CASE STUDIES OF INNOVATIVE PLANNING AND DESIGN PRACTICES

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CITY OF HARRISONBURG, VIRGINIA
RESOURCE RECOVERY FACILITY:
A CASE STUDY

INTRODUCTION

A resource recovery operation can take a number of forms, from an attempt at recycling aluminum cans, glass, or scrap metal to a multi-million dollar trash burning steam generation plant. The latter is a relatively recent and has a number of environmental consequences. Perhaps the most important effect is that rather than expending energy, as well as the landscape, by burying thousands of tons of solid waste in a landfill, such a facility utilizes the waste to produce energy. The process greatly reduces the amount of trash which must be buried, and at the same time reduces the need to purchase other energy producing resources.

There are currently seven large scale resource recovery facilities operating in the state of Virginia. These facilities operate at various capacities, under a variety of conditions. The facility most recently developed is located in Harrisonburg, Virginia.

The initial proposal for creation of Harrisonburg's plant was submitted to the city council by the Assistant City Manager in 1975. After a series of negotiations, investigations of its feasibility, and other exploratory steps, the plant was completed in the Spring of 1982.

The following is a study of Harrisonburg's Solid Waste Resource Recovery Facility. The contents of the study include a summary of the factors which instigated the city's investigation into the feasibility of building a steam plant, a detailed discussion of the sequence of steps which followed the city's selection of a consultant to conduct a feasibility study to the eventual completion of the plant itself, and an examination of problems encountered after its completion. This is followed by a description of the steam production from trash process adopted by Harrisonburg, a comparison of Harrisonburg's plant operation and costs to other similar facilities operating throughout the state, and finally, an examination of lessons which might be derived from the city's experiences.

Harrisonburg Virginia: Why A Steam Plant?

Located in the center of Rockingham County, the City of Harrisonburg, Virginia has a population of approximately nineteen thousand, including nearly eight thousand James Madison University students. In the early 1970s officials of Harrisonburg realized that the existing landfill was fast approaching its capacity limit. In 1975, Assistant City Manager John Driver proposed that the city investigate the feasibility of burning the trash that would otherwise be buried in the landfill, using it to generate steam which could then be sold to one or more institutions in the area.

There were a number of motivating factors which favored a plant of this nature. The estimated useful lifetime remaining the existing landfill was 15 to 20 years. When the remaining space was exhausted, the city would have to select another site to take its place. This would require locating, and purchasing the site, and acquiring state environmental approval as well as appeasing those residents located near the site. The combination of these factors, along with rising fuel costs, the opportunity to turn a profit with a plant, and the permanence of the solution prompted the council to proceed with the study.

In April of 1975 and city council voted to study the possibility of heating buildings at James Madison University, (formerly Madison College) and Rockingham Memorial Hospital.

Negotiations began with Rockingham County, to develop the facility as a joint venture. This step was partially due to the assumption that a plant would not be feasible for a municipality the size of Harrisonburg, since it (the city) would not generate a sufficient supply of solid waste.

The combined solid waste produced by Rockingham County and the city of Harrisonburg totalled approximately 750 tons per week. This would be enough to produce about as much steam heat as 250 tons of coal.

<u>Events Through to Completion of the Plant</u>

Twice the city applied for an $18,000 federal grant in order to fund the steam plant's feasibility study. However it was denied both times and the city was forced to fund the study through its budget.

In March of 1976 the council voted to hire the Williamsburg firm of Martin and Associates to conduct a feasibility study of a trash burning steam generation plant for a price of $22,500 (News Record 3/23/76). The study was to begin in April and be completed in approximately four months. However, due to personnel problems Martin and Associates repeatedly delayed the study. In the city's search for another firm for the job, three were considered: Hayes, Seay, Mattern and Mattern of Roanoke; Wiley and Wilson of Lynchburg; and William F. Couslich Associates of Woodbury, New York. In November of 1978 the city chose to hire Couslich Associates since it had been supplying the Williamsburg firm with much of their information.

Rockingham County and the city of Harrisonburg were in tentative agreement as of July 1977 to create a Harrisonburg--Rockingham Waste Recovery Authority. The authority was proposed by county engineer, Don Krueger and Assistant City Manager, John Driver who had both evaluated the project and concluded that it would be a feasible venture. The authority would operate the steam plant, the county landfills and trash collection. It would consist of three members each from the county and the city. Mr. Krueger stated that he felt the authority could handle the project better than the city or the county separately, and that it would help to prevent squabbles between the two (New Record 7/12/77).

Later that year the county backed out of the project, (WHY?) and then in November again showed interest, and directed their attorney to resume talks with Harrisonburg officials. The county ultimately decided not to participate since they had floated bonds (define) for a previous project and did not wish to go further in debt.

The Couslich firm was hired to evaluate the plant's potential talk with perspective steam customers (buyers?), draw up the actual engineering plans, and work up an economic feasibility report for the city. At this point it was uncertain who would purchase the steam to be sold at 20 percent below the cost of alternate fuel. There was still some uncertainty that the city would build the plant.

One possible location for the plant was north of the city near the Rockingham county fairgrounds, and adjacent to the proposed site of a printing plant, a potential candidate for steam consumption. Another possible site lay south of the city on the city shops property. The eventual site selection would be somewhat dependent on the steam customers' location, since loss of steam heat through the lines made it economical to locate as close as possible to the customer. The primary customer possibilities were later narrowed to James Madison University, and Rockingham Memorial Hospital (New Record 6/27/79).

At this point, the preliminary plans for the project were $27,000 and total fee of $180,000 if the plant were built, at an estimated plant cost of $2,000,000. The feasibility study was completed in May of 1979.(This paragraph is unclear)

In June of 1979 the city council voted to proceed with plans to construct the now estimated $3,400,000 plant. At this time the city was collecting about 50 tons of trash a day; the proposed plant would require 68 tons a day to produce enough steam heat to offset its operating costs. By permitting free dumping at the plant, nearby communities and individuals would contribute to the supply and would therefore make up the difference.

The cities fuel oil costs during this period were 64 cents per gallon. Using this rate as a base, the city would need to charge $6.21 cents per 1,000 pounds of steam. Operating at a volume of 50 tons per day the cost per ton of waste for disposal would be $14.97. However, O.P.E.C. nations were in the midst of meeting and a 20 percent price hike was expected, causing the price per gallon of fuel oil to jump from 64 to 77 cents per gallon. In this event the city would charge $7.43 per 1,000 pounds and lower its disposal costs to $7.60 per ton (New Recor 6/27/79).

On June 11, 1980 the city council voted to spend $100,000 on the engineering and design costs for the plant and steamlines. A meeting took place between city officials, engineers, financial advisors, and representatives of James Madison and Rockingham Memorial, both of whom expected to purchase steam from the lant (New Record 6/12/80). Two weeks later the council approved a now 7.5 million dollar plant. James Madison and Rockingham Memorial would sign twenty year contracts within three months.

The plant site was in a ravine about 450 feet east of *-81 and about 1,000 feet north of the J.M.U. field house then under construction. (New Record 6/25/80) J.M.U. had bought the land and sold it to the city for $1.5 million, a figure representing a subsidy for J.M.U.'s convocation center as well as payment for the property with the project cost still nearly a million dollars less than expected had the plant been built at the proposed city shop's property, the high price was somewhat justified.

In August of 1980 a state Air Pollution Control Board official attended a hearing on the plant, and permit was granted in September. Shenandoah National Park Superintendent Robert Jacobson, who expressed concern over the increased levels of man-made pollutants, constituted the only opposition. Jacobson asked what type of fuel the plant would replace, feeling that coal or oil pollutants emitted from the plant would probably be less harmful then those put out by the replaced fuel. whereas natural gas emissions would increase the level of air pollution. (The previous phrases are unclear. Coal/oil would be less harmful than What? The type of fuel plant would repalce? or less harmful than gas?) Miro D'Virka, one of the plant's designers responded that J.M.U. used oil and natural gas, and that the hospital used natural gas. D'Virka added that despite this use there would be less sulphur dioxide and about the same amount of ash and dust emitted from the plant as was currently produced by J.M.U.'s and Rockingham Memorial's boilers. He also stated that no pollutant levels would increase. D'Virka noted that the plant was designed to produce only .03 grams of partical emmissions per cubic foot of air, well below the existing state standard of .08 grams (News Record 6/29/80).

The emissions situation improved when the (?) decided to sell all of the steam produced by the plant to J.M.U. rather than to both the university and the hospital. The steam would replace J.M.U.'s fuel sources which were more offensive pollutants than the hospital's. This decision came about after J.M.U. indicated in the spring of 1980 that they could utilize all of the steam the plant could produce by connecting the new convocation center to the s steam lines. The city had not yet committed itself to selling steam to either the Hospital or the University. However, Assistant City Manager, John Driver had made a "gentleman's agreement" with the hospital, and therefore the city consulted the hospital prior to the official agreement made with the University. The end result was a twenty-year contract with J.M.U. to purchase steam at 10 percent below alternate heating fuel costs. J.M.U. would have to use the steam, not only to heat the center, but also to run the center's air conditioning system. The University agreed to buy 3,000 pounds of steam per hour, enough to supply all of the University's summer energy needs.

J.M.U. spends approximately $450,000 annually on natural gas. The plant would supply about 40 percent of the University's winter energy needs, about $180,000 worth of natural gas, and at a 10 percent discount the University would then save somewhere between $15-18,000 per year. From a resource conservation standpoint the plant would reduce the consumption of natural gas by about 10,000 cubic feet per ton of refuse (Breeze 9/12/80).

The city accepted bids for construction of the plant in May of 1981. The Whiting-Turner Company of Baltimore submitted the lowest of the five bids received, with a bid of $7,179,000. The plant that Whiting-Turner planned to build had already been designed by the William Couslich firm of New York, with the exterior design developed by the architectural firm, Davis and Associates of Harrisonburg.

The city had not anticipated the $7 million plus bid. Earlier in the year the engineering firm had estimated that the total project construction costs at $7.5 million - $5 million for the plant and $2.5 million for the access roads and steamlines. A more recent estimate indicated a plant cost of $6.75 million (News Record 5/7/81).

Bids on the steamline construction were not received until February 1982. the city hired Branch Associates of Roanoke to construct the lines. Branch Associates in turn hired the firm of Mullin and Jones Contractors (also of Roanoke) as a subcontractor to actually install the lines.

One June 9, 1982, the city council voted unanimously to sell $10,450,000 in twenty-year bonds in order to fund the steam plant project. Construction of the project would begin in August and would be completed in fifteen months. the start of the construction of the steamlines would start in may, so that the completion of the two segments would coincide (New Record 6/10/81).

On August 11, 1981, the city began an advertising campaign asking city residents to save their paper trash to feed the steam plant during the testing scheduled for late October or early November. Whiting-Turner would run the testing as part of the contract agreement with the city (New Record 8/12/82). The test would consist of a firing of each furnace continually for ten days at near capacity, then both furnaces simultaneously for ten days.

The individual ten-day tests resulted from concern over whether or not the city would be able to gather the needed trash to fuel borth furnaces for a thirty-day period. To avoid this type of problem when the plant started actual operation, the city negotiated with private trash collectors in the area, and finally agreed not to charge any dumping fee, so as to give the private haulers an incentive to utilize the plant rather than the Rockingham County landfill, (the landfill charged a per ton dumping fee) (New Record 9/16/82).

After a few minor delays, testing of the plant began in early November, only to be shut down due to some unforseen problems, such as garbage clogging the hoppers which feed the furnaces, and garbage not completely incinerated, thus leaving too much residue. The problem of excessive residue was remedied by simply feeding additional air into the furnaces to increase the burning. Purchasing a shredder to chop the garbage up and allow it to dry prior to being placed in the hoppers could have solved the first problem but this measure would have added a substantial expense to the project. Instead, the city opted for a design that would minimize the need for a shredder (News Record 11/26/82). With this design trash would be loaded into the hopper at a reduced rate to allow it to clear somewhat before adding more trash. Neither of the problems was regarded very seriously, and the testing resumed two weeks after the shutdown (Breeze 12/8/82). The plant began operation in December.

The project cost $10 million to build, and (based on a four month study), in April it generated $40,000 a month for the city from J.M.U. for steam produced from each ton. The plant currently pays for its operation, but has not yet operated at a profit. The full economic analysis will not be possible until the plant has been in operation for a full year, with no extended shutdowns.

Examination of Plant and Steamline Difficulties

The city experienced a number of complications with the plant shortly after its completion. On May 12, 1982 a fire in the plant, believed to have been caused by some type of flammable liquid which spread fire from the furnace to the floor underneath and cracked the concrete support, put the south end furnace out of operation until repairs could be made. When completed, the repair bill totaled $38,000. However, the city's insurance paid for all but $5,000 of this amount, and the furnace resumed operation in September (News Record 9/19/83).

Another difficulty was of leakage of steam. The steamline connecting J.M.U. to the plant consists of about 4,000 feet of eight-inch lines which are buied and surrounded by insulating material known as Protexulate. Protexulate is a powdery substance designed to keep the steam in the lines from cooling through contact with lines that have been chilled through ground contact. The lines are not encased in a conduit except where they pass through the fifteen manholes along the path from the plant to J.M.U. The manholes are located at points where the lines are jointed to allow for a change of direction or elevation.

In the spring after the plant began operation, steam was seen rising from three of the manholes. A probably cause was infiltration of ground water into the manholes which then came in contact with the steam lines themselves. Following a meeting between city officials and representatives of Branch Associates of Roanoke, (the firm which built the steamlines),the city decided to excavate the manholes to investigate the source of the infiltration (New Record 5/13/83).

While the leaking manholes at this point, according to plant director John Holsten, presented little more than a nuisance, he noted that the plant had to burn more garbage in order to produce the needed pressure since some heat was lost through the lines being exposed to the water. Fortunately, the leaks occurred in the spring when J.M.U.'s steam demand was less than in the winter. Thus, the University did not suffer from a loss of energy.

The question of what caused the leaks sparked a debate between Couslich (the engineering firm that designed the steamlines and plant) and Branch. Couslich claims that Branch had executed welding joints sloppily and had failed to use enough packing material around the sleeves. Branch, on the other hand, claimed that the insulation material specified was insufficient, but the firm did agree to repair the leaking manholes at its expense (New Record 6/21/83). Repairs on the steam lines began on August 8th and were completed in November.

Steam Production from Trash Burning: The Process Adopted by Harrisonburg

The Harrisonburg plant employs a mass burn process to generate steam from trash. The facility is located on a 2 1/2 acre site just east of Interstate 81. The plant is housed in a six story 80 X 120 foot, green metal building and has a 65 foot chimney. There are three bays on the east side of the building which allow trucks to dump trash into the 20 foot deep pit, capable of holding approximately 280 tons of garbage. Two of the bays are for conventional rear end dump trucks, and one bay is to accommodate top unloading trucks (News Record 5/10/82).

Once the trash is deposited in the bin, a 23 1/2 ton crane hoists the waste up and places it in the hoppers at either end of the pit. The hoppers feed the two furnaces, each of which can handle 50 tons of trash per day. The crane moves along a track which allows it to be positioned above the hoppers in order to deposit the trash, as well as making it possible for the operator to pluck items such as old trash cans, or bicycles from the bin in orer to prevent them from clogging the hoppers or jamming the furnace (News Record 10/7/82).

The crane operator sits in a control room locate above the pit. Along with operating the crane, the controller must also maintain the proper temperature in the furnaces an pressure in the boilers (the boilers are situated over the furnaces). The control room itself is air conditioned to offset the heat of the furnaces, and is equipped with a kitchen and lounge for the employees.

At one side of the pit a tire shredder, connected to the pit via a conveyor, transports the chopped tires and deposits them in the pit.

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The furnace operates like a woodstove, the one difference being that it has large fans forcing air through wall vents to increase the burn.(Woodstove or furnace?) The air is drawn from above the storage pit to reduce odors.

The bottom of the furnaces tilts downward, so that as a large revolving grate turns the trash, unburnable debris is forced down toward the bottom of the furnace (News Record 5/10/82). the furnace then empties into a bin filled with water, which has a conveyor running through, lifting the residual out of the bin and carrying it out to be hauled to the landfill.

Other Resource Recovery Facilities Operating in Virginia

There are six other resource recovery facilities operating within the state of Virginia. Five of the six are steam-producing facilities, and one simply recovers recyclable materials. Of the five steam generating facilities, three have a larger ton per day capacity than Harrisonburg and one is the same, but only two of these are currently operating at a higher rate. The Navy owns one of the larger operating facilities, located at the Navy station in Norfolk, Virginia. The facility has operated since 1967, when it was built for $2.1 million. the plant has had approximately another $2.1 million spent on it in repairs and design improvements.

The facility has a capacity of 360 tons per day (TPD) of trash, with two 180 TOD boilers which operate alternately to process 140 TPD of waste from the base from two or three truck loads per day coming from the city of Norfolk. the plant produces approximately 40,000 pounds of steam per hour (as opposed to 26,000 pounds at Harrisonburg). This accounts for about 10 percent of the basic needs of (Norfolk base?).

The plant was designed for a five-day operation and in 1982 was running 24 hours a day, seven days a week. Thus by necessity the plant runs until it breaks down, is repaired, and commences operation again.(Delete?) Eventually the plant will require a major overhaul.

The waste must be sorted before entering the furnace. In 1978 some methyl ethyl ketone got into a boiler, causing a major explosion and fire. High quantities of documents also present a problem in that they cause the furnaces to burn quite hot, which leads to heavy exhaust and gas emmissions (Hans Mueller).

The second facility, which operates at greater TPD rate than Harrisonburg, is owned by NASA and leased to the city of Hampton. The plant, located near Langley Air Force Base, became operational in November of 1980 at a cost of $10.4 million. About 70 percent of the funding for the plant came from the city of Hampton, about 20 percent from NASA, and 10 percent from Langley.

The facilities two 100 TPD boilers are operated by the city, which also collects about 88 percent of the trash burned in the plant (Hans Mueller).

The city of Salem, Virginia operates a system with 2,000 pounds per hour steam capacity, (Harrisonburg's plant has a capacity of approximately 26,000 lbs/hr.). The plant cost $1.8 million, and was completed in December of 1978. The plant runs five days per week, 24 hours per day, and costs about $600,000 annually for operation weekly so that the system burns 50 to 100 TPD, 35 of which come from the yard itself and the rest from the city of Norfolk. The system generates about 27,000 lbs./hr., but suffers from a major air pollution problems, since the present electrostatic precipitator (?) is too small (Hans Mueller).

The last steam-producing recovery facility is owned by the Army, and is located at Fort Eustis, Virginia. The facility began operation in January of 1981 at a cost of $2 million. The plant capacity is quite small compared to the facilities previously mentioned, at 40 TPD. The steam serves approximately 20 buildings adjacent to the site. Bulky ferris metals are manually separated before arrival, and other residuals are buried in a landfill (Hans Mueller).

Finally, a Triple S Trammel Burke's Cannon, with a total design capacity of 400 TPD, is owned and operated by the Henrico Resource Development Partners. The plant began operation in July of 1981, for a cost of $1.8 million. The procedure used completely differs from that of the steam generating facilities. One tone at a time is loaded into the cannon, charged with 400 psi. of air pressure, a large valve opens and the content shoot out into a room. Two Ding's magnets recover metals. Owens of Illinois accepts glass, (if sorted by color) (Hans Mueller).

Facility Comparison

Table

Facility	Funding Cost	Construction Capacity	T.P.D. Current	lb's/hr Steam	Profit
Harrisonburg	City 8.9 m	100 T.P.D.	85	26,000	Possible
Salem	City/Fed 1.8 m	100 T.P.D.	80-90	24,000(?)	Break even
Henrico Co.	Private 1.8 m	400 T.P.D.	300-400	None	Yes
Fort Eustis	Federal 1.5 m	40 T.P.D.	40	9,000	Break even
Portsmouth	Federal 4.2 m	160 T.P.D.	80	27,000	Break even
Norfolk	Federal 2.1 m	360 T.P.D.	140	45,000	Break even
NASA/Langley	Fed./City 30% 70% 10.4 m	200 T.P.D.	200	55,000	Break even

In summary, Harrisonburg's plant, while not the largest in the state, is the newest, and perhaps the most environmentally sound steam-producing recovery plant. It was funded wholely through municipal bonds, whereas all of the other facilities were either partially or wholly funded by private or federal money (i.e., NASA, Navy, Army). None of the facilities, other than the Henrico County project operates at a profit, whereas one hopes that Harrisonburg,s plant will eventually pay for itself and begin to turn a profit.

Possible Lessons Derived from Harrisonburg's Experiences

The city encountered a number of complications along the path from conceptualization of a steam plant as an alternative means of solid waste disposal in 1975 to the eventual start of operation in 1981. The majority of these complications resulted from matters beyond the city's control. The faulty steamlines, plant fire, and initial confusion over whether Rockingham County would be a partner in the project exemplify matters which the city could not control.

One possible suggestion to avoid some of the pitfalls encountered by Harrisonburg might be to have a more rigid agreement between parties involved in creation of the facility. This measure may have prevented the delays caused by the county's indecision or reluctance to commit itself to the project.

When asked if he had any advice for other municipalities considering the creation of a similar facility, Assistant City Manager John Driver said that the characteristics and circumstances involved with a particular community would dictate the nature of, or need for, a plant. He felt he could not advise a community to go into debt on a project of this nature unless, as in the case of Harrisonburg, (with depleted landfill space, and no suitable alternate sites) circumstances leave few alternatives. Mr. Driver added that in the case of Harrisonburg, if he could do over again he would not change his decision to back the plant.

The Harrisonburg effort demonstrates that a plant of this nature can be designed, funded and operated by a municipality independent of outside help.

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HENRICO COUNTY

REFUSE RECYCLING FACILITY

As the world continues to exhaust its energy supplies at an increasing rate, and as municipalities' landfills reach their capacities, necessitating additional land for refuse burial, it makes sense to search for alternative schemes to help halt this continuing economic drain on the world's energy and land resources. One such alternative program is a refuse recovery system whereby garbage brought into a landfill is separated into categories with some of the divided products burned to generate energy. With this method both energy and land are conserved. While most of the projects have been federally funded, the project discussed in this report was built by a group of private investors hoping to make a profit while conserving resources. Although the facility is a desirable undertaking, it has run into some problems.

The Richmond metropolitan area is a rapidly growing center of 720,000 people, 200,000 of which live in suburban Henrico County. As the county continues to flourish economically, its landfills have become over burdened with added waste that comes with new development. In 1981, with a newly patented process for refuse recovery, Henrico Resource Development Partners approached Henrico County with its proposal to purchase three acres of landfill (3) on Charles City Road, and to construct (def. city's 3rd landfill?) within four months (Jan 1982): "a facility for the purpose of reducing the size of municipal solid waste (MSW) and converting it to refuse derived fuel (RDF) by means of explosive decompression."[1] With the county's approval, two structures were built on the site for the procedure with a capability of processing 400 tons/day of MSW. Ideally, the recycling facility would operate 24 hours a day; however, continuous operation would not proceed unless customers had been secured prior to the production.

Henrico Resource Development Partners hoped to profit by selling energy to coal burning industries and paper mills in the Richmond area. To do this, the Partners had to set up an aggressive sales tactics, as the customers they intended to court were extremely leary of using refined garbage in their coal and wood waste boilers. There was a stigma attached to this new fuel; the customers though that they would be receiving "wet garbage" (food products, and yard debris) that would wreck their boilers. Of course, in the recovery process, 90% of the MSW's moisture content is lost, making the final product adequate for the desired use (a statement the Partners stressed).

Meanwhile, Henrico County at the beginning was more than happy to have this revolutionary system operating, since if something was not done to reduce the amount of refuse, additional land would have to be bought for more landfills. "Henrico officials have said that if the (refuse recovery) system is successful and works as anticipated, landfill costs will be cut in half and the life of the landfill at least quadrupled."[2]

The aforementioned production capability of 400 tons/day is more realistically estimated at 100 tons/day. Each day Henrico County paker (?) trucks transport their loads of residential garbage to landfill 3 where the waste is weighed in and paid by the county to be processed at $15/ton (tipping fee). A manually operated loader inside the tipping room scoops up the MSW and pushes it into a conveyer belt which loads a 40-foot long, 9-foot diameter trommel screen, a rotating cylinder that filters the garbage. All debris under five inches in diameter falls through the screen at this point onto another conveyor that leads to waiting vehicles which transport these particular waste products to the landfill. This garbage consists of rotting wastes, small bits of paper, glass jars, aluminum, and other metal containers which all constitute about 50% of the total weight of the municipal solid waste. One of the investment partners, Carl Mahler, stated that the firm ultimately wants to salvage the aluminum and glass jars, but that a process had not been developed for separation of these products intact. He further stated that with the development of a method to separate glass products by color, a new market would open up immediately for the partners. A glass manufacturer in nearby Toano would buy the glass at a competitive price; however, the partner said at this time it would not be profitable since glass is bought at only 5 dollars/ton on the average. Certainly, though, glass could rise to a profitable price in the future and make this option desirable.

The remaining MSW (larger pieces) is now moved into the patented comminution tank which compacts tha material and compressed air pumped into the tank pressurizes the waste at between 300 and 500 psi for a few minutes until its ejection from the tank. This process forces the material from a highly pressurized atmosphere to a normal atmospheric environment, creating a situation whereby the material is torn into small pieces call "fluff," which consists of 97% cellulose (wood & paper) and 3& heavier materials. The fluff moves to the Bag House where the material is separated again by another trommel screen. The small material (which? 1st ones or smaller of sorted fluff or all of fluff?) is loaded into trucks to be transported as refuse derived fuel to customers, while the 3% heavier material consisting of pieces of carpet, cloth, jean remnants, and plastic bags can either be recycled or, with payment to the county, taken back and buried at the landfill. (See previous page for full process of a different project.)

In dealing with the costs and income of the project, I received very little information, although Mahler said that 50% of the project's income went towards production of the refuse-derived fuel. The charts on the following pages depict statistics for the average break-down of MSW and costs involved as well as income of an average system with production capabilities of 100 tons daily. The two charts show slight discrepancies.(in what? What about it?)

While waste recovery plants are significant in moving towards better conservation, they have had many setbacks since their beginning with, in severe cases, many failing. The Henrico Project was not exempt from the following problems. Malfunctions and wrong calculations developed both technically and economically. The failures discovered immediately were conveyor drives becoming wrapped in wire and cloth strips, trommel holes getting stopped-up with rods and tubes, light fluff blowing everywhere, and household residues and yard clippings adding moisture to the process. Abrasive materials damaged conveyers and drives and wore-down hammers. Even volatiles exploded while passing through shredders, causing fires. To resolve these problems, plants, including Henrico, modified initial construction. Equipment was enlarged and strengthened while repeated processes (of what) were added so that the plant could continue production during mechanical breakdowns.[3] Some of these problems listed previously have been a major contributor to the Henrico plant's current shut-down after only two years in operation. Carl Mahler stated that the company was retrofitting the facility with more durable, efficient equipment.

When building a project such as this, many environmental concerns arise. The Henrico facility conducted numerous preliminary studies as required by law. These studies concerned air, water, noise, solid waste, and odor generated at the project. The following information centers on virtually every concern of the environment. First, air pollution is a possible problem at the site, since particulate emissions occur throughout the refuse recycling procedure. Any particles created in the machine room are designated for venting at the Bag House. The particulates (particles?) generated at any point n the process consist of long pieces several thousand microns in size less fine dust found in normal air. Although none of the emissions is vented directly into the outside air, they eventually mix with the outside air through partial air openings in the building required in order to provide an outlet for air ejected from the comminution tank. There appear to be no other hazardous emissions emitted from the project. The state of Virginia's air pollution control board exempted the project from obtaining a permit because the facility would not process more tha 100 pounds of material per hour and the rate of uncontrolled emissions from the plant would not exceed one ton per year.

Water pollution has not posed a major problem either. In the development of the project, it was decided that the tipping room would need to be washed-down periodically (about one a week) with 100 gallons of water either from a well on site, ponds, or the neighboring water system. Wash-down water would not run out of the tipping room but be diverted into a trough that would channel the runoff into a septic tank. To prevent the air compressor from overheating, a cooling system was built and now operates much like a car radiator with an initial fill-up of water and occasionally treated to maintain sanitary conditions. Minor generic (?) leaks have occurred, (where?) though. At no time does any process or cooling water used in the refuse recovery procedure get discharged into state waters.

In preliminary studies, noise emitted from the project, due mainly to the comminution tank when it releases the MSW from its pressurized environment, was not calculated. Estimates that it would be heard from background noise at a distance of 150 yards, far enough from the neighboring Wedgewood Farms subdivision. The facilities noise levels have fallen outside full force of the Noise Control Act.

Approximately 50% of the MSW unloaded at the tipping room is buried at the landfill, including glass, metal, and decomposing food wastes. In the future, the heavier facility will salvage MSW for aluminum, other metals, and glass, but carpet, jean, and plastic scraps will always be buried at the landfill.

(Since state law requires a permit from the Commissioner of Health to operate landfills. In 1978, the Department of Health, Division of Solid & Hazardous Wastes, issued a permit to Henrico County for the operation of Landfill 3. At the time, the state of Virginia had no laws pertaining to the operation of recycling facilities; however, it approved the project anyway.) All in parentheses "out of place".

Odor at the site has not proven any worse than before construction sine processed municipal solid waste (MSW) (97 % cellulose) does not give off any pronounced odor. The State Air Pollution Control Board sets the level of acceptable odor at an odor objectionable to individuals of ordinary sensitivity. This emission standard does not apply to the refuse recycling plant since the process generates no strong, putrid odor. Any foul smells generated because of the dumping of the MSW in the tipping room would come under the Department of Health's jurisdiction rather than the SAPCB. As long as the waste is processed daily, there is no need for emission standards.

Recently, the Henrico Refuse Recycling Facility was bought from Henrico Resource Development Partners by an unnamed Texas investor. Mahler foresees for the project a biodigestor for production of methane gas, and possibly its own electrical generation. He said the Texas investor wants the Henrico facility to be a national show-case for numerous future projects. At 1.8 million dollars for construction costs and a possible 400 ton/day capacity, the project is very economical compared to similar projects in Virginia. In a recent interview, Haywood Wigglesworth of the Henrico County Public Works Department about the refuse recovery system felt the project was moving in the right direction towards better conservation practices. He said it would most likely never reach its projected 400 tons per day production, because of both lack of buyers for the fuel and cash flow problems. Unfortunately, in light of these problems, the county is in the process of purchasing 60 acres for another landfill in northwest Henrico. Wigglesworth said until the project proves successful over time, the county will have to build more landfills. (What kind of cash flow problems?) (Financing?)

Although the Henrico project has run into numerous snags, I feel the problems will be short-lived if the investor becomes more aggressive in his selling of the product than the previous owners, and if all the problems are worked out that have plagued the system's operation in the past. Further, as energy becomes scarcer and more expensive, as does land, I project the system will become successful profit wise; however, until the customers are sold on this fuel, profitability will be out of reach for this project.

ENDNOTES

1. Memorandum on operation of Refuse Recycling Facility in Henrico County from Arlene C. Schler, September 2, 1981.
2. Richmond Times Dispatch, 1982.
3. Phoenix article: "From Municipal Waste- What Went Wrong?", p. 34.

Telephone interview with Carl Mahler, Investor-Partner, Henrico County Public Works Department, 15 May 1984.

Telephone Interview with Haywood Wigglesworth, Employee, Henrico County Public Works Department, 15 May 1984.

*Note all other technical data and statistics used in this paper came from the Memorandum by Arlene Schler.

Petersburg Planned Resource Recovery Facility
A Case Study

United Bio-Fuel Industries, Inc. (UBFI) is presently involved in the development of a resource recovery facility to be located in Petersburg, VA. Founded and incorporated by Jack Kidwell in 1980, UBFI is dedicated to the future use of refuse derived fuel (RDF), to develop ethanol alcohol for future use as gasahol (UFBF fact sheet)(What is UFBF?) The UBFI resource recovery plant in its initial stages, is an innovative and far reaching plan which may provide insight for and inspiration to other companies or localities wishing to establish a facility of this type. The project has had its successes and failures but appears to be finally on its way. The following is a study of the original plan, the problems, and the future of this Petersburg facility.

The proposed schedule of development for the RDF facility is roughly as follows:

1. The initial facility will produce RDF in cubes to be sold as boiler fuel with additional sewage separation of ferrous and aluminum to help meet the project costs through resale.
2. "An optional provision will be made to add the necessary boiler and turbine generator to produce electricity for sale to VEPCO under PURPA regulations as this need develops." (Feasibility Study, UBFI).

   This first sequence is UBFI's primary objective at this time, with projected ground breaking next year and production capability by 1986. This initial stage of making and selling the cube enables the facility to produce ethanol.

The unique aspect of UBFI's planned facility is its future to produce an alternative energy through use of municipal solid waste, agriculture and forest products (The Project, p.1). The proposed date for the intermediate level of the ethanol plant is 1988 with a commercial production date of 1990 (UBFI). (What about the second development?)

ORIGINAL DESIGN

The original design of the RDF plant was of a very large scale with a production capability of 1,350 tons per day (TPD) of municipal sold waste (Feasibility, page 1). The original date for ground breaking of this facility was Summer 1983 with phase plus or minus - shredding; magnetic separation and production of RDF cubes, to be completed 22 months later (Waste Age, p. 82). However, UBFI encountered several problems on the realization of these plans.(Awkward-rewrite).

The most seriously crippling problem to reaching a facility size of 1,350 TPD was in receiving commitments from localities on their municipal solid waste. The second problem UBFI encountered was an "inability to obtain a fixed operating guarantee for the term of debt" (Feasibility Study, p.1). Therefore, with these limitations, UBFI had to scale down its facility size to meet the limitations imposed on the project.

The plan called for development of the facility in three phases. The first phase would separate and shred the MSW, produce the RDF cube fuel and produce electricity, processing 1,350 TPD of MSW at a capital cost of 100 million dollars (Waste Age, p. 82). Phase two of the proposed facility was the production of ethanol alcohol with a proposed production of a 50 TPD cellulose alcohol research facility to produce 20 million gallon per year at a cost of 135 million dollars. The final phase three involved actual ethanol production using a licensed process of enzymatic hydrolysis of cellulose for a production of 37.5 million gallons per year of alcohol at a cost of 136 million dollars (Waste Age Magazine, November 1983).

REVISED FACILITY

The revised plan for the RDF cube production facility, is to scale down to the possible, realistic, waste commitments obtained by Petersburg, Fort Lee, Hopewell and Colonial Heights. At this time the planned facility has been reduced to a 650 TOD capacity. This smaller facility will operate with a 2-shift, 6-day per week production line. The facility, as revised, will produce 20.4 TOH (hour)? of MSW from the four localities mentioned above on a 2 SBM (?) process line (Feasibility, p. 1-2). The facility structure and design all have the future capability to scale up to the original 1,350 TPD facility when MSW commitments can be finalized. The plant scale at the 650 TPD facility will also have more of the problems (?) encountered "by expensive transfer operations," due to the close proximity of the surrounding areas (Development Approach, UBFI). The total proposed MSW capacity for committed present MSW is 450 TPD however, a potential of 1,395 TOD, is to feasible 2,986 TPD (UBFI).(??) Attached is a chart by UBFI illustrating the distances and options of present and future MSW commitments for the plant. Francis B. Richerson, Vice-President of Engineering for UBFI, feels that once the plant is in operation, commitments from many of the other communities will come quickly. Until that time the commitments of the four localities will enable the initial plant facility to operate (Francis Richerson). Each of the municipalities shown on the graph are all within 100 miles, all feasible in terms of cost efficiency in transportation.

COSTS AND REVENUES

The initial cost of the RDF portion of the pl ant was developed by UBFI in a development approach study. The costs for the start up, operations, equipment and construction of the RDF plant will be approximately 10.3 million dollars.

UBFI obtained authorization in July 1980 to issue IDB (?) for project funding. The actual funding of the initial plant will be privately obtained in 75% IDB's and 20% equity ownership (Feasibility Study, UBFI).

A breakdown of the operation costs for the future 171,600 tons per years facility is as follows: labor costs at $5.04 per ton of MSW, operating and maintenance at $6.67 per ton for a total of $11.71 per ton of MSW. Processing 171,600 tons per year would then net $2,009,145 per year in operating cost (Development Approach, UBFI). The financial stability of the facility therefor rests on a variety of revenue proposed by UBFI for the facility. (What are they?)

The RDF cube itself will be sold for approximately $15.00 per ton with a projected revenue of $1,287,000 per year (Development Approach, UBFI). However, four possible problems arise with the sale of RDF cubes for boiler use. The first is the relative price of the cube fuel in relation to other fuels. The second problem is with the heating value of the fuel (Diaz, Savage and Golueke, p. 36-37). UBF compared RDF to coal and found that "the price/BTU relationship between RDF and coal offers an attractive and economic savings with lower emissions levels" (Feasibility Study, UBFI). The projected heating value of the RDF to be produced at the Petersburg facility is 7,000 BTU/lb and has an ash content of 5-6% (Feasibility Study, UBFI). If these values become the standard for the cubes produced, then the cost per ton in comparison to wood and coal provides for a cos t effective, relatively efficient alternative.

The ash content and moisture are additional problems which RDF fuel use may encounter (Diaz, Savage and Golueke, p. 36-37). The high ash content of RDF causes problems for oil and gas burners. These type of boilers must have provisions to remove the ash (burners or boilers?) (Diaz, Savage, and Golueke, p. 37). When used with coal boilers the ash content increases by so much that it reduces productivity (Diaz, Savage and Golueke, p. 41). The RDF used by UBFI is 5%-6% ash, a relatively low level, therefore that ash content will be of less importance. "The high moisture content of refuse-derived fuel detracts from its quality as a fuel in three ways: 1) reduction of heat value, 2) absorption of energy from other processes further down and 3) recondensation on cool surfaces, forming corrosion (Diaz, Savage and Golueke, p. 36). The proposed moisture content of 20%, will be one of the disadvantages to using this fuel (UBFI). Although coal is the most efficient fuel for use in terms of cost, heating value, moisture and ash, its relative cost makes RDFa viable option (UBFI). Reductions in overall efficiency may be weighed against the cost to make RDF attractive to industry.

An additional source of revenue for the facility is through aluminum and ferrous separation. UBFI projects the ability to recycle 4% aluminum at 680 tons per year for a revenue of 274,400 dollars. Ferrous will also be separated at 4.2% at 7,207 tons per year for a total of 180,175 dollars (Development Approach, UBFI).

I was initially skeptical about the estimates for ferrous and aluminum for a number of reasons. The first question I had was whether or not the amount of aluminum packaging could d decrease in future years, causing an overall decline in aluminum waste. This potential could prove to be a problem in the future if UBFI relies heavily on aluminum for revenues. The second question I had was whether or not the estimates were conservative. The final area of concern was whether UBFI had commitments for the resale of the ferrous and aluminum. Since ferrous and aluminum accounted for $454,575 in revenue, there is some significance to these questions. Francis Richerson informed me that the estimates for the ferrous and aluminum recycling capabilities were "ultra conservative" and that in reality they hoped to be able to disregard this totally as a source of primary revenue (FR Telephone, May 1984).

In addition to the recycling and the cubes, UBFI Listed Tipping Fees as the most prominent source of revenues. The city pays a user's fee for land fill use. When the resource recovery facility opens this user's fee will be diverted to the facility for decreasing the city's need for land fill usage, and for leasing the potential problem of ground water pollution for the area (Francis Richerson). UBFI projects that these tipping fees will amount to $2,059,200 in revenue (Development Approach, UBFI).

FACILITY AND PROCESS

The actual physical facility will be on an 8-mile acre tract of land in Petersburg, Virginia. The particular land area desired is currently being examined for rezoning by the public council. The area is presently zoned for a lower industrial use in the city than is required for this type of facility (Lenord Muse,(sp.?) Planning Department). Lenord Must (sp.?)of the Petersburg Planning Department informed me that the case will be decided by the middle of the summer. The facility itself will be 59,625 ft square, 265' X 225' with a storage pit size of 78' X 192' X 15". The storage capacity of the facility will then be 1,213 TPD (Calculations for MSW, FR 1984). A scale drawing by the Teledyne Company is attached.

The proposed process used will be a new technology by an Australian firm SBM/SBM. This process is, according to UBFI, better than the traditional Teledyn design in five ways: 1) It is the best possible process for future adoption for ethanol production; 2) The new process provides for a higher grade RDF with a better fuel value; 3) The company will provide for guarantees of the system; 4) The design will provide easier, more cost effective scale up for future production (Feasibility, UBFI); and 5) There is the "possibility of obtaining export credit from Australia" (Francis Richerson). I was unable to obtain a copy of the design or a schematic due to the inavailability to obtain printed matter in the United States.

The excitement at UBFI seems to be with the eventual alcohol conversion process. Once the RDF facility is working on its original scale, the company hopes to develop into the area of ethanol production. The eventual goal is for "the development of a 50,000,000 gallon per year ethanol distillery, using cellulose as a primary feedstock for conversion (UBFI fact sheet). Two thirds of the cellulose material will come from the waste and one third from forest and agriculture to produce the ethanol (UBFI, p. 3). The process which UBFI plans to use for the conversion is simultaneous saccrification/fermentation (UBFI)(?). At present, UBFI plans to obtain funding for a 50 TPD demonstration plant; the plant has been designed but lacks the pre-treatment design (FR, May 1984). UBFI hopes to get 3 million dollars to fund the project from DOE's research and development fund (richerson). The current state of the funding is that Congress has authorized DOE to release the money requested.

Presently, research is being held by Gulf Oil and Raphael Katzen on "a one ton per day continuous process which successfully produced ethanol from cellulosic feedstocks" (The Project, UBFI). The success of this research facility has helped to provide UBFI with developmental and design options for the proposed 50 ton facility. If successful, UBFI will be the first full scale operational alcohol conversion plant in the county (UBFI).

CONCLUSION

The future of the Petersburg facility is impossible to speculate on at this point. Hopefully they will be able to break ground as planned next year and develop a commercial facility to produce ethanol in five years. The way in which UBFI has approached this project may be a helpful guide for companies in the future wishing to embark on a project of this type. Taking a step by step approach UBFI has developed a totally self-productive design for an RDF project, which has the potential for use in alcohol conversion. The delays which UBFI has encountered seem relatively minor in comparison to the dimension of the project.

In an attempt to judge the overall-projected impact of this facility on Petersburg, I contacted Lenord Muse of the Petersburg Planning Department. Due to the private nature of the facility and its lack of completion, it was impossible to obtain any concrete opinions on the project from Muse. However, comments that the facility is likely to favorably affect the economy of the city (Muse, May 1984).

It is difficult to judge the impacts of a facility by its projections. So many things may change in the next few years that to speculate on UBFI's success would be premature. One thing that can be said however, is that this facility in its size and innovation will provide for lessons and encouragement for future facilities.

THE SOUTHEASTERN TIDEWATER ENERGY PROGRAM
A SOLID WASTE PROCESSING FACILITY IN
PORTSMOUTH, VIRGINIA
A PRELIMINARY CASE STUDY

SOLID WASTE

The Tidewater Region of Southeastern Virginia is out of "good" dump sites and there is a growing realization that "landfill" areas - places where garbage and trash may be piled and levelled and covered with dirt - so longer exist in that populous region. Gradually, and adverse effects of a concentration of refuse are apparent - fouling water supplies, emitting a stench, creating unsightly barren landscapes unstable for building, and interfering with natural drainage. The usual alternative is mass burning, which, unless carefully controlled, causes widespread air pollution.

There are several different ways to dispose of refuse. Landfill has been the most usual method until recent consideration of a limited supply of spare land. In the past some land was viewed as worthless, people though that in marshes and ravines water was infinitely self-healing or able to absorb any amount of any kind of waste, yet retain its valued qualities of potability and a healthy environment for living things. Now, however, planners have both information about the inherent problems of waste dumping and some potential solutions. Too often public opinion (action?) lags, and the one inexorably convincing argument for an environmentally sensible practice is that of money. Rising energy costs, added to the expenses incurred in acquiring and managing land for dumps, has led to the use of refuse as a fuel.

There are three systems which dispose of refuse by converting it to energy used or proposed in Virginia. Harrisonburg's facility burns the trash to generate steam f or space heat. Salem's system burns trash at a lower temperature which releases methane, and then burns the methane to generate steam. This system has some problems associated with its relatively small size; non-continuous operation produces some pollution and mechanical failures. Harrisonburg's setup requires an electrostatic precipitator to remove pollutants from the air. A third variation is the use of a giant shredder, integral to Portsmouth's plan. The refuse will be sorted and chopped and converted into fuel which the adjacent Naval Shipyard can use with coal to fire both the electrical generators and steam heat plants. In any of these cases, ferrous metals and sometimes aluminum, glass and cardboard can be sorted and reclaimed separately.

Six cities - Chesapeake, Franklin, Norfolk, Portsmouth, Suffolk and Virginia BEach - and the two counties of Southampton and Isle of Wight joined together to form the Southeastern Virginia Planning District Commission. In January, 1973, the Southeastern Public Service Authority (SPSA) of Virginia was formed to implement the recommendations of the Commission. The Authority is a political subdivision of the state of Virginia, created under the Water and Sewer Authorities Act.

At about the same time that dump space was a concern, the Navy realized that the Naval Shipyard in Portsmouth needed a new power plant; the aging facility is not efficient and not sufficient for the amount of energy needed. Pollution is also an inevitable by-product of inefficient or partial burning; the shipyard has been operating in violation of clean air standards with a variance, as has the city of Portsmouth with its mass burning of refuse. The shipyard searched for reliable and less expensive fuel, and chose to design a plant which could use coal rather than oil. Refuse derived fuel (EDF) can be used with coal, while oil is compatible with mass-burned refuse. Originally, the SPSA planned to build both the refuse processing plant and the new power plant. Although the design of a co-generation plant was 1/3 complete in 1979, problems in negotiating an energy contract with the Navy called a halt to the plan. The Navy wanted to retain control of the power plant. Subsequently, SPSA initiated a similar plan, referred to as the Regional Solid Waste and Resource Recovery Project.

In October, 1983, a contract was awarded by the Navy for the construction of an RFD-coal co-generation power plant, the Navy approved a contract with SPSA to provide RDF, and the project is now in Phase I. A description of the project - its implementation, process and costs - will form the body of this case history. The SPSA commissioned a feasibility study by the consulting firm of Henningson, Durham & Richardson, Inc., of Norfolk. The study, released in April, 1984, describes the project and analysis the costs.The general recommendation is that construction begin at once on a solid waste processing facility.

The following map shows current disposal practices. The new plan, also on the map, involves Phases I and II. Phase I will immediately alleviate the waste disposal problem by creating a large regional landfill. In addition, it calls for seven solid waste transfer stations and support facilities. This centrally located site of 308 acres will handle one-half million tons of waste each year. All the communities plan to use the regional site except Virginia Beach, which will continue with its own landfill site, Mt. Trashmore II. Virginia Beach is reluctant to lose the revenue obtained in "tipping fees" from trash haulers. Phase I will extend over the three years it will take to construct the fuel processing facility, starting inJanuary, 1985. Equipment associated with Phase I includes 22 tractors and 27 open top trailers to transport refuse from the transfer stations to the landfill site.

During Phase II, the seven transfer stations will facilitate carrying wastes to the processing plant. An estimated 16% of solid consisting of demolition and construction debris, large branches and tree trunks, and metal objects is not suitable for processing as it cannot be handled by the shredder. Also, a high percentage at one time of a certain material such as wood can cause a problem in maintaining an even burn rate in the shipyard furnace. The regional site at Suffolk will then hold the rejected wastes.

Approximately 76% of the wastes delivered to the processing facility will be converted to fuel, which the Navy will buy. Materials rejected by the facility will go to Mr. Trashmore II, which will also handle the non-processible refuse from Virginia Beach and the ash residue from the power plants. Excluding the ash residue, about one-third of the original sold wastes must still be put into landfill.

The amounts of refuse calculated are worth some consideration. For example, each person in the Tidewater region (possibly typical of Americans across the country) generates a trash average of about 4.5 to 5 pounds per day. Summer amounts far exceed those in the winter; in February waste disposal is at a minimum, greatly increasing from March through July. The nine areas (including the Naval Shipyard) together generate about 800,000 tons of waste per year, including construction and commercial debris. These figures are largely based on scale data, as weights are regularly recorded in current disposal procedure. Without construction of the processing facility (Phase II), the Suffolk landfill may be used for seven years. The RDF plant will increase this figure to over 25 years.

The feasibility study describes proposed operations of the processing facility in detail. The wastes will be weighed as received n dump trucks, which then deposit their payload on the tipping floor. Front end loaders will stack the waste, removing unsuitable material to containers destined for the landfill. The process mainly involves sifting, in two trommels, and shredding the material for two reasons: 1) to obtain a uniform fuel particle size, nominally 3-inch, and 2) to remove glass, sand, gravel and grit. Ferrous materials are removed by a magnetic belt separator. In the future, aluminum may also be recovered. Two other potential recovery materials are cardboard and plastic film, but the process involved in their reclamation involves a significant initial cost for an uncertain market. A separate tire shredder will handle tins and feed its contents gradually into the fuel mix.

The RDF processing plant will be located near the Naval Shipyard power plant and an enclosed conveyor belt will transport the RDF for storage at the power plant. Storage space will accommodate up to three days of RDF, allowing the processing plant to take a three-day holiday. It would be far more efficient and less expensive to have the processing and power plants under one roof, as originally proposed as the loose RDF is not readily transported. The SPSA will remove the ash from the power plant as part of its contract with the Navy.

The main items of equipment required for processing are shredders ($1,318,000) and trommels ($3,600,000), or giant sieves. Trucks, from end loaders, railroad cars and conveyors will move the wastes. Stationary cranes help to move the non-processible material. A comprehensive control system is planned.(Describe this system).

It should be noted that refuse may contain unpredictable and dangerous elements; there is also a risk of explosion from the spontaneous generation of methane in refuse that is allowed to accumulate over several days.(This paragraph goes elsewhere).

The Portsmouth facility is scheduled to be considerably larger than any in Virginia at present. It is planned to handle 2,000 tons per day, or a maximum of 730,000 tons per year. Present waste amounts would require processing of 650,000 tons each year, but waste amounts will rise as population increases. The facility should be adequate for the area at least through the year 2010. The largest facility listed in the Harrisonburg case study is Henrico County's with a capacity of 400 tons per day. At a projected cost of $26 million for Phase I and $93 million for Phase II, it is also by far the most expensive solid waste project. The issuance of 20-year guaranteed revenue bonds (Phase I) and 30 year revenue bonds (Phase II) will finance the project, with the first bond issue approved in April, 1984.

Costs are divided into initial construction, financing, and annual operation and maintenance. In order to evaluate the net system costs, the user tipping fee is used as a means of comparison. Some revenues may be expected from recovery metals, but the principal source of income is the sale of RDF to the Federal government and any remaining costs must be offset by the tipping fees. The contract negotiated between the Federal government and SPSA guarantees the purchase of at least 833 tons of RDF per day. About 1,370 tons of RDF may be used to keep the Navy's boilers fueled at the proposed design level. Although the co-generation design allows 100% coal or 100% RDF, the expected ratio is 80% RDF and 20% coal.

The costs and revenues have been projected through 2010 using different rates of inflation, but for comparison we will look at the year 2000, assuming an inflation rate of 6%. Future costs and revenues have been converted back to 1983 dollars. The summary of the life cycle cash flow analysis anticipates a reduction of the tipping fee from $17.69 per ton to $7.53, a good indiction that the processing system is economically viable. If we compare the costs of waste disposal by processing with Phase I only (expanded landfill) the tipping fee in 2000 for landfill disposal would be $12.58, significantly higher than $7.53 for RDF. The tipping fee should continue to drop in the next century, and the financial picture brightens with the inclusion of the sale of scrap metal.(Why compare for Phase I only? Is there possiblity of not building Phase II?)

The price paid by the Navy, set in the Refuse Derived Fuel Contract, guarantees the Federal government of 15% savings on fuel over the going price for coal. The current cost of coal is $2.50 per million BTUs. Since coal and RDF generate quite different amounts of energy per pound (one pound of coal gives 13,200 BTUs, one pound of RDF gives 5,400 BTUs), one must estimate according to energy delivered, although tons delivered is convenient for capacity calculations. In addition to the 15% price discount, the navy will be reimbursed for 65% of the amortized expenses connected with the construction and operation of the new co-generation power plant. SPSA is obligated to meet the Navy's needs and time frame.

A second price for the sale of RDF to the Navy is the fuel used to generate electricity, which may be sold to Virginia Electric Power Company. The price includes a 15% discount on VEPCO's avoided cost payments to the Navy plus a reimbursement for the remaining 35% of costs associated with burning RDF. The average 1984 rate of VEPCO's avoided costs (define) is $.02573/kwh. All operating costs and revenues were escalated at the same rate.(?) Of course, if fuels escalate at a higher rate than general inflation, revenues from the sale of RDF will be higher, and the cost-benefit ratio becomes more advantageous to RDF.

A solution to the landfill problem, fuel at a discount for the Federal government, energy recovered from trash - these are all solid reasons for this Tidewater project to proceed and to succeed. Virginia Beach is currently hesitant about staying in the plan because of the city's present dump site and possible loss of tipping fees. However, RDF would extend the useful life of the landfill, and they are slated for the large part of materials that cannot be processed (unclear). Even without Virginia Beach, the processing plant would be built. The project would be on a somewhat smaller scale without the trash from Virginia Beach, but with the Naval shipyard as a guaranteed customer, it appears a sensible investment.

I asked Durwood Curling, Executive Director of SPSA whether he thought this system would be applicable to other regions, and he replied positively. It is important, however, to isolate certain requisite conditions for success, based both n this study and others in the state. First, there must be a reliable source of solid wastes. Second, the processing plant should be large enought to afford efficient equipment.(benefit from lower equipment costs?). Third, there must be a guaranteed buyer. Unless there is additional investment in turbines to generate electricity, it is efficient to have the buyer or power plant in close proximity to the processing plant. Fourth, there needs to be some space to landfill reject material and ash. Fifth, the basic ingredient is the person or people who are willing to persist in developing a scheme which is still innovative. The Portsmouth people are following a model in operation in Ames, Iowa. Who might be next?

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Resource Recovery Facility at Salem, Virginia: A Case Study

The 1970s was a decade which spawned new opportunities for improving the quality of life for mankind but, at the same time, new threats to our survival also emerged. New evidence was uncovered that indicated unchecked industrialization and depletion of the world's resources would upset the delicate balance of the global ecosystem. Moreover, the Arab oil embargo made the industrial powers of the west painfully aware of the tenuous and vulnerable nature of their energy lifeline. It became abundantly clear that the next global conflict might not arise as a result of enmity between disparate political ideologies but from the desire to control and exploit dwindling strategic resources.

For America it was a time of awakening and introspection regarding our traditional attitudes toward energy use, natural resources and the impact our drive for material wealth was having on the environment. The term "spaceship Earth" entered the popular vocabulary and became the banner under which a burgeoning environmental movement began to marshall its forces. It implied that the earth is a closed system, a system in which outputs become inputs and in which the products of man and the by-products of his production may change in form but they still remain in the system. Scientists warned of the pernicious threat which accumulating wastes posed to human life and the environment. An informed and concerned public began to demand that the government address environmental issues, put in place legislation to control and mitigate forseen hazards and insure the health and safety of the nation. On October 21, 1976, President Ford signed into law the Resource Conservation and Recovery Act of 1976--now Public Law 94-580- and the nature of solid waste management in this country changed dramatically. In comparison to other environmental legislation, the new law was rather modest. Regulatory and financial provisions were limited to the most serious environmental problems. However, the new law did vastly expand the definition of solid waste in an effort to bring the greatest range of potentially threatening by-products of human activity under control. In addition, the Environmental Protection Agency (EPA) was required to publish by October 21, 1977, guidelines describing the "level of performance" that could be attained by various available solid waste management practices to protect public health and the environment. Compliance with these guidelines is mandatory for federal agencies and a precondition for assistance to state and local governments.

Of the many aspects of PL-94-580, the most notable for the purposes of this paper is Subtitle D which is called the "State or Regional Solid Waste Plans." These are designed to "assist in developing and encouraging methods for the disposal of solid waste which are environmentally sound and which maximize the utilization of valuable resources and encourage resource conservation. " Every state plans to qualify for approval must meet six minimum requirements including the provision for local governments to enter into long-term contracts for the supply of solid waste to resource recovery facilities. This certainly was a step in the right direction to encourage cooperation between state and federal agencies and sound assessment of a state's energy problems and promise. However, the planning and approval process could be cumbersome and time consuming. Some municipalities were faced with urgent questions about their energy future and had already begun to seek solutions to their problems. Salem, Virginia is one town that was able to do so successfully.

Three hundred billion pounds of solidwastes are collected by municipalities throughout the United States annually and the problem of how to dispose of them in an acceptable manner is becoming an urgent issue for many cities. In the early 1970s, Salem, Virginia (pop., 23,500) found itself among those cities faced with this problem. The available landfill space within Salem's boundaries was rapidly being depleted. At first, the city council responded by contracting a local engineering firm to identify and test other sites in the area for suitability as sanitary landfill. This was understandable since landfill has traditionally been one of the cheapest and most widely practiced methods of solid waste disposal. The general aversion to spending money on what is discarded as worthless and the apparent out of sight, out of mind philosophy of town residents made the ease of operation and low cost landfill still attractive to the city council. In the end, however, the search for more landfill area had to be abandoned and an alternative method for disposing of the city's solid waste investigated. This result occurred because no other suitable landfill sites could be found within the city limits. Selecting a site outside the city was prohibited by a Virginia statute which prevents a city from operating a landfill in a county without the county's permission.[5] The Roanoke metropolitan area had developed a regional landfill but its distance prevented its serious consideration as an answer to Salem's problem. Also, getting permission to use the landfill would only have caused emotional debate between the two communities since Roanoke would understandably resent having to act as a dumping ground for Salem's problem.

So things did not look good for Salem at that point but the trends of the early 70s which sparked environmental action worked in the city's favor. Fuel costs were escalating, causing many large volume consumers to seek means of attenuating their use of primary fuels; state and federal agencies were working together to implement environmental legislation, and these two trends combined to hand technology a serious challenge and the impetus for developing efficient, safe, and innovative methods of solid waste disposal. "Thus, Salem city council was in a highly receptive mood when, in June 1976, Mohawk Rubber Company, which operates a large tire plant in Salem, came to them proposing to buy steam from a resource recovery facility, which the city would build."[6] The company was looking for an alternative to natural gas as a fuel supply and offered to furnish the building site adjacent to their plant at 1500 Indiana Street. Negotiations began at once and Salem city officials made a trip to Siloam Springs, Arkansas to observe a modular combustion unit (MCU) with a steam production system. This facility began operation in June 1975 and was the first MCU to use energy recovery for steam production. It represented the latest and best technology compatible with Salem's purpose, and after seeing the plant in operation, Salem opted to employ a similar system.

For many years, resource recovery from municipal solid waste devoted most of its attention to large-scale projects serving urban population centers which generate sizable quantities of waste. These projects were of interest because of their economic potential and design to serve large-volume energy consumers such as a utility, industrial complex, or district heating system. However, at the same time, a number of firms were designing and building small-scale (15-50 tons per day) modular incinerators to accommodate refuse disposal on a variety of scales. "One study indicates that the United States has 15 times as many small communities of 8,000 to 200,000 population."[7] Like Salem "these communities are faced with many of the same problems confronting the larger urban areas, particularly escalating fossil fuel costs, burgeoning solid waste generation, high costs of environmental control, intense competition for land use and decreased sites for environmentally sound disposal of solid wastes. Thus, many of the same benefits of resource recovery that can accrue to larger communities, such as reduced volume for land disposal, decreased use of fossil fuel through recovery of energy, improved environmental conditions, strengthened local industrial base, and increased employment opportunities also can accrue to the smaller communities, albeit on a smaller scale."[8] The technology behind the potential benefits of resource recovery is incineration of solid waste.

Incineration has always been an attractive method of solid waste disposal but the technology has not been very efficient. Early systems consisted of large metal framed structures and firebricks with fans and draft ducts which supplied air to the burning waste materials in an uncontrolled fashion. The by-products of combustion, unburned smoke and odor, were exhausted from the main burning chamber and exited the system through a tall stack high above the facility. The inevitable result was the eventual settlement of dirt and soot on nearby communities. Fortunately, increased environmental concerns of the late 60s, which culminated in the 1970 Clean Air Act, forced industry to respond to more stringent air pollution control requirements and spurred the development of more efficient incineration systems. Thus, two chamber controlled air technology arrived in time to meet the demand for systems that could comply with tighter air pollution requirements. Controlled air technology falls into two categories - starved air and excess air. The starved air technique is the method employed at Salem.

The incinerators are called "starved air" because they operate at a level below the calculated amount of air required t provide the pro per amount of oxygen necessary for complete combustion of the particular waste being consumed.[9] The air-flow characteristics can be pre-set depending upon incoming waste material characteristics or modulated by temperature sensing probes within the units. Refuse is pushed into the main chamber by a ram feeding device at pre-set intervals which are controlled by an adjustable timer. Once the waste enters the main chamber the oxygen deficient atmosphere or "starved air" condition allows only a very controlled burning rate. The low air velocity is designed to create a stable burning process while effecting partial oxidation of the waste as well as reduction in particulate entrainment. The gases generated during the oxidation process then pass into the secondary combustion chamber (afterburner section). The gases from the lower chamber, which include various pyrolytic and oxidative compounds pass into the upper chamber through a turbulent mixing zone where ignition takes place and additional air is added to complete the oxidation reactions.[10] Ash is automatically ejected from the primary chamber into a water-filled trough where a drag conveyor continuously moves it to a dump truck. This prevents ash or residual dust from becoming airborne and fouling the ambient air. Once the truck is filled, the ash can be taken to a landfill and disposed of. The two chamber controlled air design effectively burns off any odors or particulates so that the system is inherently non-polluting. No special air pollution control devices are required in order to comply with EPA regulations. However, some states may have more strict regulations and scrubbers or baghouses will be required.

Insert diagram Figure 1 here.

While the appropriate system for the recovery plan was being evaluated, negotiations between Mohawk Rubber Company and Salem were proceeding. The city agreed to lease 2.8 acres of land adjacent to the Mohawk plant for the site of the new facility. All steam produced by the facility is to be sold to Mohawk. The duration of the contract is to be 20 years and during this time the city must make all of its steam production available for purchase by Mohawk. Mohawk could not resell the steam to a third party without the consent of the city; however, the city could sell any steam produced over and above Mohawk's maximum requirements and not purchased by Mohawk.

The steam will be provided at the rate of 15,000 pounds per hour of dry saturated steam, a total of 360,000 pounds within a 24 hour period per day for a minimum of 260 days per year.[11] The price of the steam is obtained from a formula which increases the steam price proportionally with price increases in the cheapest available boiler fuels Mohawk can use.[12] These fuels are: natural gas (when available), number 2 fuel oil, and number 6 fuel oil.

Once the contract had been resolved to the satisfaction of both parties, the city made a $2 million dollar general bond issue available to finance the facility's construction.[13] At this point the city ran into a problem. the bond attorneys told the city that it would not be able to use the bond money for the steam production portion of the process.[14] It seemed that funds for the energy recovery would have to be obtained elsewhere, until the Economic Development Administration came to Salem's aid with a grant of $302,000 for the steam equipment.[15] Bids were then received for the plant's construction. Branch and Associates of Roanoke were chosen as the General Contractor while Consumat Systems of Richmond provided the steam equipment.

The MCU's employed at the plant are two CONSUMAT Dual CS-1200 systems which can handle 25 tons each or a total of 100 tons per day of municipal solid waste. Each unit is capable of independent operation and is comprised of two hydraulically operated, automatice loaders; two matched primary chambers; one secondary chamber with primary chamber close-off provisions; one CRS-1600-F steam production module; an integrated control panel; all breaching structures; and other items required.[16] A wet ash conveyor system which discharges at a single point serves both systems. The refuse is loaded by a front end-loader operator who takes a pile of raw garbage from the tipping floor adjacent to the incinerator units and feeds each primary chamber in a preset sequence. The main control panel for each unit is located on the incinerator structural platform. An auxiliary fuel, either natural gas or number 2 fuel oil, is required to start the incinerators at the beginning of each week. Fuel may also be needed on other occasions to maintain proper combustion temperatures in the system. The cost of the auxillary fuel is estimated to be around 4 to 6 percent of the steam revenues.[17]

Approximately 80 tons per day of the municipal garbage processed at the plant is provided by residential and commercial sources in the City of Salem. Salem citizens, industries and others provide the other 30 tons. In addition, Mohawk disposes of 1 and 1/2 tons of rubber waste at the facility.[18] There is no tippling fee for Salem citizens who bring small qu antities of refuse in private automobiles or pickups. all others are charged at the following rate; City of Roanoke, $7.50 per ton; private non-profit institutions, $7.50 per ton; business and commercial haulers, $9.50 per ton; minimum for any load, $4.75 per ton.[19] Only burnable wastes are accepted. Insert diagram "Two Consumat Dual 1200 Systems" here.

Each ton of garbage produces around 4,800 pounds of steam. the net heating value of the garbage is estimated to be 4,000 to 4,500 BTUs per pound. When operating under full capacity, the plant is capable of saving 174 million cubic feet of natural gas or its fuel oil equivalent per year.[20]

Front-end separation of the refuse material was not considered in the early planning stages of the facility. However, in June 1980, the city council approved a contract with Reynolds Aluminum to set up a system for separating waste ferrous materials, glass and aluminum cans from refuse prior to incineration. The intention was for Reynolds to pay for the installation of the separation system and all maintenance over $1,500 annually in return for all the recovered aluminum.[21] Salem and Reynolds agreed to share equally any income from other separables. Unfortunately, when I visited the plant, the separation system was not in use and had not been for many months. Apparently there was a mechanical malfunction and the scheduled maintenance had not been performed. The plant personnel I spoke with said they did not have time to correct the problem because they had been performing scheduled maintenance on the incinerator units. The shift supervisor said that the plant had sufficient manpower at present to do the front-end separation themselves. In addition the incinerators were designed to effectively dislodge "clinkers" which result from molten glass or metals entering the system. Such incidents have been rather infrequent considering the heterogeneous nature of the waste material but, effective front-end separation results in a higher BTU output per pound of garbage so there is an incentive. Hopefully, the separation system as installed will soon be revived to free the plant staff from performing the task manually.

The resource recovery facility at Salem seems to be a successful operation and should be an auspicious signal to other municipalities throughout Virginia and the United States faced with scarce landfill. the problems the plant has faced so far have been overcome without much difficulty; among them, obtaining qualified personnel to staff the facility and working out the mechanical bugs in the system.

Certainly the economics seem promising. In fiscal year 1980, 20,970 tons of waste were processed and $174,036 worth of steam sold bringing the city's waste disposal cost (without debt service on the plant) to $5.60 a ton.[22]

While figures may make the future look promising, there are some doubts as well. First, the ash, while handled effectively on site, must be taken to the city's remaining landfill for disposal. How long will the landfill last and is the ash of a benign nature so that it will pose no threat to the environment in the future? (Find out) Recently the question has been raised concerning incineration and the production of "acid gas." Acid gas is hydrochloric acid released in a gaseous state as the result of burning plastic.(f.o.) Is the controlled air incineration technology capable of mitigating this threat and what are the cs? Through B.A.C.T. (Best available Control Technology), more is being learned about acit gas and may lead some states to require acid gas controls on resource recovery facilities regardless of size. Durability is another question mark in the future of MCUs. Can the systems meet a twenty year life expectancy under the rigors of 24 hour a day operation burning heterogeneous municipal wastes? Certainly the resultant wear and tear on moving parts will result in more operational problems. In spite of the doubts, MCUs are the best and sometimes the only alternative small municipalities like Salem have. (What are they doing to forsee these mechanical problems?)

The energy problems America faces can only be partially mitigated by technological solutions. Each stem forward brings potential risks and new responsibilities. Much can be accomplished in the realm of energy conservation simply by a change in attitude and lifestyle. It is essential that we realize progress can no longer be measured by GNP and bigger and better technical achievement. Our survival depends upon our ability to choose between those technologies that we can control and those we cannot.

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[2]Ibid, p. 2.

[3]Ibid, p. 7.

[4]Fred N. Rubel, Incineration of Solid Wastes, (Noyes Data Corporation, 1974), p. 3.

[5]Jane L. Hough, "Energy Recovery System Pays Off," Nation's Cities Weekly, August 25, 1980, p. 5.

[6]Ibid, p. 5.

[7]Robert H. Brickner and Brenda Harrison, "Smaller May Be Better," Waste Age, March 1980, p. 28.

[8]Ibid, p. 28.

[9]Ibid, p. 29.

[10]Ibid, p. 29.

[11] Steam Agreement, Salem City Records, 1977, p. 5.

[12]"Facts about the City of Salem Virginia's Garbage Disposal System with Energy Recovery," City Records.

[13]Hough, p. 5.

[14]Ibid, p. 7.

[15]Ibid, p. 7.

[16]"Facts," City Records.

[17]Ibid.

[18]Ibid.

[19]Ibid.

[20]Ibid.

[21]Hough, p. 5.

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Salem City Records, City Hall, Salem Virginia.

Insert diagram Salem Site Plan here.

Insert diagram General Building Dimensions here.

FLOYD AGRICULTURAL ENERGY CO-OP, LTD.

INTRODUCTION

Much of today's political unrest is centered in the Middle-East. One of the major reasons that the U.S. is concerned about this is because we import a lot of our petroleum from this area. Our dependence on this oil was magnified during the embargoes of 1973 and 1979. A good proportion of our (increasing) annual trade deficits is because of petroleum imports. This national headache could be lessened and eventually eliminated through the use of American-made (hurrah!) alcohol fuels.

There are only four countries in the world which consistently export grain - the U.s., Canada, Australia and New Zealand.[1] Occasionally Argentian does, but they usually import more agricultural products than they export. America is blessed with a climate which makes the raising of crops more of a sure thing than most regions of the world. American farmers are sitting on top of a goldmine, and that is ironic considering many farmers are paid not to farm due to screwed up (poor wording) economic conditions. Because farms are nothing more or less than large solar energy collectors which convert sun energy into biomass, farmers need to start thinking of themselves "as the operators of energy plantations rather than merely producers of food."[2] When we realize that we could eventually grow all of our fueld needs, the future looks a lot brighter. We would no longer be at the mercy of OPEC which has used oil as a weaon against the U.s. in the past.

What is alcohol? The type of alcohol call ethanol is the waste product of growing yeast. The yeast organisms grow and take in sugar, protein, vitamins and minerals and in the process give off carbon dioxide, ethanol, and a new generation of yeast cells. The beauty of the system is that all the materials used are renewable, which means we can produce alcohol forever unless we really screw up (there you go again) our land. The still can be connected to solar power, and the alcohol can be produced from poor grade raw materials like "moldy grain, fire damaged grain, waste cheese whey, waste grain dust, waste cellulose, waste molasses, waste and rotten potatoes, waste and damaged fruit, elevator rejected corn and any industrial plant waste tha contains starch cellulose or sugar such as dried milk."[3]

Ethanol can be used for a blend with gasoline (gasahol), as a substitute for gasoline altogether, as a substitute for diesel fuel, as a substitute for home heating fuel, as a substitute for kerosene, as a substitute for "sterno," as the starting product for many plastics such as polyethylene, as as the starting material for any number of chemicals and pharmaceuticals.

Ethanol is less explosive, more stable than gasoline, less polluting, more efficient, more economical (better mpg), causes less wear on engines, and is cleaner burning which would cut down on the number of oil changes needed. Even the waste, carbon dioxide, can be used: for the carbonation of beverages, for inert gas storage of wet grain as a sterilizer, for drying grain, to manufacture certain trypes of fertilizer such as urea, in CO 2 fire extinguishers, in refridgeration systems, to manufacture dry ice and in inert gas environments for special industries. The mas residue produced when corn is used to make alcohol is a very good concentrated feed for livestock, and is more economical to export because the starch is removed and the nutrients are concentrated.

The opportunities are there and it is just a matter of time before we are forced to take advantage of them.

Insert photocopy of wood pile here.

Insert photocopy of industrial drums here.

THE PAST, PRESENT AND FUTURE OF THE CO-OP

(Please inform the reader what you are going to talk about - what is the "co-op"?)

In 1979 Duke Staengl, founder of the co-op and coordinator since the beginning, obtained a grant from the department of energy. With this under his belt, he got additional funds from future co-op members and local creditors, and constructed the original distillery. Doint most of the work themselves, the co-op avoided the high cost of subcontracting. They also did extensive salvaging which Mr. Staengl estimates saved them (thusfar) as much as $250,000.

The primary objective of the co-op is "to provide small farmers in this area with a mechanism to increase the profitability of small farming."[4] The other goals include: stabilizing the fuel supply in the area, helping to re-employ farmers, and putting unused land back into production. At first the cop-op was using industrial sugar and starch wastes in the fermentation process. The waste would be ground up with enzymes that break the starches into simple sugars, and then the yeast was added. This yielded a beer solution with solids that would be filtered out and used as animal feed. When corn (elevator rejected corn) was used the co-op would sell the corn mash feed to local cattle, hog, and poultry farmers. The beer solution was then boiled and the vapors distilled. This process would yield wet alcohol which contained about 2 percent water. Wet alcohol does not mix with gasoline so the co-op had to send it to a drying plant in Southeast Virginia. At this point the co-op was losing money and something had to be done. In early 1984 Luke Staengl and two employees mortgage their land to obtain $50,000. They then procured $100,000 from private investors and purchased an anhydrous drying column. The investors who bought the column formed a private corporation and the column is now leased to the co-op. This allows for various creative tax benefits to both parties. Since the installation of the drying column the co-op has temporarily shut down its still for renovations. Meanwhile, the column has been busy drying alcohol that is shipped in from other places. Renovation includes the installation of two stainless steel 4000 gallon tanks which would allow for continuous fermentation (as opposed to batch fermentation, which takes 48 hours a load). Currently the co-op can put out 200,000 gallons of dry alcohol a month. By next September the renovations should bring them up to 500,000 gallons a month. Also, they will be using more plant materials that the co-op members can produce themselves, such as Jerusalem artichokes and sugar beets. (WRITE IN SENTENCE) Which to use depends on ecological as well as financial considerations. For example, sugar beets and Jerusalem artichokes "require less work, result in less soil erosion, and can be grown on land not used for food production."[5] Using corn, however, allows two uses to be made from the same crop, since currently much corn is grown as cattle feed.

Other renovations include: the construction of a conveyor system which would fed sawdust into the furnace (switching from scrap wood to sawdust will reduce labor cost) automatically, and the installation of heat exchangers which would increase efficiency in the distillation process.

Insert photocopy of Young man here.

Insert photocopy of Front of furnace here.

Insert photocopy of "employee relations" here.

ECONOMICS

Currently the co-op is drying other peoples' (whose?) wet alcohol at the rate of 150,000 gallons a month and charging 21 cents per gallon.

150,000 X .21 = $31,500 total/month

They purchase 50,000 gallons of wet alcohol a month, dry it, and sell it for $1.92 per gallon.

50,000 X 1.64 = $82,000 Cost

50,000 X 1.92 = $96,000 Sell

$96,000 - $82,000 = $14,000 total per month

They purchase an average of 1,350 gallons of gasoline a month at $1.00 per gallon, blend it with ethanol and sell it to members at $1.12 per gallon.

1,350 X $1.00 = $1,350 Cost

1,500 X $1.12 = $1,680 Sell

$1,680 - $1,350 = $330 total/month

Present total:
$31,500 + $14,000 +$330 = $45,830 per month gross income

Future Possibilities

500,000 gallons dry alcohol/month sold at $1.92 per gallon.

500,000 X $1.92 = $960,000 total/month

80 tons of corn mash per month sold at $1.60 per ton (dry)

80 X $1.60 = $128 per month

And the same amount of gasahol sold to members = $330 per month

Future Total:
$960,000 + $128 + $330 = $960,458 per month gross income

Obviously, the future looks very bright for the co-op. With renovations the gross income should increase twenty fold. Currently, the co-op has a storage capacity of 100,000 gallons. This will have to be increased slightly to keep pace with the increased production. The co-op might also go into the business of large scale gasahol blending, for which larger tanks would be needed.

Insert photocopy of Storage Tanks here.

Insert photocopy of plumbing here.

Insert photocopy of building which houses the still drying column here.

A SHORT HISTORY OF GASAHOL IN THE UNITED STATES

In 1979, partly due to the Iranian oil embargo, Texaco and Ashland Oil (separately began to offer gasahol to consumers. They had good intentions, but were a little short-sighted on a few engineering basics. They blended their gasahol in their petroleum distilleries and transported it through their gasoline pipelines. What they failed to realize was that there were residues in the pipelines that the alcohol would break down and absorb. Also, there were water pockets (especially in pipe transfers) that the petro would ignore, but the alcohol would absorb. This resulted in some very bad gasahol which was really just gasoline with some unmixed watery alcohol. This bad gasahol had some disasterous effects in cars, and people avoided it like the plague thinking the very idea of gasahol was bad. That is why people need to be re-educated and taught the value of alcohol as a fuel. The Floyd agricultural energy co-op is gearing up efforts to educate the community and will include monthly programs covering topics such as "solar power, energy crops, water and wind power, organic versus chemcial farming, soil and water conservation, and any related topic of interest to members or the community."[6]

ENDNOTES

[1]Crombie, Nance, Making Alcohol Fuel (Minneapolis: Rutan Publishing, 1979), p. 5. [2]Ibid. [3]Crombie, p. 6. [4]Staff, "Sunthetic Fuels Taking Off in Floyd," New River Valley Free Press, May 1984, p.3, Col. 1. [5]Ibid, Col. 3. [6]Ibid.

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DIRECTIONS TO THE CO-OP

Take Route 8 west out of Christiansburg for about 27 miles. Route 8 intersects with Route 221 in the town of Floyd. Take Route 221 north for about five miles until you reach Route 679. Take a left here and go about 5/8 of a mile up the road. The co-op will be on the right side of the road. Walk in door. Introduce yourself. Ask questions. Leave. (John, is the place that burned down this past winter?)

SMALL HYDROPOWER IN VIRGINIA:
THE BURNSHIRE DAM

:hp1.Introduction:ehp1. :p.Throughout the history of this country, energy has always been cheap and plentiful, and its future availability taken for granted. However, in 1973, the Arab oil embargo reordered many Americans' attitudes towards energy and its use. Increasing prices for petroleum products, the use of petroleum resources for political purposes, and the questionable future of fossil fuel reserves all have an adverse effect on economic and social development not only in this country, but world-wide. In order to reduce dependency on these unstable fuel sources, many countries have initiated programs to capitalize on renewable sources of energy -- such as solar energy, wind, geothermal energy, biomass, -- and hydropower.

Only a small percentage of the electrical energy in the United States is provided by hydropower. Most of this energy is generated by large systems, such as the Tennessee Valley Authority. It isn't very likely, however, that hydropower will make any significant contributions to the United States' energy future, since most of the larger sites have already been developed. It is this fact that has paved the way for a new trend: small hydropower.

Small hydropower has emerged an an easily-developed, clean, and cost-competitive energy source. In the United States any hydropower facility that has a capacity of less than 15 megawatts is considered small. The potential for small hydropwer in this country, as well as around the world, is great. Along with the New England states and the Pacific Northwest, Virginia has become an area where small hydropower has been reborn and has begun to grow. Rivers like the Shenandoah and the James lend themselves well for the application of small hydropower. Furthermore, one of Virginia's two major power utilities, Virginia Electric and Power Company, is heavily reliant ton expensive, not easily-developed fuel sources. This fact gives the electricity generated by the small hydropower plants a willing market. One old, small hydropower facility that has been renovated and has been able to take advantage of the current energy situation is the Burnshire Dam.

The Burnshire Dam is located two miles east of Woodstock, Va., on the North Fork of the Shenandoah River. Built originally in 1922, the dam spans 400 feet across the river and has an available head of twelve feet. With its flow rate of 475 cubic feet per second, the Burnshire Dam has a power capacity of 410 kw., and an annual production of 1,795,800 kwh, per year. The plant is in excellent condition; almost all of its machinery has either been rebuilt or replaced.

Burnshire's real significance is that it was on of the first small hydro plants in Virginia to become operational. Since the idea of small, privately owned hydroelectric power plants was an unfamiliar concept in Virginia when Burnshire was being renovated, Burnshire set precedences in the field, both institutinally and technically. The decisions made at Burnshire and the ideas that were tested there have had a definite influence on hydropower development throughout the State.

<u>Burnshire's Rediscovery</u>

The man most responsible for Burnshire's rediscovery and renovation is Brett Gilbert. While driving through the countryside east of Woodstock in 1979, the Dam caught Gilbert's eye. In the early 1970s, Gilbert owned and operated a greenhouse business, which he heated with oil. When the oil embargo struck, his operating costs rose 500 percent, forcing him out of business. At first sight, the old dam site seemed like a readily-available, economical source of power to fuel a new greenhouse business.

gilbert made his original plans to renovate the old dam site without knowing about a law that was passed just a year befoe he ran across Burnshire. That law was the Public Utilities Regulatory Policies Act (PURPA), passed in November of 1978. Basically, PURPA created an energy market for non-utility public and private energy producers. PURPA requires that utilities must purchase power from "qualifying facilities" for the cost of producing that energy plus the avoided costs, that is, the costs of extra capacity that the utilities have avoided by buying power from these qualifying facilites. "Qualifying utilities" to all non-utility cogeneration plants, as well as facilities using renewable energy sources (solar energy, wind, hydropower, etc...) that generate les than 80 megawatts. A second way in which PURPA has encourage non-utility power production has been by making these qualifying facilities exempt fromalmost all of the regulatory restrictions imposed on the utilities. Gilbert eventually became aware of PURPA and would go on to focusing his efforts on taking advantage of the new law.

Since it had been many years since the dam had been operational (Why hasn't dam been in operation?), there were many aspects of the facility that either had to be overhauled, replaced or repaired. One of the first major projects undertaken was the dredging of the forebay. Debris, trash and silt can build up in the forebay and completely cut off the water supply from the turbines. Over the years, over 20 tons of trash and silt had built up on the trash racks of a single turbine.

This job was temporarily abandoned during the summer of 1980, when the drought of the summer sent the water level to a point low enough where the breached section of the spillway could be repaired. The low water level allowed concrete to be poured and gave it time to set. The process of repairing the spillway itself took two and half months of the summer.

Almost all of the internal mechanisms, the turbines and the generators, had to be rebuilt or totally replaced. While almost all of the physical repairs on the powerhouse and the spillway took a single year to complete, another year was spent simply hooking up to the utility.

Problems Faced

When Gilbert set out to make Burnshire operational, the idea of private, non-utility hydropower production was a new concept in Virginia. gilbert no past experience to draw from; no one else's mistakes to learn from. Most of decisions that he made were based on educated guesses and some basic intuition.

Since Burnshire was the first operation of its type in the state, there were no regulations that specifically applied to its operation. Gilbert was fortunate in this respect, because it simplified the procedure for getting approval for his plant. Essentially, the only institutional restriction (What is an institutional restriction/problem?) imposed on burnshire was that it "not poison the fish." Since the small hydro industry has grown so greatly in Virginia, institutional regulations and restrictions have recently been established to govern the operations of such plants.

Although gilbert faced few institutional problems, he was not free of technical problems. Burnshire had laid dormant for many years, and as a result much of its equipment was either badly damaged or ruined from time and neglect. Most of Gilbert's problems stemmed from trying to repair or replace the plant's equipment at a cost that would allow the plant to operate at a profit.

This was the case with Burnshire's generators. Gilbert originally contacted manufactureres of large generators in order to obtain bids and estimates. General Electric, one of the leading manufactureres of large generators, qoted Gilbert a price of $700,000 for the generators. Instead, Gilbert obtained a set of second-hand, 19th-century generators. By rebuilding these old generators at a cost of between $5,000 and $10,000, Gilbert saved &690,000 over G.E.'s estimates. Gilbert also obtained estimates for three new turbines of $50,000, $50,000 and $40,000. Instead, Gilbert paid one-tenth that amount for turbines that he acquired from scrap.

Gilbert found innovative ways to keep renovation costs at a minimum. He used readily available industrial machinery and scrap parts. In other cases, entire systems were redesigned. When faced with a $30,000 estimate for a govenor, Gilbert decided to design his own. In a system such as Burnshire's, the generators are paced by the utility's signal. If a power outage occurs, the generators have no restraint on them, and can "run away" and destroy themselves. Traditional governors apply pressure to the turbine shaft, putting strain on the turbines, but also slowing down the generators. Instead, gilbert devised a gat-closing system that would close off the water supply from the turbines and thus shut down the generators. The gates are closed by a system counterweights and heavy springs that are constantly applying pressue to a pivot arm that in turn rotates a shfaft that closes the gates. What counteracts the force of the weights and springs, and therefore keeps the gates open, is a single air cylinder. When a power outage occurs, a switch is out which releases the air from the cylinder and as a result closes the gates by allowing the counterweights to act. This simple system costs Gilbert a tiny fraction of the traditional govenor's cost.

Once a small hydropower plant is in operation, its only real overhead ead is maintenance. The more the maintenance costs can be decreased, the greater the profits. With a small hydroplant, one of the most time-consuming tasks associeated with maintenance is the cleaning of trash racks. Gilbert suggests that to mzximize efficiency, trash rack cleaning should be automated, so that only two-man-hours a day are required for the process.

But perhaps the biggest, or at least most time-consuming, technical problem faced by Gilbert was interfacing with the utility. The process of hooking up to the utility consumed an entire year, as much time as all the other renovation tasks put together. Again, since this sort of project was new in Virginia, both Gilbert and VEPCO, (What does VEPCO stand for) the nearest utility supplier, were working with no previoius cases to draw experience from, which slowed the process of developing a breaker and interfacing systesm. Although VEPCO was fairly cooperative, the utility required that Burnshire be equipped with an adequate breaker system in order to protect its men and equipment fro lethal power surges. Again, Gilbert sent out for bids and estimated for breaker systems and received an answer of $50,000. Instead, Gilbert bouht a used oil-filled breaker for $500 and as a back up system used the signal from the phone company, at a cost of $103.

Advice to Future Developers:

Being one of the first to develop small hydropower in Virginia, Brett Gilbert believes that certain factors contribute to success in the small hydro industry. First, Gilbert says that the prospective developer must be willing to "get dirty." Gilbert sees himself and other small hydro developers in the state as a combination of "...truck mechanics, pack rats, and blacksmiths." He claims that he employed all of these skills when he rebuilt Burnshire.

Secondly, the use of readily available industrial machinery and scrap parts is essential. When Gilbert was rebuilding Burnshire, parts for small hydro developments were scarce because of lack of demand. Gilbert admits that this is no longer true. The recent increased demand for generators, turbines, etc...for small hydroplants has resulted in a market for such items, which can now be easily and relatively inexpensively obtained from anumber of manufacturers. However, Gilb ert still claims that the job can be done more inexpensively using readily available industrial machinery and scrap parts, without sacrificing any quality.

Thirdly, Gilbert feels that planning is essential. Jumping into a small hydro project without full knowledge of what that involves can be pretty risky. A prospective developer should have a good grip on all of the details of the development before investing a penny.

Small hydropower production is a very dynamic industry. Revolutions literally occur in the field every year. As one of the first small hydropower producers in Virginia, Gilbert's experiences at Burnshire have had an influence on the industry throughout the state. Many of the ideas tested at Burnshire have been adopted as general practice across the state. The practices used and the lessons learned at Burnshire can be of great use to future hydropower developers, as they already have to those projects that have come since.

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THE GATHRIGHT DAM HYDROELECTRIC DEVELOPMENT

The objective of this report is to document a particular innovative energy planning and/or design development occurring in the state of Virginia which can be used for future reference to similar project developers by giving insight to actual problems encountered during the development stages.

The particular project in this case is a hydroelectric generating plant which is to be retrofitted on the Gathright Dam.

Lake Moomaw and the dam itself are located in the George Washington National Forest on the Jackson River approximately four miles north of Falling Springs in Alleghany County. Completed in 1978, the dam was constructed, and is owned and operated by the Army Corps of Engineers for recreation and flood control purposes. "prior to planning the dam in 1967, the Corps of Engineers considered hydroelectric power at the site but at that time such power was not deemed feasible due to the very low cost of oil."[1] Construction of the dam is of earth, and rockfill 257 feet high and 2,310 feet long, having an available head of 2138 feet.

With the accelerating cost of fossil fuels, pollution control as a result of their use, and energy in general, the potential of this untapped renewable energy resource is quite valuable both economically and environmentally. "President Carter listed the Gathright Dam as a candidate for hydropower development in his survey of the available renewable resources in November of 1980."[2] The Noah Corporation located in Aiken, South Carolina also recognized the potential and decided to make an economically and politically popular move by contacting the city of Covington.

Covington, in Alleghany County, Virginia, is about twelve miles north (downstream) of the Gathright Dam. The city has a population of 9,000 and is one of the most economically depressed areas in the Commonwealth. Unemployment and energy cost are extremely high. The Hercules Corporation, a major employer in Covington, was destroyed by a recent fire and gave high power cost as on of the reasons for not rebuilding in the area.[3]

The Noah Corporation linked the potential resources of the Gathright Dam and the depressed city of Covington, and during the contact in mid-1980, revealed its potential to Covington officials:

> Covington could use the power produced from the plant as an inducement to attract industry to the area by offering energy at low prices as well as offsetting its own load requirement and use any net revenues to improve the city.[4]

So on august 8, 1980, Noah and Covington entered into written agreement. Soon after the agreement was signed, Noah and Covington filed a joint application for a preliminary permit to the Federal Energy Regulatory Commission (FERC). If issued, it would secure priority for the project licensing for at least three years, while the necessary feasibility studies were performed. Subsequently two competing applications were filed: Continent Hydro of Boston and the City of Martinsville, Virginia. Relative to this, Covington and Noah quickly amended their application placing it in Covington's name only utilizing the municipal preference rule of the 1920s Federal Powers Act.

The final agreement between Noah and Covington is that:

> Covington looks solely to Noah as its agent to prepare the necessary studies and application sto negotiate agreements and arrangements for equipment purchases, power sales and wheeling and any other act as may be deemed necessary to accomplish the management and development of the project. Covington in turn will own and operate the project facility, and retain all rights to use the power for use beneficial to the city. The entire project would be financed by Noah, and only if project becomes a reality will Covington compensate Noah on a quantum merit basis from the revenues produced from power sales.[5]

With the quick action of Noah and Covington, PERC awarded the preliminary permit to Covington over the other applicants, and Noah, as Covington's agent immediately began the feasibility studies.

During this step of the hydro development, preliminary engineering studies, detailed economic, legal, and environmental issues are examined, and a course of action is recommended. Knowing the property would have to be leased from the government at $35,000 per year, Noah anticipated installing a design capacity of 6.0 MWs, and a maximum capacity of 6.9 MW, producing nearly 40 million KWHr per year, expecting several years into the project net revenues in excess of $200,000 annually with 4 to 6 good jobs created at the site.[6] Construction would take 18-24 months creating 75-100 jobs with the labor and material cost around $6,000,000.

An operation mode termed Power Buffer, requiring a release of water over the winter months that would drop the lake level three feet was proposed. The increase of power production during the winter months would yield higher revenues due to relative high peak power surges. As the recreation and spawning seasons begin, the lake level would be allowed to rise to its normal level.

Once all this information was compiled, Covington, through Noah, would apply for a license for certification as a qualifying facility from PERC. Upon certification, the application would be puclicly noticed in the local papers, giving the community a chance to comment on the proposed project and its mode of operations.[7] Copies of the application would also be sent to the same 14 state and federal agencies ranging from the Historic Preservation officer to the Department of Interior.[8] Covington then would apply for Permit 401 from the State Water Control Board and Permit 404 from the Corps of Engineers. Detailed engineering plans would then be sent to the Corps for approval, as well as Poer purchase agreements settled with VEPCO. Finally, if all went well the plant would be constructed and on-line by mid 1985.

However, when Covington filed the application for licensing as a Qualifying Facility, PERC requested additional information. "This information ranged from clarification of the exact amount of acreage within the project boundary to details regarding generators, circuit breakers, switch gear, step up transformers, etc."[9] During this delay and before the official comment period several protests were filed. The Westvaco Corporation filed a protest to intervene to PERC on July 8, 1983. Westvaco owns and operates a pulp and paper mill at Covington, and is the city's largest employer. As part of its manufacturing operations, Westvaco requries approximately 32 million gallons of water per day from the Jackson River. Any use of the Gathright Dam that would interfere with the augmentation of that flow could have a severe impact on Westvaco's operation.[10] Nearly the same date, the Citizens United for River and Property Rights also filed a protest based on the following:

1) The parties have not been fully advised regarding the environmental, economic and recreational impact of this project.
2) That the "pulsing" or "peak power" provisions of the applicant's latest proposal will adversely affect aquatic life downstream from the Gathright Dam for many miles.
3) That these "pulsing" or "peak power" provisions will adversely affect recreational activities such as fishing, boating, canoeing and hunting on Lake Moomaw as well as the Jackson River downstream from the Gathright Dam.
4) That these "pulsing" or "peak power" provisions of said application will cause serious erosion problems downstream from Gathright Dam.
5) That the transmission lines associated with this project will have an adverse environmental impact on surrounding owners.

5) That the transmission lines associated with this project will have an adverse environmental impact on surrounding owners.

6) That this project will negate the flood control purposes of the Gathright Dam.[11]

The United States Department of the Interior did not file a formal protest but gave several comments and suggestions regarding the hydro development. Some of these suggestions were: limiting the lake fluctuations to less than six inches during spawning periods, placing fine mesh screens over the intake ports, and recommendations that the Jackson River not be dewatered for any length of time, as during construction Noah had anticipated for a distance of 4,500 feet.

By complying with the seventeen conditions listed in the State Water Control Board Permit 401, Covington and Noah met the concerns of both the protesters and the Department of Interior.

The conditions in Permit 401 were as follows:

1) That all the construction materials will be nonerodible, inorganic material.

2) That the closure to discharges to the Jackson River from Lake Moomaw, necessary for the installation of the penstock, etc., shall not exceed 12 continuous hours. The interruption of flow through the tunnel at Gathright Dam necessitated by this construction shall be scheduled for February or March and shall be fully coordinated with the Virginia Game and Inland Fisheries.

3) That all work shall be done in such a manner as to minimize sedimentation of State waters.

4) That the applicant shall employ measures to prevent and/or control spills of fuels or lubricants from entering the waterways of the State.

5) That all denuded areas associated with the project's construction shall be provided with adequate ground cover or seeding upon completion of the project to arrest soil erosion.

6) That all dredged, excavated, or fill material that is stored on site shall be contained in such a manner as to prevent its entry into State waters.

7) That the facility shall be operated in run-of-the-river mode.

8) That the water discharged from the facility shall have a dissolved oxygen concentration of at least 5.0 mg/l (ppm) and a temperature not greater than 70 degrees. The pH shall range from 6.0 to 8.5.

9) That the trash and debris removed from the trash racks shall be disposed of in a proper manner. The casting of trash and debris onto State waters is specifically forbidden under State law.

10) That the applicant shall bear the responsibility of reimbursing the Commonwealth of Virginia for any fish mortality caused by the operation or construction of the facility. Should a mortality occur, the applicant shall

implement measures to reduce or prevent such an event in the future.

11) That should scouring of the banks of the Jackson River occur as a result of the operation of the facility, the applicant shall provide energy dissipators or streambank protection which will eliminate scouring.

12) The construction and operation of these facilities shall not compromise the design functions of the Gathright Dam, ie., flood control, water quality management, fisheries habitat protection, recreational uses, etc.

13) That the State Water Control Board's West Central Regional Office be notified when construction begins so that staff inspections of the project may be made.

14) The applicant shall immediately notify the Board of any modifications of this project and shall demonstrate in a written statement to the Board that said modifications will not violate any conditions listed in this Certification. If such demonstration cannot be made, the applicant shall apply to the Board for modification of this Certification.

15) In issuing this Certification, the Board has relied upon the statement and representation made by the applicant in their application and other correspondence or communications.

16) In issuing this Certification, the Board has not taken into consideration the structural stability of the proposed structure.

17) This Certification is subject to revocation for failure to comply with the above conditions and after proper hearing.

And so, with Permit 401 issued and the withdrawal of the protest, the project development could continue.

Permit 404 for activities in waters of the Commonwealth of Virginia from the Corps of Engineers and dealing mostly with the crossing and dredging of navigable waters in the U.S. had also been applied for. Proposed in the construction was a discharge tailrace excavated in bedrock in the Jackson River below the dam, where some 360 cubic yards of earth and rock must be removed. Also, the transmission lines must cross the river below the dam. Information requested in the application included the method of dredging where the spoil was to be dumped, construction materials of the power house, the height over the river of voltage of the transmission lines.[14] Noah provided the necessary information, and the Permit was issued to Covington.

With all the appropriate permits except for the licensing certification from PERC received as of June 4, 1984, Noah is finalizing power purchase agreements with VEPCO. Covington anticipated getting 6.2 cents per KWhr for on peak periods, and 3.0 cents for off peak periods of power production. Covington also anticipates within several weeks the issuance of the license from PERC.

Detailed engineering plans must still be approved by the Corps, but Noah has been working closely with the Corps and expects all to go well. If so, Covington hopes to have the plant constructed and on line by late 1985, several months behind schedule.

FOOTNOTES

[1]The Noah Corporation, Executive Summary, The Gathright Dam Hydroelectric Development by Covington Virginia, date unknown.

[2]Same as above.

[3]Same as above.

[4]Same as above.

[5]The Noah Corporation and Covington Virginia, Agreement, July 31, 1981.

[6]The Noah Corporation, A Memorandum sent to Covington, April 12, 1983.

[7]Same as above.

[8]Same as above.

[9]Same as above.

[10]The Westvaco Corporation, Petition to Intervene, July 8, 1983.

[11]Alleghany County, Virginia, Protest and Motion to Intervene, July 1, 1983.

[12]United States Department of the Interior, Comments sent to PERC regarding the Gathright Dam hydro development, June 28, 1983.

[13]The State Water Control board, Certification No.82-0614 of permit 401, September 17, 1983.

[14]The Army Corps of Engineers, Joint Premit Application for Activities in Waters of the Commonwealth of Virginia, filled by Covington, Virginia, July 26, 1982.

HYDRO-ELECTRICITY AND JOSHUA GREENWOOD

In the State of Virginia, individuals are seeking new sites for the development of privately owned production plants to feed public utilities' power grids This is occurring largely in the field of hydro-electric generation. The story here is of the hope and persistence of most small hydrodevelopers.

In 1928, a dam was completed across the Appomattox River at Petersburg. The dam was 550 feet inlength and stretched across the north canal, the river proper (joining several small islands in midstream), and across the south canal. The dam was a concrete gravity dam and at one time fed seven mills -- five mills located on the north canal and two mills located on the south canal. As recently as four years ago, the dam on the south canal had been breached and some leakage occurred in the center of the dam.

About 2 and 1/2 years ago in 1982, Joshua Greenwood proceeded to inquire about the purchasing of the dam. He described this phase as basically routine. He wnet before the State Corporation Commission (SCC) and received his license. His only real trouble cam from the environmentalists. Canoe enthusiasts were fearful that if Greenwood was allowed to purchase the entire dam, canoeing along the Appomattox River would be cut at the point of the dam. In a compromise, the City of Petersburg maintained its ownership of the south canal portion to allow canoes a passage. Greenwood was allowed to purchase the river and the north canal sections of the dam.

Mr. Greenwood emphasized the point that a private developer of hydro-electric could easily spend as much as one million dollars developing a site of only 500 kW. The purchasing of the site, renovation of the dam and generation system, legal costs and on-line connection costs are expensive if these are purchased brand-new or from outside companies. In addition, one must consider the cost of financing one million dollars. Greenwood had a different approach; he like hydro development so much he bought his own company.

Greenwood Iron Works came into being shortly after Greenwood entered the hydro project. He purchased a lathe that could turn a piece of metal 6 and 1/2 feet in diameter and other smaller metal-work equipment to allow him to produce turbines for himself. He cited the cost for a small turbine from Allis Chalmers would cost one hundred thousand dollars. Greenwood essentially used the capitol and resources of his company, Greenwood Iron Works, to finance most of the project.

During renovation, the best example of this use of company resources concerned the excavation of a large section of bedrock to increase run and head for the turbines. An outside contractor would have charged about $40,000 to do the work. However, after purchasing a dump truck and a backhoe through his company and jack-hammers and other equipment, Greenwood was able to do the work at a cost of $4,000. The excavation produced 16 loads of rock and was done mostly by him.

The project is not completed yet. Since Greenwood mostly works on this dam in-between the work at his other company--the iron works. He hopes to proceed slowly and without any need for bank financing. This avoided finance charge will make the project turn a profit quicker but it takes longer to complete construction if the capital is not readily available.. Greenwood hopes that compromise will pay off. What he needs now is the installation of a 150 kW synchronous motor to be used as the first generator. Then Greenwood plans to borrow money to pay for the equipment needed to connect the plant to VEPCO. After that the project is underway with total cost at about $100,000. Later, another generator of 350kW capacity will be added to bring the total capacity to 500 kW. Greenwood hopes that with the two generators a more balanced flow can be achieved during low water level periods. That is, when the water is too low to run both generators only one can be used instead of shutting down the whole system. The second generator will be added at a cost of $50,000.

After a meeting with the State Corporation Commission (SCC), VEPCO was allowed to lower its rates for cogenerated electricity to about 4 cents/kWHr. This in itself does not bother Greenwood because he knew that buy-back rates for elecricicity eventually will go up again. But it did provide an opportunity to investigate other markets which include:

1) sell to VEPCO at 4 cents/kWHr.

2) sell to Virgnia State College at a rate negotiated at 4.9 cents/kWHr.

3) sell to private homes and businesses nearby at some rate between 4 cents and the retail rate VEPCO charges.

4) use this electricity at his own company then sell the off-peak power to VEPCO.

(See map for reference) (?) Of course most of these strategies can be mixed so that peak power can be sold to the localities while non-peak power can be sold to VEPCO> Since VEPCO does not have separate peak and off-peak rates, this plan may be the best overall.

At 4 cents/kWHr., this plant's income should be basically this:

$.04/kWHr.
@ 500 kW capacity
$20 per hour
@ 24 hours per day
$480 per day
@ 365 days per year
$175,200 per year
@ 80% yearly operating time
$140,160 per year income

This calculation is before taxes and shows that the system pays for itself in about a year. And because little finance charges have been acquired, the system is only bought once. (?)

In the future, Joshua Greenwood does plan to develop other hydro sites. He first wants to finish this one. By using his own company, building his own equipment, and limiting outside financing, Greenwood hopes to make more sites feasible. Joshua Greenwood proudly states that his plant alone, made in Virginia, saves VEPCO 100,000 gallons of oil that more often than not must be imported. Hydro-electricity is clean, efficient and renewable, but perhaps best of all, it is independent of the shaky world of global politics.

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Information supplied during a telephone interview with Joshua Greenwood on June 5, 1984.

A CASE STUDY OF THE HARRIS BRIDGE AND WALKER MILL DAM HYDROELECTRIC FACILITIES

This is a study of two small scale hydroelectric installations on the Rockfish River, Nelson County, Virginia. They are owned by John Pollock who is in charge of getting the facilities producing electricity once again. The Rockfish Corporation, owned by Mr. Pollock, is in charge of refurbishing the facilities and keeping them operating.

The Rockfish Corporation owns two old dam sites on the Rockfish River near the small town of Schyler located in Nelson County, Virginia. The first site is the Harris Bridge Dam which the Rockfish Corporation put back to work generating electricity in October of 1982. The second site, the Walker Mill Dam is currently being refurbished, and was in use from 1921 to 1969 until it was damaged in a flood. The dam was constructed in 1901 of stone blocks, and is 230 feet long and 18 feet high. The flow, which is 270 cubic feet per second (cfs), is diverted from the dam through four gates down an open flume or canal (approximately 300 feet long) to the powerhouse. At the powerhouse there are two wooden gates which control the flow to the two turbines. There are two trash racks located at the powerhouse which protect the turbines from river debris. These trash racks must be cleaned twice daily to insure that the maximum flow reaches the turbines. The turbines are Leffel turbines designed to operate on the site's 19.5 foot head and they are rated at 200 kilowatts each. The Powerhouse also contains the two 200 kilowatt General Electric generators and two Woodward Governors. The turbines, generators, and the Woodward governors were all original equipment which was refurbished.

The electricity generated is delivered two miles to APCO and then wheeled to VEPCO.

Annual production should be approximately 1,650,000 kilowatt hours. The cost of getting this facility on line was approximately $240,000.

The Walker Mill Dam is located approximately 1.5 miles downstream from the Harris Bridge facility. The facilities are currently being refurbished and should have a capacity of 700 kilowatts. the dam itself was built in 1905 and is 210 feet long and 35 feet high, which will give the system a head of 35 feet. There is five foot section of the dam which needs to be repaired before this maximum head is reached. Two of the three gates controlling the flow to the turbines need repair, and trash racks like those installed on the Harris Bridge Facilities will be used. The original cross-flow turbines will be repaired and used again. A new powerhouse must be constructed since the original one was washed out in the flood of 1969. The facilities will use three induction generators and the electricity will be delivered to an APCO substation 200 feet away, and then wheeled to VEPCO. The annual production should be approximately three million kilowatt hours. The estimated cost of getting this facility on line is $270,000.

To operate a hydroelectric facility where the electricity produced is sold to someone other than the producer themselves a license or exemptions from the Federal Energy Regulatory Commission (FERC) must be applied for granted. In both the Harris Bridge and the Walker Mill dam facilities exemptions were granted by FERC. To receive the exemption the major requirement was ownership or the rights to the site. An environmental report was also turned in with the request for the exemption. Fisheries and Wildlife Department can also be a major concern to the developer especially on streams where there are migratory fish. If there are migratory fish in the stream then fish passes must be installed and this greatly increases the cost of the hydroelectric installations. The Fisheries and Wildlife Department also wants fish screens which will protect all species and sizes of game fish. According to Pollock this specification is ridiculous since screens that small would be quickly clogged with trash and slow the flow going to the turbine. Fish also avoid the area around the turbines because of the noise.

The major problem the Rockfish Corporation has encountered is selling the electricity to the utility company. Utility companies are required by PURPA (?) to purchase the electricity from small power producers at a "fair" price. (According to Pullock?) the utilities do everything in their power to discourage the Rockfish Corporation, for instance imposing extremely tough interconnection regulations. These regulations exceed what the company themselves use, but they (utilities?) still require others to meet the tougher regulations. (Which company? Rockfish? Or should it be companies meaning other small scale companies?) The generators of the Walker Mill Dan facilities must produce a voltage level equivalent to APCO's voltage level in the adjacent lines. The Rockfish Corporation has asked the utility (which?) to special order a transformer which would step up the hydro facility's voltage to that of APCO's. The utility refused stating that two of their stock transformers must be used instead. This results in a doubling of the cost for Rockfish Corporation. Pollock spends a good deal of his time in court on matters concerning these issues.

There are certain risks involved in hydroelectric installations, and financing can sometimes be difficult. Pollock owns both the Harris Bridge dam and Walker Mill dam facilities. Pollock makes a partnership with someone who finances 40 percent of the system's total costs, and the partner in turn receives Federal energy tax credits and write-offs for his capital investment. The partner owns 90 percent of the facility until his initial investment is repaid, and then the ownership percentage changes to 10 percent. Pollock owns 10 percent of the systemuntil his partner is repaid and then resumes the 90 percent ownership. Pollock also owns and runs the Rockfish Corporation, which is in charge of refurbishing the facilities. Essentially, a good part of Pollock's 60 percent investment is time and labor. The rest of his investment money is borrowed from banks with varying interest rates.

There is more to refurbishing these hydroelectric facilities than it first appears. Since there are few companies who are knowledgeable about refurbishing these facilities. On the Walker Mill Dam bids were taken for one small phase of the refurbishing, and the lowest bid came back at $250,000. The Rockfish corporation hopes to refurbish the whole facility for $270,000. Avoiding overhead costs, and individual's doing as much as they can (does this refer to employees, or Mr. Pollock's activities?) seem to be the only feasible alternative for small scale hydroelectric systems.

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BACK BAY WATERSHED MANAGEMENT PLAN
A CASE STUDY BEFORE THE CASE

The Back Bay Watershed Management Plan was selected for a case study because of its perceived innovativeness. The plan is actually still in its preliminary stages; only a draft of the plan has been completed to date. Unfortunately, the draft itself is not available to the public at this time. a presentation of the final draft of the plan is expected sometime in June (1984), but most of the studies and information will not be completed and available until sometime in 1985.[1] This material will be combined in a technical manual for Back Bay. From this technical manual and the plan, a detailed analysis of Back Bay's situation should be evident.

Back Bay and it tributary bays are located in the Southeast corner of Virginia Beach, Virginia.[2] It extends along the shoreline of the Atlantic Ocean from approximately the North Carolina-Virginia State Line to Dam Neck Corner, Virginia Beach. The bay is separated from the Atlantic Ocean by sand dunes on False Cape. Inland, the bay reaches to Princess Anne Road. In addition, it lies entirely within the city boundaries of Virginia Beach.[3]

Characteristically, Back Bay has been considered to be a threatened, valued resource. It is valued for the service it provides as a drain or receiving waters for about one third of the city.[4] Also, Back Bay offers may aesthetically desired characteristics to the area that are difficult to measure but worth protecting. The qualities and benefits of Back Bay can be divided into two areas: environmental and economic.[5] Environmentally, Back Bay offers a source of recreation and relaxation to the public in the form of hunting, fishing, and bird watching to name a few. The area is actually considered to be one of the state's prime fishing and hunting sites.[6] Swimming and beach activities are also possible.

A portion of the Back Bay area has been set aside as a National Wildlife Refuge and covers 4,589 acres.[7] Its main purpose is to provide a sanctuary for birds. Since the refuge is located on the Atlantic Flyway, the path of migratory birds. The area also serves as a habitat for many species of plants and wildlife, attracting people and money to the area.[8]

(Rewrite. Is this paragraph necessary?)The whole Back Bay area offers educational opportunities. The bay is a rare urban asset, providing the public with a place to view nature and appreciate our natural heritage. Appreciation of nature is a difficult task when such an environment as Back Bay can offer panoramic views of water, marsh, forest and dune.

Economically, Back Bay is also important. The bay serves as the receiving waters for the surrounding area, specifically the southeastern quadrant of the city. The water that enters the bay can carry traces of substances from the land, sewage, construction and farming, etc. The quality of the water is affected by what these trace substances are and the quantity of the pollutants. The bay can dispose of these pollutants by natural processes, but there is a limit on how much it can process.[10] (This paragraph depicts economic use of Back Bay.

the area that the water drains from is called a watershed. Back Bay's watershed is determined by the ridge line that runs N-S from Dam Neck Corner, along Princess Anne Road, to the North Carolina border. Rainfall east of this ridge drains into Back Bay. Any activity carried on in the watershed can eventually affect the water quality of the bay if the activity causes pollutants that can be carried by rainwater.[11]

Farming and livestock in the watershed can be compatible with maintaining the bay's quality. However, problems will arise if pesticides and fertilizers are used too liberally and/or animal wastes are not taken care of properly. Human health is not at stake, but the addition of these substances into the bay can limit the desirable fish population. If this happens the city not only loses fish population, but the fisherman will eventually stop coming. So, by taking some precautions and having concern for the bay's quality, agriculture should be able to continue without affecting the bay.[12]

Back Bay is vulnerable to man's activities because the health of the bay's ecosystem is linked directly to runoff from the watershed. The main ecological concerns are the water quality, the wildlife population, land use affect, and ecosystem stability. Many studies have been done on the bay itself, but they have been limited. Therefore, the knowledge is fragmented and incomplete.[13] Conclusive data is non-existent, but more complete and comprehensive data is currently being compiled.

Devising solutions is not an easy task, but Virginia Beach has begun its attempt. As early as the mid-1960s, positive steps were taken to help Back Bay: (The city began pumping saltwater into the bay and the regular pumping of saltwater into the bay helps conditions). Increased salinity (salt content) aids in controlling algal growth in the high nutrient levels of the bay.[14] It is also supposed to induce the growth of the ideal fish food. Saltwater pumping costs Virginia Beach $76,972 a year with $10,000 assistance from the State. The options of pump continuation, termination, or modification will be considered when the complete data is determined.[15]

By looking at what has been done in the past, the planners are ready to determine their next step. On February 1, 1982 the Back Bay Study Committee was established. This committee was to investigate the current ecosystem status of Back Bay and recommend policies to aid in local decision making about the area.[16] (The next to paragraphs are indicated with REWRITE)After determining what studies had been done and were currently underway, the committee gathered literature and discussed its findings with the Virginia Commission of Game and Inland Fisheries. It found that the ?fragmented facts? were not useful as applied to local issues and that the ecology of the bay was declining. (Why? What happened?) The city found it necessary to do further research on the matter. by application through the Hampton Roads Water Quality Agency, Virginia Beach asked (Who?) for $30,000 to fund the project. At this time, Roy Mann Associates, Inc. was retained (Hired?) to produce the Back Bay Watershed Management Program. The objectives of the plan were to develop data for the whole area that affects Back Bay as well as specific Back Bay information.[17] A comprehensive report was not under way.

To involve the public and encourage public participation, progress reports of the study were made available to the media. In an article on March 12, 1983, the Ledger-Star and the Virginia-Pilot announced that City Council had approved $150,000 spending for a year-long study of Back Bay. The study was to begin the following week. Additional funding was still hopeful, but might not be collectable for another six months. The firm of Roy Mann Associates, Inc. would begin its study by looking at the saltwater pumping, sewage-disposal policies, land use strategies, and agriculture improvement possibilities.[18]

By June 17, 1983, the firm diagnosed that Back Bay appeared to be in fair shape (define), but information was still very limited. October 1983 was set as the release date of the preliminary report on the date of the preliminary report on the Bay's condition with the final diagnosis set for November.[19] On October 4, 1983, a supplement appeared in the Ledger-Star and the Virginian-Pilot. It consisted of a map of Back Bay and answered questions about it. There was a section to be filled out (pertaining to what?) and returned to the Back Bay Committee. This was to aid the committee in making decisions about policies for Back Bay Management.

The development of the Back Bay Watershed Management Plan has been difficult and must be innovative because Back Bay is plagued by a variety of problems. For example, Virginia Beach is certainly causing some pressure on the area for development because "the largest part of the shore is under the protection of public agencies as wildlife refuge and park."[20] Not all of the land is public, though, and this can pose policy problems. Another area to deal with is the dune system on False Cape, which also needs protection from development. Not only must the planners be concerned with land use management for non-point water control in the watershed, but they also must make regulations to protect the specific sensitive lands.

W.J. Whitney, Jr., the coordinator of the Mayor's Committee on Back Bay, feels that the bulk of the technical manual will be ready in 1985 and the final format of the Back Bay Watershed Management Plan should be presented to the committee in June (1984). It will be interesting to see how the committee approaches the complexity of Back Bay's situation and to watch the implementation of the plan. Success of the plan will take time to become evident as will its defeat.

FOOTNOTES

[1]Conversation with William J. Whitney, Jr.

[2]June 17, 1983 article.

[3]October 4, 1983 article.

[4]June 17, 1983 article.

[5]Background Sheet

[6]June 17, 1983 article.

[7]Background Sheet.

[8]October 4, 1983 article.

[9]Ibid

[10]Ibid

[11]Ibid

[12]Ibid

[13]Background Sheet

[14]June 17, 1983 article.

[15]March 12, 1983 article.

[16]Background Sheet.

[17]Ibid

[18]March 12, 1983 article.

[19]June 17, 1983 article.

[20]October 4, 1983 article.

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The attached articles (2), a map, a question-answer sheet, and background information are the only sources of my information besides several phone conversations with William J. Whitney, Jr., Chief of Comprehensive Planning, Virgina Beach, Virginia.

CLARKE COUNTY NATURAL RESOURCES CONSERVATIONS OVERLAY ZONING DISTRICT

CLARKE COUNTY, VIRGINIA

Clarke County, Virginia is situated on the northern border of the state. It is primarily a rural county with a population of 9,965 people - 1,752 of whom live in the north-central county seat of Berryville. The residents of Clarke County are engaged mainly in a diversified agricultural industry with orchards, dairies and beef cattle, and horse and swine production on more than 110m,000 acres of rolling countryside.

Although Clarke County has grown at a relatively slow growth rate of less than 1 percent per year over the past 10 years, its neighboring counties, including Loudoun, Fauquier and Frederick (MD), have all grown at twice this rate. This growth rate, coupled with their larger population base, has put development pressure on Clarke County, which has resulted in the development and passage of a number of land-use control regulations by Clarke County in order to protect its rural, agricultural character.

One of the county's preservation programs, the Natural Resource Conservation Overlay Districts (NRCOD), is the focus of this case study. Although it has a smaller impact on the County's overall development direction as say the Comprehensive Plan or such programs as the LESA, Sliding Scale Zoning and Agricultural Preservation Districting Programs, it is an example of an innovative environmental planning process which supports the land preservation goals of the County. The planning process as well as the final land-use regulations will be addressed in an attempt to give an example of the local planning process at work.

The passage of the NRCOD protection program was the ultimate result of an attempt by the county to protect the water supply source for approximately 400 people in the south-central section of the County. The Prospect Hills Spring is the sole source supply for the Clarke County Sanitary Authority's Boyce-Millwood Public Water System. Due to the concern for the protection of the spring's watershed from nearby agricultural activities, the Board of Supervisors hired the engineering firm of Schnabel Engineering Associates of Richmond, Virginia to prepare a report recommending guidelines to preserve high water quality.

A three person Prospect Hills study committee, formed by the Clarke County Planning Commission to work with the engineering firm to study this problem recommended acceptance of the Schnabel Report dated May 2, 1983 by the full Planning Commission and the Board of Supervisors.

The report findings were utilized by the County Planner/Zoning Administrator to draft the proposed NRCOD which would put more stringent land-use restrictions over the current zoning amendments, the critical recharge area of the spring has been outlined as that area within 3,000 feet of the spring. The overall intent of the ordinance is to "protect those water sources in Clarke County which are necessary to serve adequately and efficiently the public need, health and welfare, to preserve the natural environmental qualities and function of the land to purify water before it reaches such resources, and to prevent the use and development of land in designated water resources recharge areas in a manner tending adversely to effect the quantity and/or quality of such significant water resource..." Although these NRCOD Zoning Ordinance Amendments are intended to protect the Prospect Hills Spring specifically, the language states that these regulations could and should be used in other areas of the County to protect water resources which have been determined by "reasonable scientific investigation and analysis to warrant special protection."

The area is divided into three Resource Conservation Districts including:

RC-1 Natural State Buffer Area

RC-2 Restricted Use Buffer Area

RC-3 Limited Use Buffer Area

The proposed RC-1 Buffer Area controls land uses within 1,000 feet of the spring. In this area, only non-intensive agricultural, recreation and conservation uses which will preserve the area in its natural state will be permitted. A partial list of the exclusions in this area include altering the land in any fashion which would increase the rate of runoff, and chemical or biological fertilizers and pesticides applied to the ground and/or trees. The only exception for any land disturbing use is public water transmission lines necessary to service the Clarke County Sanitary Authority's purposes.

RC-2 Restricted Use Buffer Area, located between 1,000 and 2,000 feet away from the water source, again calls for non-intensive agricultural, recreation and conservation uses, but also allows for the provision of a special use permit to be issued by the proper local governing bodies for intensive agricultural operations so long as the proposed use is deemed compatible with the purposes of these regulations. The regulations never address what the term "intensive agricultural operations" means. Any proposed land disturbing activity would need to be implemented under the strict conformance of an approved erosion and sedimentation control plan drawn up in accordance with the provisions of the Clarke County Erosion and Sedimentation Control Ordinance. Strict exclusion of agricultural fertilizers and pesticides except application of limes and emergency situation pesticides administered/applied by county officials will be enforced in the RC-2 Area. If a special use residential permit is issued in an RC-2 area, the applicant must have:

a) a minimum of 2 acres of land for an individual subsurface sewage disposal system which must be designed in accordance with recommended guidelines outlined in Schnabel's Engineering Associate's Report dated May 2, 1983, and

b) a maximum lot coverage of all impervious surfaces not to exceed 20 percent of the lot.

The restrictions in the RC-3 Limited Use Buffer Area are less stringent and allow development in this 2,000-3,000 foot adjacent zone so long as it is compatible with the provisions of the regulations and has no adverse effects on the environment. Once again, an approved Erosion and Sedimentation Control Plan must be prepared by the developer and approved by the County before any development can take place. The regulations once again exclude chemical and/or biological applications of fertilizers except under strict emergency situations. The 2-acre minimum lot size and septic system design requirements similar to those in RC-2 regulations are required, but maximum lot coverage by all impervious surfaces can be as much as 30 percent of the land area.

The NRCOD Planning Process

The request to study the Prospect Hills Spring recharge area originated in early 1983 from the Clarke County Sanitary Authority to the Board of Supervisors. At that time, one of the two large landowners in the spring area was in the process of presenting to the county a development proposal that would greatly alter the land use in the area.

In order to protect the sole water supply source from any new non-point pollution sources, the Sanitary Authority's request for help resulted in the Board of Supervisors hiring the Schnabel Engineering firm to study the aqcuifer recharge area and prepare a report on recommendations to protect the spring. In addition, the Board of Supervisors also appointed the three-member committee to work with the engineers and the Clarke County Planning and Zoning Administrator to draft protection regulations for the recharge area. (Delete, repititious)

The public hearing on these proposed zoning amendments point out the differences between the engineering report recommendations and the drafted NRCOD regulations. The NRCOD regulations are more stringent than those proposed by the engineering firm. The engineering firm recommended that the existing farming activities remain, but that no expansion of them or any additional activities be allowed in the watershed area. The NRCOD regulations, drafted by the County Planner after a review of other nearby model control regulations, outlined in effect a curtailment of the existing farming activities with the elimination of fertilizer and pesticide elements into the watershed. In the public hearings that reviewed the proposal a farmer affected by the proposed regulations stated that their passage would result in the taking of his property without due compensation and that these proposed zoning amendments are within direct conflict with the County's Comprehensive Plan and Zoning Ordinance with actively promotes agricultural land-use activities. In any case, a more sensitive approach and resolution of the problem should have been proposed by the county officials.

Another issue which surfaced during the public hearing last July cited inadequate criteria for the determination of how the three recharge districts were chosen for inclusion in the protection plan. Concentric rings of 1,000 foot intervals as borders do not respond effectively to the hydrogeologic rules of nature. (Why not? What are these rules?) Therefore, it does not appear from the review of project information that the engineering firm was working in a realistic and purposeful way for the residents of Clarke County. Technical information is sometimes shared (and expensive) to come by in many small communities where there might not be a large number of highly technical elected officials sitting on the various boards and committees that are in charge of making land use decisions such as the Zoning Amendments. therefore, good consulting firms need to be identified and used by rural counties in order to get expert opinions and recommendations.

The outcome of this planning process has been the adoption of the regulations that appear in Appendix 4. This approved regulation is a watered-down version of the very restrictive proposed one. It allows for the continued use of agricultural fertilizers, but requires special permission for the application of pesticides by the appropriate county officials. Residential development is allowed in the RC (RC-3 or is this a new district?) District which now is the total area 3,000 feet out from the spring by the granting of a special use permit. This requires the developer to adhere to the septic system requirements, the two-acre lot size and the 20 percent impervious area that were outlined in the Schnabel Engineering Report.

Upon my initial investigation/information gathering stage in reporting about this Overlay District program, I was unprepared for the number of land use regulation programs which I soon discovered Clarke County was involved with presently or in the past 10 years. Although the Prospect Hills solution to what is seen as a threat to the quality of the spring appears to have been hasty and not well studied, the consistency with which Clarke County is trying to develop programs which protect their environmental resources is very reassuring and commendable.(Other egs.)

There are innovative design and site planning solutions to building in environmentally sensitive areas and I think these types of issues could be incorporated more readily in the solution to the problem rather than what seems to be an arbitrary ban on any development in these areas.

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APPENDICES

Appendix 1-----The Natural Resources Conservation Overlay District Regulations (as initially proposed)
Appendix 2-----Planning Commission Meeting, July 1, 1983-Minutes of Meeting.
Appendix 3-----Planning Commission Meting, July 11, 1983-Minutes of Meeting
Appendix 4-----Clarke County Board of Supervisors Meeting, July 19, 1983-Minutes of Meeting

FOUR MILE RUN WATERSHED PROJECT
FAIRFAX COUNTY, VIRGINIA: THE PROBLEMS OF CONSTITUTIONALITY

Sewer development resulting from greater urbanization increases the runoff speed through the drainage system, creating flooding problems in downstream areas. An example is the Occoquan Basin watershed, located near Washington, D.C. and (is this the 4-mile watershed) the Potomac River which has undergone such rapid development in the last twenty years to create the runoff problems. Therefore, in accordance with a federally authorized flood control project (When designed? What is it about?) designed to provide protection from serious streamflow event, the four jurisdictions involved in this area agreed to develop such a comprehensive water management program. But environmental concerns are not the only interests found in this underdeveloped region. real estate developers have maintained their interest in this area by directly opposing any of the ordinances created to protect the quality of the reservoir.(How much of this area is already developed? Why do real estate developers have so much clout?)

This paper will examine the federally-initiated computer-simulated runoff model adopted by this multijurisdictional agency.(Which agency?) Then we will review litigation that has been created by the conflicting interests of one of the counties involved, Fairfax County, and the powerful real estate developers interested in this area. Finally, an overall evaluation of the model and of the litigation bent on changing the downzoning will be presented.

We must first examine the reasons why the urban runoff management program was necessary. As stated earlier, the Four Mile Run watershed, which drains into the Potomac River, underwent intensive development after WWII. As is the case of urbanization, much of the land is blanketed with impervious surfaces like streets, parking lots, apartments and homes. Also, the natural drainage system had been replaced by extensive storm water sewage systems. The increased volume of flows created by the great populations as well as the increased speed at which the waters transport themselves over the impervious surfaces created flash flooding and pollutant redistribution through lower areas of the Occoquan Basin.

> Residential and commercial areas near the mouth of Four Mile Run sustained property damages totaling more than $40 million as a result of seven floods between 1963 and 1975."[1]

As a result of this, Congress authorized a U.S. Army Corps of Engineers (USACE) to undertake a channelization and bridge replacement project to provide protection from a 100-year streamflow event in 1974. That same year a multijurisdiction agency, the Northern Virginia Planning District Commission, created by Fairfax County, Falls Church, Alexandria, the Arlington County, agreed to develop such a program. (Such a program as what?)

With the aid of a Technical Advisory Committee (TAC) made up of local public works and planning staff, the NVPDC decided to use a computerized mathematical model of watershed hydrology. To best suit the environmental needs of the area, two different watershed management tools were combined: the continuous storm simulation model (STORM), and the single-event model (WREM). STORM is a computerized model "utilizing a modified version of the rational formula to translate rainfall into runoff but having no flood routing capabilities."[2] The model assumed a very intense, 4-hour thunderstorm that at its peak would reach 7.6 inches per hour. WREM added aspects to the model that took into account three major programs involved in watershed management: Land Use Management of impervious ground cover; Surface Runoff; and Transport conduits. Using this information allowed NVPDC to devise a detailed representation of the watershed and its major flow routes.

There were other difficulties besides that of creating a watershed program. Institutionally, how was the program to be implemented, and by whom? Rather than use traditional multijurisdictional problem solvers like special districts, the TAC suggested the use of the state "joint exercise of power, privilege, or authority which they are capable of exercising individually."[3] (What are each jurisdiction's roles?) While early assessment of the Four Mile Run Watershed Management Program has been promising, a full evaluation cannot yet be done until a full examination of critical litigation over the down zoning necessary in the plan's implementation is carried out.

In June 1979,m two years after the jurisdictions agreed to implement the plan, owners of 45 acres upstream from the reservoir attempted to get rezoning that would permit them to build 271 single-family and townhouse units, or six homes per acre. The problems arises in that Fairfax County, in accordance with the watershed plan, had downzoned the area, permitting only one house per acre. Previously the county's master plan allowed a density of 5 to 8 houses per acre. Nearly everyone involved opposed the county's stand. Owners were willing to spend $80,000 on best management practices to control runoff. These practices would affectively reduce the impact of runoff to what it would be if there were only one house per acre rather than six. The county later refused to rezone stating its uncertainty as to whether best management practices could adequately address the problem. By 1982 the conflict between the county and local developers became worse. Former chairman of the State Water Control Board, Norman Cole, said, "This is just a pseudo-technical report wrapped up to justify a political philosophy to maintain the area as the last remaining underdeveloped area in the county."[4] Other opponents felt the plan would keep moderate-income families out of Fairfax by making every new home an expensive estate. After granting rezoning requests for powerful developers in the Route 50 and Interstate 66 area, the county was flooded with law suits demanding a rezoning of the area. Audrey Moore, Annandale District Supervisor, recognized the potential for failure. Development foes believed the downzoning will most likely be repealed because of the great legal man-power being unleashed against the county's already overworked staff. The court battle is scheduled to end sometime late this summer.

The implications of the problems associated with watershed management are many and varied. While Fairfax County and the other municipalities solved their problems of multijurisdictional water management with great efficiency, the problems of implementation vary from real estate developer's rights to low-income desegregation and civil rights. (What are the other jurisdictions doing?) Future watershed management programs must recognize the private market's practices. A key point in the eventual failure of the plan is the fact that the developers had already obtained the rights to develop the area before the county downzoned the basin. The costs to the county for the appeasal of the developer loss due to the downzoning is far too great. One solution which might have solved the conflict might have been the Fairfax County's environmental planners' suggestion to defer the responsibility of watershed management to the developers, requiring them to affectively reduce urban drainage for full development from six to one house per acre.

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