How to drain off 4.5 megalitres of contaminated water a day... without upsetting Mother Nature.

by Garth Gee

Draining off this amount of clean water a day onto a 1800 hectare (4500 acre) property, with two creeks through it, normally would be a simple exercise in water engineering.

But when the water contains effluent from an abattoir and on no account must reach the creeks – yet must be economically treated to enrich the irrigable areas along the creek banks, it suddenly becomes a major dispersal exercise problem.

The problem

The Riverstone Meat Works, situated near Windsor about 50 km north west of Sydney (about half way between the mountains and the coast), completed a partial rebuilding of its works in 1974. The work included a new modern, ten million dollar abattoir, big enough for a daily throughput of 750 grown cattle, and 6000 small stock (sheep, pigs, calves), rendering, boning and by-products factory, and associated freezer and cold storage. The portions of the old works retained were: a fellmongery for scouring wool; a textile mill for processing the wool up to the "tops" stage, ready for spinning; a margarine factory; a cannery; and a small goods and bacon factory.

The daily volume of wastes from the new works and old factories combined was estimated to be 4.5 Megalitres (1 million gallons). Even after preliminary treatment by fine screening through a 40 mesh screen, and dissolved air floatation to recover material for by-products, the B.O.D. of the waste was in the vicinity of 800 to 1000mg/l – about four times the strength of ordinary town sewage.

This gave an effluent discharge equivalent to a city of about 60,000 people.

The problem was that the traditional treatment to bring these wastes to a quality suitable for discharge to a creek would have cost several millions of dollars.

The Riverstone Meat Company not only arrived at an acceptable solution but achieved the solution for a fraction of the cost of traditional means.

Treatment

For many years, because of the limited volume of effluent, the company had been using flood irrigation to dispose of wastes – preliminary treatment being all that was required. They had also been using non-potable water from South Creek, running through the property, to supplement the small amount of treated effluent.

With the greatly increased flow of effluent, the environmental aspects suddenly became a major consideration. The old irrigation system without extra treatment would no longer have been suitable because the untreated effluent was strong enough to kill pastures and trees if not very carefully controlled.

The company therefore decided that steps should be taken to protect the environment by treating the wastes; and that they should be cleansed to a point where they could be put to good use – by providing additional nourishment to the land nearby.

Members of the company's project engineering team had been overseas to study the latest developments in abattoir design. On their travels they were further acquainted with the successful and economical use of "anaerobic – aerobic" lagoon systems for treatment of abattoir and meatworks wastes.

When faced with the problem of pollution generally, the project engineering staff realised that an "anaerobic – aerobic" lagoon system would not only overcome the environmental pollution problems, but also show handsome return in increasing the amount of fodder which could be grown.

Although lagoons cannot usually improve effluent quality sufficiently for it to meet regulations for direct discharge into New South Wales streams or water-courses, they can produce an effluent which can be spray irrigated without odour nuisances, and will not harm pastures by putrefying in the ground.

Factors at Riverstone which were favourable for the adoption of the lagoon plus irrigation system of treatment for effluent disposal were:

The company owns about 1800 hectare (4500 ac.) of land. This land is situated in the Cumberland rain shadow area, where the rainfall is much less than either Sydney on the coast, or at Kurrajong on the Blue Mountains foothills. In this drier area, irrigation can substantially increase growth.

The algae present in the effluent would provide nitrogen and phosphorus as fertilisers, and the humus resulting from their ultimate decay could act as a soil conditioner – thus increasing the amount of fodder which could be grown.

Plenty of area was available for lagoon construction. Anaerobic lagoons in the system could be made deep to reduce the surface area, and hence any odour problems. The lagoon site was reasonably removed from populated areas.

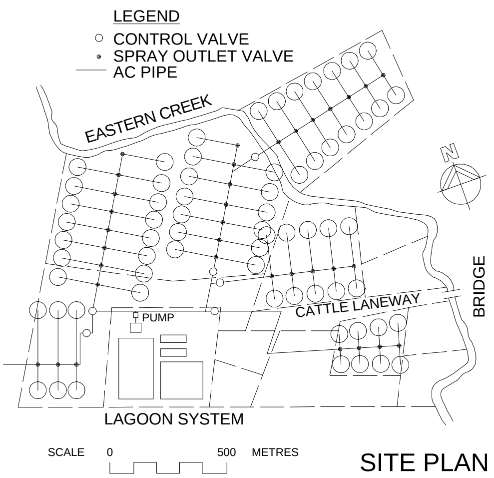
The company's project engineering staff had initial difficulties in finding information on which to base the design of the treatment lagoons, but they later received assistance from officers of the C.S.I.R.O. and the State Pollution Control Authority.

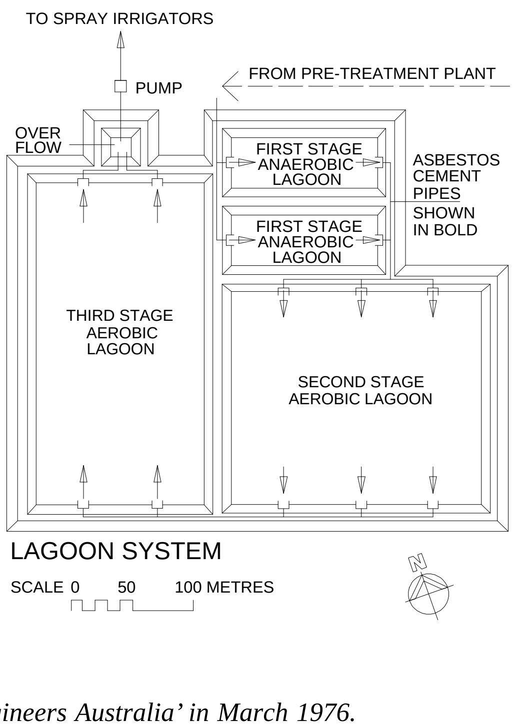
After preliminary treatment, the factory effluent is pumped through the original 300mm concrete pipe to the treatment lagoons. Which are built on the site of the old flood irrigation control works.

A.C. pipe was connected to this original line to take the initial discharge into the lagoons.

The major contractor for lagoon construction was Mr. E. Books of Windsor and the sub-contractor for the installation of the Hardie's A.C. pipe in the lagoon area was Hayes Bros. of Windor.

In departure form normal pipe-laying methods, pulverised clay rather than sand, was used as bedding material for the pipes when they passed through the pond walls. This was to prevent any seepage from one pond to the next – which could have occurred with sand. The trenches were dug with a chain digger, which pulverised the clay at the same time, forming suitable





material for the pipe beds.

The first part of the lagoon system consists of two anaerobic lagoons operation in parallel, with an estimated detention time of ten days. These lagoons are about 4.7m (14ft) deep, and each has an area of about 0.6 ha (1 $^{1}/_{2}$ ac.).

The anaerobic treatment, which can be expected to remove between 60 and 90 percent of the B.O.D., is followed by two oxidation lagoons in series. In these, the bulk of the volume of the effluent is aerobic and therefore non-offensive because of oxygen production by photo-synthesis in the algae – which flourishes under these conditions. This type of lagoon is often called "aerobic", signifying that the free oxygen is present to supporty bio-degradation and bio-oxidation of the wastes by the bacteria.

These aerobic lagoons have been designed for a total of 20 days' detention (10 days each). Each of them holds wastes to a depth of about 1.2m (4ft), and has an area of about 3.6 ha (9$^{1}/_{4}$ ac.).

It therefore takes about four weeks for wastes from the factory to pass through the lagoon systems and appear as final effluent ready to be sent to the irrigation sprays.

After six months of operation, the lagoon systems gives an effluent with a B.O.D. of only 30 mg/l compared with 1000 mg/l after pre-treatment. Some of the B.O.D. of the effluent is attributable to the algae which if removed would lower the final B.O.D. to about 5 mg/l. But algae removal is a very expensive process and is not warranted before using the water for irrigation – as the algae in fact created useful humus in the soil.

Odour discharge from the anaerobic portions of the treatment system is kept to a minimum by the crust of the lagoons. This crust greatly retards the gases in their passage from the liquid in the lagoon to the air above.

Irrigation system

The essential criteria of the disposal system, is the efficient distribution of 4.5 Ml of water laden with wastes that must not reach the creek, yet should be used to enrich irrigable areas along the creek bank.

The company's project engineering staff prepared a performance specification setting out their requirements for effluent distribution to an area of about 160 ha (400 ac.) of the 1800 ha (4500 ac.) property and the contract for the design and installation of the irrigation system was awarded to Hayes Bros. of Windsor.

Mr. Arthur Sullivan, a principal of Hayes Bros. reported: "The assignment was most unusual. Normally, when designing and irrigation system you are working with a limited supply of water and are concerned with its economical dispersement. In this case we were working with an abundant supply and had to disperse the 4.5 Ml in the most practical way possible. Because of the number of solids, which could still be present in the water, conventional irrigation systems were ruled out. Instead, it was decided to use the McPherson travelling spray irrigation system. Four of the systems were used, each features a turbine action which will pass up to 6.25 mm ($^{1}/_{4}$") solids in water. In one run each travelling irrigator (see plan) can travel up to 425 metres (1400 ft.) and irrigate 3.8 ha (9$^{1}/_{2}$ ac.) – dispersing 1.1 Ml (242,664 gallons) of water over each 12 hour shift."

The water dispersement is achieved by locating the spray irrigators at one end of a field and running out a cable link to a point at the other end. A 100 mm (4") hose, which is fed from an outlet midway, feeds water to the spray irrigator. In operation the irrigator automatically winds itself from one end of the field to the other. Water is dispersed over a 60 metres (200 ft) radius around it – with the exception of a small "V" shaped area in front – which is left initially unwatered to prevent bogging.

The lagoon effluent is collected in a small pond, which feeds to the 150 kW Harland split casing main irrigation pump. This 120lbs (100,000 g.p.h) pump supplies four moveable sprays, each which has a capacity of 30 l/s, through a total of 6,100m (almost 4 miles) of Hardies class C 250 mm, 200 mm, and 150 mm asbestos cement pressure pipe. The sprays are connected by flexible connections to any on of 30 outlets provided by the pipe system.

The pressure at the spray nozzles is required to be at least 620 kPa (90 psi). The pump is normally controlled by a time clock but there are over-riding level controls so that if the water gets too low in the collecting basin the pumps will then stop, or if it gets too high they will operate, regardless of the time clock setting.

As the water to be disposed of is at the highest elevation, once irrigation has stopped and to prevent a siphoning effect and overnight flooding a special automatic valve or hydrant tap had to be incorporated in each travelling irrigator.

Economical disposal

The system was completed in October, 1974, at a total cost for treatment and distribution of only $175,000. It could have cost several millions of dollars if conventional treatment methods had been utilised.

In addition the farm's $60,000 a year feed bill is expected to be halved this year by the use of extra fodder produced in the spray irrigation areas, and the farm manager, Mr. Tom MacNamara, predicts that within a few years the scheme will produce a feed surplus.

Future plans

"The next step in farm improvement will to be resize and reshape all the paddocks according to the irrigation layout," he said.

Once this has been done, the whole area will be ripped, recultivated, and sown to improved pasture species.

Some dams already on the farm will be abandoned, and new ones built at more

The quality of the effluent in the final aerobic lagoon now supports prolific bird life and the area is a wild life sanctuary.

Extension of the scheme to an old flood irrigation channel draining away from the creeks is being considered, which would provide another 70 hectares of irrigable land – a useful safegaurd against wet weather – when the regular irrigation areas could become water logged.

In terms of environmental and economical efficiency the dispersal system has already demonstrated its value – showing that industry can work in perfect harmony with nature… adding to the quality of life on the land that surrounds it.