
Site 11	1	Sed. Contract	1
N Carlys Rock	1	Sed. Contract	1
Site 13	1	Sed. Contract	1
13-16	1	Sed. Contract	1
Site 6	8	Sed. Contract	8
WSW Site 6	1	Sed. Contract	1
S Weir Point	1	Sed. Contract	1
NE Weir Point	1	Sed. Contract	1
W Carlys Rock	1	Sed. Contract	1
Restronguet	1	Sed. Contract	1
N Restronguet	1	Sed. Contract	1
S Restronguet	1	Sed. Contract	1
Mouth Restronguet	1	Sed. Contract	1
Inside Restronguet	1	Sed. Contract	1
Passage	1	Sed. Contract	1
Inside Point	1	Sed. Contract	1
Site C1	8	Sed. Contract	8
Site C2	8	Sed. Contract	8
Site B2	8	Sed. Contract	8
Site B1	8	Sed. Contract	8
Site A	8	Sed. Contract	8
Kennal	1	Sed. Contract	1
Pill Creek	1	Sed. Contract	1
Site F	8	Sed. Contract	8
Bio-accumulation			
20 sites	70	Bio-contract	70
Biological			
20 sites	70	Species & abundance	70

(Bio-accumulation and biological sites are dependant on local conditions.)

4. Explanation of Contents

The objectives for each section of the programme are given in the Sampling and Analysis schedule in Section 6 below.

5. Endorsement

The contents of this programme have been agreed by the Catchment Coordinator, the Water Quality Planner, the Field Controller and the Laboratory Controller.

6. Schedule of Sampling and Analysis

A schedule of sampling and analysis is given below. Objectives are identified, as are staff resources to carry out identified actions. The objectives provide an explanation for each part of the programme.

R. M. HAMILTON
Regional Environmental Scientist
16 June, 1992.

Wheal Jane Monitoring.

A. Mine

Task	Objective	Actions	Resources	Staff
1. Mine water level	to provide early warning of discharge from Nangiles Adit and for hydraulic investigations	<ul style="list-style-type: none"> - Daily dip No. 2 Shaft. - Continuous logging No. 2 Shaft. - Data presentation weekly 	<p>1/2 hr per day</p> <p>1.5 days per week</p>	<p>Site Liason Officer</p> <p>Hydrometrics</p>
2. Mine discharges a) Flow b) Quality	to identify total mine discharge flow and quality for investigations	<ul style="list-style-type: none"> - Record flow meters No.2 Shaft daily - Continuous logging at Nangiles Adit - Data presentation weekly - Sample No.2 Shaft and Nangiles Adit Monthly ARG S473 & S182 Weekly ARG S473 Daily pH, cond., Eh. 	<p>1/2 hr per day</p> <p>1.5 days per week</p> <p>Sampling run</p>	<p>Site Liason Officer</p> <p>Hydrometrics</p> <p>Site Liason Officer/ Sampling staff</p>

* Total Hydrometrics resource.

Wheal Jane Monitoring.

B. Treatment

Task	Objective	Actions	Resources	Staff
1. Mine water input a) Flow b) Quality	to identify quantity & quality of water to be treated	- Record flow meters No.2 Shaft daily - Sample No.2 Shaft Monthly ARG S473 & S182 Weekly ARG S473 Daily pH, cond., eH.	1/2 hr per day Sampling run	Site Liason Officer Site Liason Officer/ Sampling staff
2. Chemical inputs	to audit chemical use for costing and treatment performance	- Record usage of lime, flocculant, etc. weekly.	1/2 hr per day	Site Liason Officer
3. Treatment process monitoring	to understand and monitor treatment wrks performance	- Record pH, cond., Eh. at input, tailings dam, output weekly	1/2 day	Site Liason Officer
4. Treatment discharge a) Flow b) Quality	to identify discharge quantity and quality from the polishing lagoon	- Continuous logging - Data presentation weekly - Daily gauge board reading - Record pH, cond., eH daily - Sampling for metals Daily S481 Weekly ARG S473 Monthly ARG S473 + S182 - Consent sampling	1.5 days 1 hr per day	Hydrometrics Site Liason Officer Site Liason Officer/ Sampling staff

* Total Hydrometrics resource.

Wheal Jane Monitoring.

C. River

Task	Objective	Actions	Resources	Staff
1. River flow	to provide flow data for catchment investigations and loading assessments	<ul style="list-style-type: none"> - Continuous logging at Twelveheads, County Adit, Nangiles adit, Hicks Mill Bissoe Bridge, Devoran Bridge. - Data presentation weekly - Daily gauge board reading 	1.5 days	<p>Hydrometrics</p> <p>Site Liason Officer</p>
2. River quality	to provide quality data for impact asses:ment monthly	<ul style="list-style-type: none"> - Monthly samples at Twelveheads, County Adit D/S County Adit, Wellington Adit D/S Wellington Adit, Nangiles Adit, Points Mill, Hicks Mill U/S & D/S Clemows Stream Clemows Stream, Devoran Bridge ARG S473+S182 	1/2 day	Site Liason Officer/ Sampling Staff
	to provide quality data for impact assessment weekly	<ul style="list-style-type: none"> - 3 per month at Twelveheads, County adit D/S County adit, Nangiles adit Points Mill, Clemows Stream, Devoran Bridge ARG S473 	1/2 day	Site Liason Officer/ Sampling Staff
	to provide quality data for impact assessment daily	<ul style="list-style-type: none"> - Record pH, cond., Eh. at all sites daily 	1/2 day	Site Liason Officer/ Sampling Staff

* Total Hydrometrics resource.

WHEAL JANE MONITORING
D. TIDAL WATERS

Last Updated: 18-MAY-1992

TASK	OBJECTIVE	DATE	ACTIONS	RESOURCES	STAFF
1. Water quality in Restronguet Creek and Carrick Roads Springs and Neaps	To provide water quality data for impact assessment	(end June 92 (beg July 92 November 92 mid January 93	-Fixed station at mouth of Restronguet Creek: monitoring water quality over tidal cycle -HW and LW samples in Restronguet Creek at sites above fixed station -HW and LW samples in Carrick Roads -Report data after surveys	440 man hours per Spring/Neap survey (including sediment chemistry surveys)	TWIU staff
2. Sediment Quality in Restronguet Creek and Carrick Roads	To provide sediment quality data for impact assessment	July 92 November 92 January 93	-Sample sediments from Restronguet Creek and Carrick Roads (10 sites)		
3. Benthic Macrofauna	To provide information on diversity and abundance of benthic macrofauna for impact assessment	June 92	-Sample and sieve 11 inter-tidal sites in Restronguet Creek -sample and sieve 4 sub-tidal sites in Carrick Roads -preserve samples in ethanol -contract identification -analyse data in-house using PRIMER -report data	20 man hours sampling 10 man days data handling	TWIU Staff TW Planning Staff

Appendix

Analysis Required Groups

S 473

<u>Determinand</u>		<u>Units</u>
<u>Number</u>	<u>and Description</u>	
61	pH	pH
62	conductivity	Microsiemens/cm
76	temperature	degrees celsius
81	dissolved oxygen %	%
82	dissolved oxygen mg/l	mg/l
106	cadmium dissolved	µg/l
108	cadmium total	µg/l
213	copper dissolved	mg/l
215	copper total	mg/l
237	magnesium	mg/l
241	calcium	mg/l
243	zinc dissolved	mg/l
245	zinc total	mg/l
285	aluminium dissolved	mg/l
287	aluminium total	mg/l
326	lead dissolved	mg/l
328	lead total	mg/l
373	chromium dissolved	mg/l
375	chromium total	mg/l
379	selenium	mg/l
419	iron dissolved	mg/l
421	iron total	mg/l
427	nickel dissolved	mg/l
429	nickel total	mg/l
1158	redox potential	mv
7354	arsenic dissolved	µg/l
7356	arsenic total	µg/l

<u>Determinand</u>		<u>Units</u>
<u>Number</u>	<u>Description</u>	
61	pH	pH
62	conductivity	Microsiemens/cm
76	temperature	degrees celsius
81	dissolved oxygen %	%
82	dissolved oxygen mg/l	mg/l
85	BOD ATU	mg/l
99	total organic carbon	mg/l
111	ammonia	mg/l
116	total oxidised nitrogen	mg/l
117	nitrate	mg/l
118	nitrite	mg/l
119	non-ionised ammonia	mg/l
135	suspended solids 105	mg/l
162	alkalinity 4.5	mg/l
172	chloride	mg/l
180	ortho-phosphate	mg/l
182	silicate reactive dissolved	mg/l
183	sulphate	mg/l
1181	weather temperature	—
1183	weather precipitation	—
3267	flow	—

S 481

<u>Determinand</u>		<u>Units</u>
<u>Number</u>	<u>and Description</u>	
108	cadmium total	$\mu\text{g/l}$
245	zinc total	mg/l
421	iron total	mg/l

<u>Determinand</u>		<u>Units</u>
<u>Number</u>	<u>Description</u>	
61	pH	pH
62	conductivity	Microsiemens/cm
76	temperature	degrees celsius
81	dissolved oxygen %	%
82	dissolved oxygen mg/l	mg/l
105	mercury total	µg/l
106	cadmium dissolved	µg/l
108	cadmium total	µg/l
135	suspended solids 105	mg/l
158	hardness total	mg/l
172	chloride	mg/l
183	sulphate	mg/l
207	sodium	mg/l
213	copper dissolved	mg/l
215	copper total	mg/l
237	magnesium	mg/l
241	calcium	mg/l
245	zinc total	mg/l
285	aluminium dissolved	mg/l
287	aluminium total	mg/l
326	lead dissolved	mg/l
328	lead total	mg/l
373	chromium dissolved	mg/l
375	chromium total	mg/l
403	manganese total	mg/l
421	iron total	mg/l
427	nickel dissolved	mg/l
429	nickel total	mg/l
7354	arsenic dissolved	µg/l
7356	arsenic total	µg/l

WJSD

<u>Determinand</u>		<u>Units</u>
<u>Number</u>	<u>and Description</u>	
61	pH	pH
183	sulphate	mg/l
216	copper dry	mg/kg
246	zinc dry	mg/kg
254	cadmium dry	mg/kg
270	mercury dry	mg/kg
288	aluminium dry	mg/kg
329	lead dry	mg/kg
357	arsenic dry	mg/kg
376	chromium dry	mg/kg
404	manganese dry	mg/kg
422	iron dry	mg/kg
430	nickel dry	mg/kg

TWO 1

<u>Determinand</u>		<u>Units</u>
<u>Number</u>	<u>Description</u>	
135	suspended solids 105	mg/l
143	suspended solids 500	mg/l
3057	zinc digest 64 micron	mg/kg
7243	zinc dissolved	µg/l
7244	zinc particulate	µg/l
7354	arsenic dissolved	µg/l
7356	arsenic total	µg/l