RESPONSE TO

Hudson County Improvement Authority

Request for Expressions of Interest

Concerning

ALTERNATIVE DISPOSAL TECHNOLOGIES

By

Arrow Ecology & Engineering Overseas (1999), Ltd.

Featuring its

ArrowBio Process

www.arrowbio.com

06 July 2005

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COMPANY BACKGROUND

General

Name of Firm: Arrow Ecology & Engineering Overseas, Ltd. <www.arrowecology.com>

Name of Technology: ArrowBio Process www.arrowbio.com

Patents: U.S. Patent 6,368,500 – 09 April 2002; European Patent 1 216 101 B1 – 02 May 2003

Principal Contact Person:
Melvin S. Finstein
105 Carmel Road
Wheeling, West Virginia 26003
Tel: (304) 242-0341
Email: finstein@envsci.rutgers.edu

Israeli Contact Person:
Yair Zadik
19 Herzelia Street
Haifa 33301, ISRAEL
Tel: 011-972-505-424239
Email: yair@arrowecology.com

Firm History

Early History. The progenitor company is "Hydro-Power Ltd.," established in 1975. In 1991 its name was changed to "Arrow Ecology Ltd." -- under whose aegis the conception and early development of the ArrowBio Process took place. In 1999 the Process was spun off to Arrow Ecology & Engineering Overseas (1999) Ltd., which is the formal respondent to this RFEI. The resources of the parent firm are available to the spin-off and vice-versa.

The parent firm, Arrow Ecology (Certified ISO 2002), is a professional environmental service and contracting/implementation company providing a full service approach to environmental problems and regulatory compliance. Its total personnel number about 60. Its many projects include the treatment of domestic and industrial wastewaters and solids residues through the advanced variant of anaerobic digestion known as Upflow Anaerobic Sludge Bed (or blanket) digestion (UASB). The significance of the experience with UASB digestion is developed later.

Representative Projects. Arrow Ecology Ltd. is experienced in the following areas: Environmental Consulting; Design and Long Term Planning; Construction and Maintenance of Industrial and Municipal Sewage Systems and Treatment Plants; Site Remediation; Treatment of Hazardous Waste; Solid and Liquid Waste Transportation; Industrial Process Sludge and Municipal Sludge Treatment; Road Maintenance; Environmental Laboratory Services; Construction and Maintenance of Pipelines and Pumping Stations; Design and Construction of Industry Related Building Projects; Design and Construction of Hydro-Mechanical Systems; Maintenance Services for Chemical and Petrochemical Plants - Oil Refining Units, Cooling Towers, Boilers and Heat Exchangers; Maintenance/Renovation of Large Oil and Fuel Tanks.

Thus, Arrow Ecology is a professional environmental services and contracting/ implementation company providing a comprehensive full-service approach to environmental problems and regulatory compliance. The company offers a wide range of environmental and industrial services, as represented below in large-scale projects completed from 1992 to the present.

Project	Client
Cleaning and oil recycling of crude oil tanks	Petroleum & Energy Infrastructure
Cleaning and oil recycling of heavy oil tanks	Israeli Electrical Co.
Design and construction of a waste water treatment plant	Gadot Chemicals Ltd.
Lime sludge treatment	Israeli Oil Refineries
Maintenance of production units	Israeli Oil Refineries
Marine oil spill treatment	Ministry of The Environment
Oily sludge treatment and recycling	Israeli Oil Refineries
On-site treatment of waste water from chemical cleaning operations	Israeli Electrical Co
. On-site treatment of cooling water polluted with PCB's	Israeli Electrical Co.
Biological Process design, upgrading and maintenance of an industrial waste water treatment plant	GADIV petrochemicals Ltd.
Recycling of solvents and polypropylene from sludge	Carmel Olefins Ltd.
Renovation of main drainage system polluted with heavy oil	Israeli Oil Refineries
Renovation of main drainage pipelines	Israeli Oil Refineries
Renovation of production units	Carmel Olefins Ltd
River oil spill treatment	Alliance Tires Ltd.
Site remediation of a tank farm polluted with heavy oil	Delek Oil Co.
Design and construction of a waste water treatment plant	Israeli Military Industries
Seed washing system	Haze'ra
Wastewater treatment system	Haze'ra
Anaerobic reactor and system upgrade	GADIV Petrochemicals Ltd.

Baseline Personnel Resources (local project-specific personnel and company affiliates recruited as needed)

SAMY Y. EZAIR, Chairman and Chief Financial Officer

Education: B.A./M.B.A. 1971/1973 – Hebrew University, Jerusalem, Israel.

Affiliations: Board member of real estate and construction companies

Professional Experience:

Mr. Ezair has long-term experience in management and as a managing director in companies including real estate, building, liquid waste treatment, and environmental projects. His experience in management started in 1975 when he established "Hydro Power Ltd." that later became Arrow Ecology Ltd. He was an officer in the Israel Defense Force.

Mr. Ezair will be in charge of the financial activities of the project.

BOAZ ZADIK, Co- CEO, in charge of R&D, Engineering and Operations

Professional Experience:

Mr. B. Zadik manages the development, operations, and human resources of Arrow Ecology Ltd. His experience includes sixteen years of project management in the petrochemical industry, treatment of special wastes, and design and treatment of industrial wastewaters and sludges. He was a principal in the ArrowBio project, from its inception to bringing the system to maturity through development of the semi-industrial scale facility in Hadera, and then in the planning, construction and operation of the full scale plant at the Tel Aviv transfer station (reference facility). Previously Mr. B Zadik was an Army personnel management officer in charge of three thousand soldiers and logistic organization.

Mr. B. Zadik will be in charge of construction and operations of the project.

YAIR ZADIK, Co-CEO in charge of Business Development and Marketing

Education: B.Sc. 1989 – Bar Ilan University, Ramat Gan, Israel;

Physics and Computer Sciences Studies 1989-1992 (interrupted by military duties)

Affiliations:

Colonel (Reserve) in the Israeli Air Force.

Director of High-Tech Companies.

Elected Director in the Israeli Export Institute.

Holds Israel's National Defense Award (2003).

Professional Experience:

Mr. Y. Zadik leads the business development team of Arrow Ecology Ltd. and manages the connection between market demands and developmental projects. Additionally, he serves as a director in high-tech companies and is an elected board member of the Israeli Export Institute. Colonel Zadik served as a senior project manager in the Israeli Ministry of Defense and the Israeli Air Force, and received the National Award Prize for his contributions to the defense of the nation.

Mr. Y. Zadik will be in charge of business management and is the headquarters Point of Contact for the project.

AMIR ASSA, Chief Scientist

Education:

B.Sc.1988 – Ben-Gurion University, Beer Sheeba, Israel, Biotechnical Engineering

M.Sc. 1991 – Hebrew University, Jerusalem, Israel, Biotechnology Sciences

Professional Experience:

Mr. Assa is the inventor of the ArrowBio Process. He leads the development of the biological, chemical, and energy systems of Arrow Ecology Ltd. He is a well-known expert in biological treatment technologies and the scaling-up of such processes. He heads projects involving bacterial culture production, use of fungi in waste treatment, wastewater treatment technologies, and biological treatment of hazardous/toxic liquids from the petrochemical industry.

Mr. Assa will be in charge of the process planning for the project.

MELVIN S. FINSTEIN, Principal Contact Person, Scientific Consultant and Representative of the ArrowBio Process in the United States

Education:

A.A.S. 1954 – Long Island Agricultural & Technical Institute, Farmingdale, NY, Agriculture

B.S. 1959 – Cornell University, Ithaca, NY, Biology/Agronomy

M.S. 1961 – Cornell University, Ithaca, NY, Soil Microbiology

Ph.D. 1964 – University of California, Berkeley, Microbial Ecology

Affiliations:

American Society of Microbiology

Solid Waste Association of North America

Professional Experience:

A native of Cambridge, Massachusetts, Dr. Finstein served in the U.S. Army before earning his B.S. and M.S. degrees from Cornell University, and Ph.D. degree from the University of California, Berkeley. From 1965 to 1999, Dr. Finstein was a Professor in the Department of Environmental Science, Rutgers University -- the State University of New Jersey, where he now holds the position of Professor Emeritus. Author or coauthor of over fifty published papers reporting laboratory and field experimentation, Dr. Finstein is well known internationally in the area of biological process control and the microbial ecology of waste processing systems.

Dr. Finstein will be the Principal Contact Person, coordinator, scientific consultant, and public liaison for the project.

VLADIMIR BUKACHIN, Senior Mechanical Engineer

Education:

B.S. 1971 – Israel Institute of Technology, Engineering Institute, Haifa, Israel, Mechanical Engineering

Professional Experience:

After serving in the Army of the U.S.S.R and immigrating to Israel, Mr. Bukachin completed his formal education. He leads the headquarters mechanical engineering team of Arrow Ecology Ltd. He designs liquid biological treatment systems, and mechanical solutions for conveyors and hydraulic systems. Mr. Bukachin has over thirty years experience as a project planner and is an inventor and patent holder of a number of systems.

Mr. Bukachin will be a process engineer on the project

AYELET SIF, Procurement Team Manager

Education:

B.Sc. 2000 – Israel Institute of Technology, Engineering Institute, Haifa, Israel, Civil Engineering

Professional Experience:

Ms. Sif leads the procurement team of Arrow Ecology Ltd. She is in charge of vendor relations, sub-contracting of projects, and the supervision of the progress of projects from initiation to final completion. Previously she was in charge of the Haifa Municipality Department of Planning for sewage systems.

Ms. Sif will be the procurement manager for the project.

Development of the ArrowBio Process

The history outlined above, particularly projects involving wastewater and residual solids treatment using the UASB variant of anaerobic digestion, led to the development of the ArrowBio Process. UASB digestion is the preferred technology worldwide for strong wastewaters, but prior to Arrow's adaptation it was thought inapplicable to biodegradable organic solids as found in municipal solid waste (MSW). Uniquely, the ArrowBio Process is able to utilize UASB digestion with its many advantages to treat solid phase organics. Moreover, this application is necessarily linked to the utilization of water, derived from the waste, for water-based gravitational separation of non-biodegradables (includes recyclables). That is, separation of non-biodegradables is integrated with preparation of biodegradable organics for UASB digestion. These technical matters are detailed below.

Over its decade long development, the ArrowBio Process has progressed systematically through these stages: laboratory bench scale; field scale pilot plant; demonstration scale proof of concept plant (Town of Hadera); and a full-scale industrial plant at the Tel Aviv MSW transfer station in Hiriya (Reference facility).

In recent months, the ArrowBio Reference facility was inspected by numerous international entities. Without exception, all found ArrowBio to be the leading technology for mixed MSW worldwide. These inspections led to different joint ventures and agreements in Australia, the UK, Spain, Mexico, Greece, and Cyprus. In the United States, the ArrowBio Process is short listed in the County and in the City of Los Angeles, California, and in two New York City projects.

In particular, teams of Australian inspectors have spent considerable time at the plant. Their evaluation reports are given later in this response.

TECHNICAL DESCRIPTION – VIDEO PRESENTATION

Five copies of a CD accompany the five copies of this printed submittal. One of the tracks on the CD is a four-minute video (with audio) showing the operation of the Reference plant at the Tel Aviv transfer station. Viewing this video is suggested before perusing the detailed description of the science and technology of the ArrowBio Process given next.

TECHNICAL DESCRIPTION – TEXT DOCUMENT (see next)

ArrowBio Process for Municipal Solid Waste: Recovery of Material and Energy Resources in a Single System

Melvin S. Finstein

Introduction.

After extensive development involving laboratory, pilot, and small commercial scale steps, a full-scale ArrowBio plant opened in early 2003 at the preexisting Tel Aviv, Israel, Municipal Solid Waste (MSW) transfer station (Figure 1).

Figure 1. The ArrowBio plant at the Tel Aviv, Israel, transfer station. The physical separation/preparation element of the plant is under the roof at the left, and the biological element is beyond the roof at the right. In the background is the Hiriya dump, now closed and being remediated as part of the future Ayalon Park.

The design capacity of a standard ArrowBio module is 200 tons/day or 70,000 tons/year. However, lack of space at the preexisting transfer station imposed two constraints. First, the two elements had to be apart, though this is not a major drawback as they are connected by pipelines. Second, there was space for only one 100 ton/day separation/preparation line rather than two lines as in a standard module. The biological element shown is sized for two lines as in a standard module.

System Integration. The physical and biological elements of the Process are integrated such as to make possible the recovery of both material (e.g., non-compliance food containers) and energy (methane-rich biogas) resources in a single facility. Typically, about 70% of MSW mixtures, such as Type 10, consist of biodegradable organics (food preparation wastes, plate wastes, diapers, incidental vegetative material, food tainted paper), yielding methane. Other waste streams such as Types 23 and 25 are nearly 100% biodegradable.

Not only must the biodegradables be isolated and prepared for energy recovery, but the non-biodegradables must be sub-fractionated into the various types of secondary materials for recycling to the extent practicable, as well as residual to be landfilled. In initiating theses tasks, mixtures that are currently landfilled in their entirety are tipped directly into ArrowBio's special purpose separation/preparation water vats.

Roles of Water in ArrowBio's Physical and Biological Elements.
The water in the vat is in circulation with water newly freed from the waste through biological action at the back-end. That is, the source of the water in both elements is the moisture content of the waste, typically comprising around 30% of the weight of MSW.[1] The biological gasification of organic solids leaves behind the water in liquid form.

In the water vat, the non-biodegradable and biodegradable fractions are separated gravitationally. Separation in water is far more efficient than in air, owing to the comparative densities (relative buoyancies) of the two fluids. Thus, depending on their specific gravity and tendency to absorb water, items sink, float, or become suspended in the water.

A central feature of the system is that, because separation/preparation is in water, it is possible to use UASB digestion, which requires its organic feed in solution or fine suspension. Thus, both front - and back- ends of the system are frankly watery and function reciprocally.

Other benefits of tipping into water include dust suppression and the neutralization of odors delivered with "ripe" loads. Neutralization is immediate because odorous compounds are soluble in water. Their biodegradation soon follows in enclosed digesters, preventing downstream generation of nuisance odors. Also, being watery evens-out surges and regulates the rate of progression through the processing train, contributing to the system's overall resiliency.

Physical Element: Separation and Preparation. Figure 2 is a close-up of the exterior of the physical element. Its functions are two-fold -- to remove traditional recyclables (e.g., non-compliance bottles and cans) and other non-biodegradables, while simultaneously isolating the biodegradable for UASB digestion. Visible are a large settling tank (2a), cyclone at the terminal end of a film plastic removal system (2b) [leads to a baler (Figure 3)], large trommel screen (2c), and office and control room (2d). The separation and preparation functions, performed in unison, are inextricable.

[1] Finstein, M.S. 2003. "Operational Full-Scale ArrowBio Plant Integrates Separation and Anaerobic Digestion in Watery Processing, With Near-Zero Landfilling." *Proceedings of WasteCon 2003, SWANA's 41st Annual International Solid Waste Exposition*, October 14-16 2003 St. Louis, Missouri, p. 290-296.

Figure 2. Visitor entrance to the physical separation/preparation element of the plant (bins in forefront remain from construction.

Figure 3 shows one of the material products recovered.

Figure 3. Bales of plastic recovered from mixed MSW

In the separation/preparation vat, the watery flow carrying the heterogeneous mixture of MSW materials follows multiple pathways that are, by design, complex, overlapping, and repetitious. As such, the agencies of solubilization, size reduction, screening, and gravitational separation are given diverse and repeated opportunities to complete their work. The multiplicity of pathways makes it impossible to describe events in a linear fashion. The interior of the physical element is shown in Figure 4.

Figure 4. Inside the physical separation/preparation plant element, viewed toward the visitor entrance (see Figure 2 for orientation). The tipping platform is in back of the viewer. For scale, the railing is waist high. (Photo taken in early testing.)

The load is tipped onto a walking floor (4a), from which it falls into the water vat immediately upstream of a partially submerged rotating paddle (4b). The paddle urges floaters and buoyancy-neutral items forward into the main body of water (4c). Sinkers are diverted to the left and passed sequentially to a bag breaker (4d), magnetic pickup (4e), eddy current device (4f), and a pneumatic (vacuum/forced draft) station (4g) from which film plastic is swept into ductwork (4h). Ducts from several such stations converge on the cyclone (see Figure 2). Thereby, metals and film plastic are removed. Items that escape this processing train the first time around reenter the water vat (4c) for another chance to dissolve, float or sink or, if buoyancy-neutral, be suspended in the forward-moving water column.

Overflow from the water vat, screened to exclude large items, passes though smaller enclosed trommel screens (4i) and thence, according to partitioning criteria, to large (see Figure 2) and small (4j) settlers. In the settlers grit is separated from organics and removed from the system.

Meanwhile, larger floaters and buoyancy-neutral items are lifted (4k) to a slow speed shredder (4L) and thence to the large trommel screen (4m). The "overs" from this trommel consist mostly of film plastic and are removed at a pneumatic station. The "unders" (material that passed through screen) are washed into a non-mechanical device for further solubilization and size reduction. Non-soluble substances are thus reduced to a suspension of fine particles whose surfaces are roughened to favor microbial colonization.

Thus non-biodegradables are recovered for recycling as secondary material commodities, and soluble and particulate organics come into solution or fine suspension, including food sticking to containers and the contents of unopened diapers. The latter are disrupted in the processing train, freeing the feces, urine and cottony absorbent. Insoluble biodegradable organics (e.g., non-source-separated food-tainted paper products, tough fruit rinds) get increasingly soggy and fragmented, ultimately to the point of passing screens of selected sizes. The organics, now in watery isolation, are pumped to the biological element. In turn, return water from the biological element refreshes the separation/preparation water vat.

Within half an hour after tipping the last load of the day, the work of the physical separation/preparation element is complete. This part of the plant is then shut down until deliveries resume the next working day.

Biological Element: Transforming Organics to Useful Products. The biological element is shown in Figure 5. The organic flow first enters acidogenic bioreactors (5a) for several hours of preliminary treatment. There, readily metabolized substances already in solution are fermented (e.g., sugars fermented to alcohols), while certain complex molecules are biologically hydrolyzed to their simpler components (cellulose to sugar, fats to acetic acid). The overflow, rich in such intermediate metabolites, then enters the UASB bioreactor (5b).

Fig. 5. Biological element of the plant (see text and box).

UASB digestion is a generic, mature technology specifically designed for the treatment of high strength *wastewaters*, such as in dairy and candy manufacture and other industries. Hundreds of such systems are in use worldwide – in the wastewater treatment domain. The ArrowBio Process, by rendering solid phase organics into a strong wastewater, makes UASB, with its superior performance characteristics, applicable to MSW.

UASB

Snapshot of Upflow Anaerobic Sludge Blanket (bed) digestion

While a full outline of UASB digestion is beyond the scope of this paper, its main features are described herein. Two terms as used in the field are first noted: *Solids* refers, in context, to the microbial community performing the work; *granules* refers to the particles formed spontaneously by that community. Other special terms are italicized on first use.

Each granule is a miniature, mature, complete ecosystem performing the complex stepwise transformation of organic waste to stabilized residue and biogas. Moreover, in gasifying the organic material, the water in the waste is liberated and left behind in liquid form. The granules are kept in watery suspension to a given "blanket" (or column) height by the bubbling of the gas, abetted by pumping.

Specific features setting UASB digestion apart from older, less efficient, forms of anaerobic digestion are two: the wateriness of the feed, and the *Solids* and *Hydraulic Retention Times (SRT and HRT).* In other MSW applications using conventional digestion the feed is a thick paste (up to 30% solids/70% water), and the SRT and HRT values are identical or nearly so (~ 15 days). In UASB digestion as used in the ArrowBio Process the feed is watery (~ 4% solids/96% water), and the SRT and HRT vastly different (~ 75 days and 1 day, respectively). The difference in the SRT and HRT is at the heart of UASB digestion.

It might seem at first that the watery nature of UASB is an uneconomic use of reactor volume. The opposite is true, however, because UASB digestion unleashes the power of microbes in a manner not otherwise possible. This is manifested in faster and more complete transformation of organics to biogas. The practical results include: less residual organics and their more complete stabilization; more biogas richer in methane; a modest facility footprint (two acres, inclusive, for a one-module 70,000 tpy plant).

Operationally, excess biological granules suspended in similarly excess water (both excesses represent growth at the expense of the waste) are transferred to a settling tank (5c). Supernatant is pumped to the physical separation/preparation element as needed for makeup water, or to an aerobic tank for polishing (5d) if necessary. Water may be stored (5e) or used immediately as in irrigation. The solids are dewatered for use as stabilized organic soil amendment.

Some of the biogas is used to fire boilers (5f) to maintain UASB digestion at its optimum temperature of ~ 95°F (35°C). Otherwise, depending on site-specific circumstances, the gas

fuels an electrical generator (5g) via a storage tank (5h). Waste heat from the generator contributes to the maintenance of digestion temperature.

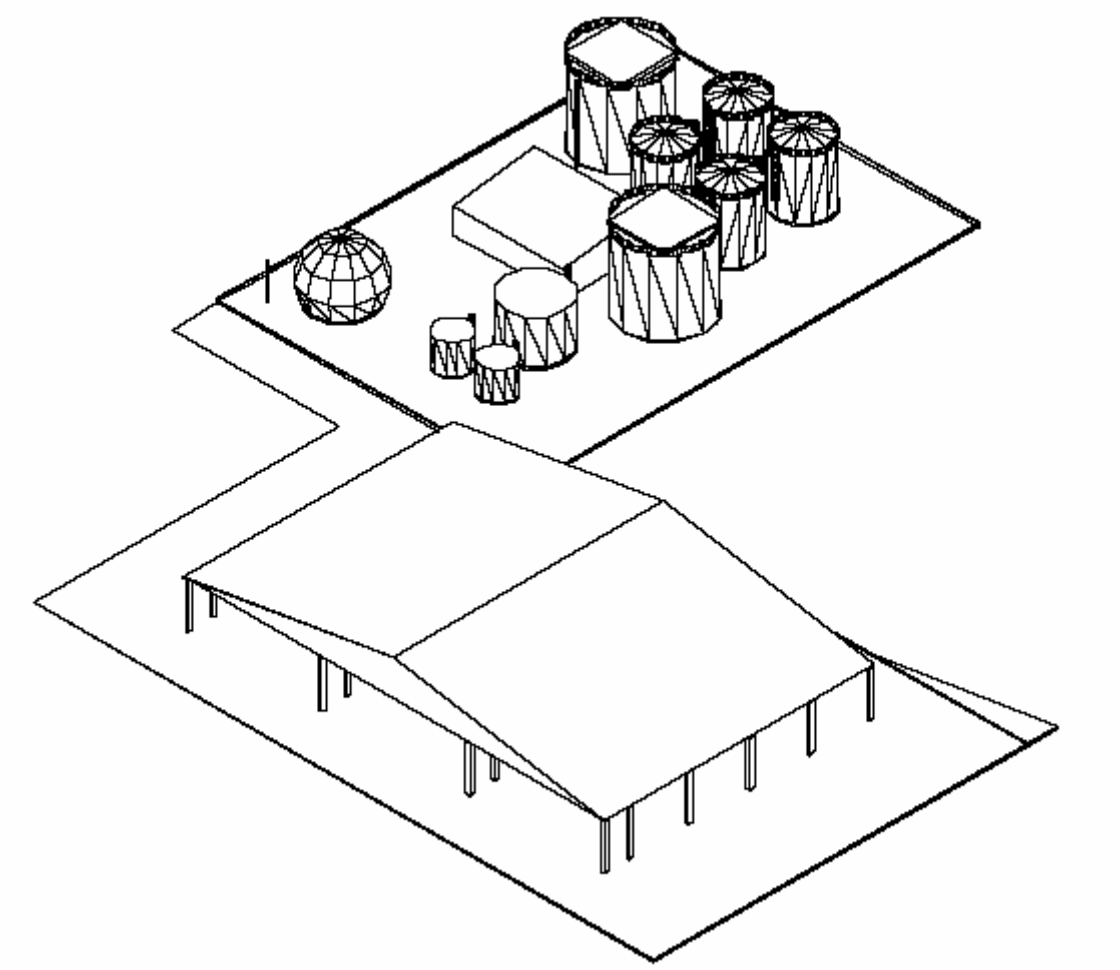
Simplicity, Economics, and Benign Processing Conditions. Because the ArrowBio Process is essentially based on two benign phenomena (gravitational separation in water and advanced anaerobic digestion), processing conditions are mild throughout. By involving only biological temperatures and ambient pressures, the system may be said to "work with nature."

Being based on these two phenomena implies, correctly, that the economics of construction, operation, and maintenance are favorable. Moreover, most of the components are "off the shelf," and construction is local. Another implication is that, unlike systems based on harsh non-biologic reactions at high temperatures and pressures, there is no generation of toxic or hazardous compounds with their potential release into the environment.

Broader Significance of the ArrowBio Process. The transition of municipal solid waste management from being a matter of mere disposal to one of material and energy management is irrevocable, yet still in a formative stage. We expect the ArrowBio Process to play an important role in that transition.

GENERAL LAYOUT OF PROPOSED FIRST MODULE (~ 300 tpd)
FOR HUDSON COUNTY IMPROVEMENT AUTHORITY

The building in the lower rectangle represents the physical separation/preparation component of one module. Three water vats and associated equipment are not shown. The building would be enclosed on all sides. The upper rectangle represents the biological component of one module. Shown are: two methanognic (UASB) bioreactor tanks, each served by two acidogenic pre-reactor tanks; a rectangular building housing a genset; smaller tanks for hydraulic balancing and excess culture storage, an aerobic wastewater treatment; a spherical gas storage building; and a safety flare**.**



INDEPENDENT EVALUATIONS OF ARROWBIO PROCESS

As was noted above, the ArrowBio Process is short-listed by a number of jurisdictions, each of which performs its own background check and technological evaluation. New York City, for example, evaluated forty-three technologies from which nine have been selected for closer examination (includes Arrow). The full NYC report is available on line.[2]

We make particular note of the technical review by Australian inspectors, because their evaluation included extensive on-site work at the Reference facility at the Tel Aviv transfer station. After examining a number of systems, Waste Services of New South Wales/ANZ Investment Banking commissioned Douglas Partners Pty. Ltd., an Australian engineering consulting company, to conduct an in depth examination of the ArrowBio plant. This resulted in two Douglas Partners reports to WSNSW/ANZ, both of which are excerpted below. The September 2004 report is on the technology per se, and the October 2004 report is on the quality of the digestate (i.e., organic soil amendment product). Both reports are reproduced in their entirety in the accompanying CD.

Later, WSNSW/ANZ commissioned a different Australian consulting firm, GHD Management Engineering Environment, to specifically examine the Reference plant, on site, for any potential to cause odor and noise nuisance. The odor and noise reports, dated March 2005, are reproduced below.

Since then, Waste Services of New South Wales has entered into an agreement with Arrow Ecology & Engineering Overseas Ltd. to build a facility in Belrose, a suburban of Sydney, Australia.

[2] "Evaluation of New and Emerging Solid Waste Management Technologies." New York City Economic Development Corporation/Department of Sanitation, 16 September 2004.
< http://www.ci.nyc.ny.us/html/dos/pdf/pubnrpts/swmp-4oct/appendix-f.pdf>

Douglas Partners
Geotechnics • Environment • Groundwater

REPORT
on
INDEPENDENT TECHNICAL REVIEW

ARROWBIO® SOLID WASTE TREATMENT PROCESS

Prepared for
WASTE SERVICE NSW / ANZ INVESTMENT BANKING

Project 37387
September 2004

Douglas Partners Pty Ltd
ABN 75 053 980 117

96 Hermitage Road
West Ryde NSW 2114
Australia

PO Box 472
West Ryde NSW 1665

Phone (02) 9809 0666
Fax (02) 9809 4095
sydney@douglaspartners.com.au

EXECUTIVE SUMMARY

Douglas Partners Pty Ltd (DP) has been commissioned by Waste Service NSW and ANZ Investment Bank as the Independent Technical Expert to undertake a due diligence technical evaluation of a proposed mechanical-biological waste processing system for the treatment of Municipal Solid Waste (MSW).

The Waste Treatment technology under review comprises a two stage process namely:

- An initial water based separation which removes the recyclable materials and prepares the organic stream for treatment;
- Biological treatment of the organic fraction resulting in the production of stabilized compost and biogas.

The treatment process is being considered by Waste Service NSW for installation at its Belrose Waste Management Centre.

The scope of the independent technical review comprised:

- A review of current relevant issues relating to management and processing of Municipal Solid Waste;
- A review of available technical information regarding the process plant operated by Arrow Ecology Ltd in Tel Aviv, Israel;
- An inspection of the waste facility at Tel Aviv. This plant is similar to the one proposed for Belrose even though the detailed design of the proposed Belrose plant is not available at this stage.

The plant operated by Arrow Ecology Ltd in Tel Aviv is designed to cater for approximately 70,000 tonnes of Municipal Solid Waste per annum. The waste is delivered between about 6 am and 2 pm daily and is processed by a small number of highly trained technical personnel using a purposed designed process control system that allows intervention at any stage of the treatment. The plant proposed for Belrose will be similar in most respects to that already operating in Tel Aviv except that it will have a number of parallel processing streams to cater for the treatment of 100,000 tonnes of Municipal Solid Waste per annum.

The basic concept of the ArrowBio process comprises an integration of well proven water based mechanical and biological waste treatment units. The waste is dumped directly onto a walking floor which progressively moves the material to a large flotation tank. Heavy material such as glass and metal settle to the bottom of the tank whereas plastics and other light materials float to the top whilst organics remain in suspension. The heavy fraction is removed from the bottom of the flotation tank for further mechanical screening and separation. A trommel screen is used to split open plastic bags and magnetic and eddy currents remove ferrous and non-ferrous metals into different streams. The light fractions are removed from the flotation tank through a paddle wheel where it is then shredded and passes through an inclined trommel screen to separate the plastic components for recycling. The final processing occurs in a high pressure hydo crusher where water is used to shear the organics into small fragments in preparation for biological treatment. Once the preprocessing is completed the materials are then in readiness for acetogenic and methanogenic anaerobic biological treatment which essentially produces a fluid stream which is recycled into the process and biogas which can be utilized to generate power and compost.

The ArrowBio system has a number of innovative concepts which have been integrated into a mature waste treatment process. The system is modular in design and simple in concept as well as in operation. The modular nature of the plant means that it can be easily duplicated to allow treatment of any volume of waste. The system allows for the intake of unsegregated Municipal Solid Waste with highly variable solid waste contents. The operation of the system is thus not depended upon the waste input having to meet certain specified waste composition criteria. Whilst the full details of the mechanical pretreatment facilities for Belrose is still to be finalised, it would appear that no presorting by hand will be necessary. In general, the mechanical material separation/recovery facility relies on simple screening by flotation and thus provides a reliable, initial segregation process to recover the majority of recoverable materials for recycling. Bulk waste materials that are not suitable for direct feed into the biological treatment system are removed by hand after initial inundation in the separation tank. The biodegradable fraction of the waste is degraded gradually into various fractions. The most soluble and easily biodegradable organic portion is degraded into biogas whereas the solid organic waste which is not readily biodegradable is retrieved as compost. The entire biological treatment process is closed and therefore there are no odour problems associated with the treatment of the organic rich water. The waste process

system based upon the ArrowBio technology is flexible and yet relatively simple to operate. The process design provides for the systematic segregation of wastes of different treatability. As a result various waste fractions can be treated separately in an optimized manner.

The ArrowBio process has been well proved through approximately two years of commercial scale operations. Prior to that, a smaller pilot plant was tested at Hadera in Israel for 1½ years.

Douglas Partners supports the proposed technology as a suitable means of waste treatment based upon the information obtained from Arrow Ecology Ltd and observations made during a visit to Tel Aviv. In general, the following conclusions are made:

- Arrow Ecology Ltd has the relevant experience and credentials;
- The technology selected is well proven with good operational records;
- The selected integrated system has good and efficient system design;
- The operational technical plant at Tel Aviv aptly demonstrates the technical feasibility of the selected integrated system;
- The reliability of the system is supported by good operational records of the Tel Aviv facility;
- The proposed process is essentially an innovative means of getting all organics in an easily digestible form and then utilizes standard wastewater treatment technology to reduce the organic waste to methane for use in power generations;
- In overall terms the technical and financial risk is low.

FROM DOUGLAS PARTNERS SECOND REPORT OF OCTOBER 2004, ON THE ARROWBIO DIGESTATE

4. CONCLUSIONS

Based on the results of the analysis performed by Arrow Ecology Ltd and Douglas Partners and observations made at the Tel Aviv plant it is considered that the process is suitable for treating MSW at Belrose. The output from the plant can be used as landscaping or top-dressing on the adjacent landfill because there is a low potential for mobility of heavy metals. The materials has a high nutrient value which can be utilised as a growing medium for the landfill cover. The plant at Tel Aviv operates with an almost total absence of odour so there should be no difficulties in this respect from neighbours. Douglas Partners has no hesitation in confirming that the ArrowBio System is an innovative integration of well proven water treatment technologies for processing of municipal solid waste.

Yours faithfully
DOUGLAS PARTNERS PTY LTD

Reviewed by

Michael J Thom
Principal

Ronnie Tong
Principal

Note: Complete copies of both Douglas Partners reports are included in the CD.

REPORTS OF "GHD MANAGEMENT ENGINEERING ENVIRONMENT" OF NEW SOUTH WALES, AUSTRALIA, ON NOISE AND ODOR AT THE ARROWBIO REFERENCE FACILITY AT TEL AVIV TRANSFER STATION

Table 1 Noise measurement results

Test No.	*Description*	A	63	125	250	500	1000	2000
1		79	73	75	76	78	74	70
2		80	72	77	79	76	74	70
3		80	80	78	77	76	73	68
4		77	75	77	75	74	73	65
5	transfer station noisy	75	72	74	74	72	70	65
6	influenced by t/s noise	72	72	73	68	63	58	57
7		72	70	72	73	70	67	63
8		76	69	73	73	73	72	68
9	open side	76	73	73	75	74	70	67
10		83	75	78	82	81	79	75
11	doors close	81	80	84	79	78	74	77
12		69	65	68	65	65	64	59
13		74	72	75	70	68	69	66
14		75	70	76	71	74	69	66
15	gas smell	64	71	72	67	68	57	56
16		66	77	74	66	61	58	57
17		75	75	77	70	67	64	66
18		70	75	83	68	67	63	66
19		67	75	70	66	61	59	58

The noise levels are in decibels (dB). We measured both dBA (which is a weighted combination of noise frequencies) and also the noise levels at selected frequencies. While the noise modelling is not complete, the levels are quite low. In other words, we would not expect to have noise issues with neighbours.

David Gamble
Principal Environmental Engineer
Service Line Leader - Waste Management

GHD | MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street Sydney NSW 2000 | http://www.ghd.com.au

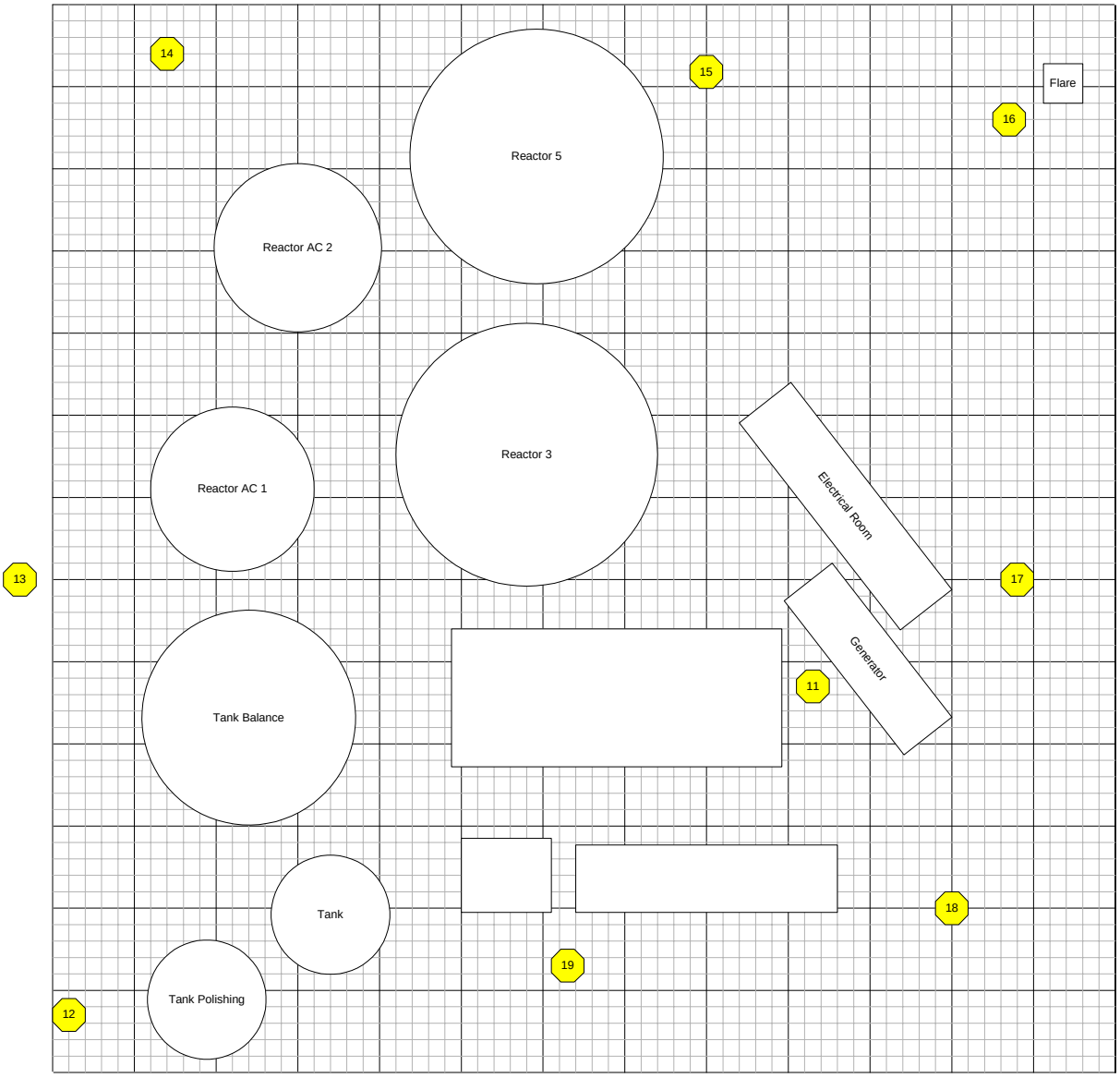


Figure 1 Locations of noise measurements – Tank Farm

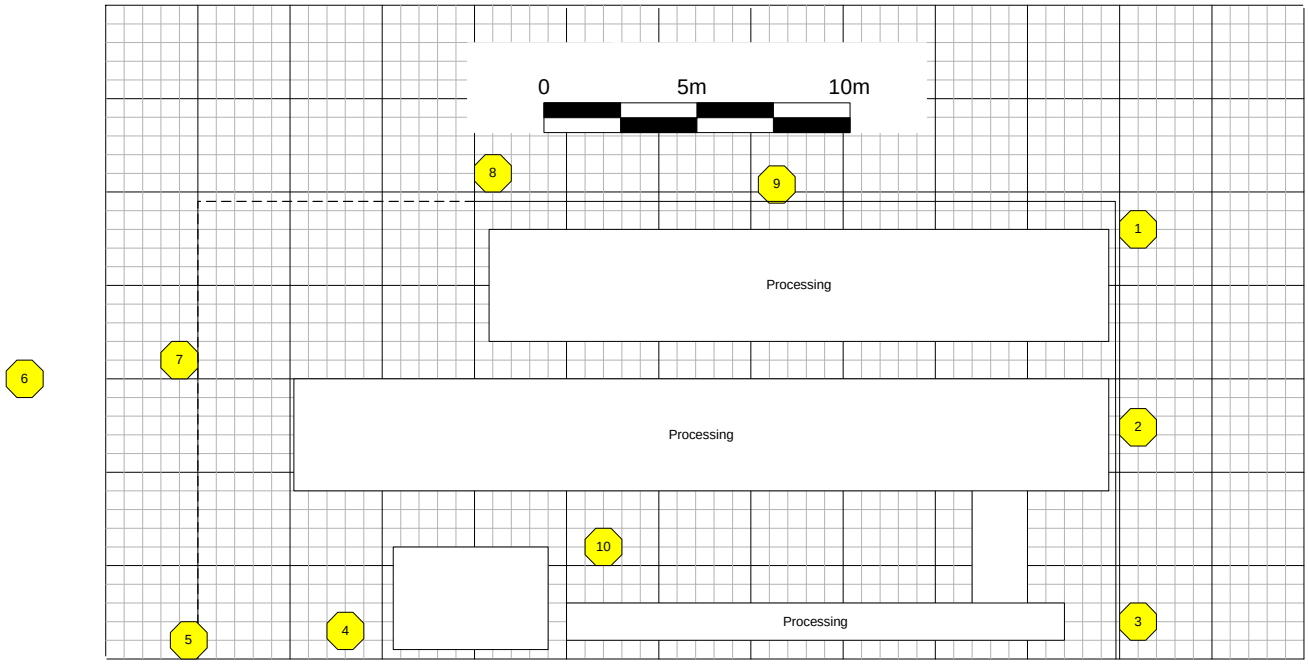


Figure 2 Locations of noise measurements - Main Plant

The odor testing reported below was done by A Due Diligence team of experts from GHD Engineering Management Environment, New South Wales, Australia, while inspecting the ArrowBio Reference plant.

ODOUR MONITORING - FIELD DATA SHEET

Location: **Hiria waste treatment plant, Israel**

Sampler(s): **David Gamble, John Sheen** Date: **13 March 2005**

Time	**Odour concentration (D/T)**							**Notes**
hh:mm	60	30	15	7	4	2	<2	
11:40				X	X			By David Gamble, at front of the plant, inside building
11:45				X	X			By John Sheen, at front of the plant, inside building
12:00				X				By John Sheen, near the first VAT, inside building
12:10			X	X				By David Gamble, near the first VAT, inside building
12:20							X	By David Gamble, near the gas generator

The odour measurements are in odour units (OUs). Generally, 1 OU is the level where an odour can be detected by the human nose. In NSW, the general rule is that a level of 2OUs should not be exceeded at the property boundary. However higher levels are possible within the plant.

In ArrowBio's case, the levels measured away from the plant were very low. At the boundary, the levels would be undetectable, that is, below 1 OU. This is very good compared with most technologies, which have biofilters. The biofilters *[at other plants]* themselves are odoiurous, so the 2 OU level can be hard to achieve at the boundary of a small site. *[bracket added by MSF]*

David Gamble
Principal Environmental Engineer
Service Line Leader - Waste Management
GHD | MANAGEMENT ENGINEERING ENVIRONMENT
10 Bond Street Sydney NSW 2000 | http://www.ghd.com.au

LETTER FROM DAN REGION ASSOCIATION OF TOWNS
(OWNER OF TRANSFER STATION)

תל אביב

רמת גן

חולון

בת ים

נבעתיים

בני ברק

* * *

אזור

אפעל

נבעת שמואל

גני חקוה

סביון

קרית אונו

Monday, July 19, 2004

Assessment of the ArrowBio technology – Hiriya, Israel

ArrowBio technology was selected by The Dan Region Association of Towns (DRAT) to set up a 60,000 tonne/year (200 tonnes/day) running plant at our MSW transfer station in "Hiriya". The transfer station receives on the average of 2,700tons/day. The decision followed a broad investigation of alternative technologies for the waste treatment at our site. The ArrowBio technology was found as an environmentally friendly technology that has advantages over other waste treatment facilities.

The 200 tonnes/day facility was build in "Hiriya" (with some limitation of space) and was completed on January of 2003 and is in a running stage since then. DRAT is following the running operations and is satisfied with the progress and the waste treatment of the facility.

The ArrowBio technology receives unsorted MSW. The 1st stage is an Automatic sorting of recyclable materials which results in the sorting and purifying of the biodegradable material. The next step is the biological treatment of the organics to produce Bio-gas, containing 70 – 80% Methane. The Bio-gas is then collected to a landfill gas generator (power station) to produce electricity and heat (the heat is used to warm the reactors). The electricity is used for internal use and the access goes out to the grid. Clean, purifies water from the facility will be used in the future for watering the park and washing the waste collection trucks.

To sum up a year's operation:
The technology works.
The plant receives unsorted MSW waste.
There are no "smell" problems from the plant.
The recyclables are separated and sold as commodities.
The biological part works well to produce good quality Bio-gas.

One of the main issues when selecting a "partner" to work in your backyard is their credibility and friendliness. Definitely the ArrowBio team is a pleasure to work with on a daily basis.

Sincerely,

Danny Steinberg
Association Engineer

P.O.B 437 OR-YEHUDA 60200 ת.ד. 437 אור-יהודה מיקוד
Fax: 03-6314761 פקס: Tel: 03-6314725 טל:
E-mail: igud@ayalon-park.com
www.hiriya.co.il

DATA FROM REFERENCE FACILITY

Biogas Quality

Description	Content
Methane CH_4	70% to 80%
Carbon Dioxide CO_2	20% to 30%
Water Vapor H_20	Removed prior to use
Hydrogen Sulfide H_2S	Less than 100 ppm
Ammonia NH_3	Less than 90 ppm
Oxygen O_2	Less than 1%
Nitrogen N_2	Less than 1%
Heating Value of the Processed Biogas (HHV)	11,500 Btu/lb@60F

A report from the analytical laboratory performing the gas analysis follows.

SPECTROLAB
INTEGRATED LABORATORY, ELEMENT ANALYSES & ENVIRONMENTAL SERVICES.

לכבוד
אמיר אסא
חץ אקולוגיה בע"מ

17.12.03

BIOGAS (1)

שלום רב,

הנדון: דו"ח בדיקה מעבדתית מס' 0371203

דוגמתכם: ביו-גז
תאריך הגעה: 02.12.03 דיגום ע"י: המעבדה בדיקה אחרונה:
סוג הבדיקה: לפי דרישה הזמנתכם מס': מכתב

דיגום ביו-גז ממתקן חץ בחיריה ביום 02.12.03 בשעה 14:15.
טמפרטורת אויר בזמן הדיגום - 17.2°.
הדיגום בוצע מברז במתקן לשקית TEDLAR בנפח 5 ליטר.
לפני הדיגום בוצעה מדידה ע"י מר אמיר אסא בעזרת מד נייד. המד הראה 78% מתאן.

תוצאות:

טמפרטורת ביו-גז נדגם	-	14.6°	Temperature (°C)
מתאן	-	81%	CH_4
חמצן	-	< 0.5%	oxygen
לחות	-	3.8 מ"ג/ליטר	humidity

מאשר הדו"ח: אלי בר-נל, מנהל המעבדה

ת.ד. 2046 רחובות 76120
טל' 08-9474583, פקס' 08-9461032

- יש להתייחס למסמך זה במלואו ואין להעתיק ממנו למסמכים אחרים.
- הנתונים המפורטים משקפים במדויק את התוצאות שנתקבלו במעבדה והינם חסויים.
- מסמך זה מכיל 1 עמודים

Electricity Exported

Electricity exported to the grid (kWh) of the Israel Electric Company

קוו"ש	תאריך
198,680	דצמבר 2004
141,280	נובמבר 2004
155,500	אוקטובר 2004
308,020	ספטמבר 2004
115,680	אוגוסט 2004
39,120	יולי 2004
233,200	יוני 2004
235,600	מאי 2004
238,420	אפריל 2004
238,420	מרץ 2004
338,700	פברואר 2004
239,240	ינואר 2004

Quality of excess water before and after aerobic polishing

Characteristics of water derived from waste – prior to aerobic polishing (Gallons per ton incoming MSW ~ 25)

Parameter	Concentration	Units
BOD	*66*	mg/L
COD	*618*	mg/L
TSS 105^{o}	*256*	mg/L
pH	*7.7*	mg/L
Total Nitrogen	-	-
Phosphorus	*10*	mg/L
Arsenic	*<0.1*	mg/L
Cadmium	*<0.01*	mg/L
Copper	*<0.05*	mg/L
Lead	*<0.1*	mg/L
Mercury	*<0.05*	mg/L
Molybdenum	*<0.05*	mg/L
Nickel	*<0.05*	mg/L
Selenium	*<0.05*	mg/L
Zinc	*<0.05*	mg/L
Chlorides	*626*	mg/L

Characteristics of water after aerobic polishing (Gallons per ton incoming MSW ~ 10-15 owing to evaporative loss.

Parameter	**Concentration**	Units
BOD	20	mg/L
COD	150	mg/L
TSS 105^{o}	5	mg/L
pH	8.3	mg/L
Total Nitrogen	-	-
Phosphorus	<0.5	mg/L
Arsenic	<0.1	mg/L
Cadmium	<0.01	mg/L
Copper	<0.05	mg/L
Lead	<0.1	mg/L
Mercury	<0.05	mg/L
Molybdenum	<0.05	mg/L
Nickel	<0.05	mg/L
Selenium	<0.05	mg/L
Zinc	<0.03	mg/L
Chlorides	286	mg/L

The above water analyses were performed by SpectroLab (see for biogas).

With respect to the first table on water (overflow direct from UASB), the wide COD/BOD ratio (618/66) is typical of UASB water in applications of this technology to strong wastewaters. With respect to the second table (after aerobic polishing), it represents high quality reclaimed water suitable for use in the irrigation of landscape plantings. This is the use to which it is put at the installation at the Tel Aviv transfer station.

Quality of Digestate

Comparison of USEPA and NJDEP standards and Rutgers University Cooperative Extension & Research recommendations for soil amendments, and ArrowBio digestates. Both sets of standards are the more stringent ones for "Exceptional Quality" products. No entry indicates limit not set.[1]

Element	USEPA[2]	NJDEP[3]	Rutgers[4]	ArrowBio[5]	ArrowBio[6]
As (arsenic)	41	41	41	<5	<5
Cd (cadmium)	39	39	21	1	2
Cr (chromium)	-	-	1200	36	140
Cu (copper)	1500	1500	1500	57	182
Pb (lead)	300	300	300	30	58
Hg (mercury)	17	17	17	2	4
Mo	[50][7]	-	18	2	5
Ni	420	420	420	12	24
Se	100	100	28	<5	<5
Zn	2800	2800	2800	335	1122
Ag				<5	<5
Al				4018	9772
B				<5	<5
Ba				119	364
Be				<2	<2
Ca				37190	118900
Co				5	10
Fe				5389	12380
K				2740	5119
Li				</=6	<=6
Mg				2808	6950
Mn				151	325
Na				2276	3277
P				5888	25310
S				7450	17490
Sr				120	312
Ti				46	66
V				9	18
TKN (g/kg)				0.74	0.90
Ash (%)				11.7	14.3
VSS (%)				41.4	19.8
Moisture (%)				46.9	65.9

[1] Mg/kg dry weight, except where indicated.
[2] USEPA monthly average limits for "Exceptional Quality" products (more stringent than the "generally acceptable" limits..
[3] NJDEP monthly average limits for "Exceptional Quality" products..
[4] Rutgers Cooperative Research & Extension, Fact Sheet 954
[5] Acidogenic digestate (sampled 18 August 2004; Analysis by AminoLab, Kiryat Weitzman)
[6] Methanogenic (UASB) digestate (sampling and analyzed as in footnote 5)
[7] Limit for molybdenum unresolved, but indicated value likely to be adopted.

With respect to potentially harmful elements (first ten listed), the ArrowBio digestates would easily pass the standards for "Exceptional Quality" organic soil amendment products. With respect to beneficial elements (N, Ca, Mg, Fe, P. K, S), the digestates are of value for remediation and horticultural purposes (also see Douglas Partners report of October 2004).

Another quality issue, not addressed by any formal standards or recommendations, is that of Man-made Foreign Matter (M-mFM). This refers to particles of glass, ceramic, concrete, metal, rigid and film plastic, and fabric that is present in MSW and may be inadvertently carried into the finished organic soil amendment. A comprehensive study found that conventional MSW-derived composts were seriously contaminated with M-mFM, compromising or eliminating their utility in agriculture and horticulture.[3] This condition is expected of anaerobic digestates where removal of non-biodegradable material in MSW is via conventional devices working in air.

In contrast, digestate from the ArrowBio Process is a nearly free of M-mFM.[4] This desirable condition may be attributed to the system's unique front-end separation/preparation stage. Unlike composting or other anaerobic digestion systems in which only air based separation can be used, intrinsic to the ArrowBio Process is exhaustive gravitational separation in water, as well as multiple screening prior to the biological phase of treatment. The benefits of water-based separation (and screenings) are several: recovery of recyclables; isolation of organics in preparation for UASB digestion; protection of machinery. The point germane here, with respect to compost quality and utility, is that water-based separation results in the near absence of M-mFM in the digestates.

[3] Brinton, W.F. and E. Evans, 2002. Characterizing of Man-made Foreign Matter and its Presence in Multiple Size Fractions from Mixed Waste Composting," pages 903-912. In, (F.C. Michael, Jr.., R.F. Rink, H.A.J. Hoitink, Editors) International Symposium on Composting and Compost Utilization, 6-8 May 2002, Columbus, Ohio. Sponsored by The University of Ohio, and others.

[4] Fearn, B.J., 2004. An Investigation into the Characteristics of a Municipal Waste Derived Digestate, and its Potential Commercial Performance. University of Manchester (UK), Master of Enterprise Thesis.

FINANCIAL AND CONSTRUCTION ASPECTS

It would be premature to suggest any particular means of realizing a project in Hudson County, other than to say that Arrow Ecology is in a position to Finance, Build, Own and Operate a facility. Also that the tipping fee (should that be the option adopted) would not exceed that currently incurred by the County for disposal at distant landfills. Moreover, the County would benefit from the generation of local jobs and, potentially, local manufacturing enterprises.

Other possibilities, such "turnkey" construction with ArrowBio providing training of personnel and technical support, are open to discussion.

Because over 90% of the materials and equipment going into an ArrowBio plant is nonproprietary, local suppliers and contractors would be used extensively. Construction would take about 14 months from the time of first "moving dirt."

These and other matters would come into focus as the project unfolded.

We are open to discussion of any mutually beneficial arrangement, with respect to financing, building, and operating a plant in Hudson County.

A few indications of Arrow Ecology's financial health and capabilities follow.

לאומי
leumi

To: Arrow Ecology Ltd

Date: 13.7.04

Dear Sirs,

re: Arrow Ecology Ltd.

At your request we hereby confirm that Arrow Ecology Ltd is a valued customer of our branch for more than 10 years.

We confirm that the company's accounts are maintained in good order and to our full satisfaction, and that it has always fulfilled its obligations towards us.

For your information this Bank is one of two largest Banks in Israel, with branches or subsidiaries in many parts of the world, including Los Angeles, California.

We understand that this letter is required in connection with your bid for the provision of a waste treatment plant in Riverside County and the business plan will be study by us.

The above information is given in strict confidence, at your request, for your use only.

Yours faithfully,

BANK LEUMI LE-ISRAEL B.M.
Haifa Main Branch

ADA GRINER
3650

RUTH STEG
4040

Investec

Investec Bank (Australia) Limited
ABN 55 071 292 594
Sydney Level 31, The Chifley Tower
2 Chifley Square, Sydney NSW 2000
Tel (61-2) 9236 0000 Fax (61-2) 9236 0001
Melbourne Level 20, 101 Collins Street,
Melbourne VIC 3000
Tel (61-3) 8660 1000 Fax (61-3) 8660 1010
Brisbane Level 3, 320 Adelaide Street,
Brisbane QLD 4000
Tel (61-7) 3229 5566 Fax (61-7) 3229 5533

Mr Michael Movsas
Lowther Capital
PO Box 1576
DOUBLE BAY NSW 1360

movsas@bigpond.com

10 June 2005

Re: Arrow Ecology & Engineering Overseas Ltd – New York City Municipal Solid Waste Project

Dear Michael

Thank you for introducing to us the possibility of playing a role in providing Financial Services and Advice to Arrow Ecology & Engineering Overseas Ltd ("Arrow").

We are excited by the opportunity to utilise our extensive Infrastructure Finance expertise and experience to assist Arrow to overcome the financial hurdles it will face in developing projects around the world. Accordingly, we would like to confirm that Investec Bank (Australia) Limited ("IBAL") is keen to act as Arrow's Financial Partner, as has been discussed in our meetings, both with yourself and also with Arrow's executives.

We envisage that our role as Financial Partner would involve procuring, arranging or providing project debt, mezzanine and equity funding and well as any requisite financial guarantees or security arrangements.

We have reviewed the documentation from the city of NY in regards to the potential project for waste treatment and conversion technologies. We anticipate that we would be able to provide the financial services noted above if required for Arrow's participation in this project, either in our own right, or in conjunction with our international banking associates. Please note however, that this letter should not be construed as an offer of finance or financial accommodation. Such offer could only be made once formal credit approval has been obtained.

IBAL is the Australian arm of the global Investec Group, a specialist bank that provides a diverse range of financial products and services to corporations and private clients. The Investec Group has approximately 4,300 employees in offices around the world. Investec's four principal areas of business are Investment Banking, Treasury and Specialised Finance, Private Client Activities and Asset Management. Investec held £56.8 billion of assets under management as at 31 March 2005.

We look forward to working with you to grow the business of Arrow Ecology Ltd.

Yours sincerely
INVESTEC BANK (AUSTRALIA) LIMITED

Mark Schneider

Mark Schneider
Specialised Finance

Certified Public Accountants

Grant Thornton
Fahn Kanne & Co.

Tel-Aviv, March 7, 2005
7280/1179

Arrow Ecology & Engineering
Overseas (1999) Ltd.
19 Hertzalia Street
Haifa

Gentlemen,

At your request, enclosed please find a translation of the balance sheets of Arrow Ecology & Engineering Overseas (1999) Ltd., as of December 31, 2003, 2002 and 2001.

Before relying on these translations, the reader is advised to read them in conjunction with the original Hebrew financial statements as of December 31, 2003, 2002 and 2001 and for the years then ended, together with the accompanying notes.

Yours sincerely,

Fahn Kanne & Co

Fahn, Kanne & Co.
Certified Public Accountants (Isr.)

Head Office:
Levinstein Tower
23 Menachem Begin Road
Tel-Aviv 66184, ISRAEL
P.O.B. 36172, 61361
Tel. 972-3-7106666
Fax. 972-3-7106660
info@gtfk.co.il
www.gtfk.co.il

ARROW ECOLOGY & ENGINEERING OVERSEAS (1999) LTD.

Balance Sheets

	December 31,		
	2003 NIS'000	2002 NIS'000	2001 NIS'000
ASSETS			
Current assets			
Cash and cash equivalents	-	6	3,091
Government institutions	4	50	62
	4	56	3,153
Investee company	7,505	-	2,560
Fixed assets	-	-	2,560
	7,509	56	5,713
LIABILITIES AND SHAREHOLDERS' DEFICIT			
Current liabilities			
Credit from banking institutions	162	-	8
Other payables and credit balances	1,209	3,327	6,873
	1,371	3,327	6,881
Shareholders' equity (deficit)			
Share capital	68	34	33
Premium on shares	12,752	-	-
Receipt on account of shares	6,936	9,380	9,381
Accumulated deficit	(13,618)	(12,685)	(10,582)
	6,138	(3,271)	(1,168)
	7,509	56	5,713

אהן, קנה ושות'-לזיהוי בלבד
ראה מכתבנו מס [illegible] מיום 2/1/05

חץ אקולוגיה והנדסת אוברסיז (1999) בע"מ

דוחות רווח והפסד

	ביאור	לשנה שהסתיימה ביום 31 בדצמבר 2004 אלפי ש"ח	2003 אלפי ש"ח
הכנסות ממכירת טכנולוגיה	1ה'	1,503	1,906
הוצאות:			
תפעולית לצד קשור		(2,280)	(946)
הנחלה וכלליות	6	(241)	(21)
		(2,521)	(967)
רווח (הפסד) מפעולות		(1,018)	939
הכנסות (הוצאות) מימון, נטו		167	(284)
רווח (הפסד) לאחר מימון		(851)	655
חלק החברה בהפסדי חברה בת		(4,113)	(1,588)
הפסד לשנה		(4,964)	(933)