STEETLEY CHEMICALS/
REDLAND BRICKS

NRA Thames 105

ENVIRONMENT AGENCY

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STEETLEY CHEMICAL/REDLAND BRICKS LTD

Background

Steetley Chemicals was recently taken over by Redland Bricks at a cost of £400 million pounds.

One of the sites at Cranleigh has had a chequered past and due to mismanagement has a legacy of contaminated land, in particular high concentrations of Zinc, Bromates and other chemicals not desirable on any land or in any watercourse.

Before Redland Bricks Ltd are able to divest the Cranleigh site certain environmental considerations must be taken into account to make it desirable to any prospective purchaser. This includes the treatment of any surface water off the site which inevitably washes out some of the contaminated material.

The run off from the site is collected into a lower lagoon where it is treated to decrease the levels of toxicants to within the consent limits applied to the site, this is then discharged into the Collins Brook in the usual manner.

An upper dilution lagoon (see diagram) is used to blend with the untreated effluent so that levels of contaminants may also be lowered and hence decrease the need for chemical treatment.

Flocculation with lime and subsequent precipitation helps to rid the effluent of the high Zinc content, but the capacity for treatment is small. Redland Bricks have now decided that a reverse Osmosis plant (costing some 0.5 million pounds) will be necessary to treat the run off. At present the pilot plant can only deal with $1m^3$/hour but when the plant is running at full capacity (August/September 1993) there will be the ability to deal with $5m^3$/hour.

Present Situation

On Wednesday 25th November I received a call from Mr. Martin Harding the Works Manager at Cranleigh to say that due to the exceptionally high rainfall over that period, the bottom effluent/run off lagoon was almost full and that there might be a possibility of flooding with the lagoon bursting its banks and running directly into the Collins Brook uncontrolled. the level of Zn in the lagoon at this time were in the order of 180-200 mg/l/ The consent level of total Zinc from the site is 5mg/l.

After discussing several emergency plans with Mr Harding it was decided that the effluent lagoon should be pumped via a 6" pump up into the dilution lagoon to prevent "back up" and flooding. This situation carried on for a week with Mr. Harding wanting to discharge directly to the Collins Brook, but after being persuaded that we should try to exhaust every other option first he continued to pump to the dilution lagoon, contaminating the dilution water.

A week later I received a further call from Mr. Harding and Mr. Hitchcock (Environmental Manager for Redland Bricks) to say that due to the continued heavy rainfall that both lagoons were now in danger of breaching and running directly into the Collins Brook. He again requested that the valves from the lagoons he opened to alleviate the situation.

After a long telephone consultation with my Senior Pollution Officer Mr. Gerry Claydon and Mr. Paul Rowlinson from Reading H.Q. who was also on site with me, it was decided that the upper dilution lagoon should be opened sufficiently to allow the water level to decrease, but not enough to have a deleterious effect on the Collins Brook and Cranleigh Waters downstream. This it was decided was the best practical environmental option (B.P.E.O) rather than not to take control of the situation and let the more concentrated lower lagoon overflow.

The levels of Zinc in the dilution lagoon were some 50mg/l but due to the controlled way in which the effluent release was controlled and the extremely strong diluting influence of the receiving watercourse due to the heavy rainfall, the levels found in the Collins Brook upstream of the Cranleigh Waters were brought down to 3.2 mg/l (see table).

The discharge was allowed to take place until the danger of flooding was alleviated and the rainfall stopped causing the river downstream to drop, hence become less diluting.

Summary

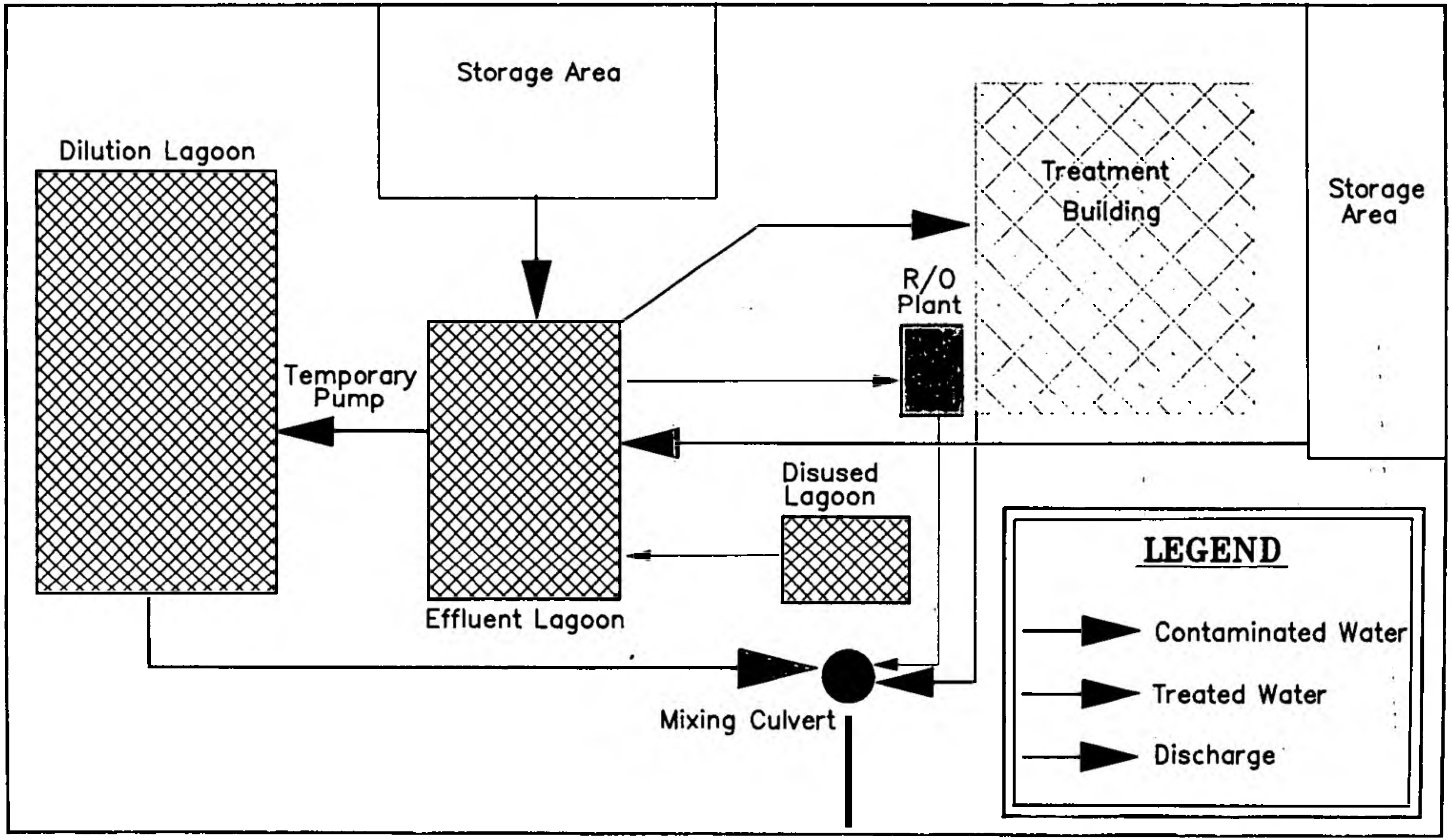
The actions taken over this period were deemed an emergency contingency plan and was seen as the lesser of the two evils. Redland were made fully aware that this was a one off situation and that under no circumstances would this have been allowed under normal circumstances.

Negotiations are under way at present with Redland to manage the situation through the winter months until the reverse Osmosis plant is up and functioning fully towards the end of next summer.

Once this situation is in place the reverse Osmosis plant should be able to cope with the volumes of run off from the sites without the danger of flooding even in heavy rainfall situations.

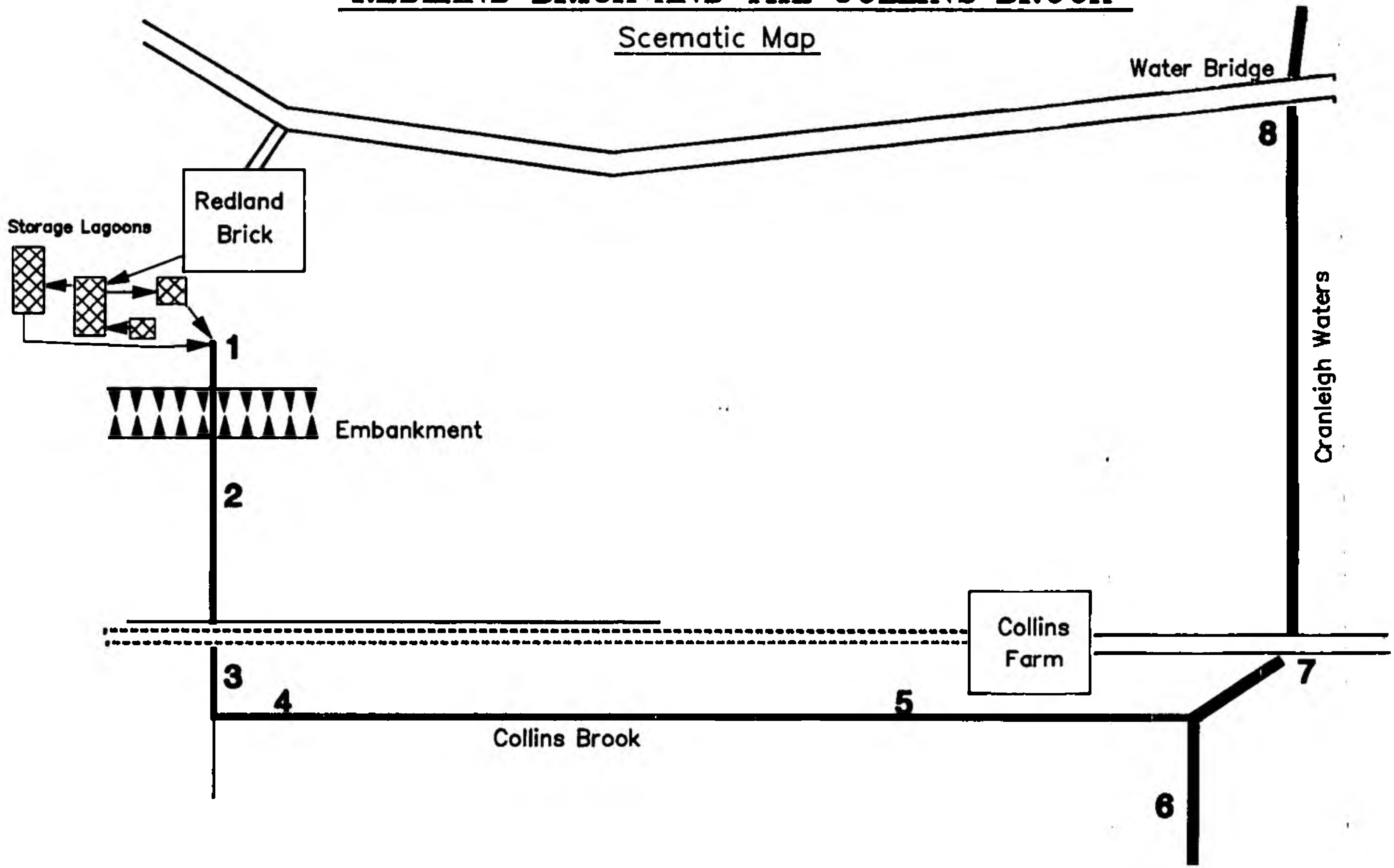
REDLAND BRICKWORKS, CRANLEIGH

Trade Effluent Flows, December 1992



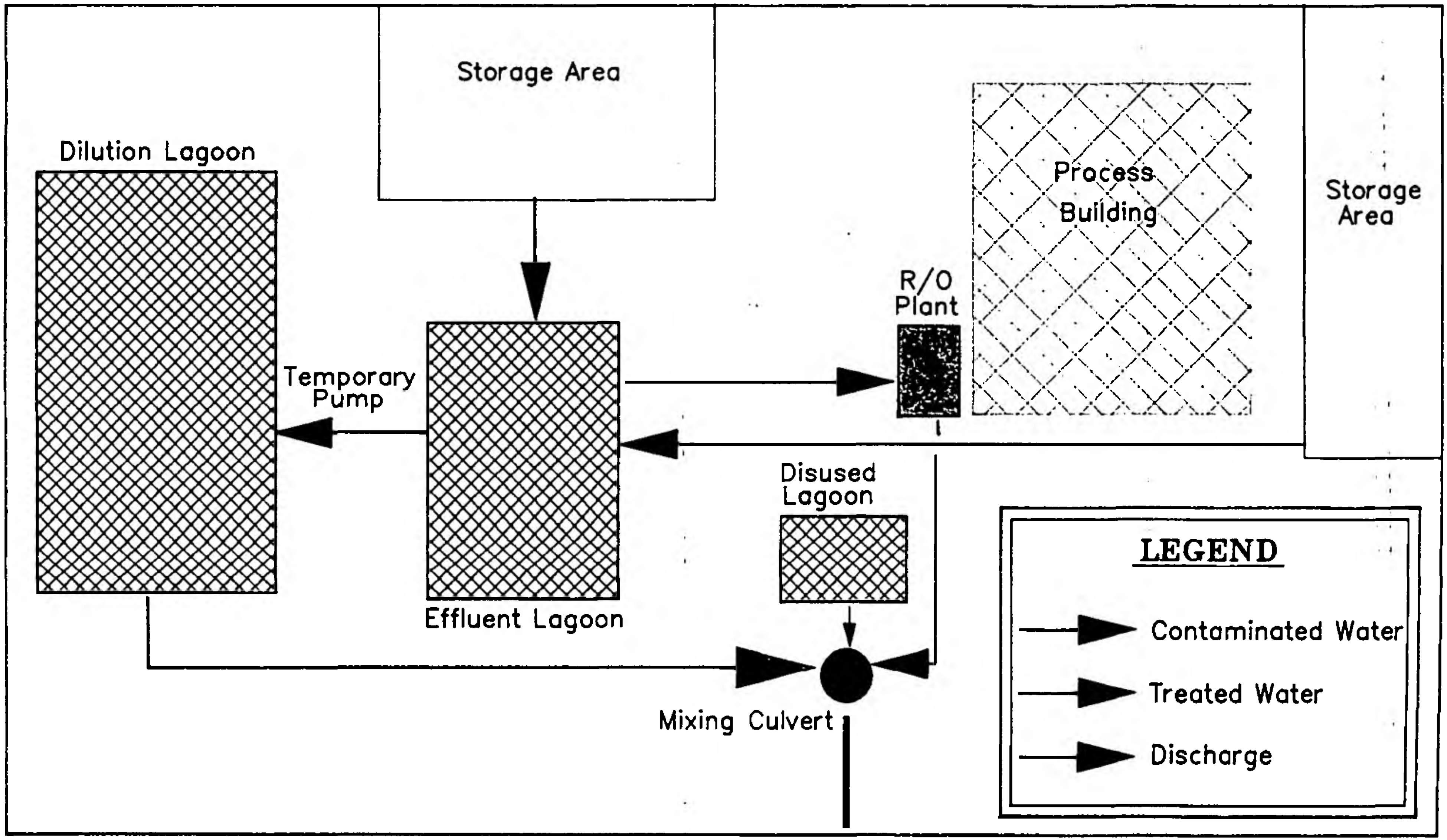
REDLAND BRICK AND THE COLLINS BROOK

Scematic Map



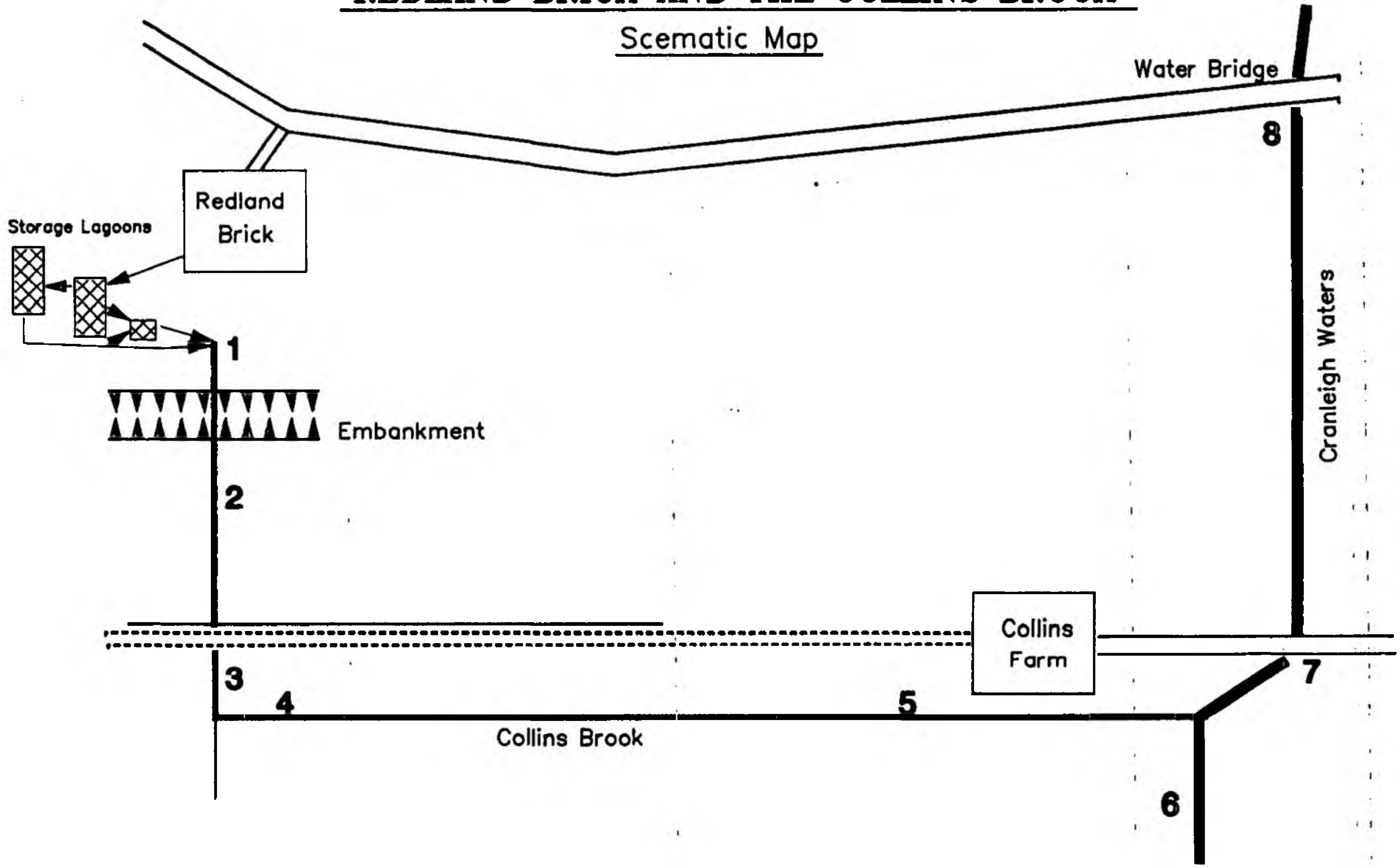
REDLAND BRICKWORKS, CRANLEIGH

Trade Effluent Flows, December 1992



REDLAND BRICK AND THE COLLINS BROOK

Scematic Map



ZINC CONCENTRATIONS IN THE COLLINS BROOK

DATE	TIME	1	2	3	4	5	6	7	8
		Redland Discharge	Collins Brook D/S Discharge	Collins Brook D/S Ditch	Collins Brook D/S Tributary	Collins Brook U/S Collins Farm	Cranleigh Waters U/S Collins Brk	Cranleigh Waters Collins Farm	Cranleigh Waters Water Bridge
2.12.92	10:30	**30**	**26**			**2.4**	**0.04**	**0.09**	**0.08**
2.12.92	12:30	**30**				**2.0**		**0.06**	**0.05**
2.12.92	12:30								
2.12.92	14:30	**34**		**16**	**6.5**	**3.2**		**0.03**	**0.03**
3.12.92	11:30								
4.12.92	12:30								

All figures in Mg/l (ppm)

Bold text indicate On-site analysis by Redland

THAMES WATER AUTHORITY
CONTROL OF POLLUTION ACT 1974
SECTION 37

Steetley Chemicals Limited
Gateford Hill
WORKSOP
Notts. S81 8AF

NOTICE IS HEREBY GIVEN that the Conditions of Consent No. 1263 granted to Berk Limited by the former Conservators of the River Thames on 13th March 1972 are hereby modified as follows:-

Delete Conditions Nos. 1, 2, 3, 4 and 5 viz:-

"1. The effluent discharged shall conform to the following standard:-

(a) Biochemical Oxygen Demand (A.T.U.) in 5 days at 20°C (68°F) not to exceed 20 milligrammes per litre.

(b) Suspended Solids not to exceed 30 milligrammes per litre.

(c) Zinc as Zn not to exceed 2 milligrammes per litre.

(d) Ammoniacal nitrogen content as N not to exceed 10 milligrammes per litre.

(e) Bromide (as BR) not to exceed 200 milligrammes per litre.

(f) Bromine (as Br) not to exceed 0.1 milligrammes per litre.

(g) Bromate (as Br) not to exceed 16 milligrammes per litre.

(h) The conductivity of the discharge shall not exceed 3,500 microsiemens per centimetre.

2. The quantity of trade effluent discharged shall not exceed $164m^3$ per day.

3. Facilities for the taking of samples of the effluent by the Conservators' Officers shall be provided and maintained in the position indicated on and in accordance with the application and plan submitted by the Applicant.

4. The pH value of the effluent discharged shall be maintained within the range of 6 to 9.

5. The discharge shall consist only of trade effluent."

and substitute therefor the following:-

1. The discharge shall consist only of trade effluent.

2. The discharge shall conform to the following standard:

(A) From May to November in any year

(I) Suspended Solids dried at 105 degrees Celsius not to exceed 30 milligrammes per litre

(II) Biochemical Oxygen Demand in 5 days at 20 degrees Celsius (Nitrification suppressed with Allylthiourea) not to exceed 20 milligrammes per litre.

(III) Ammoniacal Nitrogen content not to exceed 15 milligrammes per litre.

(IV) Zinc as Zn not to exceed 1 milligramme per litre.

(V) Bromide as Br not to exceed 450 milligrammes per litre.

(VI) Bromate as Br not to exceed 10 milligrammes per litre.

(B) From December in any year to April in the following year inclusive

(I) Suspended Solids dried at 105 degrees Celsius not to exceed 60 milligrammes per litre

(II) Biochemical Oxygen Demand in 5 days at 20 degrees Celsius (Nitrification suppressed with Allylthiourea) not to exceed 20 milligrammes per litre.

(III) Ammoniacal Nitrogen content not to exceed 30 milligrammes per litre.

(IV) Zinc as Zn not to exceed 5 milligrammes per litre.

(V) Bromide as Br not to exceed 700 milligrammes per litre.

(VI) Bromate as Br not to exceed 16 milligrammes per litre.

3. Conductivity at 20 degrees Celsius not to exceed 5000 microSiemens per centimetre.

4. The discharge shall not contain any trace of oil or grease.

5. The pH value of the discharge shall be maintained within the range of 6.0 - 9.0.

6. The discharge shall not contain any matter which will cause or be likely to cause the water in the Collins Brook to be poisonous or injurious to fish or the spawning grounds, spawn or food of fish.

7. The volume of the discharge shall not exceed 164 cubic metres per day.

8. Facilities for taking samples of the discharge by the Authority's officers shall be provided and maintained in the position indicated on and in accordance with the submitted plan.

The terms of this notice will not, without the agreement in writing of the person to whom this notice is given (or his successor) be altered before the expiration of the period ending with 31st day of July 1988 except in accordance with the provisions of Section 38(3) of the Control of Pollution Act 1974.

Date 21st July 1986

Signed.......................................
Acting Secretary

Duly authorised to sign on behalf of the Thames Water Authority

ANALYSIS REPORT
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Sample Point : COLLINS BROOK ABOVE COLLINS FARM, B URN : PWER.0002

Sampler's Ref. : GE659 Date Taken : 12/11/92
Time taken : 14:50

Purpose : R--R Compliance : YES R.O.O. :
Action : 1. Result noted

Comments 1/Oil type :
Comments 2 :

DETERMINAND	UNITS	RESULT		LIMIT
pH VALUE	pH unit	6.7000		
B.O.D. (5day using ATU)	mg/l	4.1000		
TEMPERATURE (FIELD) degC	degrees	9.0000		
DISSOLVED OXYGEN (FIELD)	mg/l	4.6000		
DISSOLVED OXYGEN (FIELD)	%satura	40.0000		
NITROGEN, TOTAL OXIDISED	mg/l	16.7000		
ORTHOPHOSPHATE as P	mg/l	0.1600		
SUITE INDICATOR - ROO		1.0000		
SUITE INDICATOR - LIST2		1.0000		
COPPER, DISSOLVED ug/	ug/l	6.0000		
COPPER ug/l	ug/l	8.0000		
ZINC, DISSOLVED ug/l	ug/l	930.0000		
ZINC ug/l	ug/l	1066.0000		
VANADIUM ug/l	ug/l	10.0000	<	
ARSENIC ug/l	ug/l	5.0000	<	
CHROMIUM, DISSOLVED ug/l	ug/l	10.0000	<	
CHROMIUM ug/l	ug/l	10.0000	<	
IRON, DISSOLVED ug/l	ug/l	667.0000		
IRON ug/l	ug/l	1550.0000		
NICKEL, DISSOLVED ug/l	ug/l	10.5000		
NICKEL ug/l	ug/l	10.0000	<	
LEAD ug/l	ug/l	10.0000		
LEAD, DISSOLVED ug/l	ug/l	5.0000	<	
BORON ug/l	ug/l	1024.0000		
ARSENIC, DISSOLVED ug/l	ug/l	5.0000	<	
COMPLETED DATE yyyymmdd		1992.1203		
LABORATORY SAMPLE NUMBER		12349.7000		

ANALYSIS REPORT
===============

Sample Point : COLLINS BROOK AT COLLINS FARM, BAYN URN : PWER.0003

Sampler's Ref. : GE657 Date Taken : 12/11/92
Time taken : 14:30

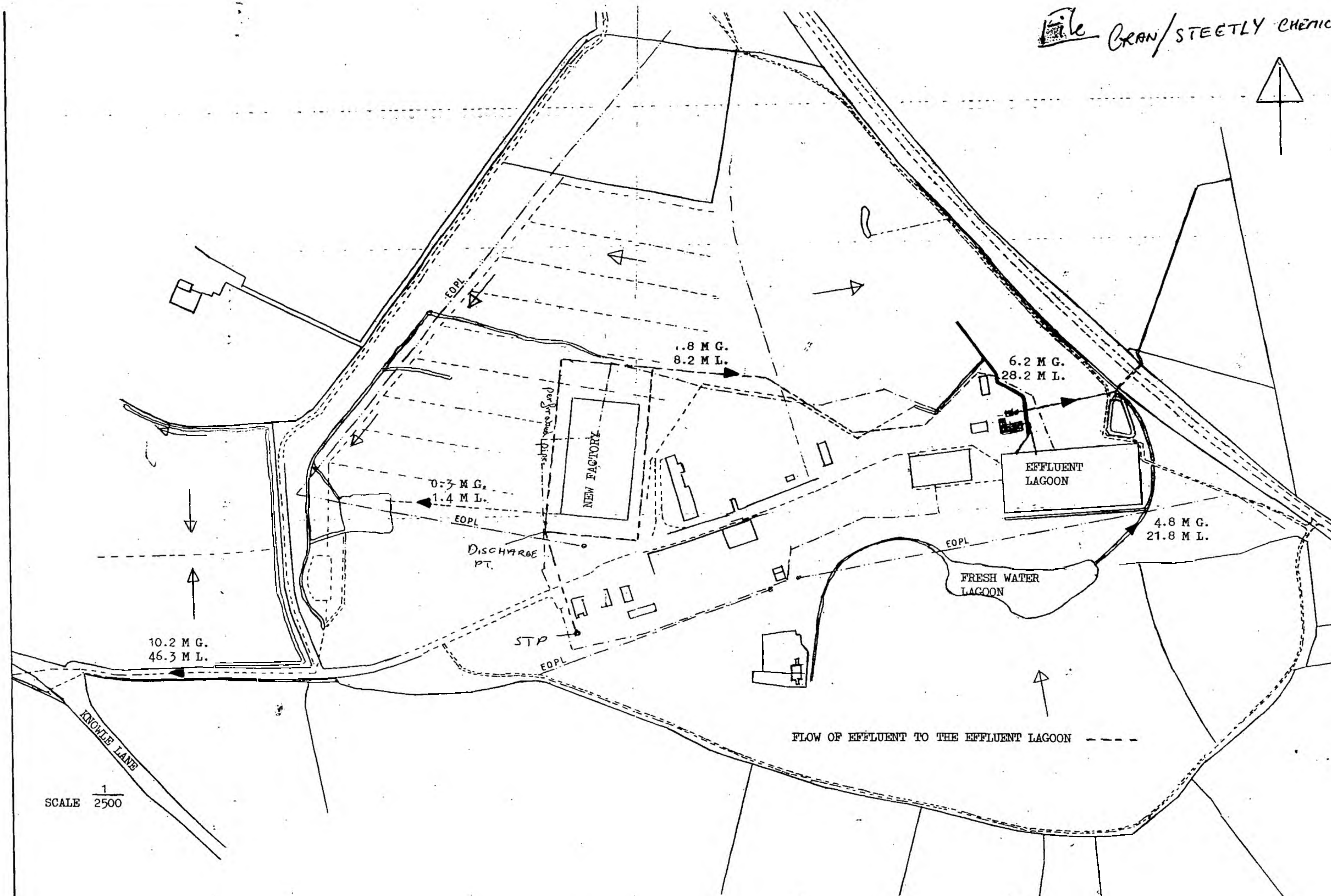
Purpose : R--R Compliance : YES R.Q.O. :

Action : 1. Result noted

Comments 1/Oil type :

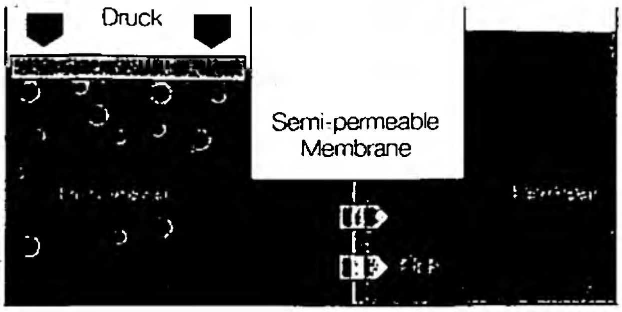
Comments 2 :

DETERMINAND	UNITS	RESULT	LIMIT
PH VALUE	pH unit	7.2000	
B.O.D. (5day using ATU)	mg/l	4.0000	
TEMPERATURE (FIELD) degC	degrees	8.0000	
DISSOLVED OXYGEN (FIELD)	mg/l	3.6000	
DISSOLVED OXYGEN (FIELD)	%satura	32.0000	
AMMONIACAL NITROGEN	mg/l	1.1300	
AMMONIA, UN-IONISED as N	mg/l	0.0030	
NITROGEN, TOTAL OXIDISED	mg/l	16.7000	
CHLORIDE AS CL (LAB)	mg/l	192.0000	
ORTHOPHOSPHATE as P	mg/l	0.2200	
SUITE INDICATOR - RQO		1.0000	
COMPLETED DATE yyyymmdd		1992.1201	
LABORATORY SAMPLE NUMBER		12349.6000	



SHEET 2OF2 | COMPARATIVE FLOWS OF THE SURFACE AND UNDERGROUND WATER DRAINAGE SYSTEM FOR THE BRICKWORKS | DRG NO. C I/EFF/89/0

PRINCIPLE OF REVERSE OSMOSIS



How reverse osmosis operates

When the membrane process is operated on the cross-flow principle, the solution to be treated is pumped under pressure along a membrane and is divided by this means into two partial flows - a permeate or filtrate which flows through the membrane and a concentrate or residual solution. In the latter, the materials contained in the water and held back by the membrane are thus concentrated.

The PATENTED
ROCHEM DISC TUBE MODULE SYSTEM -
a major advance in reverse osmosis

The following items were consciously addressed in the design of our new membrane support system:

a) The physial, technical and chemical problems associated with the application of membrane technology.

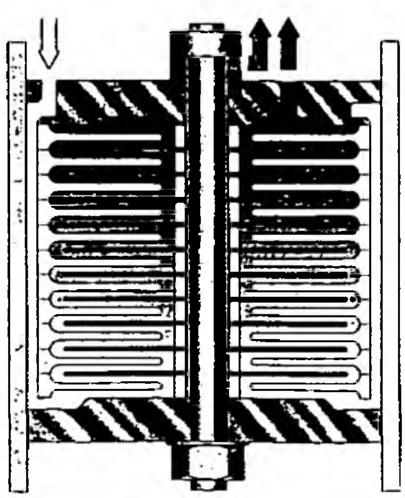
b) the special features of cross-flow filtration , and

c) the comprehensive experience gained from many years of using membrane separating technology, with special emphasis on the plate module system.

The unique modular construction and its mode of operation support and maintain membrane performance and, in most material separation applications, provide clear advantages relative to existing module systems.

The DT module concept is based on the following objectives and in service requirements:

* Cross-flow supply of the untreated solution feed to the membranes with the membrane elements being hydraulically in series.
* Creation of extremely short untreated solution flow paths in the individual membrane elements until the final flow reversal.
* Creation of an open duct over the membrane surfaces for the untreated solution.
* Design of the module plates as hydraulic discs not support to pressure loads.
* Possibility of manufacturing the module plates from various thermoplasics which do not require high strength nor contain glass fibre.
* Smallest possible mechanical loads on the membrane material used, tolerable flow-induced shear forces; eliminates membrane folding due to longitudinal extension of low-resistance permeate or filtrate drains.



Advantages of the ROCHEM DT module system

Organic and inorganic coatings on the membranes are greatly reduced. The unique modular construction and its method of operation, enhances the membrane performance and, in most material separation applications provides clear advantages relative to existing module systems.

Simple Prefiltration

The prefiltration unit consists of an upstream pressure pump, a multi-layer reversible flow filter system and downstream multiple cartridge filters. An upstream pressure of 0.5 bar is necessary for the operation of RO equipment. The sand filtration takes place by means of a fully automatic reversible flow filter system. The cartridge filters (fine filters) can be easily changed without interruption to service.

The prefilters reduce the fouling index of the untreated water. The untreated water quality after the mechanical prefiltration is sufficiently good for the operation of our DT module system. Due to the hydraulic arrangement of the DT module and the exellent chemical resistance of the membranes used, chemical conditioning of the untreated water is usually eliminated.

The fact that pretreatment chemicals are not used provides economies in operating expenses with our environment-friendly membrane technology. Thus avoiding the problems associated with storage and handling of chemicals.

RO Membrane Filtration

The high pressure pump supplies the prefiltered untreated water to the module at an inlet presure of between 30 and 60 bar.

It flows over the "series - connected" membrane cushions in which cross-flow filtration occurs. Between 50 and 70% of the water supplied permeates the membrane (water extraction ratio = treated water/untreated water x 100 in %) and becomes available as low salt and clean treated water (permeate).

The untreated water concentrate emerging from the module (sole or brine) is re-expanded at the pressure control valve and is then passed on for evaporation or spraying on the dump.

The permissible operating pressure and the permeate flow are monitored and automatically controlled by a servomotor valve.

Due to our highly effective separation, the permeate is extremely clean and the materials contained in the water are greatly reduced.

The treated water is generally unpressurized but the pressure can be increased to as much as 1.0 bar in the DT module system.

If a higher mains pressure is required, a booster pump with a small level-controlled buffer tank must be provided. This can be supplied as an option.

Plant Control

The control cabinet was designed to provide the operating and monotoring data on the front. The plant operation is automated and is controlled by a storable program microprocessor system (SPS).

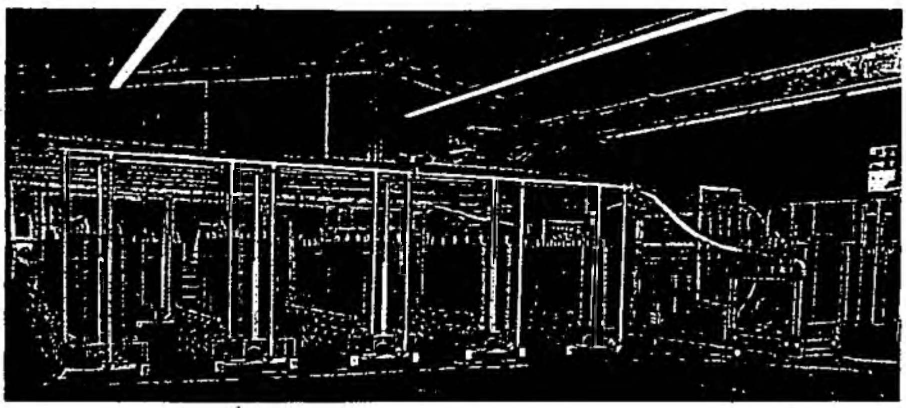
The operating condition of the plant is conveniently displayed on a flow chart and instrumentation diagram equipped with signals and alarms.

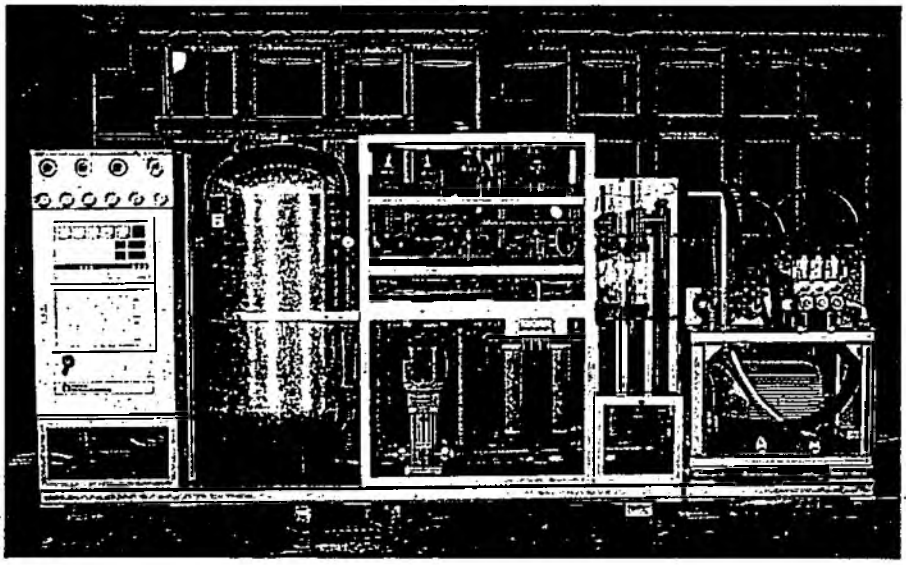
The plant is completely automatic and operates 24 hours per day without supervision. Operational faults stop the plant and the specific cause of the fault is displayed on the control cabinet. If the residual salt content is continually high, the plant will shut-down automatically.

The control system is designed for fully automatic operation with automatic pressure and flow control (extraction ratio control), remote start-up and shut-down and remote plant monitoring.

A sub-program which permits individual control of all valves and pumps can be provided for plant servicing purposes.

ROCHEM REVERS OSMOSIS PLANT FOR THE TREATMENT OF LEACHATE



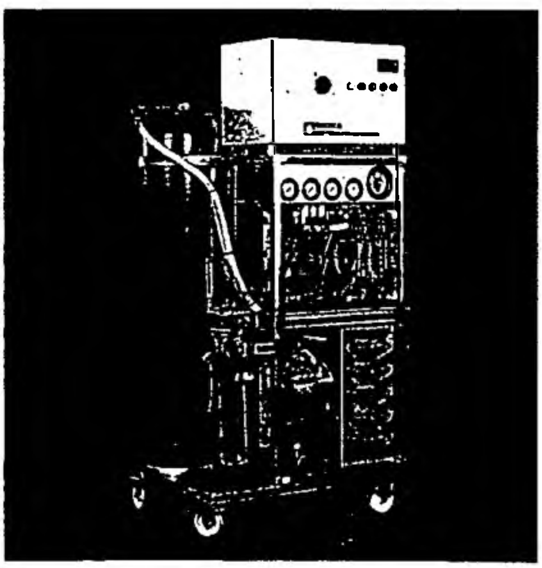


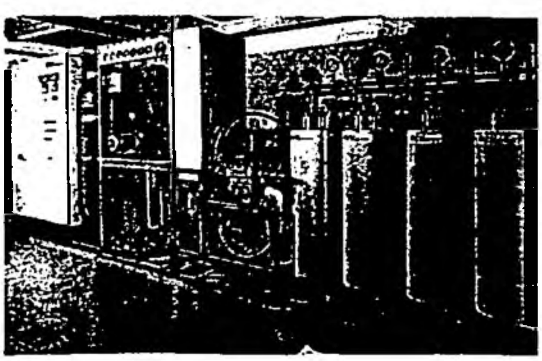
"Schönberg" domestic refuse dump

Installed membrane area 1150 sqm DT modules

Untreated leachate: 12 m³ per hour.

TOTAL CAPACITY: 288.000 m³ per annum of untreated leachate





Pilot plant:
– design criteria:

* Selection of a membrane to suit the specific problem.
* Taking account of the quality, with possible changes, of the untreated water so as to select the correct treatment.
* The desired yield as a function of the permissible concentration of the materials contained in the water.
* The quality desired for the permeate produced.
* Particular and synergistic effects on the downstream processes on both the permeate and concentrate sides.

Raindorf special refuse dump- two stage plant

Membrane area installed 100 sq. m

Parameter	Untreated water mg/1	Permeate II mg/1	Percentage rejected
Sulphate	22093,00	4,80	99,90
Chloride	6364,00	14,00	99,80
Ammonium	1955,00	42,00	97,90
Nitrate	455,00	18,00	96,00
CSB	912,00	15,00	98,40
TOC	289,00	4,00	98,60
KW	13,40	0,30	97,80
Nickel	2,78	0,10	96,40
Chromium	2,18	0,10	95,40
Copper	0,97	0,10	86,60
Vanadium	290,00	2,20	99,20

STANDARD – PLANTS FOR LEACHATE AT WASTE SITES

ROCHEM reverse osmosis plants for the treatment of leachate in waste sites are designed, as far as possible, in standard modular form. The plant concepts are based on many years of wide experience in the construction of plants for the desalination of sea water and brackish ground water.

Various plant concepts can be supplied as the basic units for the treatment of leachate – with completely automated plant control, measuring equipment, prefiltration, cleaning system and high pressure equipment with all the pipework, fittings and valves ready for operation.

The basic sections are designed as the first stage for the treatment of leachate.

Because of the problems associated with the varying quantities and qualities of leachate, the plants operating parameter can be adjusted or re-equipped to deal with different flows. The plant components are of optimum size, well matched to one another and economical in operation.

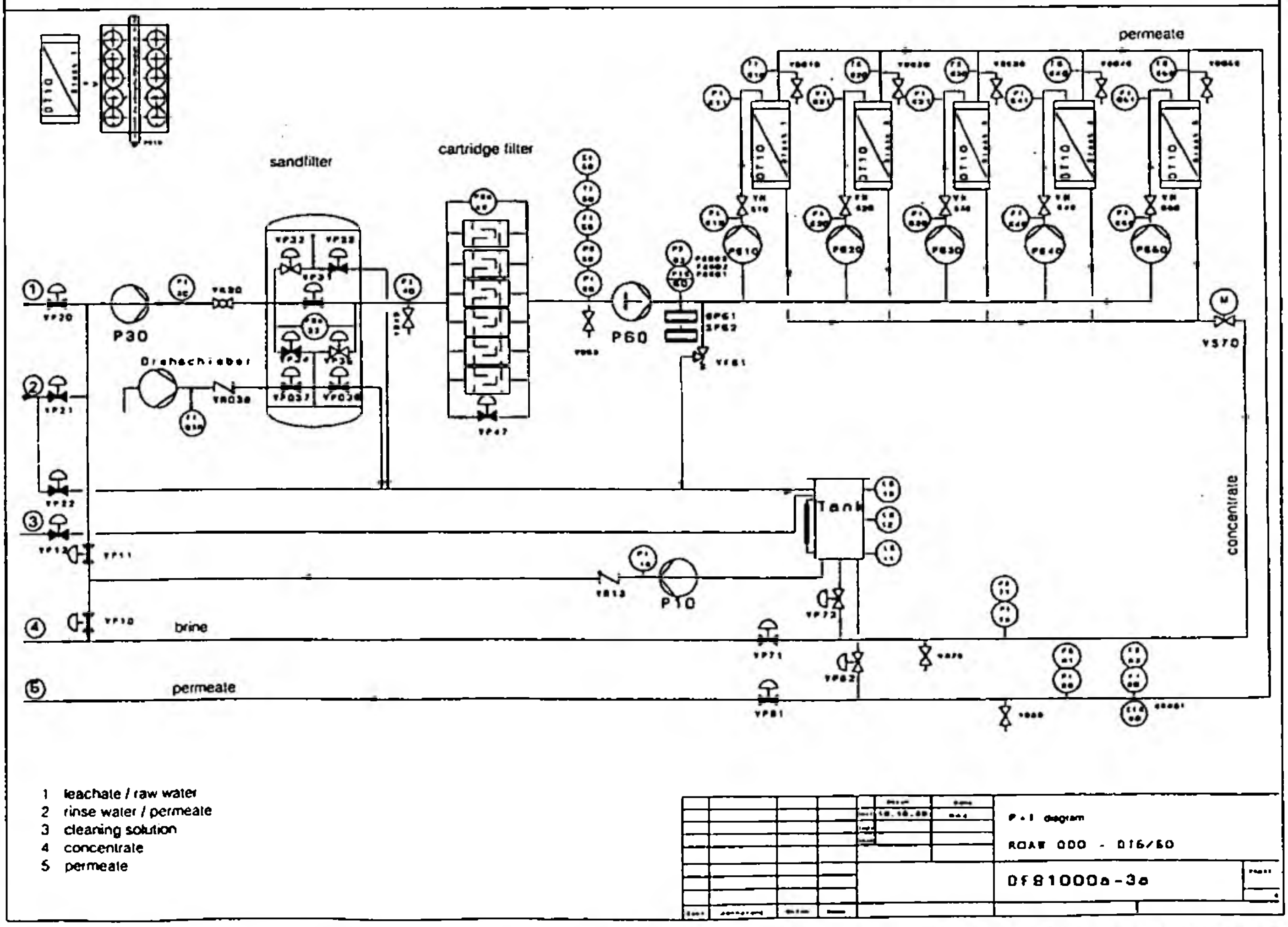
The various ranges of modules provide substantial plant size flexibility during the planning and design phases. The standardized and modular designs permit accurate investment requirement and thus prevents excessive investment.

When designing the plant for dumps with large leachate yields, it is necessary to investigate whether it would be advantageous to use a design with two or three reverse osmosis plant sections connected in parallel. This allows part-load operation and the highest possible level of reliable plant availability.

If the quality of the treated water from single stage operation does not meet the requirements, a second RO stage can be fitted downstream without the need for technical alterations. The technical designs in a second RO stage correspond to the existing Rochem Reverse osmosis standard plant range. They are available up to an untreated water capacity of 12.000 1/hour.

Untreated water handling capacities:

ROAW 100 = 500– 4000 1/h–max operating pressure 60 bar
ROAW 200 = 2000– 8000 1/h–max operating pressure 60 bar
ROAW 300 = 6000–12000 1/h–max operating pressure 60 bar



ROCHEM REVERSE OSMOSIS SYSTEM

DISC-TUBE MEMBRANE MODULE

DT

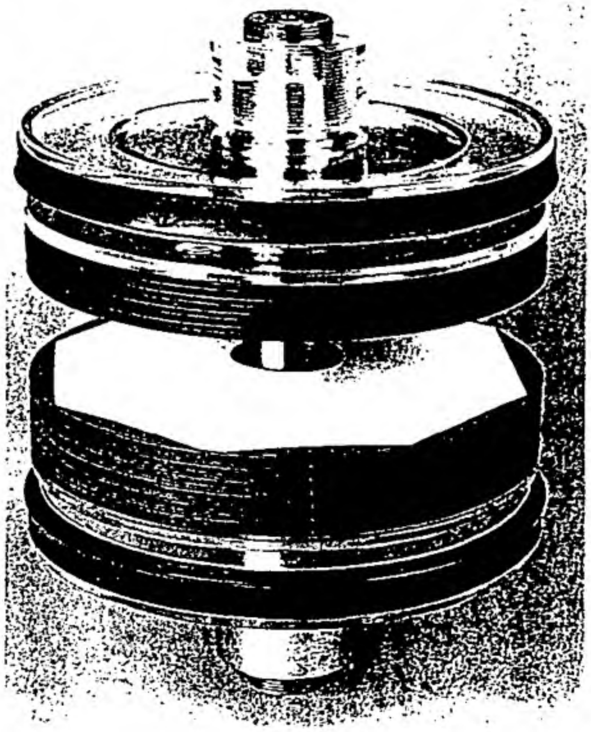
DT-Membrane-Module-System

The patended DT- MEMBRANE- MODULE is a modern design for molecular separation, desalination and purification of liquids. It can operate effectively and economically at increased turbidity and Silt Density Index levels for ultra-filtration and reverse osmosis

The disc-membrane stack is assembled on the center tension rod with metal end flanges. The module stack is covered in an open, standard 8 inch pipe. The feed water is sealed by a pressure flange seal. The pressure vesse design allows for an easy alteration of module length and tube materials. The special modular construction facilitates inspection or changing of membranes in a quick and easy manner. This further facilitated by light weight construction and materials

The disc-membrane stack operates at pressure compensation (feed to brine). The special hydraulic characteristics ensure safe operation at each pressure stage and at high pressure drops

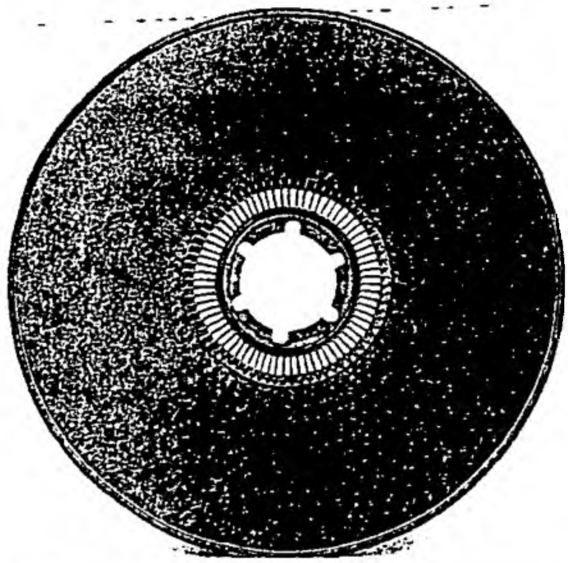
The hydraulics result in a high flow velocity across the membranes at minimum feed flow. The open feed channel over the membrane surfaces ensures optimal membrane cleaning from fouling deposits



Hydraulic Disc

The standard hydraulic disc is manufactured from the material ABS. Different materials are available for special feed quality

The disc covers the membrane cushion without putting pressure on the membrane surface. The feed water is sealed with an o-ring from the pure water manifold in the center of the tension rod. The membrane spacer and the permeate manifold are designed as an integral part of the hydraulic disc. The integrated spacer forms the open feed water channel



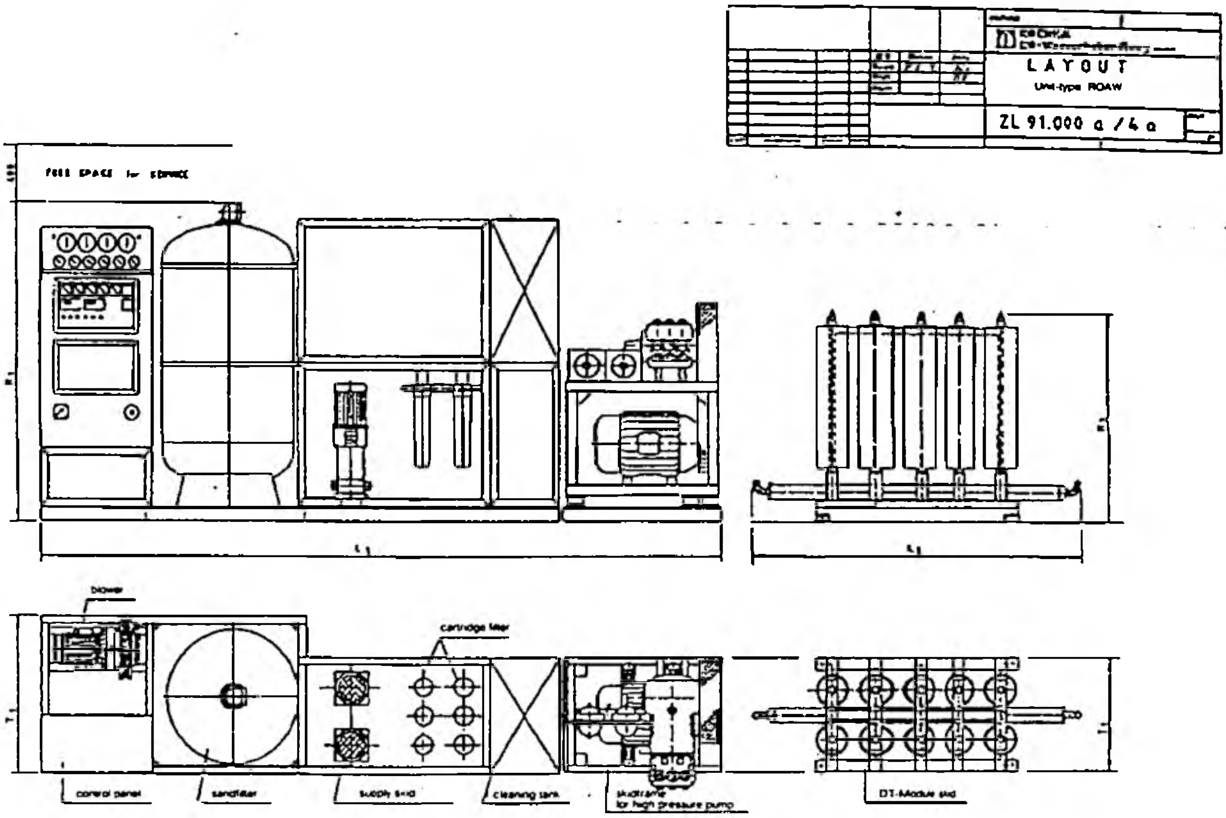
Membrane Cushion

The membrane cushions are sealed by [illegible]. This welding technology has been proven [illegible] years in different applications and with different [illegible]

The extremly short feed water path across the membrane followed by a 180 degree flow reversal eliminates polarization concentration. Consequently, the DT Membrane Module results in minimum membrane fouling and scaling. The permeate drains from the cushion's intermediate layer into the manifold with minimum flow path and minimum resistance

ROCHEM
RO-Wasserbehandlung GmbH

ONYX ENGINEERING LTD
St. Davids Walk
24A, The High Street
Mold, Clwyd
CH7 1AZ
Tel: (0352) 758986
Fax: (0352) 758440



A. Treatment quantities/ leachate occuring:

The leachate to be treated varies greatly with the season and is dependent on the weather as well.

When dumps are new, the occurrence of leachate increases with the years. In the case of old dumps, there may, in some cases, be a reduction in the annual quantity of water.

B. Untreated water/ leachate quality

The properties and chemical composition of the leachate varies widely during the course of an operational year. In addition, the properties of the untreated water can change fundamentally during the operating year.

C. Permeate output (treated water production)

Generally speaking, the membrane process (reverse osmosis) is employed with the objective of reducing the amount of leachate as far as possible (con-centration) while obtaining the best possible treated water quality.

The treated water quality must meet the local permissible acceptance specifications to avoid further treatment.

Activities in the field of dump leachate treatment (domestic and special waste dumps) are carried out in cooperationwith (among others) the University of Erlangen, the Technical University of Brunswick, the ZVSSM association, Schwabach/ Raindorf, the Burgdorf Refuse Disposal Association and the GKSS research centre in Geesthacht.

* Adaption of established machine and plant technology to the requirements at the leachate site.

* High performance level by advanced:
  - membrane technology
  - module technology
  - plant technology
  - high availability
  - easily serviced construction
  - automatic flushing and cleaning
  - operationally reliable
  - overall unattended performance

* Process parameters for the detailed engineering obtained on site by mobile test plant with operational size module (basis for scaling up).

Waste Water Treatment using Reverse Osmosis
Company History

Onyx Engineering are the distribution and operational arm of RO Environmental Systems, UK agents for Rochem Wasserbehandlung GmbH of Germany who have manufactured over 500 water treatment units in the last 10 years. In 1988 their proven disc tube module system was installed at the Raindorf Landfill Site, for leachate treatment. In total 22 units are currently installed treating leachate and effluent at between 1 and 13 tonnes per hour.

In 1990 three Rochem plants, operating in parallel, were installed at the Schonberg Landfill Site near Lubeck in Germany. The units are currently treating up to 30t of leachate per hour to the following specification.

		Leachate after aeration	Permeate I	Permeate II	% Rejection
p^H		7.7	6.8	6.6	
Conductivity	µs/cm	17250	382	2	99.9
COD	mg/l	1797	<15	<15	99.2
Ammonia	mg/l	366	9.8	0.66	99.9
Sodium	mg/l	4180	55.9	2.5	99.9
Chloride	mg/l	2830	48.4	1.9	99.9

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Waste Water Treatment using Reverse Osmosis

Technical Information

The Rochem treatment system is a separation technique involving the pressurisation of effluent against a semi-permeable membrane. the water fraction of the effluent is forced through the membrane as a permeate, whilst the contaminants in the effluent are retained and become more concentrated. The permeate is then delivered to a storage tank for the discharge to river whilst the concentrate is returned for further treatment or recycled. As the membrane is effectively a molecular sieve the permeate contains extremely low levels of BOD, ammonia and chloride; metals and red list substances are undetectable.

During the operation of any membrane system it is inevitable that the fouling of the membrane with salts will occur. This fouling reduces the membranes permeability and to compensate, the unit will increase the feed pressure to maintain the throughput of effluent. Under normal circumstances the operating pressure is in the order of 30 bar. When the operating pressure required to maintain throughput reaches 60 bar the unit is programmed to adopt a backwash mode using cleaning reagents. On completion of the cleaning cycle the unit resumes effluent treatment. Under normal circumstances a Rochem unit will operate in cleaning mode for less than 2% of its productive time. This ability to reverse membrane fouling is a unique characteristic of the Rochem system and is one of the main reasons for this treatment technique being successful in effluent applications.

In Rochem treatment systems effluent is pumped through a two stage pre-treatment filtration system, comprising a sand and cartridge filter followed by pressurisation up to 60 bar, it is then fed through the membrane system. At all stages the operating pressure is monitored and adjustments in operation made via, a programmed logic controller. Conductivity of feed, concentrate and permeate is also measured. In the unlikely event of contaminants passing through the system the unit will automatically cease operation and inform the operator via a telementary link. It is impossible, therefore for discharges outside of, what is likely to be very restrictive, consent to be made. This ability to automatically modify the performance of the unit, coupled with continuous monitoring of both feed and products and a fail safe shutdown facility ensures the minimum operator supervision.

On site trials, using a full scale plant with only a small throughput, are placed on site for three weeks to determine the actual size of the full scale system.

CRANLEIGH WATER QUALITY FIGURES 1991/92

BROMATE

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN92	FEB	MAR	APRIL	MAY	JUNE
LIMIT ppm	16	16	16	16	16	25	25	25	25	25	16	16
MINIMUM	3	5	5	5	2	8	4	8	8	1	4	3
MAXIMUM	16	18	18	10	35	52	23	25	44	18	16	32
AVERAGE	8	7	11	7	10	22	19	17	18	11	10	11

CRANLEIGH WATER QUALITY FIGURES 1991/1992

CONDUCTIVITY

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN92	FEB	MAR	APRIL	MAY	JUNE
WINTER/SUMMER STD U'SEC.	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
MINIMUM	850	850	1100	1760	650	590	910	1580	1514	450	410	1030
MAXIMUM	2910	2910	3340	1220	2270	6440	3580	3490	5400	2570	2910	4900
AVERAGE	1765	1765	2069	1466	2070	2998	2780	2415	2585	1678	2085	2250

CRANLEIGH WATER QUALITY FIGURES 1991/92

AMMONIA

	JULY	AUG	SEPT	OCT	NOV	DEC	JAN92	FEB	MAR	APRIL	MAY	JUNE
LIMIT ppm.	15	15	15	15	15	30	30	30	30	30	15	15
MINIMUM	9	9	10	13	5	10	9	21	12	2	1	7
MAXIMUM	27	27	46	25	82	127	49	62	57	32	26	24
AVERAGE	14	14	26	18	26	53	44	39	32	17	13	14

CRANLEIGH WATER QUALITY FIGURES 1991/92

ACIDITY ph LIMITS 6 - 9

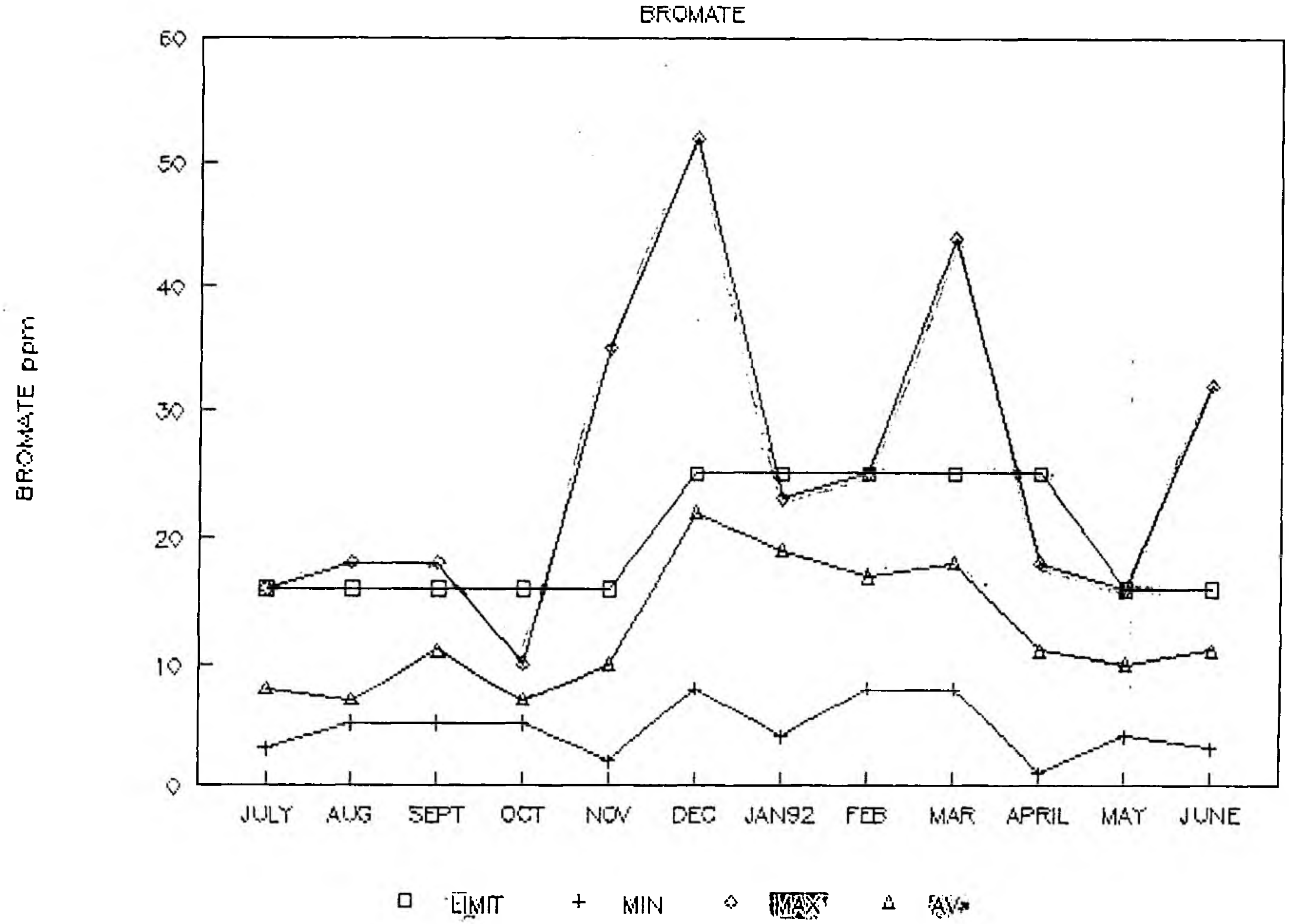
	JULY	AUG	SEPT	OCT	NOV	DEC	JAN92	FEB	MAR	APRIL	MAY	JUNE
MINIMUM	6.4	6.4	6.8	7.5	6.8	6.8	6.8	6.7	6.4	6.2	6.7	6.4
MAXIMUM	6.9	6.9	7.8	7.8	7.4	7.6	7.2	9.3	7.6	7.5	7.9	8.1
AVERAGE	6.6	6.6	7.5	7.6	7.3	7.2	6.9	7.2	6.8	7	6.8	6.8

CRANLEIGH WATER QUALITY FIGURES 1991/92

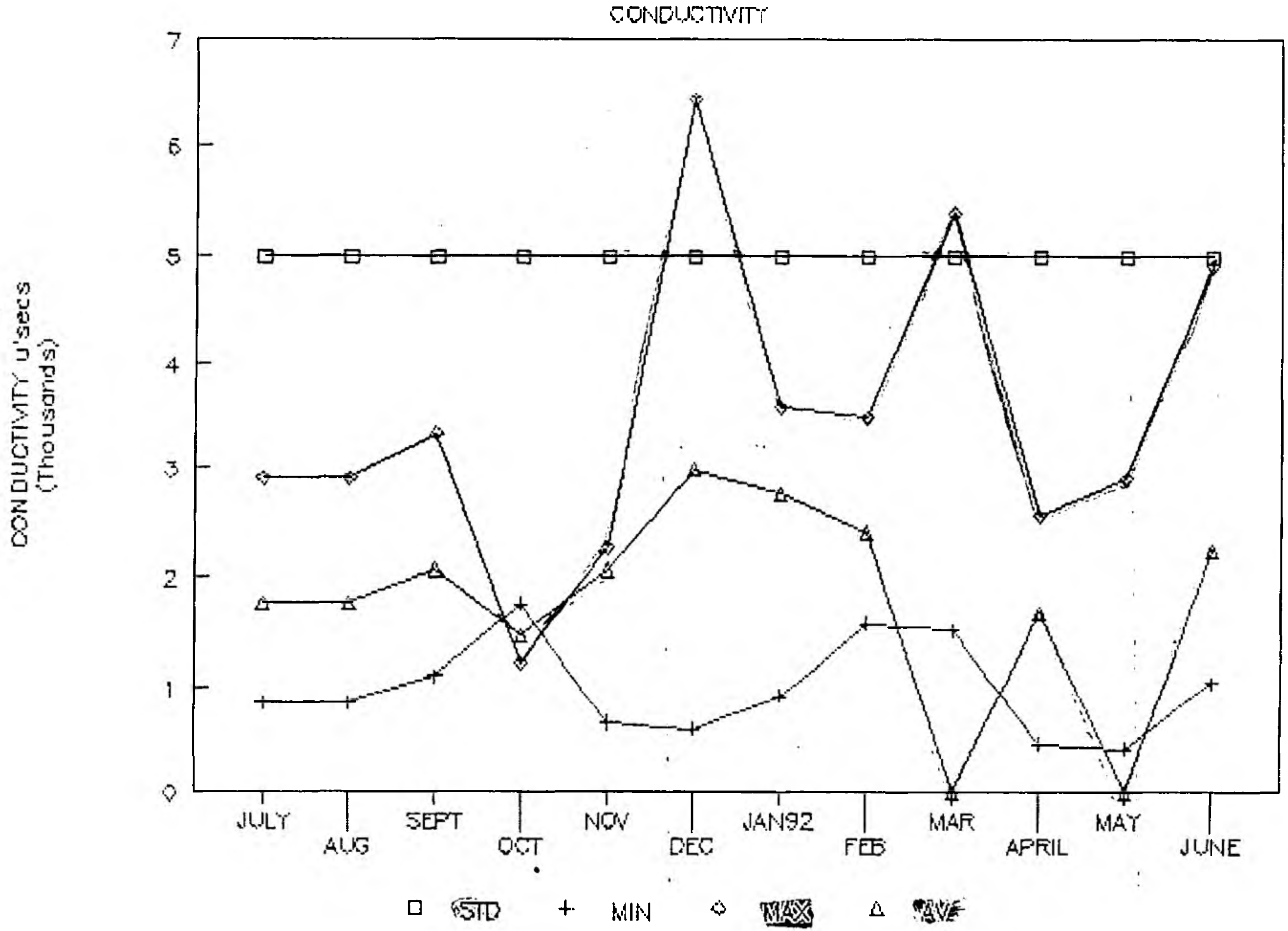
SUSPENDED SOLIDS

		JULY	AUG	SEPT	OCT	NOV	DEC	JAN92	FEB	MAR	APRIL	MAY	JUNE
LIMIT	mg/litre	30	30	30	30	30	60	60	60	60	60	30	30
MINIMUM		5	15	15	11	5	10	12	10	11	10	14	10
MAXIMUM		115	39	39	35	74	46	17	143	59	82	33	55
AVERAGE		58	23	23	23	38	12	12	31	23	19	18	16

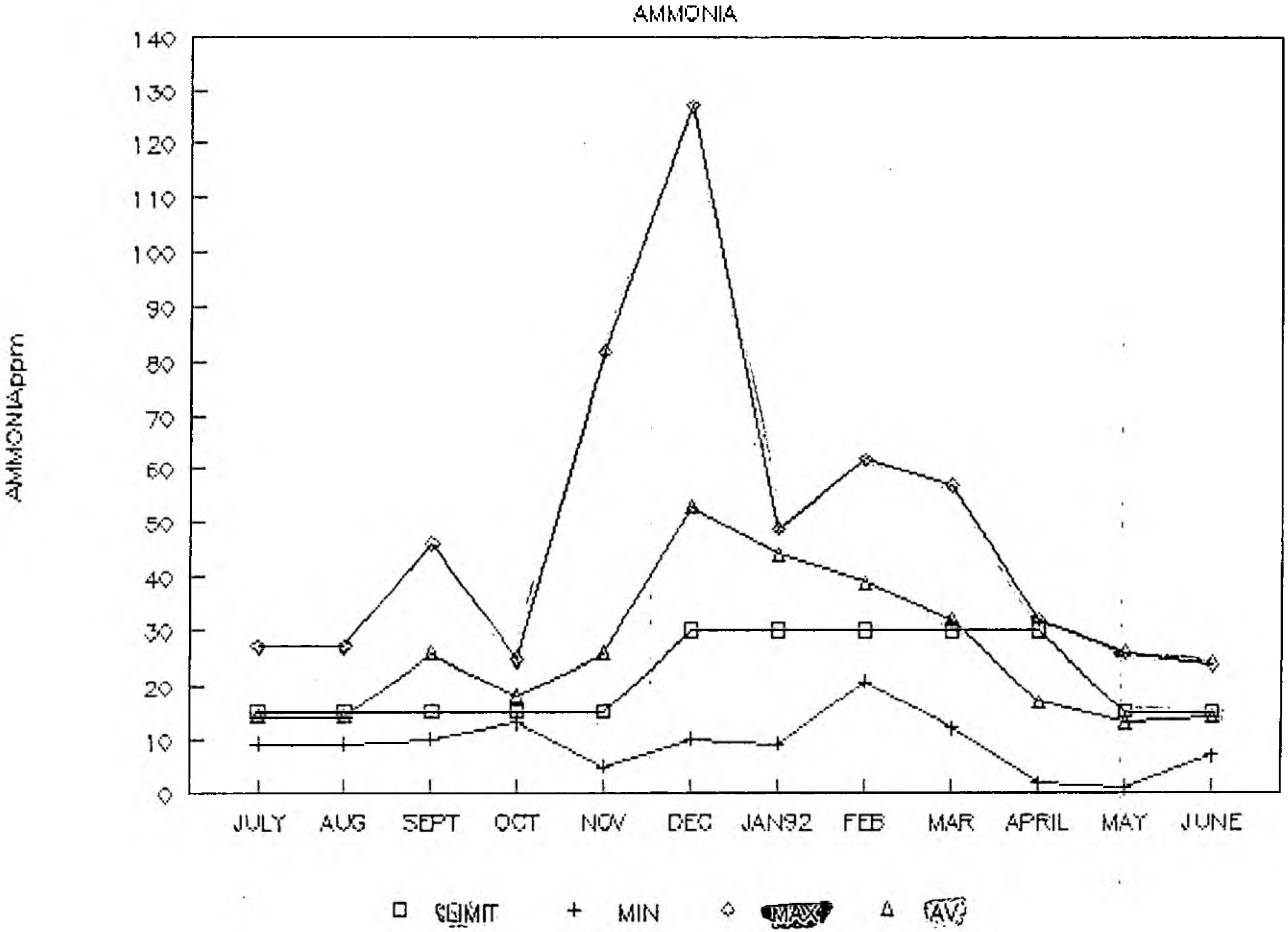
CRANLEIGH WATER QUALITY FIGURES 1991/92



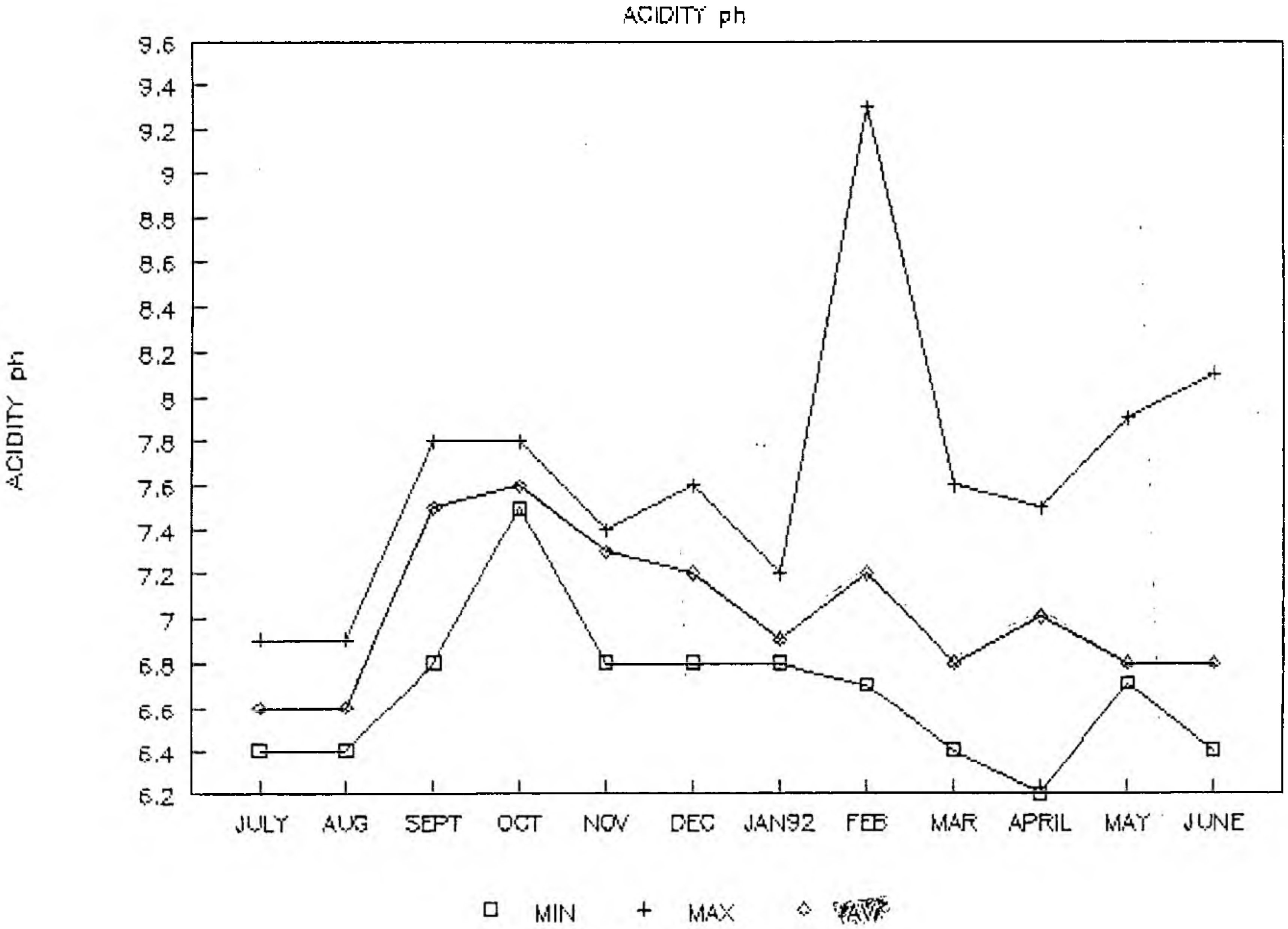
CRANLEIGH EFFLUENT STANDARDS 1991/92



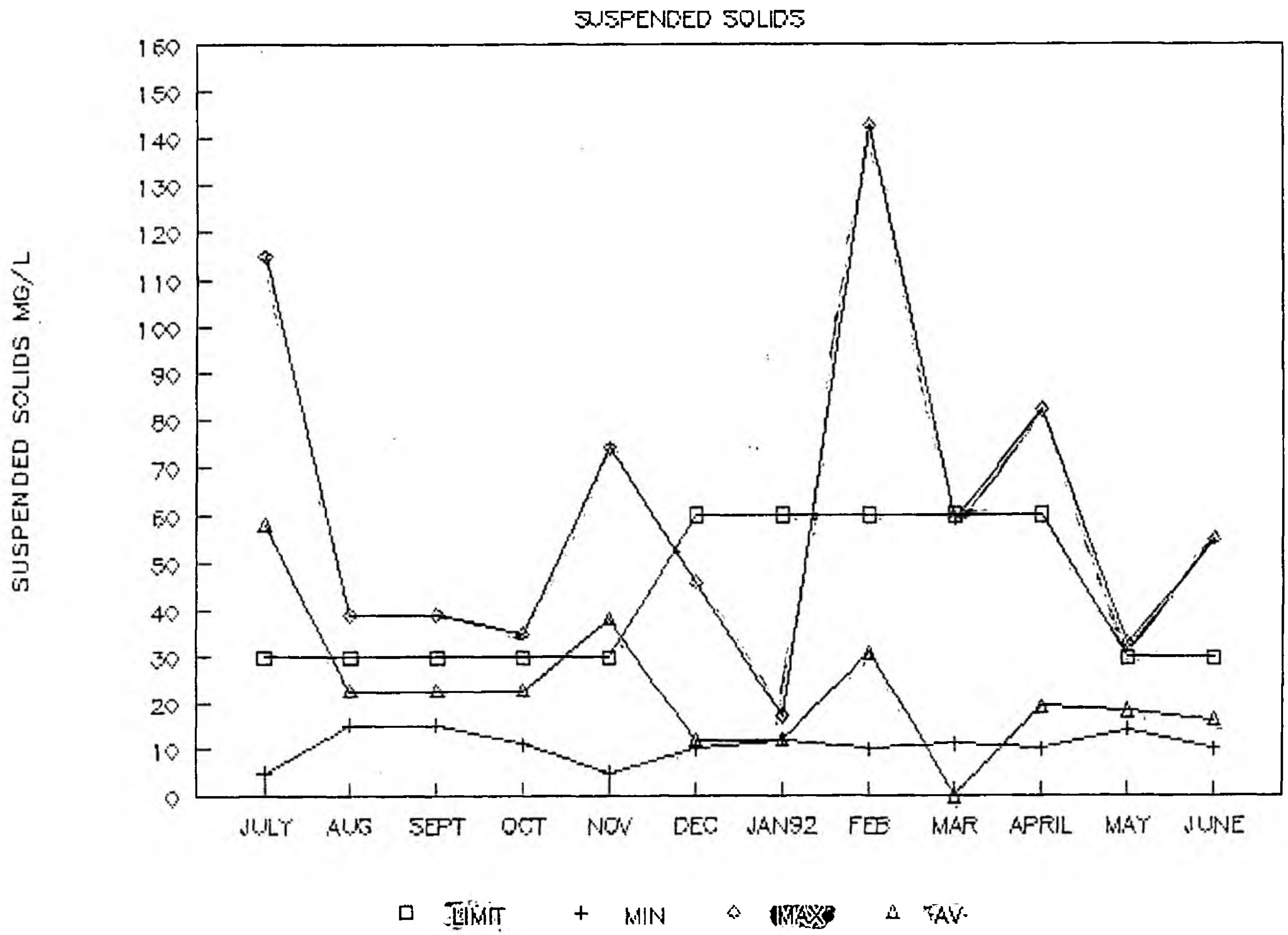
CRANLEIGH WATER QUALITY FIGURES 1991/92



CRANLEIGH WATER QUALITY FIGURES 1991/92



CRANLEIGH WATER QUALITY FIGURES 1991/92



1. Upper dilution lagoon

2. Upper dulution lagoon

3. Upper dilution lagoon

4. Pump from lower to upper lagoon

5. Inlet to lower effluent lagoon

6. Cranleigh Waters down stream