**WaterSmart Environmental, Inc.**
Post Office Box 26346
Shawnee Mission, Kansas 66225-6345
913.897.2727 fax 897.1902
H2Osmart@ix.netcom.com www.watersmart.com

# Press Release

Contact: C. G. Steiner
Phone: 913.897.2727

**For Immediate Release**
Date: December 17, 2007

**Subject: Tumbleweed Enterprises Completes Feasibility Study of biowastes-to-renewable energy, organic foods, biofuels, and water independence technology for City of Lebanon, Missouri.**

***WaterSmart Environmental, Inc.*** announces the completion of the feasibility study of its **wastes-to-renewable energy, organic foods, biofuels, and water independence technologies** for the City of Lebanon, Missouri. In addition to its normal agricultural activities the project has been designed to rid Missouri of all of its landfills. In addition, significant MSW wastes will be accepted via rail delivery on a no-charge basis. The recovered metals will be used to manufacture self-biofueled locomotives.

WaterSmart Environmental is marketing its Kyoto Protocol compliant wastes-to-energy technology on an economic development platform to concentrated animal feeding operators and to municipalities. Animal farmers benefit by purchasing biodiesel, electricity, and natural gas (methane) at a 20% discount from retail. Municipalities also benefit by making biodiesel, electricity, natural gas, and potable water available to its citizens and businesses at a 20% discount from existing prices. The technology is marketed on a build-own-operate basis thereby eliminating the necessity for local sales and property tax increases since project financing is entirely secured from the financial marketplace. Municipalities that embrace the waste-to-energy technology automatically become zero waste-to-landfill communities.

The waste-to-renewable energy technology has been slowly developed over the last 10 years. It is just now being introduced to the international marketplace. The technology has the clear potential for making every single city throughout the world energy and fuels independent while reducing oil and natural gas imports. The technology will also permit every single city throughout the world to improve water and wastewater treatment infrastructure while creating jobs and investment opportunities. The waste-to-energy technology can also be applied to Sugar Cane Mills as well as Pulp & Paper Mills with equal success. Both types of mills become energy, food, fuels, and water independent while significantly increasing profits from routine operations. In the case of Sugar Cane Mills temporary and seasonal jobs turn into full time better paying jobs. **Widespread use of the technology carries with it the potential for contributing substantially to the reversing of global warming.**

***WaterSmart Environmental, Inc.*** is a provider of waste-to-energy, food independence, water independence, and energy independence technologies and a manufacturer of highly engineered water purification components and systems. The company designs and builds a wide variety of water treatment equipment including packaged water and wastewater treatment plants, UltraPaq™ aerobic package plants, OAT™ Process anaerobic digesters with associated energy production, aerators, filters, Pur-iSep™ and SmartWater™ oil/water and solids/liquids separators, RainDrain™ perimeter trench sand filters for stormwater runoff, dissolved air flotation separators, air strippers, complete skid assembled aqueous waste treatment plants, FilterFresh™ skid mounted potable water production plants, skid mounted wastewater treatment systems for laundromats, commercial laundries, and car/truck wash facilities with water reclamation and reuse, softeners, demineralizers, activated carbon treatment equipment, and water purifiers for domestic and international markets.

PROPRIETARY AND CONFIDENTIAL

# FEASIBILTY STUDY

## City of Lebanon, Missouri

**BioWastes-To-Renewable Energy, Food, Biofuels, and Water Independence**


**1956 Photo of Laclede County Courthouse**

***WaterSmart Environmental, Inc.***

**www.watersmart.com**

**_WaterSmart Environmental, Inc._**
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Shawnee Mission, Kansas 66225-6346
Phone: 913.897.2727 ♦ Fax: 913.897.1902
*wefindsolutions@watersmart.com* ♦ *www.watersmart.com*
**_Promoting World Peace Through Economic Prosperity_**

December 17, 2007

Dear Investor:

This project will be the first to end the existence of landfills in the United States. By landfills is meant all landfills including demolition, hazardous wastes, medical wastes, inactive, and decommissioned ones as well. This can be accomplished by:

1. Accepting all MSW at a US$0.00 tipping fee by both truck and rail.

2. Sending out trash collection trucks to existing and decommissioned Missouri based landfills for the purpose of collecting all such wastes on a no-charge to the owner basis. After each site is totally excavated the company will thereafter remediate the site as a public service. The remediation service will include State of Missouri certification of compliance. The fully remediated site can then be used for subsequent economic development. The proposed remediation technology is attached for reference.

By collecting all of these wastes the facility will be able to produce significant amounts of renewable energy by using the methane gas generated by anaerobic digestion. In addition to organic matter the wastes contain significant quantities of ferrous and nonferrous metals (mostly iron and aluminum). These metals will then be used in the manufacture of self-biofueled locomotives. These locomotives will be produced at the project site to generate additional revenue.

The proposed project includes the construction of a single project building which measures 1 km x 1 km x 3 stories high. The building will engage in agricultural production and processing activities to produce food products for the export markets to create visible cash flow that will repay debt financing requirements. The building will employ 1,500 workers. The project building will include a hospital and educational facilities per the attached engineering drawing. Your investment interest is hereby solicited. With Warm Regards I am

Very truly yours,

**_WaterSmart Environmental, Inc._**

C. G. (Chuck) Steiner
President and CEO

enclosures
CGS/mns

**_Worldwide Promoters of Renewable Energy, Organic Foods, Biofuels,_**
**_& Water Independence Technologies by and for the Common Man_**

Missouri Department of
Natural Resources
Division of Environmental Quality

# Inactive Facilities

Last updated July 30, 2007

LF=Landfill | SLF=Sanitary Landfill | DLF=Demolition Landfill

| Facility | Permit # | County | Owner Name | Owner Company | Owner Address | |
|---|---|---|---|---|---|---|
| Arcadia Valley SLF | 0109301 | Iron | - | Arcadia Valley San. Board | 23 N Main St. | Ironton MO 63650 |
| Bacon Sanitary Service SLF | 0116903 | Pulaski | - | - | Rt 1, Box 670 | Dixon MO 65459 |
| Blue Summit LF, Inc. DLF | 0209501 | Jackson | Warren Hamilton | - | P.O. Box 6280 | Kansas City MO 64126 |
| Bob's Home Serv Inc Spec Ind Disp Fac | 0721901 | Warren | Laverne Zykan | - | - | - |
| Bob's Home Service Inc. SLF | 0121901 | Warren | Laverne Zykan | - | #8 West 10th, Apt. E | Washington MO 63090 |
| Bridgeton Sanitary Landfill | 0118912 | St. Louis | - | Allied Waste Industries | 13570 St. Charles Rock Rd. | Bridgeton, MO 63044 |
| Brookfield Regional SLF | 0111501 | Linn | - | - | - | - |
| Bueneman DLF | 0221902 | Warren | James Zykan Jr. | - | 25 Hiland Park Village 100-61 | Dallas TX 75205 |
| C and S SLF | 0107111 | Franklin | Matt Kingsley, P.E. | - | 12976 St. Charles Rock Road | Bridgeton MO 63044 |
| CandP, Inc. SLF | 0118501 | St. Clair | - | - | - | - |
| Carnahan SLF | 0116104A | Phelps | - | Phelps County Landfill Board | c/o City Hall, 901 Elm St. | Rolla MO 65401 |
| Centropolis SLF | 0109508 | Jackson | Warren Hamilton | - | 2500 Manchester | Kansas City MO 64126 |
| Chain of Rocks Comm Dev DLF | 0218909 | St. Louis City | - | - | - | - |

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|---|---|---|---|---|---|---|
| Chillicothe SLF | 0111702 | Livingston | - | City of Chillicothe | 715 Washington | Chillicothe MO 64601 |
| Chillicothe SLF | 0111705 | Livingston | - | City of Chillicothe | 715 Washington | Chillicothe MO 64601 |
| Chillicothe SLF | 0111703 | Livingston | - | City of Chillicothe | 715 Washington | Chillicothe MO 64601 |
| Circle "C" SLF | 0120704 | Stoddard | - | Louie Campbell and Terry Diebold | Rt. 4 | Dexter MO 63841 |
| Circle "C" SLF | 0120705 | Stoddard | - | Louie Campbell and Terry Diebold | Rt. 4 | Dexter MO 63841 |
| City of Hermann DLF | 0207301 | Gasconade | - | - | - | - |
| City of Hermann SLF | 0107301 | Gasconade | Charles Browne | City of Hermann | 207 Schiller Street | Hermann MO 65041 |
| City of Lebanon SLF | 0110501 | Laclede | B. Rhoades | City of Lebanon | City Hall | Lebanon MO 65536 |
| City of St. Louis DLF | 0218911 | St. Louis | James Suelmann | St. Louis Street Department | 1900 Hampton Ave | St. Louis MO 63139 |
| City of Sullivan SLF | 0107103 | Franklin | - | City of Sullivan | 210 West Washington | Sullivan MO 63080 |
| City of Sullivan Solid Waste SLF | 0107108 | Franklin | - | City of Sullivan | 210 W. Washington | Sullivan MO 63090 |
| Clinton SLF | 0108301 | Henry | - | - | - | - |
| Cloud 9 Ranch SLF | 0115301 | Ozark | Gordon Edmunds | Cloud 9 Ranch Club, Inc. | P.O. Box 50 | Caulfield MO 65626 |
| Clyde Foote-St. Clair County SLF | 0118502 | St. Clair | - | - | - | - |
| Colbeck SLF | 0110502 | Laclede | - | - | - | - |
| Cruts SLF (Pit #1) | 0116103 | Phelps | - | Phelps County | - | - |
| Cruts SLF (Pit 2and3) | 0116104 | Phelps | - | Phelps County | - | - |

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|---|---|---|---|---|---|---|
| Diamond Dispose-All SLF | 0108901 | Howard | - | O. Flaspohler Est. C/O B. Peterson | 21 E. Craig | Columbia MO 65201 |
| Diamond Sanitation SLF | 0118101 | Ripley | Gary Mathis | - | HC7 Box 19 | Doniphan MO 63935 |
| Doniphan Municipal SLF | 0118102 | Ripley | Larry Ponder | City of Doniphan | 124 Jefferson | Doniphan MO 63935 |
| Double "D" Sanitation SLF | 0103301 | Carroll | Larry Fultz | - | - | - |
| Double "D" Sanitation SLF | 0103302 | Carroll | Larry Fultz | - | - | - |
| Dow Riverside Plant On-Site SLF | 0109905 | Jefferson | - | Dow Chemical Co., Riverside Plant | P.O. Box 387 | Pevely MO 63070 |
| Dunklin County SLF | 0106901 | Dunklin | - | - | - | - |
| Edward Mehl SLF | 0102903 | Camden | Edward Mehl | Niangua Excavating | General Delivery | Camdenton MO 65020 |
| El Dorado Springs SLF | 0103901 | Cedar | - | - | - | - |
| El Dorado Springs SLF | 0103902 | Cedar | - | City of El Dorado Springs | City Hall | El Dorado Springs MO 64744 |
| Ellis Scott SLF | 0108306 | Henry | Gerald Ray | Allied Waste Industries | 230 South 421 | Warrensburg, MO 64093 |
| Environmental Sanitary Mgmt. SLF (Hickory Hill) | 0105101 | Cole | - | - | - | - |
| Environmental Sanitation Mgmt. SLF (Hickory Hill) | 0105102 | Cole | - | - | - | - |
| Environmental Sanitation Mgt. SLF | 0116902 | Pulaski | JJ Lewis | - | General Delivery | Waynesville MO 65583 |
| Environmental Sanitation Mgt. SLF | 0116904 | Pulaski | - | - | - | - |
| ESM, Phase II | 0116904A | Pulaski | - | - | - | - |
| Everett Quarries SLF | 0104901 | Clinton | - | - | - | - |

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|---|---|---|---|---|---|---|
| Farmer's Stone Products Co. SLF | 0111704 | Livingston | Bruce Morrison | USA Waste Services Inc. | 720 N. Washington St. | Chillicothe MO 64601 |
| Festus SLF | 0109904 | Jefferson | Kerry Patek | City of Festus | 711 W. Main | Festus MO 63028 |
| Festus SLF | 0109901 | Jefferson | - | - | - | - |
| Flynn SLF | 0100705 | Audrain | Merle E. McCurdy | - | Rt 2 Box 63 | Wellsville MO 63384 |
| Fort Leonard Wood SLF | 0116905 | Pulaski | - | - | - | - |
| Ft Leonard Wood DLF | 0216901 | Pulaski | James T. Pratt | US Government | ATZT-DPW-EE | Fort Leonard Wood MO 65473 |
| Fulton SLF | 0102701 | Callaway | - | - | - | - |
| Generally Hauling SLF (IDS) | 0107104 | Franklin | John R. Generally | - | P.O. Box 493 | Union MO 63084 |
| Generally Hauling SLF (IDS) | 0107101 | Franklin | - | - | - | - |
| Glasgow Village Park Areas DLF | 0218907 | St. Louis | - | - | - | - |
| Glendale Gardens SLF | 0109505 | Jackson | - | City of Independence | - | Independence MO |
| Gray SLF | 0116102 | Phelps | - | Phelps County | - | - |
| Henderson SLF | 0107903 | Grundy | Margaret Henderson | Henderson SLF | RR 1, Box 20 | Galt MO 64641 |
| Hinnen DLF | 0211701 | Livingston | Lawrence Hinnen | Hinnen DLF | P.O. Box 17 | Chula MO 64635 |
| Hunter SLF | 0107106 | Franklin | - | M. Kingsley (Bridgeton authority) | - | St. Louis MO |
| J-Z Disposal Inc. DLF | 0221903 | Warren | James Zykan Jr. | J.Z. Disposal Inc. | 25 Hiland Park Village 100-61 | Dallas TX 75205 |
| J-Z Disposal Inc. SLF | 0121903 | Warren | James Zykan Jr. | - | 25 Hiland Park Village 100-61 | Dallas TX 75205 |
| Jackson County SLF | 0109516 | Jackson | - | Jackson Co. Public Works | 103 N. Main | Independence MO 64050 |

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|---|---|---|---|---|---|---|
| James River Power Plant Industrial LF | 0707703 | Greene | - | - | - | - |
| Jefferson City SLF | 0105105 | Cole | Brad Zimmerman | Allied Waste Industries | 722 Dix Road | Jefferson City, MO 65109 |
| Kahle Refuse LF, Inc. (#1) | 0107303 | Gasconade | - | - | - | - |
| Kahle SLF (#7) | 0107312 | Gasconade | Bill Upman | - | 2031 M/ Cpirtmeu Rd | Sugar Creek MO 64054 |
| Kansas City Recycling Special Waste | 0709506 | Jackson | Richard I. Galamba | Kansas City Recycling, Inc. | P.O. Box 31065 | Kansas City MO 64129 |
| Lake City Army Amm. Ind. Wste Sludge LF | 0709503 | Jackson | William Melta | Dept. of the Army | L.C.A.A.P. | Independence MO 64051 |
| Lake City Army Amm. Ind. Wste Sludge LF | 0709502 | Jackson | William Melta | Dept. of the Army | L.C.A.A.P. | Independence MO 64051 |
| Lake City Army Ammun Plant SLF | 0109509 | Jackson | William Melta | Dept. of the Army | L.C.A.A.P. | Independence MO 64051 |
| Land Recovery Systems, Inc. Balefill | 0722101 | Washington | - | - | - | - |
| M and M Sanitation SLF | 0112501 | Maries | - | - | - | - |
| M and M Sanitation Co., Inc. SLF | 0116907 | Pulaski | Kevin Mehl | M and M Sanitation Co. | P.O. Drawer F | Dixon MO 65459 |
| Marr Brothers Quarry SLF | 0110102 | Johnson | - | Hilty Quarries | - | - |
| Maryville SLF | 0114702 | Nodaway | David Angerer | City of Maryville | P.O. Box 438 | Maryville MO 64468 |
| McDowell SLF | 0116105 | Phelps | - | Phelps County | P. O. Box 501 | Rolla MO 65401 |
| Mexico SLF | 0100702 | Audrain | Tanna Parish | - | 300 N. Coal St. | Mexico MO 65265 |
| Mexico SLF | 0100701 | Audrain | Tanna Parish | - | 300 N. Coal St. | Mexico MO 65265 |

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|---|---|---|---|---|---|---|
| Midwest SLF | 0107114 | Franklin | Greg Ribaudo | Midwest Landfill Inc - Allied Waste | 12976 St. Charles Rock Road | Bridgeton MO 63044 |
| Mo Mining Papermill Sludge Disp LF | 0717101 | Putnam | - | - | - | - |
| Moberly SLF | 0117501 | Randolph | - | - | - | - |
| Moreland SLF | 0116101 | Phelps | - | Phelps Co. Landfill Board | 204 E. 8th St. | Rolla MO 65401 |
| Morgan County SLF | 0114102 | Morgan | - | Morgan County Courthouse | - | Versailles MO 65084 |
| National Museum Of Trans DLF | 0218908 | St. Louis | - | - | - | - |
| Northwest LF | 0102904 | Camden | James Bowes | - | 1955 S. Stracks Church | Wright City MO 63390 |
| Ozark Gem of Missouri SLF | 0114101 | Morgan | - | - | - | - |
| Permaneer Corp. DLF | 0207101 | Franklin | - | - | - | - |
| Pollard, Forrest SLF | 0109506 | Jackson | Earl Newell | - | 103 N. Main | Independence MO 64050 |
| Poplar Bluff SLF (aka: Tom Reed SLF) | 0102301 | Butler | Tom Reed | - | Rt 7 Box 181 | Poplar Bluff MO 63901 |
| RandE SLF | 0118302 | St. Charles | - | C. Purler, N. Eikel, and R. Krum | 828 O'Fallon Rd | St. Charles MO 63304 |
| Renfro's Refuse Service DLF | 0220901 | Stone | Cleo Renfro | Renfro's Refuse Service Inc. | Route 3, Box 28 | Kimberling City MO 65686 |
| Renfro's SLF | 0120902 | Stone | Cleo Renfro | Renfro's Refuse Service Inc. | HRC 3, Box 28 | Kimberling City MO 65686 |
| Renfro's SLF | 0120903 | Stone | Cleo Renfro | Renfro's Refuse Service Inc. | Route 3, Box 28 | Kimberling City MO 65682 |
| Renfro's SLF | 0120901 | Stone | - | - | - | - |

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|---|---|---|---|---|---|---|
| Resource Recycling Ltd. SW Balefill | 0722102 | Washington | - | Middleton Enterprises | 1025 Dunn Road | Florissant MO 63031 |
| Rolla Incinerator | 0316101 | Phelps | - | City of Rolla | 9th and Elm Streets | Rolla MO 65401 |
| Rumble SLF No. 2 Phase IV Expansion | 0109519 | Jackson | Kevin O'Brien | Waste Management of MO, Inc. | 2031 N. Courtney Road | Sugar Creek MO 64054 |
| Rush Island Solid Waste Disp Area DLF | 0209901 | Jefferson | - | - | - | - |
| Rye Creek SLF | 0100103 | Adair | Charles Tharp | Rye Creek Corporation | P.O. Box 710 | Kirksville MO 63501 |
| Scott County SLF | 0120101 | Scott | Louis Hirschowitz | Scott County Court | P.O. Box 188 | Benton MO 63736 |
| Shaw, George J. Co., Inc. DLF | 0209503 | Jackson | - | - | - | - |
| Shoal Creek SLF | 0104702 | Clay | - | - | - | - |
| Southeast SLF | 0109515 | Jackson | Joseph Benco | Allied Waste Systems, Inc. | 8301 Indiana Ave | Kansas City MO 64132 |
| Southeast SLF | 0109515 | Jackson | - | - | - | - |
| Southwest Power Station Industry LF | 0707701 | Greene | - | - | - | - |
| St. Joseph City SLF (Pigeon Hill) | 0102101 | Buchanan | - | - | 11th and Frederick | St. Joseph MO 64501 |
| St. Louis City DLF | 0218911 | St. Louis | - | - | - | - |
| St. Louis County Water Co. LF | 0718902 | St. Louis | - | - | - | - |
| St. Louis Univ. Hosp. Fuel Process. Facility | 0351001 | St. Louis | Lee Stoll | St. Louis University Hospital | P.O. Box 15250 | St. Louis MO 63110 |
| Tebbenkamp, Roy and Sons SLF | 0110702 | Lafayette | Roy Tebbenkamp | - | P.O. Box 310 | Concordia MO 64020 |
| Thomas Hill Power Plant SLF | 0117503 | Randolph | Charles Means | Assoc Electric | P.O. Box 754 | Springfield MO 65801 |
| Trager Quarries SLF | 0107902 | Grundy | - | - | - | - |

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|---|---|---|---|---|---|---|
| Trenton SLF | 0107901 | Grundy | - | - | - | - |
| Tri-County SLF | 0109303 | Iron | - | - | - | - |
| Union Elec Nuclear Pwr Plant DLF | 0202701 | Callaway | - | - | - | - |
| Valley Disposal SLF | 0109902 | Jefferson | Mark Simpson | Simpson Sand and Gravel Co. | P.O. Box 68 | Valley Park MO 63088 |
| Valley Sanitation Dade County DLF | 0205701 | Dade | - | Sunray of Joplin | 815 High | Carthage MO 65836 |
| Valley Sanitation Service, Inc. SLF | 0101101 | Barton | W.W. Coleman | - | 9417 Delmar | Prairie Village KS 66207 |
| Veolia Environmental Services - City of Mexico TS | 0400701 | Audrain | - | Veolia Environmental Services | 300 N. Coal St. | Mexica, MO 65265 |
| Verlin Jones SLF | 0121301 | Taney | Gary Verhaege | - | 9240 W. 167th St | Stillwell KS 66085 |
| WandW Trans, Inc. SLF | 0100901 | Barry | Carrol Williamson | - | P.O. Box 2 | Shell Knob MO 65447 |
| Warren SLF | 0117901 | Reynolds | William Warren | c/o Joannie Watson | 623 W. Elm St. | Walnut Ridge AR 72476 |
| Warren SLF | 0117902 | Reynolds | William Warren | c/o Joannie Watson | 623 W. Elm St. | Walnut Ridge AR 72476 |
| Wat-Park SLF | 0112502 | Maries | Small Watson | Wat - Park Sanitary Landfill | P.O. Box 830 | Dixon MO 65459 |
| Wayne County SLF | 0122301 | Wayne | Marvin Bowles | Wayne County Commission | Courthouse | Greenville MO 63944 |
| Webster County SLF | 0122501 | Webster | - | - | - | - |
| Webster County SLF | 0122502 | Webster | Don Rost | Webster County Commission | Webster County Courthouse | Marshfield MO 65706 |
| West County Disp. Ltd. | 0218911 | St. Louis | - | - | - | - |
| West Lake DLF | 0218912 | St. Louis | Larry Giroux | Laidlaw Waste Systems | 13570 St. Charles Rock Rd. | Bridgeton MO 63044 |

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|---|---|---|---|---|---|---|
| West Lake SLF | 0118903 | St. Louis | - | Laidlaw Waste Systems, Inc | 13570 St. Charles Rock Rd | Bridgeton MO 63044 |
| West Lake SLF | 0118908 | St. Louis | Greg Ribaudo | LaidLaw Waste Systems Inc | 13570 St. Charles Rock Road | Bridgeton MO 63044 |
| Wheeling Dis Serv Co Ind Wst Site | 0700301 | Andrew | Clayton Buntrock | - | 1805 S. 8th St. | St. Joseph MO 64503 |
| Wheeling Dis. Serv. Co Inc. SLF | 0100301 | Andrew | - | - | - | - |
| William Walker SLF | 0101701 | Bollinger | William Walker | - | P.O. Box 58 | McGee MO 63763 |
| Wilson SLF | 0118301 | St. Charles | - | MO Dept. of Conservation | 2630 Hwy. D | St. Charles MO 63304 |
| Wilson SLF | 0120502 | Shelby | Dave Wilson | - | 204 S. Broadway | Clarence MO 63437 |
| Wright County SLF | 0122902 | Wright | Bob Tooley | - | PO Box 5 | Hartville MO 65667 |
| Zeigenbien Joe SLF | 0116908 | Pulaski | Joe Ziegenbein | - | 114 Zeigenbein Circle, Lot 16 | Waynesville MO 65583 |
| Ziegenbein Joe SLF | 0116901 | Pulaski | Joe Ziegenbein | - | 114 Zeigenbein Circle, Lot 16 | Waynesville MO 65583 |

**Other Pages Related to Landfills/Facilities**

Sanitary Landfill
Demolition Landfills
Infectious Waste
Transfer Stations
Material Recovery
Special Waste Landfills
Closed Facilities
Incinerators
Composting
Utility Waste

**Other Related Topics of Interest**

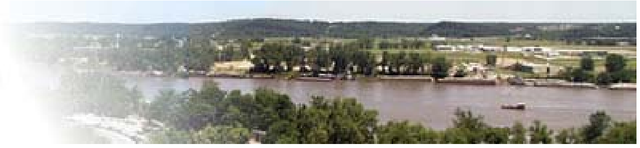
Special Projects Pending
Special Projects Completed
Status of Permit Applications
Permit Unit Pending Projects
Financial Assurance Instruments Status
Tonnage Report for the Solid Waste Facilities
Permit Unit Completed Projects
Available Publications

Land | Air | Water | GIS | Energy | State Parks | Grants and Loans | Security and Privacy | State Home Page | Site Directory | Environmental Issues | Kids and Education | Waste and Recycling | Historic Preservation | Job Opportunities | DNR Store | Search

Department of Natural Resources
P.O. Box 176, Jefferson City, MO 65102
1-800-361-4827 / (573) 751-5401
E-mail: swmp@dnr.mo.gov
Revised on Tuesday September 25 2007

Missouri Department of Natural Resources

Division of Environmental Quality



# Closed Facilities

Last Updated July 30, 2007

LF=Landfill | SLF=Sanitary Landfill | DLF=Demolition Landfill

| Facility Name | Permit # | County | Owner Name | Owner Address | | | |
|---|---|---|---|---|---|---|---|
| A and M SLF | 0103704 | Cass | Agnes Ryberg | - | - | Route 1, Box 33 | Garden City, MO 64747 |
| Ace Pipe Cleaning Liq. Wst Dis. Fac. | 0717701 | Ray | - | - | - | 4000 Truman Rd | Kansas City, MO 64127 |
| Andrew County SLF | 0100302 | Andrew | - | Andrew County Court | City of Savannah | Savannah MO 64485 | |
| Atchison County SLF | 0100501 | Atchison | Marlin Logan | Presiding Commissioner | Atchison County Court | P.O. Box J | Rockport, MO 64482 |
| Autoshred, Inc. (Johnson County SLF) | 0110104 | Johnson | - | - | Allied Waste Industries, Inc. | 5820 N. Broadway | St. Louis, MO 63147 |
| Ava Missouri DLF | 0206701 | Douglas | James Norman | Mayor | City of Ava | P.O. Box 946 | Ava, MO 65608 |
| Ava Missouri SLF | 0106701 | Douglas | James Norman | Mayor | City of Ava | P.O. Box 946 | Ava, MO 65608 |
| Bernie SLF | 0120703 | Stoddard | - | - | City of Bernie | City Hall | Bernie, MO 63822 |
| BFI - Missouri City SLF | 0104703 | Clay | - | - | Lincoln Brothers | - | - |
| BFI Clay County LF | 0704707 | Clay | - | - | - | - | - |
| BFI LF, Inc. | 0704705A | Clay | - | - | - | - | - |
| BFI Missouri City LF, Inc. | 0104701 | Clay | - | - | - | - | - |
| BFI Missouri City Spec Waste LF | 0704704 | Clay | - | - | - | - | - |

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|---|---|---|---|---|---|---|---|
| BFI of K.C. Liquid Reception Ctr | 0704702 | Clay | - | - | - | - | - |
| BFI of K.C. Sludge Trench Disp Area | 0704703 | Clay | - | - | - | - | - |
| Bollinger County SLF | 0101702 | Bollinger | - | - | Bollinger County Court | County Courthouse, Box 483 | Marble Hill, MO 63764 |
| Boone Co. - City of Columbia SLF | 0101907 | Boone | | | City of Columbia | | |
| Boone Co. - City of Columbia SLF | 0101902 | Boone | | | City of Columbia | | |
| Boone Co.-City of Columbia SLF | 0101903 | Boone | | | City of Columbia | | |
| Boone Co.-City of Columbia SLF | 0101905 | Boone | | | City of Columbia | | |
| Boone Co.-City of Columbia SLF | 0101904 | Boone | | | City of Columbia | | |
| Boonville SLF | 0105301 | Cooper | - | - | City of Boonville | 6th and Spring | Boonville, MO 65233 |
| Boonville SLF | 0105302 | Cooper | Bernard Kempf | Mayor | City of Boonville | 525 E Spring St | Booneville, MO 65233 |
| Brown SLF | 0112103 | Macon | David Brown | - | - | 1201 Engelwood | Macon, MO 63552 |
| Brown SLF | 0112104 | Macon | David Brown | - | - | 1201 Engelwood | Macon, MO 63552 |
| Burger Park SLF | 0107102 | Franklin | - | - | City of Washington | - | - |
| Burger Park SLF | 0107109 | Franklin | - | - | City of Washington | - | - |
| Callaway Plant (Units 1 and 2) | 0102704 | Callaway | - | - | Union Electric | - | - |
| Cameron SLF | 0106301 | DeKalb | Phil Lammers | City Manager | City of Cameron | 205 N. Main | Cameron, MO 64429 |
| Cass County Reclamation Corp. DLF | 0203701 | Cass | - | - | - | - | - |

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|---|---|---|---|---|---|---|---|
| Cass County Reclamation Corp. SLF | 0103701 | Cass | D.E. Pmberton Peggy Ragan | - | - | 104A East Main | Greenwood, MO 64034 |
| Centralia SLF | 0101901 | Boone | Mildred Knowles | Mayor | City of Centralia | ll4 S. Rollins | Centralia, MO 65240 |
| Centralia SLF | 0101906 | Boone | Lynn Behrns | City Administrator | City of Centralia | 114 S. Rollins | Centralia, MO 65240 |
| Chain of Rocks Amusement DLF | 0218910 | St. Louis | - | - | - | - | - |
| City of Sedalia SLF | 0115901 | Pettis | Irl Tessendorf | City Manager | City of Sedalia | P. O. Box 1707 | Sedalia, MO 65302 |
| City of California SLF | 0113502 | Moniteau | Jack Albertson | Mayor | City of California | City Hall | California, MO 65018 |
| City of California SLF | 0113501 | Moniteau | - | - | City of California | - | - |
| City of Cape Girardeau SLF | 0103101 | Cape Girardeau | J. Ronald Fisher | City Manager | City of Cape Girardeau | P.O. Box 6l7 | Cape Girardeau, MO 63702 |
| City of Carthage DLF | 0209702 | Jasper | Harold K. Neely | Solid Waste Director | City of Carthage | 326 Grand | Carthage, MO 64836 |
| City of Hermann SLF | 0107304 | Gasconade | Charles Browne | City Administrator | City of Hermann | 207 Schiller Street | Hermann, MO 65041 |
| City of Hermann SLF | 0107306 | Gasconade | Charles Browne | City Administrator | City of Hermann | 207 Schiller Street | Hermann, MO 65041 |
| City of Marshall SLF | 0119502 | Saline | Charles Tryban | City Manager | City of Marshall | 214 N. Lafayette | Marshall, MO 65340 |
| City of Marshall SLF | 0119501 | Saline | Mitchel Geisler | Mayor | City of Marshall | 214 N. Lafayette | Marshall, MO 65340 |
| City of West Plains SLF | 0109102 | Howell | Harry B. Kelly | Mayor | City of West Plains | 1910 Holiday Lane | West Plains, MO 65775 |
| Crawford County SLF | 0105501 | Crawford | Andy Sanazaro | - | Crawford County Commission | P.O. Box AS | Steelville, MO 65565 |
| Dallas County SLF | 0105902 | Dallas | Mike Bollinger | President | Dallas County Courthouse | Drawer 410 | Buffalo, MO 65622 |
| Dallas County SLF | 0105901 | Dallas | Mike Bollenger | President | Dallas County Courthouse | Drawer 410 | Buffalo, MO 65622 |

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|---|---|---|---|---|---|---|---|
| Edward Mehl SLF | 0102905 | Camden | Edward Mehl | - | - | Route 70, Box 685 | Camdenton, MO 65020 |
| Farmers Stone Product SLF | 0111701 | Livingston | - | - | - | - | - |
| Ferrous Sulfate Disposal LF | 0709701 | Jasper | - | - | - | - | - |
| Festus Air Curtain Destructor | 0309901 | Jefferson | - | - | - | - | - |
| Fort Leonard Wood SLF | 0116909 | Pulaski | Wm. David Brown | - | U.S. Army Directorate of Eng and Hsg | AZT-DEH-EE, Bldg. 2202 | Ft. Leonard Wood, MO 65473 |
| Fredericktown SLF | 0112303 | Madison | Don Maddux | City Administrator | City of Fredricktown | City Hall | Fredricktown, MO 63645 |
| Frost Road Exec. Est. SLF | 0109504 | Jackson | John Belger II | - | - | 11409 Military Club Rd | Kansas City, MO 64127 |
| Ft Leonard Wood Heat Rec. Incinerator | 0316901 | Pulaski | Thomas Reth | Facilities Eng. | - | Bldg. 220 | Ft. Leonard Wood, MO 65473 |
| Galloway Enterp., Inc. SLF | 0108102 | Harrison | Robert Galloway | | | Rt. 2 | Bethany MO 64424 |
| Gasconade-Morrison SLF | 0107302 | Gasconade | - | - | City of Morrison | - | Morrison, MO 65021 |
| Gentry County SLF | 0107501 | Gentry | Edward Manring | - | Attorney at law | 108-110 South Smith St. | Albany, MO 64402 |
| Gibler Robert SLF | 0110701 | Lafayette | Mabell Gibler | Trustee | - | 1901 Willow | Higginsville, MO 64037 |
| Hannibal SLF | 0117303 | Ralls | John Langerak | Pub Works Dir | City of Hannibal | 320 Broadway | Hannibal, MO 63401 |
| Hannibal SLF | 0117301 | Ralls | John Langerak | Pub Works Dir | - | - | - |
| Henry County Water Co Sludge Disp Pit (Private) | 0708304 | Henry | Richard Webber | Division Manager | City of Clinton | 313 S. Washington St. | Clinton, MO 64735 |
| Henry County SLF | 0108305 | Henry | Archie Childers | Childers Const. Co. | - | 2nd and Calvird | Clinton, MO 64735 |
| Industrial Salvage and Wrecking Co Dlf | 0209506 | Jackson | Dennis Roberts, Sr. | - | - | 2408 Blue Ridge Blvd | Kansas City, MO 64129 |

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|---|---|---|---|---|---|---|---|
| Jackson SLF | 0103102 | Cape Girardeau | Carl L. Talley | City Administrator | City of Jackson | 225 S. High Street | Jackson, MO 63755 |
| Joplin - Route P DLF | 0209701 | Jasper | - | - | City of Joplin | City Hall | Joplin, MO 64802 |
| Joplin - Route P SLF | 0109701 | Jasper | Bruce Rhodes | Mayor | City of Joplin | City Hall | Joplin, MO 64807 |
| Kahle Refuse LF Inc. (#4) | 0107309 | Gasconade | Marvin Kahle | - | - | 211 West Washington St. | Owensville, MO 65066 |
| Kahle Refuse LF Inc. (#6) | 0107311 | Gasconade | Harold Buddemeyer | - | - | RR 2 | Bland, MO 65014 |
| Kahle Refuse LF, Inc. ( | 0107307 | Gasconade | Marvin Kahle | - | - | RFD 1 | Owensville, MO 65066 |
| Kahle Refuse LF, Inc. (#3) | 0107308 | Gasconade | Marvin Kahle | - | - | RFD 2 | Owensville, MO 65066 |
| Kahle Refuse LF, Inc. (#5) | 0107310 | Gasconade | Marvin Kahle | - | - | 211 West Washington | Owensville, MO 65066 |
| Kahle Refuse LF, Inc. (Schlottach) | 0107305 | Gasconade | - | - | - | - | - |
| Kirksville SLF | 0100101 | Adair | - | - | - | - | - |
| Kirksville SLF | 0100102 | Adair | Tom Duden | Mayor | City of Kirksville | 201 S. Franklin | Kirksville, MO 63501 |
| Knob Noster DLF | 0210101 | Johnson | Jerry Gemes | - | - | 105 N. State St. | Knob Noster, MO 65336 |
| Knob Noster SLF | 0110103 | Johnson | Charles Barlow | - | - | 506 W. McPherson | Knob Nobster, MO 65336 |
| Lamar SLF | 0101102 | Barton | Lynn Calton | | City of Lamar | 1104 Broadway | Lamar MO 64759 |
| Lamar SLF | 0101103 | Barton | John Umpleby, Jr.,P.E. | | BFI | 3521 Centreville Ave | Belleville IL 62223 |
| Lemons SLF | 0120707 | Stoddard | Joe Duncan | - | Allied Waste Industries, Inc. | 7201 E. Camelback Road #375 | Scottsdale, AZ 85251 |
| Lincoln Brothers Chemical LF | 0704701 | Clay | - | - | - | - | - |

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|---|---|---|---|---|---|---|---|
| LiqWaCon Process Spec Waste LF | 0704705 | Clay | - | - | - | - | - |
| McDonnell Douglas Electronics Co. | 0318301 | St. Charles | Joe Jansen | - | McDonnell Douglas Electronics Co. | 2600 N. 3rd St. | St. Charles, MO 63302 |
| McDonnell Douglas Solid Waste Incin | 0318901 | St. Louis | Joe Haake | - | McDonnell Douglas Aerospace Boilers | PO Box 516 Mailcode 111-1099 | St. Louis, MO 63166 |
| McDowell SLF | 0110703 | Lafayette | Jerry L. McDowell | Owner | McDowell Trash Service | 422 South Hunter | Independence, MO 64050 |
| Mexico SLF | 0100703 | Audrain | Tanna Parish | - | City of Mexico | 300 N. Coal St. | Mexico, MO 65265 |
| Midwest Method Land Mgt. SLF | 0103304 | Carroll | John Jegen | | Midwest Method Land Management | P.O. Box 160 | Excelsior Springs MO 64024 |
| Mississippi County SLF | 0120102 | Scott | Fred DeField | Presiding Commissioner | Mississippi County Commission | Mississippi County Courthouse | Charleston, MO 63839 |
| Missouri Pass SLF (St. Louis County) | 0118914 | St. Louis | - | - | BFI of St. Louis Inc. | 2520 Aide Rd | Maryland Heights, MO 63043 |
| Missouri Precision Castings, Inc. LF | 0709703 | Jasper | Patterson McReynolds | - | MPC, Inc. | P.O. Box 1706 | Joplin, MO 64082 |
| Modern Sanitation SLF | 0102901 | Camden | Bob Hendricks | General Manager | Modern Sanitation Inc. | P.O. Box 304 | Osage Beach, MO 65065 |
| Montgomery City SLF | 0113901 | Montgomery | Steven Deves | City Admin. | City of Montgomery | 723 North Sturgeon | Montgomery City, MO 63361 |
| Montrose Station Ash Disp Facility | 0708302 | Henry | - | - | - | - | - |
| Montrose Station Ash Disp Facility | 0708303 | Henry | Cora Sickinger | - | Peabody Coal Co. | P.O. Box 39 | Freeburg, IL 62243 |
| National Refractories and Min SLF | 0100706 | Audrain | P. R. Hilleman | - | Nat'l Refractories and Min. Corp. | P. O. Box 499 | Mexico, MO 65265 |
| Nevada SLF | 0121701 | Vernon | Lynn Ewing | Mayor | City of Nevada | City Hall | Nevada, MO 64772 |
| Nevada SLF | 0121703 | Vernon | Lynn Ewing | Mayor | City of Nevada | City Hall | Nevada, MO 64772 |

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|---|---|---|---|---|---|---|---|
| New Madrid County SLF | 0114301 | New Madrid | Jay Blankenship | Presiding Commissioner | New Madrid Co. | New Madrid Co. Courthouse | New Madrid, MO 63869 |
| Newton-McDonald County SLF | 0114501 | Newton | Lloyd Adams | Chairman | Newton-McDonald County SLF Board | P.O. Box 753 | Neosho, MO 64850 |
| NKC Wastewater Tr. Plnt Sludge | 0704706 | Clay | - | - | City of North Kansas City | City Hall | N. Kansas City, MO 64116 |
| Pemiscot County SLF | 0115502 | Pemiscot | Kirby VanAusdall | Presiding Commissioner | - | Pemiscot County Courthouse | Caruthersville, MO 63830 |
| Perry County SLF | 0115701 | Perry | - | - | Perry County Commission | 321 N. Main St. | Perryville, MO 63775 |
| Phelps County SLF | 0116106 | Phelps | - | - | Phelps County | P.O. Box 504 | Rolla, MO 65401 |
| Plattco SLF (Douglas) | 0116502 | Platte | Gary Saylor | - | BFI KC Riverview/Plattco Slf | 5092 Aber Road | Williamsburg, OH 45176 |
| Plattco SLF (Riverview) | 0116501 | Platte | Gary Saylor | - | BFI KC Riverview/Plattco Slf | 5092 Aber Road | Williamsburg, OH 45176 |
| Rohlfing SLF | 0108903 | Howard | - | - | - | - | - |
| Rohlfing SLF | 0108902 | Howard | Arthur Rohlfing | - | - | 604 N. Church St. | Fayette, MO 65248 |
| Rumble I SLF | 0109518 | Jackson | - | - | Courtney Road Realty, Inc. | c/o Floyd Brown Jr. and Co. | Independence, MO 64057 |
| Salem SLF | 0106501 | Dent | C. Clark Leonard | Mayor | City of Salem | City Hall-202 N. Washington | Salem, MO 65560 |
| Savannah SLF | 0100303 | Andrew | Dave Ingersoll | Mayor | City of Savannah | 408 Court Street | Savannah, MO 64485 |
| Schroder Solid Waste SLF | 0111102 | Lewis | - | - | - | - | - |
| Schroder Solid Waste SLF | 0111103 | Lewis | Glenn Schroder | - | - | R-1, Box 259A | La Grange, MO 63448 |
| St. Francois County DLF | 0218701 | St. Francois | Allan Aubuchon | - | 200 Landfill Road | 200 Landfill Rd | Park Hills, MO 63601 |

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|---|---|---|---|---|---|---|---|
| St. Francois County SLF | 0118701 | St. Francois | Allan Aubuchon | - | - | 200 Landfill Road | Park Hills, MO 63601 |
| St. Joseph Light and Power Fly Ash LF (Private) | 0702101 | Buchanan | Michael Katzman | - | St. Joseph Light and Power Co. | P.O. Box 998 | St. Joseph, MO 64502 |
| St. Jude Industrial Park SLF | 0114302 | New Madrid | Fred Turner | Superintendent | St. Jude Industrial Park | P.O. Box 67 | New Madrid, MO 63869 |
| St. Louis County Water Co. LF | 0718904 | St. Louis | Frank Kartmann | - | St. Louis County Water Company | 535 North New Ballas Rd. | St. Louis, MO 63141 |
| St. Louis County Water Co. LF #1 | 0718903 | St. Louis | Tim Geraghty | - | St. Louis County Water Company | 535 New Ballas Road | St. Louis, MO 63141 |
| Sunray of Joplin, Inc. DLF | 0205702 | Dade | - | - | - | - | - |
| Sunray of Joplin, Inc. SLF | 0105703 | Dade | - | - | Sunray of Joplin, Inc. | 815 High | Carthage, MO 65836 |
| T and C Disposal Inc. SLF | 0110901 | Lawrence | Jackie Thomas | - | - | Route 2 | Golden City, MO 64748 |
| T and C Disposal Inc. SLF | 0110902 | Lawrence | Jackie Thomas | - | - | Route 2 | Golden City, MO 64748 |
| T and C Disposal Inc. SLF | 0110903 | Lawrence | Jackie Thomas | - | - | Route 2 | Golden City, MO 64748 |
| Topping and Winner Rd. DLF | 0209505 | Jackson | - | - | Sheffield Family Life Center | P.O. Box 419038 | Kansas City, MO 64183 |
| Union El. Co. Callaway Plant SLF | 0102702 | Callaway | - | - | Union Electric | - | - |
| Valley Disposal SLF (BFI Redbird) | 0109903 | Jefferson | Mick Steele | - | Simpson Sand and Gravel Co (Property) | P.O. Box 68 | Valley Park, MO 63088 |
| Viburnum City SLF | 0109302 | Iron | Carol Ritter | Clerk | City of Viburnum | P.O. Box 596 | Viburnum, MO 65566 |
| Washington County SLF | 0122101 | Washington | Randy Dicus | - | Washington County Commission | County Courthouse | Potosi, MO 63664 |
| Washington SW Munic.- Stuetterman Qry | 0107110 | Franklin | Jim Briggs | City Administrator | City of Washington | 405 Jefferson Street | Washington, MO 63090 |

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|---|---|---|---|---|---|---|---|
| Wayne County SLF | 0122302 | Wayne | Bob Doyle | Dist. Manager | Allied Waste Industries | 15250 Old Bloomfield Road | Dexter, MO 63841 |
| Welston SLF | 0101301 | Bates | Larry Welston | Owner | - | Route 2, Box 455 | Butler, MO 64730 |
| Willow Springs SLF | 0109101 | Howell | David Wehmer | Mayor | City of Willow Springs | 123 E. Main St. | Willow Springs, MO 65793 |
| Woods Chapel SLF | 0109517 | Jackson | Ronald D. Deffenbaugh | - | Deffenbaugh Inc. | P.O. Box 3220 | Shawnee, KS 66203 |



Department of Natural Resources
P.O. Box 176, Jefferson City, MO 65102
1-800-361-4827 / (573) 751-5401
E-mail: swmp@dnr.mo.gov
Revised on Tuesday September 25 2007

# List of Sanitary Landfills Contacts In Missouri

Last updated July 18, 2007

| PERMIT# | COUNTY | FACILITY | ADDRESS | CITY/ST/ZIP | PHONE |
|---|---|---|---|---|---|
| 0111105 | Lewis | Backridge Sanitary Landfill | 3110 Kochs Lane | Quincy, IL 62306 | (217) 223-4100 |
| 0122905 | Wright | Black Oak Recycling | One Riverway, Suite 1400 | Houston, TX 77056 | (816) 223-2870 |
| 0102302 | Butler | Butler County Sanitary Landfill | 15250 Old Bloomfield Rd. | Dexter, MO 63841 | (573) 785-5927 |
| 0115906 | Pettis | Central Missouri Landfill, Inc. | One Riverway, Suite 1400 | Houston, TX 77056 | (816) 223-2870 |
| 0101908 | Boone | City of Columbia Sanitary Landfill | P.O. Box 6015 | Columbia, MO 65205 | (573) 874-7555 |
| 0109521 | Jackson | Courtney Ridge | 2001 N. 291 Hwy | Sugar Creek, MO 64058 | (816) 257-7999 |
| 0116304 | Pike | Eagle Ridge Landfill | 13100 Hwy. VV | Bowling Green, MO 63334 | (314) 428-1155 |
| 0118915 | St. Louis | Fred Weber Inc. SLFl | 2320 Creve Coeur Mill Rd | Maryland Heights, MO 63043 | (314) 344-0070 |
| 0122103 | Washington | IESI Timber Ridge | 2629 Choteau | St. Louis, MO 63103 | (573) 678-2990 |
| 0102703 | Callaway | Fulton Sanitary Landfill | P.O. Box 130 | Fulton, MO 65251 | (573) 642-3421 |
| 0105105 | Cole | Jefferson City SLF | 722 Dix Rd | Jefferson City, MO 65109 | (573) 635-8805 |
| 0109520 | Jackson | Lee's Summit SLF | 207 S.W. Market | Lee's Summit, MO 64063 | (816) 969-7310 |
| 0120708 | Stoddard | Lemons Landfill | 15250 Old Bloomfield | Dexter, MO 63841 | (573) 624-8135 |
| 0117504 | Randolph | Moberly Municipal SLF | 101 West Reed | Moberly, MO 65270 | (660) 263-4420 |
| 0105502 | Crawford | Prairie Valley Landfill | 3975 Hwy 19 North | Cuba, MO 65453 | (573) 885-7596 |
| 0101104 | Barton | Prairie View Regional Waste Facility | P.O. Box 29 | Lamar, MO 64759 | (417) 682-6379 |
| 0110105 | Johnson | Show Me Regional SLF | 230 SE 421 | Warrensburg, MO 64093 | (660) 747-7697 |

| PERMIT# | COUNTY | FACILITY | ADDRESS | CITY/ST/ZIP | PHONE |
|---|---|---|---|---|---|
| 0107703 | Greene | Springfield Sanitary Landfill | 840 Boonville P.O. Box 8368 | Springfield, MO 65801 | (417) 742-3536 |
| 0102102 | Buchanan | St. Joseph City Sanitary Landfill | 9431 50th Road SE | St. Joseph, MO 64507 | (816) 253-9025 |
| 0107116 | Franklin | City of Washington (Struckhoff) Sanitary Landfill | 405 Jefferson St. | Washington, MO 63090 | (636) 390-1039 |
| 0112107 | Macon | Veolia ES Maple Hill Landfill Inc. | P.O. Box 389 | Macon, MO 63552 | (660) 773-5459 |
| 0118911 | St. Louis | Veolia ES Oak Ridge Landfill Inc | 1741 Sulphur Springs | Ballwin, MO 63021 | (660) 773-5459 |



Department of Natural Resources
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Revised on Wednesday July 18 2007

# List of Demolition, Utility and Special Waste Landfills

Last Update May 31, 2006

| Permit # | County | Facility | Street | City, Zip | Phone |
|---|---|---|---|---|---|
| 0721701 | Vernon | 3M Company's Nevada, MO Plants Sp. Waste LF (Private) | P.O. 33331 | St. Paul, MN 55133 | (651) 778-5393 |
| 0200701 | Audrain | A.P. Green Demolition Landfill (Private) | Green Boulevard | Mexico, MO 65265 | (573) 473-3626 |
| 0709504 | Jackson | Amoco Oily Dirt Land Treatment Fac (Private) | 1000 N. Sterling Ave. | Sugar Creek, MO 64054 | (816) 856-7834 |
| 0707705 | Greene | James River Power Stat. Utility Waste Lf (Private) | 301 E. Central | Springfield, MO 65801 | (417) 831-8854 |
| 0708305 | Henry | KCPandL Co. Montrose Fly Ash Landfill (Private) | 400 SW Hwy P | Clinton, MO 64735 | (660) 885-2284 |
| 0218913 | St. Louis | Peerless Landfill Inc. | P.O. Box 400 | Valley Park, MO 63088 | (636) 225-7000 |
| 0718905 | St. Louis | Prospect Hill Reclam Project (Private) | 10 E. Grand | St. Louis, MO 63147 | (314) 436-8728 |
| 0218904 | St. Louis | Rock Hill Demolition LF | 1233 North Rock Hill Road | St. Louis, MO 63124 | (314) 968-2336 |
| 0200101 | Adair | Rye Creek Demolition Landfill | P.O. Box 710 | Kirksville, MO 63501 | (660) 665-3224 |
| 0709505 | Jackson | Sibley Generator Station (MO Public Service) (Private) | 10700 E. 350 Hwy. | Sibley, MO 64088 | (816) 737-5600 |
| 0707702 | Greene | Southwest Power Station Industry LF (Private) | 301 E. Central P.O. Box 551 | Springfield, MO 65801 | (417) 831-8873 |
| 0717502 | Randolph | Thomas Hill Energy Center (Private) | 5693 Hwy F | Clifton Hill, MO 65244 | (660) 261-4211 |



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# Engineering Data Sheet

7218

## Process: *Express*™ Expedited Remediation Site Strategy *Simultaneous Ground and Groundwater Remediation*

**Current Technology**

Total remediation of a site is currently considered a two-task requirement. The contaminated soil is one task and the contaminated groundwater the other. In some instances the soil is remediated first and the groundwater second. On other projects the groundwater precedes the soil. In every case, however, total site remediation as described above generally takes some 10-25 years to accomplish. In this regard, remediation of the ground **above** the water table is accomplished by soil vapor extraction, thermal desorption, ex-situ soil washing, and a few other methods none of which are particularly effective or cost-effective. The time required to achieve target clean-up levels is measured in years, if not decades.

**Cleaning Beneath the Vadose Zone**

Not discussed above but part of the site clean-up equation is the necessity to clean the ground **below** the water table. This requirement comes into play wherever groundwater levels fluctuate and/or when dense non-aqueous phase liquids (DNAPL) are found in the contaminants of concern (COC). Groundwater treatment usually consists of a pump-and-treat approach, in which the groundwater is extracted, treated, and then discharged to the environment (lake, river, or land irrigation). Just recently, the concept of treating a contaminated plume with reinjection of the treated water down gradient from the plume is becoming recognized. Successful treating of a plume is actually more difficult than it appears to be because the contamination is three dimensional rather than two dimensional as is often characterized in site plans. If the groundwater is the first task, continuing contamination of the plume can occur from the still contaminated soil. If groundwater is the second task, continuing contamination of the plume can occur from soil that hasn't been effectively cleaned. In either case, the time required for complete aquifer cleaning is considerable. And this is true regardless of the rate of pumping because the rate of plume cleaning is controlled by the rather slow rate of leaching the COC from the soil rather than the rate of pumping. Consequently, the time necessary for effective plume treatment is measured in years or even decades.

**Total site remediation time and costs can be decreased by an order of magnitude by implementing simultaneous ground and groundwater treatment.** In every instance using a combination of soil washing/leaching and in-situ biological treatment can rapidly clean the contaminated ground. Bacteria, however, are far more effective at biochemically oxidizing the COC than is water at leaching the same contaminants. The faster the soil is cleaned the faster the contaminated groundwater plume can be cleaned. Biological treatment is achieved by percolating very clean water with essential nutrients and dissolved oxygen added. In addition, the same water is injected just beyond the contaminated plume in order to hydraulically drive the water towards the extraction wells. The rate of site clean-up is now controlled by the rate of pumping rather than the rate of leaching because biological treatment is achieved rapidly. As the dissolved oxygen disappears from the recirculated water, biological treatment changes from aerobic to anaerobic. Ultimately aerobic treatment will prevail throughout as the organic load and associated oxygen demand decreases. Under aerobic conditions, lysis will also eventually occur which converts the last vestiges of contamination into carbon dioxide and water, both of which are components of natural groundwater. See engineering drawings S-1003 and S-1004. *Contaminated soil does not require a contaminated aquifer to apply this process. The initial injection of make-up water is all that is required to start the comprehensive biological processes working.*

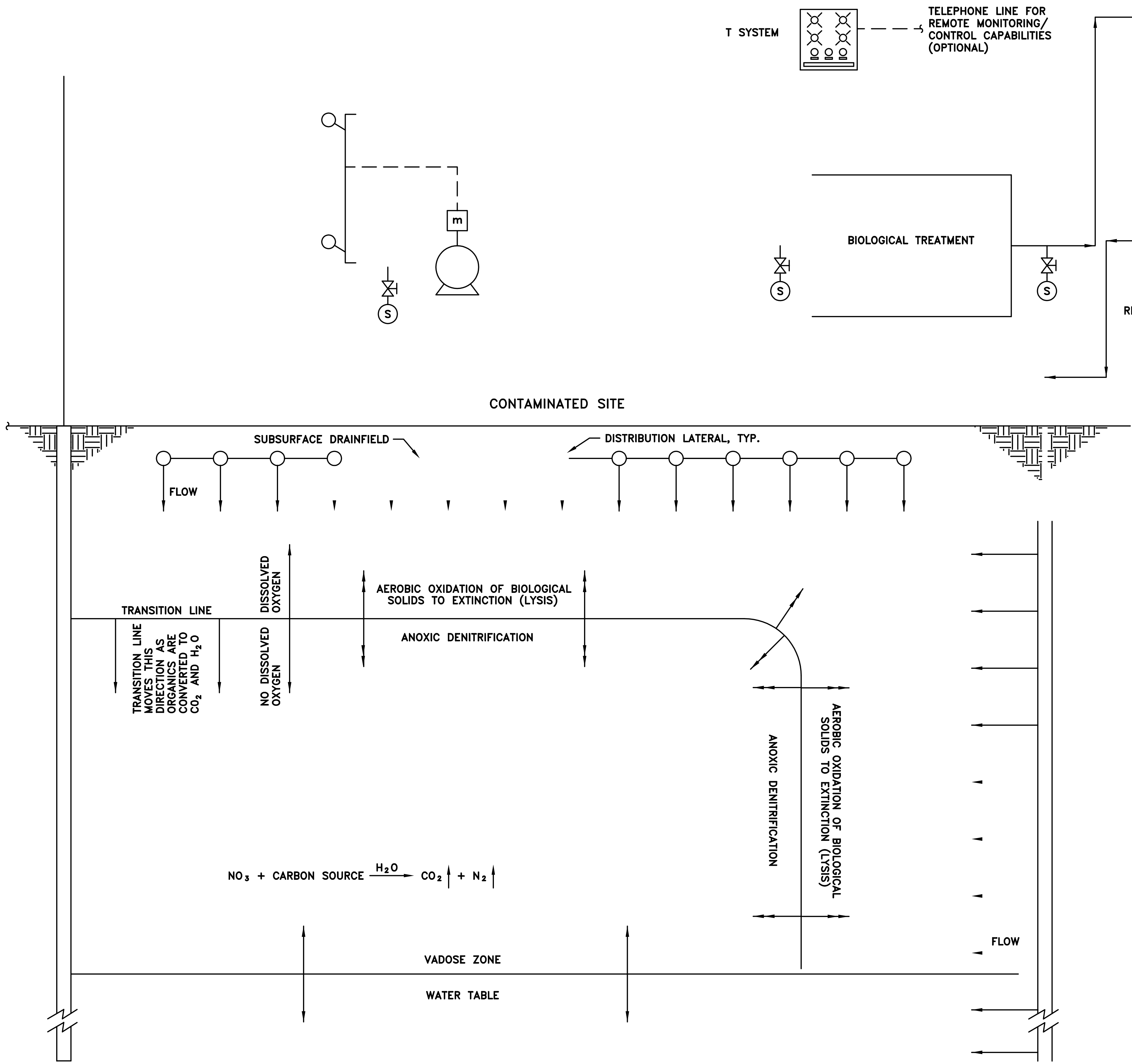
**Future Trends**

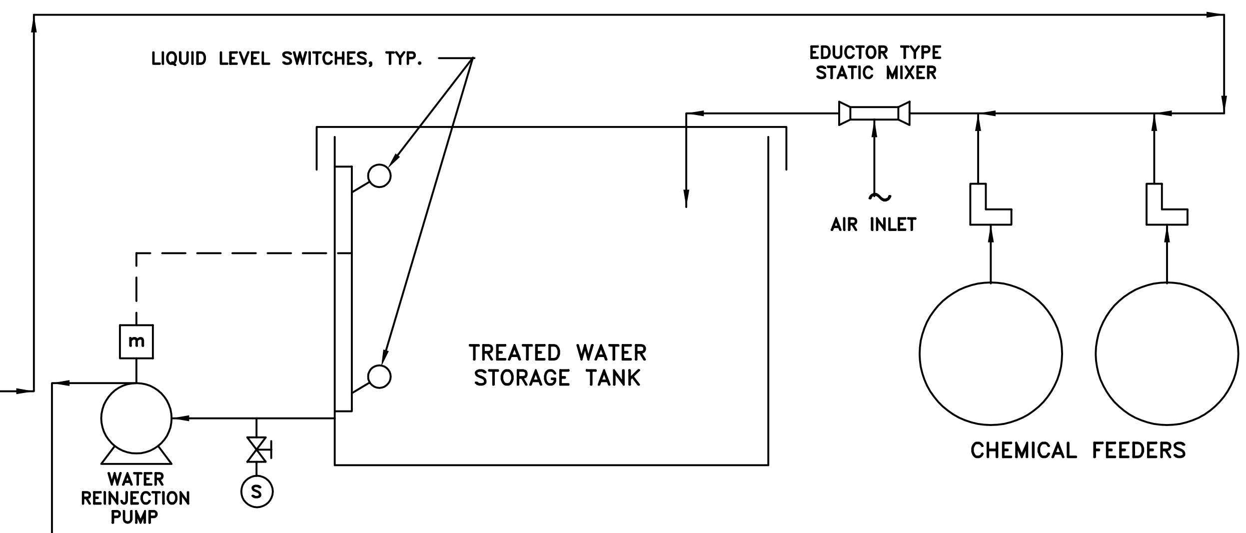
The simultaneous treatment of ground and groundwater is cutting edge technology and just now becoming recognized by the EPA in pilot plant studies. This combination treatment approach is now referred to as intrinsic remediation (IR) or remediation by natural attenuation. The several beneficial processes at work include dispersion, dilution, sorption, volatilization, abiotic transformation, aerobic oxidization, and anoxic reduction. Brownfield developers as well as the owners of contaminated sites and their remediation consultants are urged to embrace this rapid and economical method for total site remediation.

To be effective, the remediation contractor must have a thorough grasp of biological treatment technology as well as the cleaning of groundwater to high levels of purification. Contractor expertise in these two disciplines is essential if the site owner expects to achieve the time and cost savings possible through the principle of simultaneous ground and groundwater remediation. The issuing of negotiated design/build contracts based on performance can result in further expediting the remediation work.

Attached are two reprint articles, both excellent technical papers on this emerging science. For further insight into this total site remediation technique we recommend Remediation Of Petroleum Contaminated Soils by Eve Riser Roberts (1998 Lewis Publishers, an imprint of CRC Press LLC)

The engineers and scientists at WaterSmart Environmental welcome your ground and groundwater treatment inquiries with enthusiasm.




## OXIDATION REACTIONS WHICH CONSUME DISSOLVED OXYGEN

SULFIDE OXIDATION: $2O_2 + HS^- \longrightarrow SO_4^= + H^+$

IRON OXIDATION: $O_2 + 4Fe^{++} + 4H^+ \longrightarrow 4Fe^{+++} + 2H_2O$

NITRIFICATION: $2O_2 + NH_4^+ \longrightarrow NO_3^- + 2H^+ + H_2O$

MANGANESE (II) OXIDATION: $O_2 + 2Mn^{++} + 2H_2O \longrightarrow 2MnO_2 + 4H^+$

IRON SULFIDE OXIDATION: $15O_2 + 4FeS_2 + 14H_2O \longrightarrow 4Fe(OH)_3 + 8SO_4^= + 16H^+$

## REACTIONS WHICH CONSUME ORGANIC MATTER

AEROBIC DEGRADATION: $CH_2O + O_2 \longrightarrow CO_2 + H_2O$

DENITRIFICTION: $3CH_2O + 4NO_3^- \longrightarrow 2N_2 + 3HCO_3^- + H^+ + 2H_2O$

MANGANESE (IV) REDUCTION: $CH_2O + 2MnO_2 + 3H^+ \longrightarrow 2Mn^{++} + HCO_3^- + 2H_2O$

FERRIC IRON REDUCTION: $CH_2O + 4Fe(OH) + 7H^+ \longrightarrow 4Fe^{++} + HCO_3^- + 10H_2O$

SULFATE REDUCTION: $2CH_2O + SO_4^= \longrightarrow HS^- + HCO_3^- + H^+$

METHANE FERMENTATION: $2CH_2O + H_2O \longrightarrow CH_4 + HCO_3^- + H^+$

## PROCESS TREATMENT MONITORING

DISSOLVED $CO_2$ MONITORING IN EXTRACTED WATER ESTABLISHES OVERALL LEVEL OF MICROBIOLOGICAL ACTIVITY.

DISSOLVED $N_2$ ESTABLISHES ANOXIC DENITRIFICATION ACTIVITY.

CHEMICALS ADDED CONSIST OF AMMONIA NITROGEN, PHOSPHORUS, AND NITRATES. THESE NUTRIENTS ARE USED OVER AND OVER WITHIN A CLOSED LOOP (RECIRCULATED) SYSTEM. DURING THE INTIAL PHASE OF CONTMINATED GROUND REMEDIATION RAPID UPTAKE OF THE NUTRIENTS WILL BE EXHIBITED DURING WHICH TIME THEY WILL HAVE TO BE REPLENISHED. DURING THE MIDDLE REMEDIATION PHASE THE NUTRIENTS WILL BEGIN SHOWING UP IN THE RECYCLED WATER AND TO THE EXTENT FOUND, NUTRIENT ADDITION TO THE RECYCLED WATER SHOULD BE REDUCED ACCORDINGLY. DURING THE LAST PHASE OF GROUND REMEDIATION THE EXTRACTED LEVELS OF PHOSPHORUS AND NITRATES CONTINUE TO INCREASE AS A RESULT OF AEROBIC LYSIS. THEREFORE P, $NH_3$, AND $NO_3$ SHOULD ALSO BE MONITORED.

WHEN BIOLOGICAL ACTIVITY CEASES, RESIDUAL LEVELS OF P, $NH_3$ AND $NO_3$ MIGHT THEN REQUIRE REMOVAL (BY MEMBRANE TREATMENT OR ION EXCHANGE) TO RESTORE THE AQUIFER TO A CONDITION THAT MEETS DRINKING WATER OR OTHER STANDARDS.

# PROCESS TREATMENT SCHEM/



**WaterSmart Environmental, Inc.**
Post Office Box 26346
Shawnee Mission, Kansas 66225

TITLE: IN–SITU BIOREMEDIATION

JOB: SIMULTANEOUS GROUND AND GROUNDWATER REMEDIATION

| REV. | DATE | DESCRIPTION | BY | CHK |
|---|---|---|---|---|
| | | | | |
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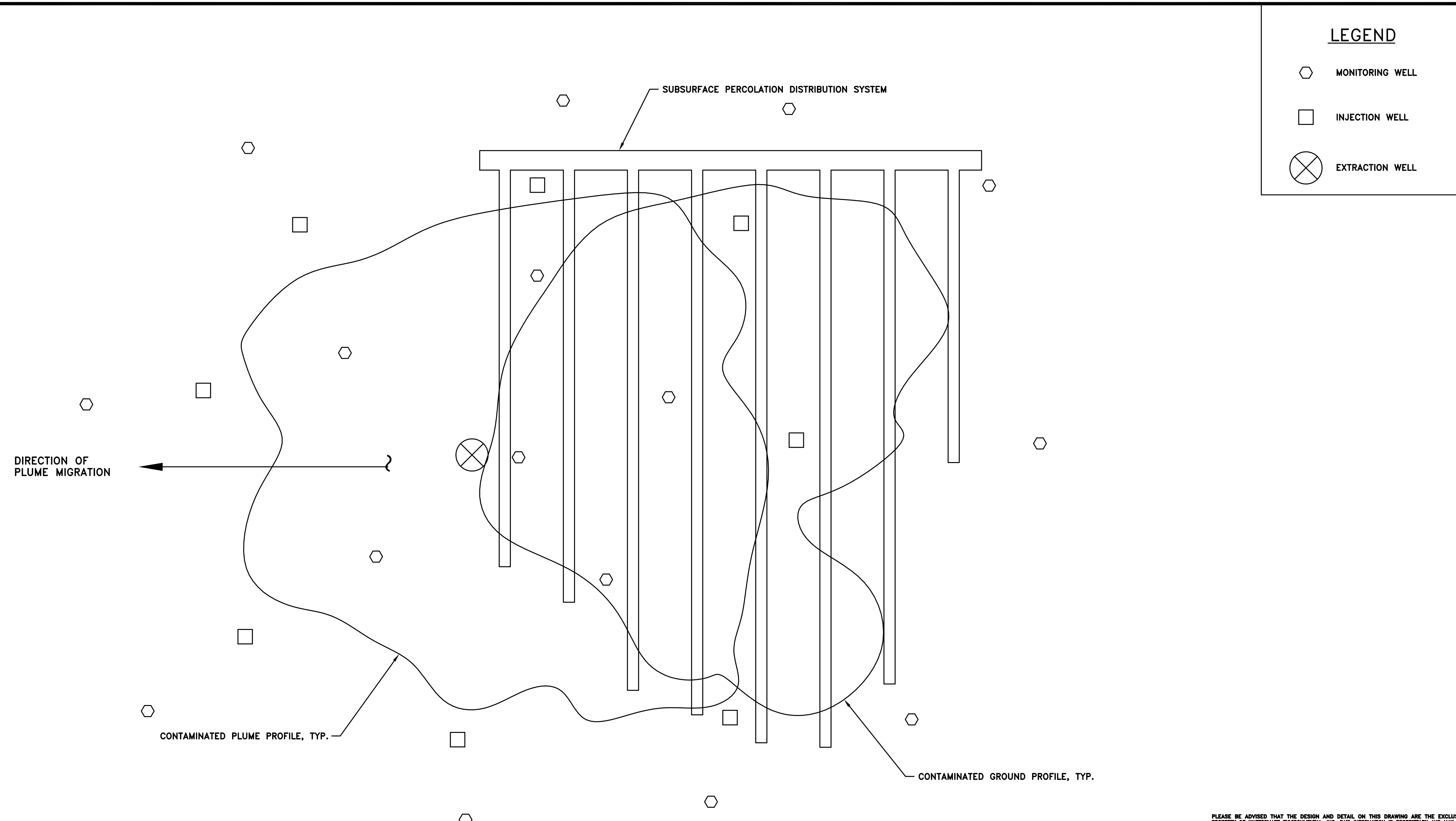
DO NOT SCALE DRAWING. USE DIMENSIONS ONLY.

| SCALE | DRAWN | DWG. NO. |
|---|---|---|
| NONE | B.E.H. | S–1003 |
| DATE 7/6/96 | CHECKED C.G.S. | |



Plot Date 8–13–97/1500 Plot Scale 1=1 PRODUCED ON AUTOCAD RELEASE 13




## SITE PLAN

PLEASE BE ADVISED THAT THE DESIGN AND DETAIL ON THIS DRAWING ARE THE EXCLUSIVE PROPERTY OF WATERSMART ENVIRONMENTAL, INC. SAID INFORMATION IS PROPRIETARY AND MAY NOT BE USED EXCEPT IN CONNECTION WITH OUR BUSINESS. ALL INVENTION RIGHTS ARE RESERVED.

**WaterSmart Environmental, Inc.**
Post Office Box 26346
Shawnee Mission, Kansas 66225

TITLE: TYPICAL IN-SITU BIOREMEDIATION PLAN

JOB: SIMULTANEOUS GROUND AND GROUNDWATER REMEDIATION

| REV. | DATE | DESCRIPTION | BY | CHK |
|---|---|---|---|---|

DO NOT SCALE DRAWING. USE DIMENSIONS ONLY.

| SCALE | DRAWN | DWG. NO. |
|---|---|---|
| NONE | B.E.H. | S-1004 |
| DATE 7/6/96 | CHECKED C.G.S. | |



Plot Date 8-13-97/1500 Plot Scale 1=1 PRODUCED ON AUTOCAD RELEASE 13

# Nonrecourse Project Capital Cost Structure

# City of Lebanon, Missouri

### BioWastes-To-Renewable Energy, Food, BioFuels, and Water Independence Plant

**The total estimated capital and development costs of the design-build-own-operate wastes-to-renewable energy project total $501,226,585 (plus funding broker commissions) utilizing both new and remanufactured process equipment. The major components of capital and other costs are as follows:**

| Item Description | Cost in US$ |
|---|---|
| Anaerobic Digester Feed Tank Constructed Cost[1] | 2,000,000 |
| Biodiesel Manufacturing Equipment Constructed Cost[2] | 15,000,000 |
| Building Size 1 km x 1 km x 2 stories high Constructed Cost[3] | 75,000,000 |
| Cement Kiln Constructed Cost[4] | 12,000,000 |
| Concrete Ready Mix Batch Plant Constructed Cost[5] | 3,000,000 |
| EAF Steel Recycling Process Equipment Constructed Cost | 3,000,000 |
| Fish Processing Equipment Constructed Cost[6] | 500,000 |
| LED Lighting Purchase Cost[8] | 10,000,000 |
| Liquefied Nitrogen Air Separation Equipment Procurement Capital Cost | 15,000,000 |
| Liquefied Nitrogen Delivery Equipment Procurement Capital Cost | 500,000 |
| Liquefied Nitrogen Storage Tank Constructed Cost | 2,000,000 |
| LNG (Liquefied Natural Gas) Storage Tank Constructed Cost | 2,500,000 |
| Methane Gas Compression Equipment Installed Capital Cost | 10,000,000 |
| Potable Water Storage Tank Constructed Cost | 2,000,000 |
| Photobioreactor Capital Equipment Constructed Cost[7] | 100,000,000 |
| Power Generation Equipment Procurement Cost[9] | 56,650,000 |
| Reverse Osmosis Equipment Procurement Cost | 2,000,000 |
| Sow procurement Costs | 5,000,000 |
| Two-Phase Anaerobic Digester Constructed Cost[1] | 74,780,080 |
| **Subtotal Project Costs** | **390,930,000** |
| Add 15% Contingencies | 58,639,500 |
| **Total Capital Costs** | **449,569,500** |
| Finance Charges | 8,000,000 |
| Interest During Construction | 20,000,000 |
| Administration/Legal | 150,000 |
| Permitting | 20,000 |
| Technology & Development Cost | 284,559,700 |
| Project Development Fee @ 3% of US$449,569,500 | 13,487,085 |
| Working Capital | 10,000,000 |
| **Total All Costs** | **785,786,285** |

**Nonrecourse Project Financing Will Be Structured As Follows:**

| | |
|---|---|
| Developer Equity as Technology, 70%[10] | 284,559,700 |
| Investor Equity as Cash, 30% | 94,712,728 |

| | |
|---|---|
| Finance | 406,513,857 |
| Loan Term, Years | 10 |
| Interest Rate | 10% |
| Developer will contribute 70% equity in the project as the value of the technology.[10] | |
| Investor will contribute US$94,712,728 cash and the balance will be financed. | |

**With Following Notes:**

1. **The anaerobic digester and its associated feed tank will be constructed of precast concrete panels. The panels will be manufactured by Wieser Concrete Products, Inc. and barge shipped to destination project site. The Wisconsin based precast concrete manufacturer POC is Phil Miller @ phone 800.325.8456 (see http://www.wieserconcrete.com/about.html).**

2. **The biodiesel production equipment will be designed and manufactured by California based R. C. Costello & Associates, Inc. The POC is Rocky Costello, P.E. @ phone 310.792.5870 (see http://www.rccostello.com/).**

3. **The low cost of the project building is made possible by the 100% internal recycling of inorganic wastes that are produced from the anaerobic digestion process. These inorganic wastes are combined with cement and water in the production of precast concrete panels. The special purpose project company will produce its own cement to further minimize construction costs. See attached WSE Engineering Drawing No. S-6099-1 for additional details. The POC at WaterSmart Environmental is Chuck Steiner @ 913.897.2727 (see http://www.watersmart.com/).**

4. **The cement kiln will be sourced through Canada based Cement Process Consulting, Ltd. The POC is Ken Postle @ phone 403.472.4519 (see http://www.cement-process.com/index.htm).**

5. **The concrete ready mix plant will be sourced through Canada based Cement Process Consulting, Ltd. The POC is Ken Postle @ phone 403.472.4519 (see http://www.cement-process.com/index.htm).**

6. **The fish production and processing equipment will be sourced through Colorado based Fisheries Technology Associates, Inc. The POC is Bill Manci @ phone 970.225.0150 (see http://www.ftai.com/).**

**7. The enclosed photobioreactor consists of 2 miles long 12"Ø clear PVC pipe. A possible supplier is Harvel Plastics, Inc. but other sources will be considered prior to procurement (see http://www.harvel.com/).**

**8. The artificial lighting for the photobioreactor consists of 5 miles of high efficiency long lasting (10 years or more) light emitting diode (LED) lighting that will be wrapped barber pole fashion around the clear PVC pipe. A possible supplier is Light Waves Concept, Inc. but other sources will be considered prior to procurement (see http://www.lightwavesconcept.com/).**

**9. The power generation equipment will be sourced through UK based Combustion, Energy & Steam Specialists, Ltd. The POC is Mike Craigie @ phone +44 (0) 1856 851177 (see http://www.cess.co.uk/).**

**10. The seemingly high percentage of developer equity as technology is justified on the basis that it is the only economic development technology that simultaneously achieves:**

- **100% compliance with Kyoto Protocol thus helping to reverse global warming,**
- **Distributed Biofuels (biodiesel and compressed natural gas or CNG) independence,**
- **Distributed Food independence,**
- **Distributed Renewable energy independence,**
- **Distributed Water independence, and**
- **Complete internal recycling of all byproducts and waste streams thereby producing a useful product—namely precast concrete products that will be used for constructing the project building itself as well as infrastructure roads, light rail transit surface transportation system, precast concrete potable water distribution system, precast concrete wastewater collection system, and precast concrete encased renewable energy power distribution system. In doing so the community initiative project will become the very first zero carbon and zero waste community in the world.**

**Climate Change has now become the most serious worldwide concern as the sustainability of our planet appears to be at rapidly increasing risk. Renewable Energy Technologies that address climate change are therefore in great demand. Technologies that address both climate change and substantial economic development are in even greater demand. The proposed waste-to-energy technology has required over 30,000 hours of research over a 10 year period to develop thus fully justifying the seemingly high percentage of developer equity as technology. It is the very first and only worldwide technology that is technically capable of simultaneous distributed energy independence, distributed food independence, distributed fuels independence, and distributed water independence with all in full compliance with Kyoto Protocol.**

**The proposed wastes-to-renewable energy technology consists of a suite of individual component technologies. The individual component technologies are:**

- **Biodiesel Production With Associated Waste Processing. The National Renewable Energy Laboratory (NREL) pioneered the very first production of biodiesel from microalgae. The research and development was carried out under the "Aquatic Species Program" (ASP) that consisted of the first production of a biofuel called "algal biodiesel" (see [http://www1.eere.energy.gov/biomass/pdfs/biodiesel_from_algae.pdf](http://www1.eere.energy.gov/biomass/pdfs/biodiesel_from_algae.pdf)). Under the referenced program Algal Biodiesel was produced through the growing of microalgae for their lipid content. The lipid content was then converted into biodiesel through chemical transesterification in the same manner that soybeans and other vegetable oils are now being converted into biodiesel. The ASP funding totaled $25.05 million over a 20 year period that began in 1978. Continuation funding was ultimately terminated when it was officially determined that algal biodiesel could not be produced economically. The ASP obtained its research data from growing microalgae in warm open ponds (Salton Sea in Southern California) at a pH of 8.2 using atmospheric carbon dioxide. The Salton Sea is the recipient of agricultural runoff nutrients as well as additional nutrients contained in municipal sewage treatment plants discharges. The Middle Cordoba Province Project will produce microalgae within an enclosed photobioreactor that will operate at the optimum growing temperature of 35ºC (95ºF) and at the optimum growing pH of 9.4. Photosynthesis will occur 24/7 rather than just during daylight hours by using long lasting light emitting diode (LED) lighting. The photobioreactor will receive the total carbon dioxide output from both the anaerobic digester as well as the power generation equipment thus substantially increasing production over that obtainable from using carbon dioxide from the atmosphere. Microalgae production will be further increased by adding the micronutrients contained in the reverse osmosis concentrate stream thus substantially improving microalgae production. The total increase of these process modifications over that obtained by the National Renewable Energy Laboratory's ASP is estimated at a factor of at least 1000 to 1. By producing the microalgae within an enclosed photobioreactor the technology becomes totally compliant with Kyoto Protocol since all discharges of greenhouse gases to the environment are eliminated.**

- **Cement manufacturing as a technology has been practiced for many hundreds of years throughout the entire civilized world.**

- **Fish farming was first practiced by the Chinese over 100 years ago. Due to the over fishing of the oceans fish farming is now widespread throughout the entire civilized world.**

- **Precast concrete panels and piping have been manufactured for the last 50 years. The use of precast concrete panels has become quite popular in the building industry during the last 10 years.**

- **Liquefied Nitrogen and Liquefied Oxygen have been produced in the marketplace for the last 50 years. Names of today's largest industrial suppliers consist of Air Liquide, Air Products & Chemicals, Inc., Cryogenic Industries, Inc., Gas Systems Corporation, and Praxair, Inc.**

- **Methane gas-to-methanol alcohol through synthesis gas (syngas) technology represents the standard method of producing methanol throughout the civilized world.**

- **Microalgae production through the use of a photobioreactor (use of artificial light rather than sunlight) is now being done at several research institutions. The technology has yet to be put into full scale commercial operation.**

- **The anaerobic digestion of municipal solid wastes (MSW) was first accomplished by two-phase anaerobic digestion in 1996 (see http://lib.kier.re.kr/caddet/retb/no66.pdf). More recently the management of municipal solids wastes is being accomplished using conventional anaerobic digestion by Waste Management, Inc., a waste management company (see http://www.wm.com/WM/environmental/Bioreactor/technologies.asp).**

- **Pig farming and processing has been practiced around the world for the last 100 years.**

- **Precast concrete panels and precast concrete pipes have been manufactured for the last 50 years throughout the world.**

- **Renewable energy power generation has been practiced for at least 30 years in the EU and 20 years in the United States.**

- **Reverse osmosis treatment has been around on a commercial basis for over 30 years. During the last 5 years its marketplace costs have been halved and it is now considered very good and very affordable technology.**

| City of Lebanon Prefeasibility Study, December 17, 2007 | Totals |
|---|---|
| Location: Lebanon, Missouri | |
| Technology Provider: WaterSmart Environmental, Inc. | |
| Project Developer:<br>Tumbleweed Enterprises<br>POC: Joe Steiner<br>Phone: 620-221-0852<br>email: Steiner@sucocoopwb.com | |
| Project Type: Economic Development through Design-Build-Own-Operate BioWastes-To-Renewable Energy, BioFuels, Organic Foods, and Potable Water Independence | |
| Project Dollar Size: US$500 million for each 1 km x 1 km x 3 story high project building | |
| Number of project buildings required: 1 | |
| Project Activities: Extensive Agricultural Production and Processing that additionally includes renewable energy, biofuels, and water production along with 100% recycling of all byproducts into precast concrete panels and piping for infrastructure development | |
| Jobs Creations Potential for each 1 km x 1 km x 3 story high project building: 1,500 | |
| BioWastes Treated: Municipal Solid Wastes (MSW), Medical Wastes, Construction & Demolition Wastes, Foods Production & Processing Wastes, and Biodiesel Processing Wastes | |
| Local Population Served for each 1 km x 1 km x 3 story high project building: 50,000 | |
| Residual Wastes to Landfill: Zero | |
| Greenhouse Gaseous Emissions to the Environment: Zero | |
| Climate Change Carbon Footprint: Zero | |
| Investor Internal Rate of Return: Optimal | |

## Detailed Project Description

Extensive Agricultural Production in each project building will consist of a 10,000 sow farrow-to-finish operation that is sized to produce excess local marketplace demand for finished pork and a 50 hectare tilapia fish farming operation that is also sized to produce excess local marketplace demand for tilapia fish. On a total processed weight basis the amount of excess processed fish produced will be about 4 times that of processed pork. Processed Tilapia fish are worth about 1.5 times as much as processed pork and therefore more profitable. The excess processed pork and processed fish will be exported to distant markets to provide visible cash flow to the project. The worldwide demand for pork on a weight basis is about 4 times that of the worldwide demand for fish. With a world population approaching 7 billion the pork and fish output of a single project building calculates out to approximately 0.075% of worldwide demand of processed pork and tilapia fish. A total of 1 ÷ 0.00075 = 1,333 project buildings would therefore be required to satisfy worldwide demand for both pork and fish. Worldwide consumption of pork and fish data is attached. The marketing idea is to produce 100% of the local demand for pork and fish with the entire excess of each sold to export markets for visible sales revenue.

In addition to agricultural production, each project building will produce Portland cement for the purpose of manufacturing precast concrete panels and piping for direct infrastructure development.

1. In the production of cement considerable carbon dioxide gas is produced.
2. When processing biowastes using anaerobic digestion both methane gas and carbon dioxide gas are produced.
3. When generating renewable energy both water vapor and carbon dioxide gas are produced.

100% of the carbon dioxide gas produced during the production of cement, the processing of biowastes, and the generation of electricity will be routed to an enclosed photobioreactor for the purpose of producing Spirulina microalgae. 75% of the Spirulina microalgae will be used as animal feed in the production of tilapia fish and pork. The remainder 25% will be converted into biodiesel biofuel (B100) and sold locally to produce visible sales revenue.

Spirulina microalgae contain about 6% lipids (fats). The production of biodiesel produces about 6% lipid (fat) conversion into biodiesel biofuel from Spirulina microalgae. The 94% remaining biowastes are returned to the anaerobic digester to produce additional methane gas and carbon dioxide gas. The resulting methane gas produced can be used for power generation or sold as a biofuel. The resulting carbon dioxide gas produced from electricity generation will be automatically routed to the enclosed photobioreactor to enable production of additional Spirulina microalgae.

The economic development objective is to produce 100% of the local demand for electricity, 100% of the local demand for biodiesel biofuel, 100% of the local demand for natural gas (methane gas is a near equivalent to natural gas) biofuel, and 100% of the local demand for compressed natural gas (CNG) automotive biofuel. Biodiesel (B100) can be used as a direct replacement for petroleum diesel without equipment modification. CNG biofuel must be used in vehicles equipped for this fuel. Each project building will engage in the modification of gasoline automotive equipment to enable the use of CNG biofuel. Automobiles that operate on CNG biofuel enjoy extended useful life of the engine by a factor of 4 or more. Trucks that operate on biodiesel biofuel enjoy extended useful life of the engine by a factor of 2 or more. Each economic development project includes the infrastructure for local distribution of renewable natural gas. To the extent that methane gas is used for electricity generation, the production of biodiesel biofuel, and the production of CNG biofuel, each qualifies for renewable energy credits since all such uses are carbon neutral.

As background information, the production of ethanol from corn and biodiesel from beans has precipitated a massive food or fuel issue throughout the world causing the marketplace price of both corn and soybeans to increase dramatically. These increases have, in turn, caused the marketplace price of ethanol and biodiesel to increase as well the marketplace price of corn and soybean based food products. It is these increases in marketplace prices that have caused the food or fuel issue. With our business model, the production of biodiesel from Spirulina microalgae stays completely clear of the food or fuel issue as does the production of CNG biofuel from biowastes. To achieve total sales of the biofuels production outputs they will be sold at a 20% discount from existing retail. At this attractive pricing 100% of routine production will easily sell in the marketplace.

**No Charge For Potable Water**

**No Charge For Wastewater Treatment**

Because nutrients will be 100% recycled internally, each project building will produce substantial liquid fertilizer concentrate that will be distributed to area farmers in need on a no-charge basis. Excess liquid fertilizer, if any, would be eligible to sell to distant markets or possibly converted into value added products. To the extent that the local market does not make use of the liquid fertilizer concentrate the fertilizer product will be sold to international markets to increase additional visible cash flow to the project.

**No Charge for Stormwater Treatment**

Because 100% of the water is recycled internally, potable water of the quality of bottled water will be distributed locally on a no-charge basis. Because water is required to process municipal solid wastes each project building will accept both sanitary wastewater and storm water for that purpose on a no-charge basis. Over time, additional stories will be added to each project building to enable additional agricultural activities that could include bananas, beets, black bass, beef cattle, beans, cassava, coffee, corn, cotton, dairies, lobster, onions, poultry, prawns, rice, shrimp, sugar cane, sweet potatoes, trout, and many other crops.

Throughout the prefeasibility study extensive efforts are made to provide balanced chemical equations and mathematical calculations, where appropriate, to permit extensive due diligence evaluations of the proposed sciences to be used.

## Marketplace BioWastes-To-Energy Feedstocks

**A determination of the amount of volatile solids (VS) is necessary in order to calculate the amount of methane gas that can be produced from the anaerobic digestion of biowastes. Eligible feedstocks consist of municipal solid wastes (MSW), medical wastes, and construction & demolition wastes. For the purpose of arriving at conservative waste figure availability, a total of 2 lbs/person/day will be used for the purpose of calculating total feedstock biowaste amounts for developing countries and a total of 5 lbs/person/day will be used for the purpose of calculating total feedstock biowaste amounts for developed countries. For an area population of 50,000 for each project building the available biowastes calculate out to 50,000 x 2 lbs/person/Day = 100,000 lbs/day, or when divided by 2,000 lbs/Ton = 50 Tons/Day for developing countries and 50,000 x 5 lbs/person/day = 250,000 lbs/Day, or when divided by 2,000 lbs/Ton = 125 Tons/Day for developed countries.**

**For undeveloped countries, the calculation for municipal solid wastes is as follows:**

> **Assuming 25% moisture content 50 Tons/Day x 75% = 37.5 Dry Tons/Day**
> **Assuming 80% organic content 37.5 Dry Tons/Day x 80% = 30 Organic Tons/Day**
> **Assuming 80% volatile solids content 30 Organic Tons/Day x 80% = 24 Tons Volatile Solids/Day or x 2,000 lbs/Ton = 48,000 lbs/Day. This amount of waste translates into 48,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 576,000 CFD of $CH_4$. At 24 cubic feet/lb, the methane production translates into 576,000 CFD $CH_4$/24 = 24,000 lbs/2,000 = 12.0 Tons $CH_4$/Day for undeveloped countries.**

**60 Tons VS/Day From MSW Undeveloped Countries**

**30 Tons $CH_4$/Day From MSW Undeveloped Countries**

**For developed countries, the calculation for municipal solid wastes is as follows:**

> **Assuming 25% moisture content 125 Tons/Day x 75% = 93.75 Dry Tons/Day**
> **Assuming 80% organic content 93.75 Dry Tons/Day x 80% = 75 Organic Tons/Day**
> **Assuming 80% volatile solids content 75 Organic Tons/Day x 80% = 60 Tons Volatile Solids/Day or x 2,000 lbs/Ton = 120,000 lbs/Day. This amount of waste translates into 120,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 1,440,000 CFD of $CH_4$. At 24 cubic feet/lb, the methane production translates into 1,440,000 CFD $CH_4$/24 = 60,000 lbs/2,000 = 30.0 Tons $CH_4$/Day for developed countries.**

**150 Tons VS/Day From MSW in Developed Countries**

**75 Tons $CH_4$/Day From MSW in Developed Countries**

**In addition to fresh municipal solid wastes, the project will directly collect an additional 10 lbs/person/Day from existing landfills, rubbish piles, and dumps for the twofold purpose of producing additional methane gas and reclaiming additional ferrous and nonferrous metals while getting rid of existing dump/landfill sites. This activity will increase the methane gas and carbon dioxide gas production from two-phase anaerobic digestion by a factor of 5/2 or 2.5 thus increasing the volatile solids from undeveloped countries from 24 Tons/Day to 60 Tons/Day and from developed countries from 60 Tons to 150 Tons/Day. The associated methane gas is increased from 12 Tons $CH_4$/Day to 30 Tons $CH_4$/Day for undeveloped countries and from 30 Tons $CH_4$/Day to 75 Tons $CH_4$/Day from developed countries.**

**No charge for MSW disposal**

**The 60 Tons Volatile Solids/Day from undeveloped countries can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 60 Tons VS/Day x 2,000 lbs/Ton x 12 = 1,440,000 cu. ft. $CH_4$/Day. 1,440,000 cu. ft. ÷ 24 cu. ft./lb = 60,000 lbs $CH_4$/Day. 60,000 lbs $CH_4$/Day x 1.375 = 82,500 lbs $CO_2$/Day. 82,500 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 41.3 Tons $CO_2$/Day.**

**US$0.00/Day From MSW**

**The 150 Tons Volatile Solids/Day from undeveloped countries can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas**

produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 150 Tons VS/Day x 2,000 lbs/Ton x 12 = 3,600,000 cu. ft. $CH_4$/Day. 3,600,000 cu. ft. ÷ 24 cu. ft./lb = 150,000 lbs $CH_4$/Day. 150,000 lbs $CH_4$/Day x 1.375 = 206,250 lbs $CO_2$/Day. 206,250 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 103 Tons $CO_2$/Day.

Revenue collected for management of landfill wastes, municipal solid wastes, medical wastes, and construction & demolition wastes: US$0/Day/Ton. Never a charge, ever. This service always provided as a public service activity only.

## Agricultural Food Production and Processing

A 10,000 Sow Farrow-To-Finish farming operation will be provided for each project building that will produce about 22 pigs/sow/year. There is a potential to increase the number of pigs since the Dutch are now reporting upwards of 30 pigs/sow/year. The 10,000 sows therefore translate into 22 x 10,000 = 220,000 pigs/year with possible future expansion possible. At a midterm weight of 100 lbs, each hog will generate wastes sufficient to produce 3.02891 cubic feet of methane gas per day (archived data from Premium Standard Farms, Kansas City) through anaerobic digestion for a total daily production of 3.02891 x 220,000 or 666,360 cubic feet. At 24 cubic foot/lb, the methane production translates into 666,360/24 = 27,765 lbs/2,000 = 13.9 Tons $CH_4$/Day.

27.0 Tons VS/Day From Pig Farming

13.9 Tons $CH_4$/Day From Pig Farming

Pigs usually reach market weight between 5 and 6 months of age at approximately 260 to 280 pounds. During this time, the pigs are often fed several corn-soybean meal based diets that change in nutrient composition to meet their needs. Pigs weigh about 3 pounds at birth and stay with the sow until 21 days of age. At this time, they are placed on a grain diet. Pigs have unlimited access to feed and water at all times. Pigs will eat about 1 pound of feed per day at weaning and as much as 8 pounds of feed per day by market weight. Water intake is about 1 gallon per day up to 5 or 6 gallons per day by market weight. Just weaned pigs (21 days of age) need to be kept at about 80 to 85 degrees Fahrenheit and by market weight 65º F. Therefore, heating and cooling systems need to be in place throughout. A total of 2 MW of electricity will be required for the pig farming operations.

2 MW Electricity Required

For market hogs the pigs will consume about 3 to 4 percent of their body weight. A 200-pound hog will consume about 6 to 6.5 pounds each day.

- Nursery pigs weighing about 10 pounds consume around 0.5 pounds
- Feeder pigs weighing about 50 pounds consume around 1 to 2 pounds
- Grower pigs (now referred to as hogs) weighing about 100 pounds consume around 3 to 4 pounds
- Finisher hogs weighing about 150 pounds consume around 4 to 5 pounds
- Hogs more than 200 pounds consume around 6 to 7 pounds

United States retail pork prices are currently around US$2.87/lb. The wholesale producer receives about 43% of this price or US$1.46/lb. The above prices represent the average for the last 3 years. As a commodity there is no guarantee they will drift up or down but will likely continue to fluctuate as they have been for the last 50 years. Current marketplace dressed pork yields are over 2,750 lbs/year/sow. A 10,000 sow farrow-to-finish operation is estimated to produce 27,500,000 lbs of dressed pork/year or an average of 75,342 lbs/Day. At US$1.46/lb the daily revenue is estimated at US$110,000.00. Associated electricity requirements for temperature and humidity control are estimated at 2 MW. The exported pork product will be the first Organic Pork produced worldwide since all the principles for its production will be followed. Organic food is produced according to a set of principles and standards concerning such issues as pesticides, additives, animal welfare (medications) and sustainability. Organic pork will carry a higher

US$110,000/Day From Pork

| | |
|---|---|
| marketplace value than non-organically produced pork similar to all organically produced food products.<br><br>In terms of investor risk assessment, the existence of the very large pork commodity market is regarded as ample proof of probable visible cash flow from this specific food product.<br><br>At a finished market weight of 250 lbs 220,000 pigs translate into 220,000 x 250 lbs = 55,000,000 lbs/year. 55,000,000 lbs/year ÷ 2,000 lbs/Ton = 27,500 Tons/year. 27,500 Tons/year ÷ 365 days/year = 75.34 Tons/Day.<br><br>The processing of pork yields about 30% biowastes. The total processing wastes calculate out at 75.34 Tons/Day x 30% = 22.60 Tons/Day. When multiplied by 2,000 lbs/Ton, the amount of volatile solids = 45,200 lbs/Day. This amount of biowastes translate into 45,200 lbs Volatile Solids/Day x 12 cubic feet of methane gas/lb Volatile Solids = 542,400 cubic feet/Day (CFD) of methane gas ($CH_4$). At 24 cubic feet/lb, the methane production translates into 542,400 CFD $CH_4$/24 = 22,600 lbs/2,000 = 11.3 Tons $CH_4$/Day. | 22.6 Tons VS/Day From Pork Processing<br><br>11.30 Tons $CH_4$/Day From Pork Processing |
| **Additional Agricultural Food Production and Processing**<br><br>Will consist of a 50 hectare Tilapia fish farm at each project building for producing and thereafter processing organically grown Tilapia filets, mostly for the export fish market. Electricity requirements are estimated at 0.5 MW. The estimated raw fish produced per day is 670,000 lbs. At a filet yield of 42% a total of 281,000 lbs (140.5 Tons of Tilapia filets) will be produced/Day along with 389,000 lbs or when divided by 2,000 lbs/Ton = 194.5 Tons of biowastes/Day. At a commodity sell price of US$2.18/lb, the daily revenue is estimated at 140.5 Tons/Day x 2,000 lbs/Ton x US$2.18/lb = US$612,580/Day<br><br>It is virtually impossible to obtain a buyer commitment on a current basis in the form of a purchase agreement for a product that is 36 months away from coming into existence. In terms of investor risk assessment, the existence of the very large fish commodity market itself is regarded as ample proof of probable visible cash flow from this specific food product.<br><br>The 194.5 Tons/Day of biowastes x 2,000 lbs/Ton = 389,000 lbs of Volatile Solids/Day. This amount of waste translates into 389,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 4,668,000 cubic feet/Day (CFD) of $CH_4$. At 24 cubic foot/lb, the methane production translates into 4,668,000 CFD $CH_4$/24 = 194,500 lbs/2,000 = 97.3 Tons $CH_4$/Day. | 0.5 MW Electricity Required For Tilapia Fish Farming<br><br>US$612,580/Day From Tilapia Fish<br><br>194.5 Tons VS/Day From Fish Processing<br><br>97.3 Tons $CH_4$/Day From Fish Processing |
| Subtotal Carbon Dioxide Gas Produced From Municipal Solid Wastes Processing: | 41.3 Tons $CO_2$/Day |
| The 60 Tons Volatile Solids/Day from Municipal Solid Wastes can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 60 Tons VS/Day x 2,000 lbs/Ton x 12 = 1,440,000 cu. ft. $CH_4$/Day. 1,440,000 cu. ft. ÷ 24 cu. ft./lb = 60,000 lbs $CH_4$/Day. 60,000 lbs $CH_4$/Day x 1.375 = 82,500 lbs $CO_2$/Day. 82,500 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 41.3 Tons $CO_2$/Day. | |
| Subtotal Feedstocks Volatile Solids From Pig Farming Wastes: | 27.0 Tons VS/Day |
| The 27 Tons Volatile Solids/Day from Pig Farming Wastes can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 27 Tons VS/Day x 2,000 lbs/Ton x 12 = 648,000 cu. ft. $CH_4$/Day. 648,000 cu. ft. ÷ 24 cu. ft./lb = 27,000 lbs $CH_4$/Day. 27,000 lbs $CH_4$/Day x 1.375 = 37,125 lbs $CO_2$/Day. 37,125 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 18.6 Tons $CO_2$/Day. | 18.6 Tons $CO_2$/Day From Pig Farming Wastes |

| | |
|---|---|
| Subtotal Feedstocks Volatile Solids From Pork Processing Wastes: | 22.6 Tons/Day |
| The 22.6 Tons Volatile Solids/Day from Pork Processing Wastes can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 22.6 Tons VS/Day x 2,000 lbs/Ton x 12 = 542,400 cu. ft. $CH_4$/Day. 542,400 cu. ft. ÷ 24 cu. ft./lb = 22,600 lbs $CH_4$/Day. 22,600 lbs $CH_4$/Day x 1.375 = 31,075 lbs $CO_2$/Day. 31,075 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 15.5 Tons $CO_2$/Day. | 15.5 Tons $CO_2$/Day From Pork Processing Wastes |
| Subtotal Feedstocks Volatile Solids From Tilapia Fish Farming Wastes: | 1.4 Tons/Day |
| The 1.4 Tons Volatile Solids/Day from Tilapia Fish Farming Wastes can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 1.4 Tons VS/Day x 2,000 lbs/Ton x 12 = 33,600 cu. ft. $CH_4$/Day. 33,600 cu. ft. ÷ 24 cu. ft./lb = 1,400 lbs $CH_4$/Day. 1,400 lbs $CH_4$/Day x 1.375 = 1,925 lbs $CO_2$/Day. 1,925 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 0.96 Tons $CO_2$/Day. | 0.96 Tons $CO_2$/Day From Tilapia Fish Farming Wastes |
| Subtotal Feedstocks Volatile Solids From Tilapia Fish Processing Wastes: | 194.5 Tons/Day |
| The 194.5 Tons Volatile Solids/Day from Tilapia Fish Processing Wastes can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 194.5 Tons VS/Day x 2,000 lbs/Ton x 12 = 4,668,000 cu. ft. $CH_4$/Day. 4,668,000 cu. ft. ÷ 24 cu. ft./lb = 194,500 lbs $CH_4$/Day. 194,500 lbs $CH_4$/Day x 1.375 = 267,437 lbs $CO_2$/Day. 267,437 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 133.7 Tons $CO_2$/Day. | 133.7 Tons $CO_2$/Day From Tilapia Fish Processing Wastes |
| Subtotal Carbon Dioxide Gas Produced From Pig Farming Wastes: | 18.6 Tons $CO_2$/Day |
| Subtotal Carbon Dioxide Gas Produced From Pork Processing Wastes: | 15.5 Tons $CO_2$/Day |
| Subtotal Carbon Dioxide Gas Produced From Tilapia Fish Farming Wastes: | 0.96 Tons $CO_2$/Day |
| Subtotal Carbon Dioxide Gas Produced From Tilapia Fish Processing Wastes: | 133.7 Tons $CO_2$/Day |
| Subtotal Carbon Dioxide Gas Produced From Electricity Generation: | 247.0 Tons $CO_2$/Day |
| Subtotal Carbon Dioxide Gas Produced From Cement Manufacturing: | 67.2 Tons $CO_2$/Day |
| Total Carbon Dioxide Gas Produced: | 483.0 Tons $CO_2$/Day |
| Subtotal Methane Gas Produced From Municipal Solid Wastes: | 30.0 Tons $CH_4$/Day |
| Subtotal Methane Gas Produced From Pig Farming Wastes: | 13.5 Tons $CH_4$/Day |
| Subtotal Methane Gas Produced From Pork Processing Wastes: | 11.3 Tons $CH_4$/Day |
| Subtotal Methane Gas Produced From Tilapia Fish Farming Wastes: | 0.7 Tons $CH_4$/Day |
| Subtotal Methane Gas Produced From Tilapia Processing Wastes: | 97.3 Tons $CH_4$/Day |
| Subtotal Methane Gas Produced From Biodiesel Processing Wastes: | 97.1 Tons $CH_4$/Day |
| Total Methane Gas Produced: | 249.9 Tons $CH_4$/Day |

## Two-Phase Anaerobic Digestion

All of the wastes associated with agricultural production will be managed through two-phase anaerobic digestion technology. Traditional anaerobic digestion (often referred to as conventional high rate anaerobic digestion) produces a biogas that consists of 1/3 carbon dioxide gas by volume and 2/3 methane gas by volume as a common gas mixture. Two-phase anaerobic digestion, however, produces the same gases as two distinct gases consisting individually of carbon dioxide gas and methane gas. The separation of the two gases permits each to be managed individually.

In every anaerobic digester the ratio of carbon dioxide gas produced relative to methane gas is 1:2 on a volumetric basis. The molecular weight of methane gas ($CH_4$) is 16 (12 for Carbon + 4 for Hydrogen) whereas the molecular weight of carbon dioxide gas ($CO_2$) is 44 (12 for Carbon and 32 for Oxygen). 1 x 44 = 44 weight units for carbon dioxide gas and 2 x 16 = 32 weight units for methane gas. 44 divided by 32 = 1.375. Carbon dioxide produced relative to methane produced is therefore 137.5% on a mass basis. The actual weight of methane gas produced may be found by multiplying its cubic feet by the factor 0.0423

**Products Of Two-Phase Anaerobic Digestion**

**Volatile Solids (VS) x 12 = cu. ft. $CH_4$**

**cu. ft. $CH_4$ x 0.0423 = lbs $CH_4$**

**lbs $CH_4$ x 1.375 = lbs $CO_2$**

lbs/cu. ft. to arrive at its actual weight in lbs. This weight may be multiplied by the factor of 1.375 (137.5%) to arrive at the corresponding weight of carbon dioxide produced in lbs. The amount of methane gas generated through two-phase anaerobic digestion may be found by multiplying the volatile solids weight of the biowastes in lbs by 12 to arrive at the cubic feet of methane gas produced in lbs.

Other sometimes handy mathematical relationships are:

1 Ton VS/Day produces 24,000 $CH_4$/Day from two-phase anaerobic digestion
1 Ton VS/Day produces 0.508 Tons $CH_4$/Day from two-phase anaerobic digestion
1 Ton VS/Day produces 0.698 Tons $CO_2$/Day from two-phase anaerobic digestion
1 Ton $CH_4$/Day used for electricity generation produces 2.75 Tons $CO_2$/Day
83,780 $CH_4$/Day produces 1 MW of simple cycle electricity power generation

## Enclosed Photobioreactor for Spirulina Microalgae Production

The enclosed photobioreactor consists of a 2,200,000 foot long 12"Ø clear schedule 40 PVC pipe spiral wrapped externally with ultra high efficiency long lasting (10 years +) light emitting diode lighting for continuous photosynthesis. A small portion of the Spirulina microalgae produced will be continuously recycled to the start of the photobioreactor to provide the required seed to enable continuous Spirulina microalgae production. Electricity requirements = 6.0 MW for the lighting and associated recirculation pumping equipment.

The photobioreactor will receive 100% of the carbon dioxide gas output of the two-phase anaerobic digester and 100% of the carbon dioxide gas output from electricity generation. In addition, it will receive 100% of the output of macronutrients from the reverse osmosis treatment equipment deployed downstream from the two-phase anaerobic digester. The Spirulina microalgae require both carbon dioxide and macronutrients to maximize their rate of growth. The photobioreactor will be operated at a temperature of 35ºC (95ºF) and a pH of 9.4 to further optimize Spirulina microalgae rate of growth. Please refer to attached WSE Drawing Nos. S-6099-1 and S-9900-1 for additional information.

Spirulina will be produced using photosynthesis in the same manner that has existed for billions of years in the oceans of the world. The photosynthesis reaction is:

$$6\,H_2O + 6\,CO_2 + \text{photons} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6\,O_2$$

water + carbon dioxide + light energy → glucose carbohydrate + oxygen

The chemical mass balance of the above equation becomes :

$$108\text{ gm } H_2O + 264\text{ gm } CO_2 \rightarrow 180\text{ gm glucose carbohydrate} + 192\text{ gm } O_2$$

total of 372 gm reactants → total of 372 gm products

For each 264 grams of $CO_2$ reacted 180 grams of glucose carbohydrate and 192 grams of $O_2$ will be produced. For each ton of $CO_2$ reacted, 180/264 or 0.682 tons of glucose carbohydrates and 192/264 or 0.73 tons of $O_2$ will be produced. Glucose carbohydrates equate to Spirulina microalgae, a plant type material called phytoplankton.

**One Ton $CO_2$/Day Produces 0.682 Tons Of Glucose Carbohydrates/Day (Spirulina Microalgae)**

Respiration occurs in the Mitochondria of cells. It is almost the exact opposite reaction to photosynthesis. These two reactions work together to maintain a biological balance on earth. The respiration reaction is:

$$C_6H_{12}O_6 + 6\,O_2 \xrightarrow{\text{Mitochondria}} 6\,H_2O + 6\,CO_2$$

**It is generally believed that photosynthesis occurs only during periods of sunlight (or artificial light) and that respiration occurs only during periods of darkness. Horticulture studies have established that several, but not all, species of plants can be grown under continuous lighting. The same studies have established that photosynthesis and respiration can and do occur simultaneously under continuous lighting conditions. Plants are multi-cell and capable of learned behavior whereas Spirulina microalgae are single cell plants and therefore totally incapable of acquiring learned behavior. Spirulina microalgae can therefore be grown under continuous lighting conditions even though they have never been exposed to continuous lighting conditions for billions of years. Continuous lighting therefore approximately doubles total Spirulina growth relative to day/night growth rates.**

**The glucose produced during photosynthesis contains about 6% lipids (fats). Lipids are efficiently converted into biodiesel through a transesterification process. Each ton of $CO_2$ will simultaneously produce 0.68 tons glucose carbohydrates x 0.06 = 0.04 tons biodiesel and 1.0 – 0.04 = 0.96 tons of byproduct biowastes. 100% of the byproduct biowastes will consist of volatile solids. One ton $CO_2$/Day can therefore produce 0.04 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 0.04 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 90.91 gallons/day. The same one ton $CO_2$/Day will produce 0.96 tons x 2,000 lbs/ton = 1,920 lbs volatile solids/day or 21.12 lbs volatile solids/gallon of biodiesel produced/day.**

**One Ton $CO_2$/Day Produces 0.04 Tons Biodiesel/Day**

**One Ton $CO_2$/Day Produces 0.96 Tons Volatile Solids/Day**

**One Ton $CO_2$/Day Produces 90.91 Gallons Of Biodiesel/Day**

**Each Gallon of Biodiesel Produced Produces 21.12 lbs of Volatile Solids**

## Biodiesel Production

**All biodiesel produced will fully comply with American Society for Testing and Materials (ASTM) Standard Specification D 6751-03. The referenced specification is attached to the prefeasibility study.**

**The amount of biodiesel produced is directly dependent on the amount of Spirulina microalgae produced. The amount of Spirulina microalgae produced is directly dependent on the amount of carbon dioxide gas that is added to the photobioreactor. Since carbon dioxide gas is produced by electricity generation, two-phase anaerobic digestion, and cement production, the total amount of $CO_2$ produced must be determined from each source.**

**Source No. 1: Electricity Generation:**

**30 MW of electricity will be produced for the community initiative. Another 21.5 MW of electricity will be used internally for the photobioreactor, air liquefaction, methane gas compression, tilapia fish lighting, pig production, and general building use. The total amount of electricity produced therefore equals 30 MW + 21.5 MW = 51.5 MW.**

**When generating electricity $CO_2$ is produced according to the following combustion equation:**

$$CH_4 + 2O_2 + 7.52\ N_2 \rightarrow CO_2 + 2H_2O + 7.52\ N_2 + \text{heat}$$

**methane + oxygen + nitrogen → carbon dioxide + water + nitrogen**

**The chemical mass balance of the above equation becomes:**

$$16\text{ gm } CH_4 + 64\text{ gm } O_2 + 105\text{ gm } N_2 \rightarrow 44\text{ gm } CO_2 + 36\text{ gm } H_2O + 105\text{ gm } N_2$$

**total of 80 gm reactants → total of 80 gm products**

**Please note that nitrogen is not a reactant as it does not participate in the reaction. For each ton of $CH_4$ used for electricity generation a total of 44/16 or 2.75 tons of $CO_2$ will be produced along with a total of 36/16 or 2.25 tons of $H_2O$. 2.25 tons of $H_2O$ is, in turn, equivalent to 2.25 tons H2O x 2,000 lbs/ton = 4,500 lbs ÷ 8.34 lbs/gallon = 540 gallons of**

**1 Ton $CH_4$ Produces 2.75 Tons $CO_2$ From Electricity Generation**

**1 Ton $CH_4$ Produces 2.25 Tons $H_2O$ From Electricity Generation**

**1 Ton $CH_4$ Produces 540 Gallons Of Water From Electricity Generation**

water.

**51.5 MW Of Electricity Produces 247.5 Tons Of $CO_2$/Day**

**51.5 MW Of Electricity Produces 89.89 Tons Of $CH_4$/Day**

If 51.5 MW of electricity is produced to provide energy independence within the Community Initiative, a total of 51.5 MW x 83,780 $CH_4$/Day/MW = 4,314,670 cubic feet of methane gas will have to be used each day. At 24 cubic foot/lb, the methane usage translates into 4,314,670 cu. ft. $CH_4$/24 = 179,778 lbs/2,000 = 89.89 Tons $CH_4$/Day. Since each ton of $CH_4$ produces 2.75 Tons of $CO_2$ the generation of 51.5 MW of electricity produces 89.89 x 2.75 = 247.0 Tons of $CO_2$/Day due to the generation of electricity. Since each ton of $CH_4$ produces 2.25 Tons of $H_2O$, the generation of 51.5 MW of electricity also produces 89.89 x 2.25 = 202 Tons of $H_2O$/Day.

Source No. 2: Two-Phase Anaerobic Digestion:

To determine the amount of $CO_2$ produced first requires a determination of the amount of $CH_4$ produced as $CH_4$ production directly determines $CO_2$ production by a factor of 1.375.

To determine the amount of $CH_4$ produced first requires the amount of volatile solids that are treated as each lb of volatile solids x 12 = cu. ft. $CH_4$ produced.

The volatile solids available from MSW processing are 60.0 Tons/Day as listed above.
The volatile solids available from pig farming are 27.0 Tons/Day as listed above.
The volatile solids available from pork processing are 22.6 Tons/Day as listed above.
The volatile solids available from tilapia fish farming are 1.4 Tons/Day as listed above.
The volatile solids available from tilapia fish processing are 194.5 Tons/Day as listed above.
The total volatile solids available as listed above = 60.0 + 27.0 + 22.6 + 1.4 + 194.5 = 305.5 Tons $CH_4$/Day. 305.5 Tons $CH_4$/Day x 1.375 = 420.1 Tons $CO_2$/Day.

The project building will engage in the manufacturing of cement. Carbon dioxide is produced in cement making as a result of the production of a process ingredient called 'Clinker'. Clinker is made when limestone is heated to produce lime. Substantial amounts of carbon dioxide are simultaneously formed during this reaction. The final amount of carbon dioxide produced varies depending on the type of cement being made. Each project building will be manufacturing 300 Tons/Day of Portland type cement.

According to the *Annual Review of Energy and the Environment,* (Vol. 26: pp 303-329, November 2001) average $CO_2$ emissions/Ton from cement production = 448 lbs. At a cement production rate of 300 Tons/Day the total carbon dioxide emissions = 300 Tons/Day x 448 lbs $CO_2$/Ton = 134,400 lbs/Day ÷ 2,000 lbs/Ton = 67.2 Tons $CO_2$/Day. Adding this amount of $CO_2$ to the above total of 420.1 Tons $CO_2$/Day = 487.3 Tons $CO_2$/Day that will be produced from electricity generation, two-phase anaerobic digestion of volatile solids feedstocks, and cement production.

**332.3 Tons Spirulina Microalgae Produced/Day**

Since each ton of $CO_2$ produces 0.682 Tons of Spirulina microalgae 487.3 Tons $CO_2$/Day produces 487.3 x 0.682 = 332.3 Tons Spirulina microalgae/Day.

75% or 249.2 Tons Spirulina/Day will be used for feeding tilapia fish and pigs. The remaining 25% or 83.1 Tons Spirulina/Day will be used in the production of biodiesel (B100). 83.1 Tons Spirulina production is the equivalent of 25% of 487.3 Tons $CO_2$/Day or 121.8 Tons $CO_2$/Day. 249.2 Tons Spirulina production is the equivalent of 75% of 487.3 Tons $CO_2$/Day or 365.5 Tons $CO_2$/Day.

**18,381 Gallons Of Biodiesel Produced/Day**

Since one ton $CO_2$/Day produces 0.682 Tons of Spirulina microalgae, 108.3 Tons $CO_2$/Day produces 108.3 x 0.682 = 73.86 additional tons of Spirulina microalgae increasing its production from 295.5 Tons/Day to 369.4 Tons/Day.

**58.5 Tons $CH_4$/Day plus 38.6 Tons $CH_4$/Day = 97.1 Tons $CH_4$ Produced/Day From Biodiesel Production**

Since one ton $CO_2$/Day produces 0.04 tons biodiesel/day, 121.8 Tons $CO_2$/Day produces 121.8 x 0.04 tons = 4.87 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 4.87 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 11,073 gallons/day.

Since each gallon of biodiesel produced generates 21.12 lbs of volatile solids, 11,073 gallons x 21.12 = 233,856 lbs. Volatile Solids/Day. 233,856 lbs Volatile Solids/Day ÷ 2,000 lbs/Ton = 116.9 Tons Volatile Solids/Day. The 116.9 Tons Volatile Solids/Day from biodiesel production can be converted into $CO_2$ production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs $CO_2$ produced or 116.9 Tons VS/Day x 2,000 lbs/Ton x 12 = 2,806,272 cu. ft. $CH_4$/Day. 2,806,272 cu. ft. ÷ 24 cu. ft./lb = 116,928 lbs $CH_4$/Day. 116,928 lbs $CH_4$/Day x 1.375 = 160,776 lbs $CO_2$/Day. 160,776 lbs $CO_2$/Day ÷ 2,000 lbs/Ton = 80.4 Tons $CO_2$/Day.

Since one ton $CO_2$/Day produces 0.04 tons biodiesel/day, 80.4 Tons $CO_2$/Day produces 80.4 x 0.04 tons = 3.22 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 3.22 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 7,308 gallons biodiesel/day thus increasing biodiesel production from 11,073 GPD to 18,381 GPD.

Since the basic waste-to-energy process fully satisfies electricity demand the excess methane gas will be beneficially used for:

1. The production of methanol through syngas technology that is used as a required feedstock in the production of biodiesel biofuel,
2. The production and sale of compressed natural gas (CNG) biofuel surface transportation fuel, and
3. The production and sale of renewable natural gas biofuel to the marketplace.

## Pig and Tilapia Fish Feed Requirements:

The 10,000 sow operation will produce 75.34 Tons/Day of finished hogs. It takes about 1.2 lbs of feed to increase a pig's weight by 1.0 pound. The 75.34 Tons of finished hogs will require 75.34 x 1.2 or 90.41 Tons of feed per Day. The production of tilapia fish is 335 Tons/Day. It takes about 1.2 lbs of feed to increase the fish weight by 1.0 pound. The 335 Tons of finished fish will require 335 x 1.2 or 402 Tons of feed per Day. Combined feed requirements are 90.41 + 402 = 492.4 Tons feed/Day. Spirulina microalgae production at 332 Tons feed/Day will mostly satisfy pig and tilapia fish feed requirements. As the MSW volume increases the volume of Spirulina microalgae will automatically increases. It won't take much of an increase in MSW volume to fully satisfy total feed requirements.

If the percentage of Spirulina microalgae use is changed from 75%-25% to 90%-10% sufficient feed would be produced at the expense of reducing the production of biodiesel. The preferred initiative is to increase collection of MSW biowastes by excavating area landfills and dumps for the purpose of treating their contents with two-phase anaerobic digestion to increase the associated production of Spirulina microalgae. In so doing, the volume of biodiesel production could remain the same.

| | | |
|---|---|---|
| Subtotal Methane ($CH_4$) Gas Production From Municipal Solid Wastes (MSW): | | |
| | 60 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 1,440,000 cu. ft./Day. 1,440,000 cu. ft. $CH_4$/Day ÷ 24 lbs/cu. ft. = 60,000 lbs. 60,000 lbs ÷ 2,000 lbs/Ton = 30 Tons $CH_4$/Day | 1,440,000 cu. ft. $CH_4$/Day = 30 Tons $CH_4$/Day From MSW |
| | | |
| Subtotal Methane ($CH_4$) Gas Production From Biodiesel Processing Wastes: | | |
| | 4,659,366 cu. ft. $CH_4$/Day ÷ 24 cu. ft./lb = 194,140 lbs. 194,140 lbs ÷ 2,000 lbs/Ton = 97.1 Tons $CH_4$/Day | 97.1 Tons $CH_4$/Day From Biodiesel Wastes |
| Subtotal Methane ($CH_4$) Gas Production From Pig Farming Wastes: | | |
| | 27 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = | 648,000 cu. ft. |

| | | |
|---|---|---|
| | 648,000 cu. ft./Day. 648,000 cu. ft. $CH_4$/Day ÷ 24 lbs/cu. ft. = 27,000 lbs. 27,000 lbs ÷ 2,000 lbs/Ton = 13.5 Tons $CH_4$/Day | $CH_4$/Day = 13.5 Tons $CH_4$/Day From Pig Farming Wastes |
| **Subtotal Methane ($CH_4$) Gas Production From Pork Processing Wastes:** | | |
| | 22.6 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 542,400 cu. ft./Day. 542,400 cu. ft. $CH_4$/Day ÷ 24 lbs/cu. ft. = 22,600 lbs. 22,600 lbs ÷ 2,000 lbs/Ton = 11.3 Tons $CH_4$/Day | 542,400 cu. ft. $CH_4$/Day = 11.3 Tons $CH_4$/Day From Pork Processing Wastes |
| **Subtotal Methane ($CH_4$) Gas Production From Tilapia Fish Farming Wastes:** | | |
| | 1.4 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 33,600 cu. ft./Day. 33,600 cu. ft. $CH_4$/Day ÷ 24 lbs/cu. ft. = 1,400 lbs. 1,400 lbs ÷ 2,000 lbs/Ton = 0.7 Tons $CH_4$/Day | 33,600 cu. ft. $CH_4$/Day = 0.7 Tons $CH_4$/Day From Tilapia Fish Farming Wastes |
| **Subtotal Methane ($CH_4$) Gas Production From Tilapia Fish Processing Wastes:** | | |
| | 194.5 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 4,668,000 cu. ft./Day. 4,668,000 cu. ft. $CH_4$/Day ÷ 24 lbs/cu. ft. = 194,500 lbs. 194,500 lbs ÷ 2,000 lbs/Ton = 97.3 Tons $CH_4$/Day | 4,668,000 cu. ft. $CH_4$/Day = 97.3 Tons $CH_4$/Day From Tilapia Fish Processing Wastes |
| | | |
| **Total Methane ($CH_4$) Gas Generation from all sources:** | | 249.9 Tons $CH_4$/Day |
| | | |
| **OAT Process Power Generation Potential:** | | |
| | | |
| | 249.9 Tons $CH_4$/Day x 2,000 lbs/Ton = 499,800 lbs/Day. 499,800 lbs/Day x 24 cu. ft./lb = 11,995,200 cu. ft./Day. 11,995,200 cu. ft./Day ÷ 83,780 cu. ft./MW = 143 MW. 143 MW less 15% parasitic digester plant use = 122 MW Net | 122 MW Net |
| | | |
| | **Two-Phase Anaerobic Digester Size Calculations:** | |
| | Volatile Solids = 249.9 Tons/Day x 2,000 lbs/Ton = 499,800 lbs/Day | |
| | VS:COD = 1:2, COD = 999,600 lbs/Day | |
| | Organic Loading lbs COD/Day/Cubic Foot = 6 | |
| | Digester Size = 999,600/6 = 166,600 Cubic Feet | |
| | Digester Size In Gallons = 1,246,335 Gallons | |
| | Safety Factor = 1.5 | |
| | Digester Size = 1,869,502 Gallons (120' x 120' x 20'H) | |
| | Estimated Constructed Cost At US$40/Gallon = $74,780,080 | |
| | | |
| | Building Size: 1 km (3,280') x 1 km (3,280') x 3 - 50' stories high w/3 side double wall construction to accommodate photobioreactor and employee housing = 50,000,000 total sq. ft. of precast concrete construction estimated @ US$1.50/sq. ft. = US$75,000,000. Project building will manufacture its own cement and will purchase a ready mix plant (3 concrete delivery/mixer trucks) to minimize precast concrete panel construction costs. | |
| | Remanufactured 300Tons/Day Cement Kiln Purchase Cost = US$12,000,000 | |
| | Remanufactured Ready Mix Batch Plant Purchase Cost = US$3,000,000 | |
| | | |
| | Photobioreactor: 2,200,000 foot long 12"Ø Clear PVC schedule 40 pipe = US$100,000,000 to includes ultra high efficiency long lasting (10 years +) light emitting diode (LED) lighting for photosynthesis @ US$10,000,000 Electricity requirements = 6.0 MW | |
| | | |
| | 10 MGY Biodiesel Manufacturing Equipment Cost Estimate: US$15,000,000. | |

| | | | |
|---|---|---|---|
| | **Electricity Requirements = 0.5 MW** | | |
| | | | |
| | **Two (2) 110 GPM 4:2:1 Array Reverse Osmosis Equipment Cost Estimate: US$2,000,000** | | |
| | | | |
| | **Digester Equalization Feed Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity** | | |
| | | | |
| | **Potable Water Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity** | | |
| | | | |
| | **Anaerobic Digester Feed Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity** | | |
| | | | |
| | **Liquefied Nitrogen Storage Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity** | | |
| | | | |
| | **Liquefied Natural Gas (LNG) Storage Tank Cost Estimate: $2,500,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity** | | |
| | | | |
| | **EAF Steel Recycling Process Equipment Cost: US$3,000,000** | | |
| | | | |
| | **12,000,000 CFD Compressed Methane Gas (CNG) Equipment Cost Estimate = US$10,000,000. Electricity Requirements = 2 MW** | | |
| | | | |
| | **221 Ton/Day Liquefied Nitrogen Air Separation Equipment Cost Estimate: $20,000,000. Electricity Requirements = 10 MW** | | |
| | | **Liquefied Nitrogen Delivery Equipment: US$500,000** | |
| | | | |
| | **10,000 Sows Procurement Cost Estimate @ US$500/Sow = US$5,000,000** | | |
| | | **220,000 pigs/year (603 pigs/day) Swine Processing Equipment Cost Estimate: US$5,000,000** | |
| | | | |
| | **51.5 MW Natural Gas Fueled Combined Cycle Power Generation Equipment @ US$1,260/kW = 51,500 kW x US$1,100 = US$65,000,000** | | |
| | | | |
| | **Total Electricity Generation Requirements:** | | |
| | | **For each project building: 51.5 MW (includes projected demand for the next 20 years** | |
| | | **For Photobiorector = 6.0 MW** | |
| | | **For Compressed Natural Gas (CNG) = 2 MW** | |
| | | **For Liquefied Nitrogen (LN2)(LIN) = 10 MW** | |
| | | **For Liquefied Oxygen = Included with Liquefied Nitrogen** | |
| | | **For Tilapia Farming = 0.5 MW** | |
| | | **For Pig Farming = 2 MW** | |
| | | **For General Building use = 2 MW** | |
| | | **Total Electricity Installed Capacity Requirements = 51.5 MW** | |
| | | | |
| | **122 MW potential less 51.5 MW used = 70.5 MW remaining. At 83,779 cu. ft./MW, 83,779 cu. ft. x 70.5 MW = 5,906,420 cu. ft./Day available to marketplace at US$0.70/126.67 cu. ft. or US$32,640/Day as CNG automotive fuel. If sold to a natural gas pipeline the revenue would be slightly less by about 10%. If Argentina increases the marketplace price of natural gas some sales to natural** | | |

| | | |
|---|---|---|
| | gas pipelines would be considered. | |
| | | |
| **Schedule of Project Construction Costs:** | | |
| | **Anaerobic Digester Feed Tank: US$2,000,000** | |
| | **Biodiesel Manufacturing Equipment: US$15,000,000** | |
| | **Building Size: 1 km x 1 km x 3 Stories High Constructed Cost: US$75,000,000** | |
| | **Cement Kiln Constructed Cost: US$12,000,000** | |
| | **Concrete Ready Mix Plant Constructed Cost = US$3,000,000** | |
| | **EAF Steel Recycling Process Equipment Constructed Cost: US$3,000,000** | |
| | **LED Lighting Purchase Cost: US$10,000,000** | |
| | **Liquefied Natural Gas (LNG) Storage Tank: US$2,500,000** | |
| | **Liquefied Nitrogen Air Separation Equipment: US$15,000,000** | |
| | **Liquefied Nitrogen Delivery Equipment: US$500,000** | |
| | **Liquefied Nitrogen Storage Tank: US$2,000,000** | |
| | **Methane Compression Equipment: US$10,000,000** | |
| | **Photobioreactor: US$100,000,000** | |
| | **Potable Water Storage Tank Constructed Cost: US$2,000,000** | |
| | **Power Generation Equipment: US$56,650,000** | |
| | **Reverse Osmosis Equipment: US$2,000,000** | |
| | **Sow Procurement Costs: US$5,000,000**<br>**Electricity Requirements = 2.0 MW** | |
| | **Tilapia Fish Farming Acreage: 50 hectares x 24' H**<br>**Tilapia Fish Farming Production: lbs/day = 281,400 of tilapia filets**<br>**Tilapia Fish Farming Electricity Requirements = 0.5 MW**<br>**Fish Processing Equipment: US$500,000** | |
| | **Two-Phase Anaerobic Digester: US$37,390,000** | |
| | **Subtotal Project Construction Costs: US$353,540,000** | |
| | **Add 15% Contingencies @ 53,031,000 = US$406,571,000** | |
| | **Total Project Construction Costs:** | **US$443,961,080** |
| | | |
| **Project Visible Cash Flow Revenue Streams:** | | |
| | **From Sanitary Wastewater – US$0.00** | |
| | **From Municipal Solid Wastes – US$0.00** | |
| | **From Agro Wastes – US$0.00** | |
| | **From Animal Wastes – US0.00** | |
| | **From Electricity: 44 MW x 24 = 720 MWh/Day @ US$45.00/MWh = US$47,520/Day. This amount of electricity generation will provide the average demand load of the participating communities for the next 20 years.** | **US$47,520/Day** |
| | **From Biodiesel: 18,381 GPD always priced at 80% of existing marketplace retail. Current retail is US$1.67/gallon. US$1.67 x 80% = US$1.34. 18,381 x US$1.34 = US$24,630/Day.** | **US$24,630/Day** |
| | **From Liquefied Nitrogen (LN2)(LIN): 244,003 GPD priced at US$0.50/gallon = US$122,000.00/Day.** | **US$122,000/Day** |
| | **From Compressed Natural Gas (CNG) Fuel:** | **US$32,640/Day** |
| | **From Processed Pork Exports: Retail pork prices are currently around US$2.87/lb. The wholesale producer receives about 43% of this price or US$1.46/lb. The above prices represent the average for the last 3 years. As a commodity there is no guarantee they will drift up or down but will likely continue to fluctuate as they have been for the last 50 years. Current marketplace dressed pork yields are over 2,750 lbs/year/sow. A 10,000 sow farrow-to-finish operation is estimated to produce 27,500,000 lbs of dressed** | |

| | | | |
|---|---|---|---|
| | **pork/year or an average of 75,342 lbs/Day. At US$1.46/lb the daily revenue is estimated at US$110,000.00.** | | **US$110,000/Day** |
| | **From Fresh Tilapia Filet Exports: US$613,452 at a sell price of US$2.18/lb** | | **US$613,452/Day** |
| | **Renewable Energy and other Credits based on estimated 36 MW Project Power Generation:** | | |
| | | **One Certified Emission Reduction Credit = 1 Tonne $CO_2$ Reduction. 51.5 MW Project Power Production x 24 hour/Day = 1,236 MWh/Day. 1,236 MWh/Day x 1,100 lbs $CO_2$ Reduction (using natural gas)/MWh ÷ 2,000 lbs/Ton = 680 Tons/Day = 248,000 T/Year x 2,000/2,204 = 225,226 Tonnes/Year @ US$20 (range of US$20-US$40) = US$4,504,000/Year ÷ 365 = US$12,341/Day for years 2008-2012 delivery.** | **US$12,341/Day** |
| **Total Project Revenue Streams:** | | | **US$962,583/Day** |
| | | | |
| **To the extent that electricity is generated, the combustion off gases ($CO_2$, NOx, $N_2$, and H2O) will be entirely used for Spirulina microalgae production. After Spirulina microalgae production has occurred the remaining Nitrogen gas ($N_2$) will be liquefied and sold to the marketplace. The remaining $N_2$ gas stream will also contain Oxygen gas ($O_2$) due to the respiration of microalgae during their production in the same manner that trees and plants give off oxygen. This oxygen will be simultaneously liquefied during the liquefaction of $N_2$ and subsequently distilled off, compressed, and subsequently used internally as a welding gas, to enhance cement manufacturing, to enhance fish farming, and for smelting iron into steel. Some of the Nitrogen Gas will be used as a protective blanket gas in the production of methanol through syngas technology. The methanol is produced as a required feedstock in the production of biodiesel.** | | | |

**Additional Notes:**

1. **Land Requirements: Estimate 300 hectare**

2. **Time to design-build-install-operate is estimated at 36 months.**

3. **Lighting for tilapia must be a daily cycle of:**
   **7.5 hours of total darkness**
   **0.5 hours of sunrise (begins at 6 a.m. w/3 ft-candles)**
   **15.5 hours of daylight (max 10 ft-candles)**
   **0.5 hours of sunset (begins at 10 p.m. w/3 ft-candles)**

4. **Sufficient building room remains to add a 10,000 beef cattle operation, a 10,000 milker dairy farm, and significant poultry operations along with all of the associated processing equipment to produce value added products consisting of dressed beef, milk, and other dairy products, broilers, and eggs. All of these activities represent future economic development activities.**

# PROJECT KEY PROFESSIONAL STAFF

## *Curriculum Vitae*

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***Employee:* C.G. (Chuck) Steiner, BS, JD**

***Education***

St. John's University, Collegeville, Minnesota. B.S. Degree in Chemistry, 1959

Wm. Mitchell College of Law, St. Paul, Minnesota. J.D. Degree in Law, 1969

***Publications***

Steiner, C. G., "Take a New Look at the RBS Process, "Water & Wastes Eng., 41, (May, 1979)

Steiner, C. G., "The Biological Approach to the Rotating Disc Process," Presented at the First National Symposium on Rotating Biological Contractor Technology at the Seven Springs Mountain Resort, Champion, PA, (February 4-5, 1980).

Steiner, C. G., "A Primer on Separators and Particle Separation", Pollution Equipment News, Vol.18, No.3, (June, 1985).

Steiner, C. G., "Plate Separation--Budding Conventional Technology?", WATER/Engineering & Management, (March, 1986).

Steiner, C. G., WSE Publication No. 380, "Silica Contamination Removal From Spent Fuel Pools And Refueling Water Storage Tanks At Nuclear PWR Power Generation Plants", (June 1993).

Steiner, C. G., "Advanced Aqueous Waste Treatment Concepts", Presented at the Environmental Management and Technology Conference & Exhibition International at Atlantic City, NJ, (June 9-11, 1993).

Steiner, C. G., WSE Publication No. 394, "A Historical Review of Oil/Water Separator Designs", (March 1994).

Steiner, C. G., WSE Publication No. 796, "Design Manual and Tutorial – Particle/Liquid Separation Systems", (May, 1996).

Steiner, C. G., "Energy From Wastes", Asia Water, (October, 1999).

Steiner, C. G., "Understanding Anaerobic Treatment", Pollution Engineering, (February, 2000).

Steiner, C. G., "Biofuels For Energy Independence", REFOCUS, (March/April, 2003).

Steiner, C. G., "Kyoto Protocol-compliant waste-to-renewable energy with zero air, water, and solids pollution", The Bulletin on Energy Efficiency, (December, 2004).

Steiner, C. G., "Waste-to-Energy Plan", Pollution Engineering, (March, 2005).

Steiner, C. G., "Biodiesel – The Probable Only Fuel of the Future, Renewable or Otherwise", Earthtoys - Emagazine, (October, 2005).

Steiner, C. G., "Economic Development Through Biomass Waste-To-Energy Technology", Earthtoys - Emagazine, (December, 2005).

Steiner, C. G., "Energy Independence For Everyone, To Include Food, Natural Gas, Biodiesel, And Water As Well", The Bulletin on Energy Efficiency, (December, 2005).

Steiner, C. G., "THERE'S GOLD IN THEM THAR WASTE HILLS", Earthtoys - Emagazine, (April, 2006).

Steiner, C.G., "Reversing Global Warming Through A Worldwide Waste-To-Energy Policy", Earthtoys - Emagazine, (October, 2006).

Steiner, C. G., "**SuperGreen** Buildings Technology With Zero Greenhouse Gas (GHG) Emissions To The Environment", Earthtoys - Emagazine, (December, 2006).

Steiner, C. G., "**SuperGreen™**, Self-Fueled, Double Hull, **Dual-Biofuel™** Powered SuperStrong Concrete Barges and Ships That Exhibit Zero Greenhouse Gas (GHG) Emissions and Include Onboard Ballast Water Treatment", Earthtoys - Emagazine, (February, 2007).

***Patents***

Two-Phase Anaerobic Digestion Process Utilizing Thermophilic Fixed Growth Bacteria (US Patent No. 5,630,942)

**Certifications**

40 Hour OSHA Course, 1990-1997

***Memberships***

American Council On **Renewable Energy**

American Institute of Chemist (Professional Chemist - Accredited)

American Meat Institute

American Society for Testing and Materials

American Water Works Association

Global Village Energy Partnership

Incinerator Institute of America, Member T-6 Testing Committee

National Air Pollution Control Association

National Canners Association

USEPA Combined Heat and Power (CHP) Partnership

Wastewater Equipment Manufacturers Association

Water Environment Federation

***Experience Summary***

Thirty Five years in design, marketing, new product development, plant operation, and general management of water purification equipment manufacturing and supply.

***Employment History***

President, Chief Executive Officer, and Principal Scientist of WaterSmart Environmental, Inc., a manufacturer of water and wastewater treatment equipment and a worldwide provider of next generation waste-to-**renewable energy** and other climate change technologies.

Chief Process Engineer for Smith & Loveless, Inc., a manufacturer of water and wastewater treatment equipment.

Product Manager for Pielkenroad Separator Company, a manufacturer of particle/liquid separation equipment.

Director of Environmental Services for Geo. A. Hormel & Company with P&L responsibility over its two pollution control equipment manufacturing divisions.

Director of Marketing for Cherne Industrial, Inc., a national supplier of packaged laboratories for the water and wastewater treatment industry.

Director of Environmental Control for Fire Engineers, Inc., a manufacturer of solid waste disposal incinerators.

Department Manager for Twin City Testing & Engineering Laboratories, Inc., a large regional independent testing laboratory.

Chief Analytical Chemist for Federal Cartridge Corporation, a munitions manufacturer.

R&D Chemist for 3M Company, a diversified manufacturer.