



**United States Department of Agriculture
Rural Development**

September 23, 2011

SUBJECT: Finding of No Significant Impact (FONSI)
LanzaTech Freedom Pines Biorefinery
Soperton, Georgia

DESCRIPTION OF ACTION

The U.S. Department of Agriculture, Rural Business-Cooperative Service (RBS) has received an application to transfer a lender guarantee and new plant operator for an existing loan guarantee provided under the RBS 9003 Biorefinery Assistance Program. The proposed transfer of the guarantee is for retrofit actions and operations to produce advanced biofuels at the site of the existing Range Fuels biofuels facility in Treutlen County, Georgia. The applicant proposes to modify existing processes and add some additional facilities there to process woody biomass and produce approximately 2 million gallons of ethanol and 3-7,000 pounds of butanediol (2,3-BDO) annually; the production of which would help meet the national goal for renewable fuel standard production of 36 billion gallons of renewable fuels by 2022 established by the Energy Independence and Security Act of 2007.

The environmental analysis of this proposed action are contained in a Supplemental Environmental Assessment (EA) adopted by RBS in 2009; an EA prepared by the Department of Energy (DOE) in 2007; a comparative analysis of the proposed changes are summarized in Attachment 1.

LanzaTech proposes to modify and add to existing facilities to operate a cellulosic biofuels facility on the site of the existing Range Fuels biofuel plant, a site of 281 acres located two miles north of Soperton, Georgia. The feedstock LanzaTech will use is woody biomass which is available within a 50 mile radius of the plant. The processing technology will be a hybrid approach of using Range Fuels syngas production facility with syngas fermentation from using a LanzaTech proprietary microbe, process, and bioreactor design. The existing Range Fuels facilities for feedstock handling, drying, and reactor devolatilization will be used at the site. In addition, existing utility systems, water supply, natural gas, electricity and wastewater treatment will be used.

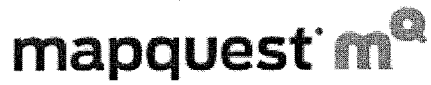
This proposal, modification and operation of an advanced biofuels facility, does not pose significant adverse effects to the natural or human environment.

1400 Independence Ave, S.W. Washington, DC 20250-0700
Web: <http://www.rurdev.usda.gov>

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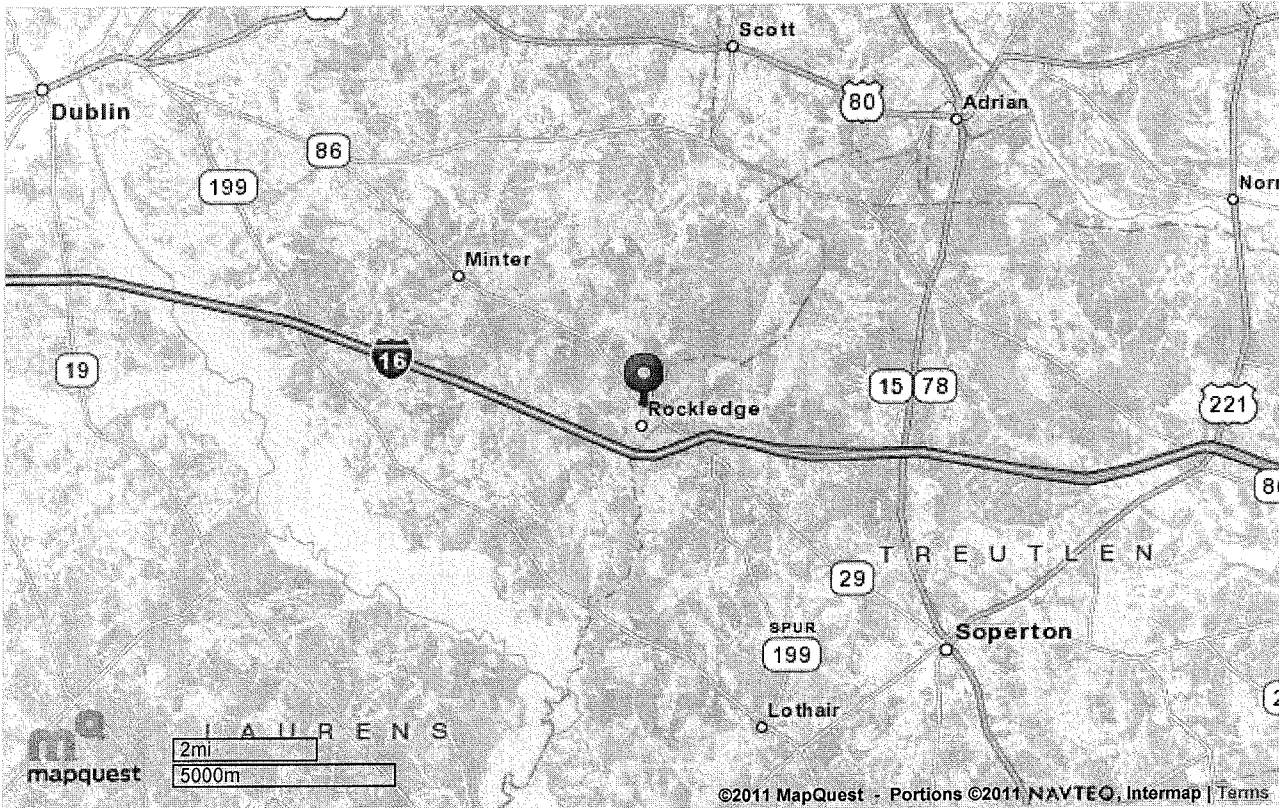
Attachment 1



Map of:
Soperton, GA 30457-5270

Notes

LanzaTech Site (926 Commerce Drive)



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Range Fuels Soperton Plant, Soperton, Georgia
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Save Date: 9/20/11 By: Korinek, Susanne File Location: \\Seasrv01\eng\1A - Process Solutions\11-30224_LanzaTech\Drawings\General\G-002.dwg

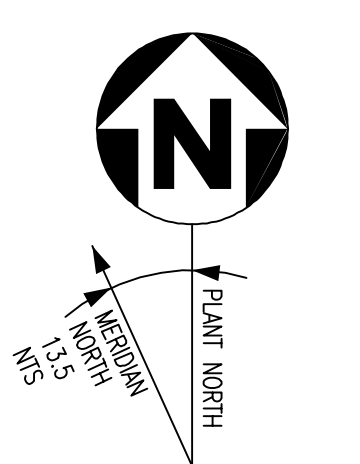
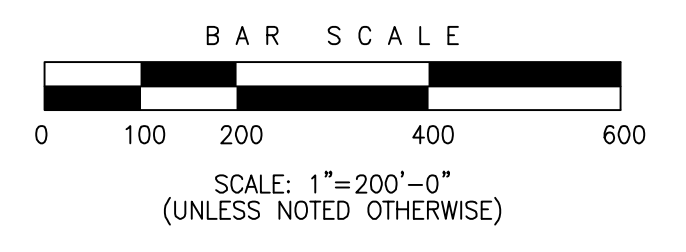


GENERAL NOTES

- 1. NOT USED.

KEYED NOTES

- ① NOT USED.



PRELIMINARY - NOT FOR CONSTRUCTION

Reference Drawings				Revisions				Revisions					
Drawing No	Title	Rev	Date	By	Description	Rev	Date	By	Description	Rev	Date	App'd	Client Approval Milestone
		A	09/20/11	DGT	ISSUED FOR PRELIMINARY REVIEW								



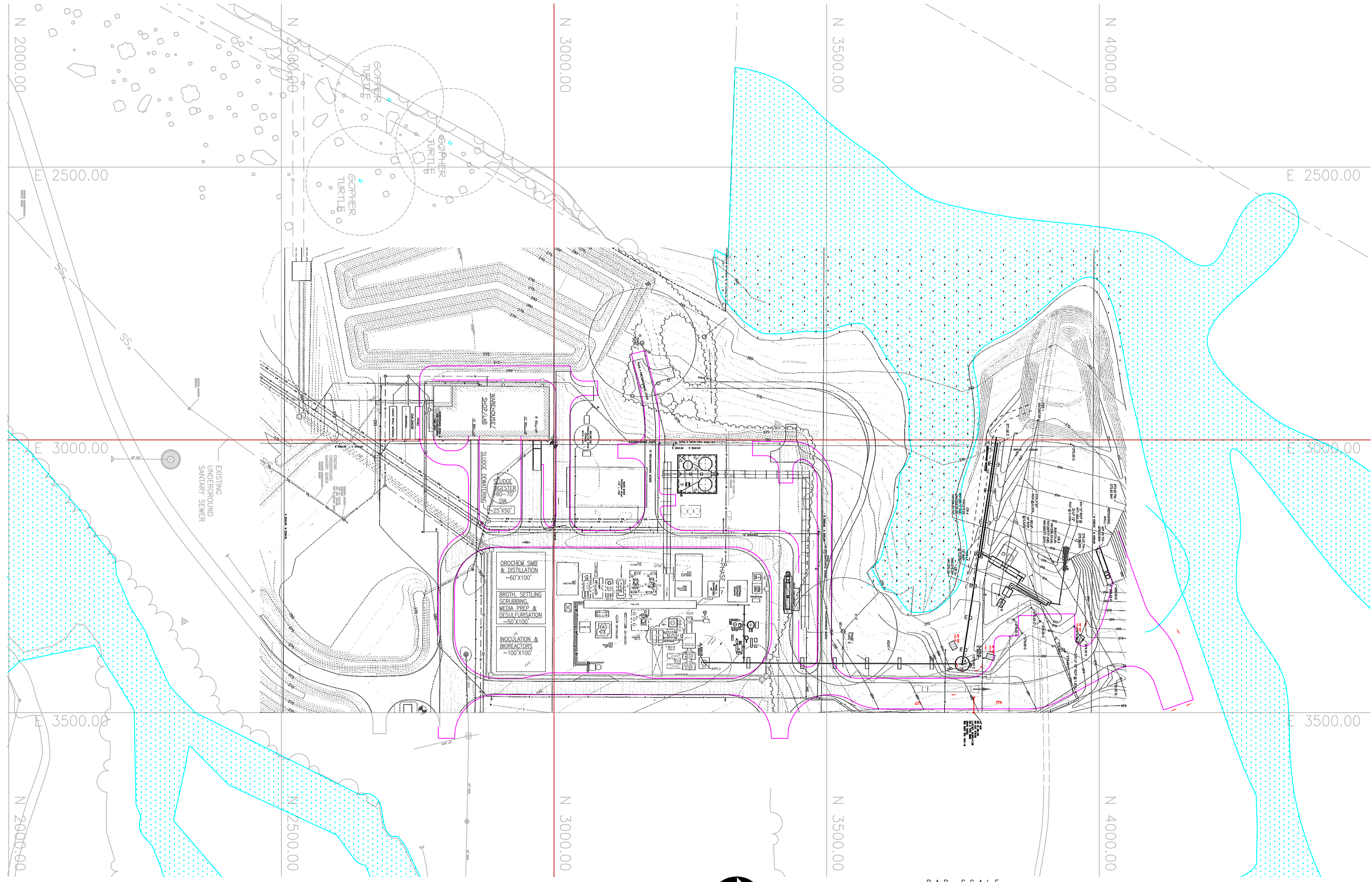
**SITE
GENERAL ARRANGEMENT
WETLANDS LOCATION**

125 TPD SOPERTON PLANT

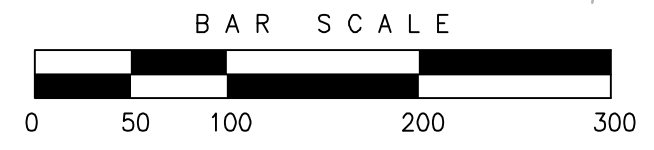
Project No: 30224.00	Drawing: G-002	Rev: A
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Subconsultant:
Drawn: SKK
Engr: PWS
Appr:
Check:
Check: DGT
PMgr: DGT

File Location: \\Seasrv01\eng\1A - Process Solutions\11-30224_Lanzatech\Drawings\General\G-003.dwg
 Save Date: 9/20/11 By: Korinek,Susanne



PLAN
 SCALE: 1" = 100'-0"



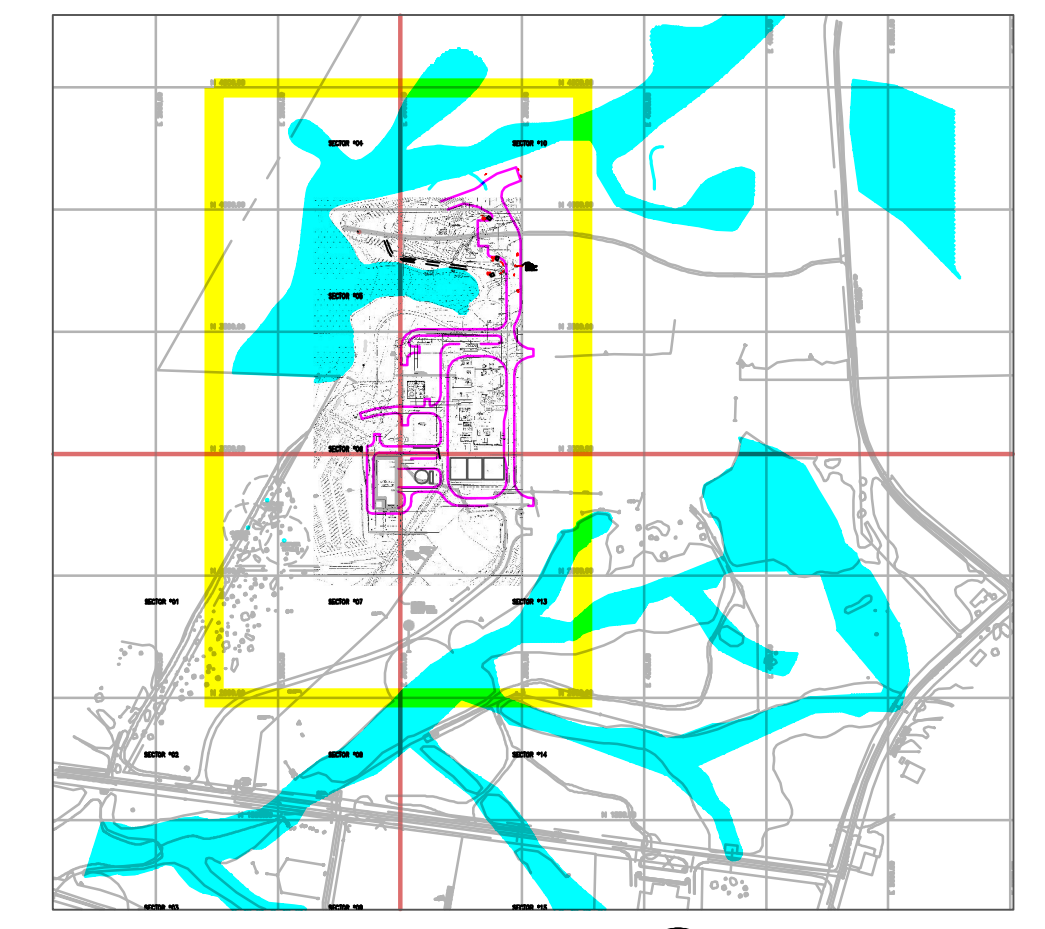
SCALE: 1" = 100'-0"
 (UNLESS NOTED OTHERWISE)

GENERAL NOTES

- 1. NOT USED.

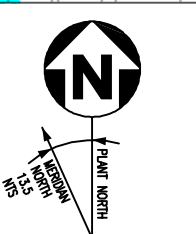
KEYED NOTES

- ① NOT USED.



KEY PLAN

SCALE: NONE



PRELIMINARY - NOT FOR CONSTRUCTION

Reference Drawings				Revisions				Revisions					
Drawing No	Title	Rev	Date	By	Description	Rev	Date	By	Description	Rev	Date	By	Description
		A	09/20/11	DGT	ISSUED FOR PRELIMINARY REVIEW								

LanzaTech

Rev Date App'd Client Approval Milestone

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Subconsultant:
 Drawn: SKK
 Engr: PWS
 Appr:
 Check:
 Check:
 PMgr: DGT

SITE GENERAL ARRANGEMENT WETLANDS LOCATION SHT. 2 OF 2

125 TPD SOPERTON PLANT

Project No: 30224.00
 Drawing: G-003
 Rev: A

**Side-by-Side Environmental Impact Comparison - Range Fuels vs. LanzaTech
(Tab "Inputs and Outputs" provides summary comparison of input/output streams)**

Existing Environment (See excerpt from EA for more detail)	Consequences of Range Fuels Construction and Operation	Differences in LanzaTech Construction and Operation
1. Land Use		
<p>The county is rural with forestry and some agricultural uses. Forestry accounts for 80% of the county's land use. The facility is located 2 miles northwest of Soperton in an Industrial Park occupied by 7 other commercial operations. The majority of the site was previously cleared and consists of old field plant communities, streams, and wetlands. Buffer areas around streams and wetlands were not cleared and contain mature deciduous trees.</p>	<p>Create 12.8 acres of impervious surface and 1.3 acres of planned paved road. Would not change intended industrial use of land and would have negligible impact on forest land in Treutlen county.</p>	<p>LanzaTech units are within Range Fuels' planned area of impervious surface and no paved road required.</p>
2. Geomorphology, Geology, Seismic Hazard, and Soils		
<p>The topography at the site ranges from 250 to 320 feet above average mean sea level (AMSL). Four soil series occur within the proposed project area: Gilead, Lakeland, Norfolk, and Plummer. The Gilead and Norfolk Series cover the majority of the proposed project area. The Gilead Series consists of moderately well drained, firm, clayey soils found in the upper coastal plain and has moderately slow permeability. Two soil types from the Norfolk soil series (Norfolk loamy sand with 2 to 5 percent slopes and Norfolk loamy sand with 2 to 5 percent slopes, eroded) that are designated as prime farmland by the NRCS occur on the proposed project site (Alex Comegys - NRCS personal communication, July 20, 2007). Based on review of the Treutlen County, Georgia Soil Survey, these soils</p>	<p>Minimal impact on geomorphology. Low risk for earthquake. New disturbance to ~48.3 acres of soils. Negligible impact on prime farmland.</p>	<p>Reduced area of soil disturbance.</p>
3. Hydrology		

<p>Surface Water: There are three unnamed streams within the Range Fuels site. The primary stream is approximately 2 feet wide. This stream flows from the northeast to the southwest and is joined by two additional unnamed streams within the property. One of the tributary streams is a perennial stream that originates offsite and the other is an intermittent stream that flows only in response to an offsite water discharge. The primary drainage on the property originates from farm ponds offsite, with additional flows provided by a spring/ seep in the north-eastern portion of the property. There are no Federal Emergency Management Agency (FEMA) designated floodplains or floodways on the site (Treutlen County, 2006).</p> <p>Groundwater: Several aquifers underlie the lower half of the Oconee River basin in Treutlen County, which includes the Range Fuels site. The only aquifer that receives recharge in Treutlen County is the surficial aquifer, and this recharge area is more than 5 miles away from the site.</p>	<p>No encroachment on surface waters or existing buffers. Potential soil disturbance during construction, with possible modified surface water runoff patterns. Mitigated through use of construction and post-construction BMPs. Planned groundwater withdrawal of 316,800 gpd would have minimal impact on other groundwater users.</p>	<p>Water supplied by City of Soperton; no need for additional groundwater withdrawals.</p>
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4 **4. Water Quality**

<p>The 303(d) List of Waters reports on streams and lakes identified as impaired for one or more pollutants and do not meet one or more water quality standards. There are no 303(d) (DNR, 2007) listed segments of impaired waters near the project area. Because there would be no changes in harvest site runoff characteristics following removal of feedstock, there would be no impacts to water quality resulting from the purchase of feedstock materials.</p>	<p>Impact of runoff during construction mitigated by BMPs. Post-construction, impact of additional impervious surfaces expected to have no direct impacts to existing stream and wetland buffers.</p> <p>Post-construction grading and detention pond to contain or treat stormwater. Facility SPCC plan to minimize potential impacts to surficial aquifer due to hazardous material release.</p>	<p>Unchanged. See Table 4-1 for specifics.</p>
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5 **5. Wetlands**

<p>Approximately 18 acres of forested wetlands have been identified on the project site within the Industrial Park. Approximately 90 percent of the wetlands on the site are within a forested area immediately adjacent to perennial and intermittent streams that bisect the property, extending 30 to 100 feet to either side of the stream channel. The remaining 10 percent of onsite wetlands are emergent wetlands located in the eastern portion of the parcel that would remain undeveloped. Additional wetlands are located on the parcel adjacent to the Industrial Park that would contain the chipper. This parcel contains two small forested wetlands. Both wetland areas are located outside of the area proposed for the chipper, storage areas, and truck travel.</p>	<p>Layout of Range plant and supporting infrastructure avoided encroachment on wetlands and associated buffers. No long term negative impacts to wetland hydrology from replacement of the culvert.</p> <p>Encroachment into two wetlands totaling 0.61 acres were self-reported and addressed in Supplemental EA. The encroachments were found to have negligible temporary impacts to hydrology. With purchase of mitigation credits, the encroachments considered to have no net impacts on the wetland.</p>	<p>Unchanged. Facility will remain within planned footprint.</p>
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6. Biological Resources

<p>The facility site includes 6 parcels totaling approximately 275.1 acres. Approximately 67.4 of the 275.1 acres would be developed for the project and the remaining acreage would be kept as natural and landscaped greenspace. The main facility site would cover 115.7 acres, much of which has been previously cleared. Within the previously cleared areas, much of the northern and western areas of the site are vegetated with native grasses, dominated by brooms edge, while the southern and eastern portions of the site are predominantly bare dirt. The areas surrounding wetlands and streams on the parcel were not cleared and a 30- to 100-foot wide strip of mature trees remains around the streams and wetlands. These forested areas are dominated by hardwoods (red maple, magnolia, sweet gum and willow oak). It is expected that the site and the surrounding areas would contain a variety of common small animals including field mice, armadillos, opossums, foxes, rabbits, snakes and squirrels, as well as a variety of birds typical of the upper coastal plain of Georgia in forested areas. The northwestern and western perimeter</p>	<p>Possible minor impacts to biological resources and habitat quality. Displacement of animals during construction mitigated by ability to migrate to adjacent habitat via preserved riparian corridors and forest habitat. Activity during operations would have negligible impact on regional populations. Feedstock is normally removed from harvest sites before replanting and therefore does not provide habitat for nearby animals.</p>	<p>Unchanged.</p>
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7	7. Protected Species		
	<p>CH2M HILL conducted multiple site visits in the spring and summer of 2007 to assess the site for protected species. No federally protected species were identified during these site visits. Habitat and evidence of the presence for gopher tortoise, state listed as threatened, were identified. None of the other protected</p>	<p>Gopher tortoise burrows were identified. A gopher tortoise relocation program was implemented and exclusion fences constructed. Range agreed to notify USFWS if Indigo Snakes were found. No known instances of federally protected</p>	<p>Unchanged.</p>
8	8. Safety and Occupational Health		
	<p>Firefighting services currently are provided for the Industrial Park by the Soperton Fire Department, located in downtown Soperton approximately three miles from the proposed plant. Police services at the proposed plant would be provided by the Treutlen County Sheriff's Office in Soperton. Medical services, including emergency rooms, are available at the Fairview Park Hospital in Dublin, Meadows Regional Medical Center in Vidalia, and Emanuel Medical Center, in Swainsboro, approximately 26, 21, and 25 miles, respectively, from the proposed plant.</p>	<p>Hazards result from high temperature and pressure operations, and from toxic and flammable materials. Hazards addressed in site safety plan.</p>	<p>Hazards from high temperature and pressure operations reduced.</p> <p>Significant reduction in hazard from 2,3-BDO product compared to methanol. Ethanol product unchanged. See Tables 8-1, 8-2 for details.</p> <p>See Attachment 2 regarding microbe safety.</p>
9	9. Noise		
	<p>Noise, in the context of this analysis, refers to sounds generated by activities that could affect employees of the facility, employees of nearby commercial operations, residents near the proposed facility, or wildlife. Noise levels within the Treutlen County Industrial Park are variable, depending on truck and train traffic in the area. While no specific data have been compiled for the Treutlen County Industrial Park, background noise levels in these areas would be expected to range from 40 db, to 75 dBa, with occasional upward spikes related to rail and road traffic.</p>	<p>Construction noise limited to daylight hours. Staff to use hearing protection and follow OSHA standards. Operational noise primarily due to chipping. No adverse impacts to outdoor or indoor activities in local residences. Noise disturbance for truck deliveries at one residence during daylight hours only.</p>	<p>Significantly reduced noise levels: (1) no chipper planned; (2) estimated 10 trucks/day at current capacity versus > 500 considered in Range EA.</p> <p>Surrounding forest acreage will be maintained as a noise buffer.</p>
10	10. Meteorology		

<p>Treutlen County is characterized by a warm and humid, temperate climate. Average annual temperature ranges from lows of about 53°F to highs of approximately 78°F. Average annual precipitation is approximately 46 inches. Treutlen County has a low incidence of tornadoes, which is 3.1 times lower than the national average. Only one damaging tornado has occurred since 1950. Georgia has not experienced a major hurricane (Category 2 or</p>	<p>No impact on climate or weather. Minor potential risk for severe weather to adversely impact operations.</p>	<p>Unchanged.</p>
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11 11. Air Quality

<p>Treutlen County is in attainment for all criteria air pollutants, including the new 8-hour ozone standard (USEPA, 2007b). Because the proposed facility would not be built in a criteria air pollutant non-attainment or maintenance area or emit any criteria pollutant in excess of the major source threshold of 100 tpy, a full CAA conformity determination is not required.</p>	<p>Temporary and minor construction-related air quality impacts due to dust during construction.</p> <p>Criteria pollutants below threshold for Prevention of Significant Deterioration regulations. Facility to be constructed and operate under "Air Permit to Construct and Operate" issued by EPD.</p> <p>Ambient concentrations of all toxic air pollutants below acceptable ambient concentrations (AAC).</p>	<p>Unchanged. See Table 11-1 for details.</p>
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12 12. Waste Management and Hazardous Materials

<p>Treutlen County has no landfill sites within the county. Solid wastes are collected and transported to the Toombs County Landfill. The Toombs County landfill is located approximately 18 miles southeast of the site along SR 29, and has capacity to accept solid wastes for an additional 20 years, and is permitted to accept both solids/ sludges and construction/ demolition debris. No hazardous waste sites or hazardous materials have been identified on the site of the Proposed Action.</p>	<p>No known hazardous waste sites. No impacts from hazardous materials during construction. Spill prevention and containment measure and flare placement designed to reduce impacts from fuel production, storage, transport.</p> <p>No hazardous wastes generated and solid wastes can be accommodated in existing Toombs County Landfill.</p>	<p>No hazardous wastes generated. Biocatalyst replaces solid inorganic catalyst and is disposed of through anaerobic digestion.</p> <p>Residual solids from digester are returned to gasifier feed or disposed of with char, leaving no net solid output from the unit.</p>
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13 13. Cultural Resources

In July of 2007, Brockington and Associates, Inc. conducted a field survey of the site in compliance with Section 106 of the National Historic Preservation Act, and 36 CFR Part 800. Research found only one previously recorded archaeological site (9TU20) within a 1.6-km (1-mile) radius of the project tract. Site 9TU20 consists of a small scatter of lithics and ceramics. The site was recorded by Garrow and Associates, Inc., in 2000 and was found to not be eligible for nomination to the NRHP. No previously recorded historic structures or other architectural resources were identified within 1.6 km (1 mile) of the field survey. During the structures survey, no intact structures older than 50 years were identified within the project area.

No NHRPO eligible cultural resources were found.

Unchanged.

14 **14. Transportation**

<p>The Georgia Central Railways local line runs along the southwestern boundary of the Treutlen County Industrial Park. This line transports goods and materials to a mainline junction in Dublin. There is no train service on weekends and the rail line does not support passenger service. Approximately 3 miles north of the Soperton Industrial Park, there is an exchange from SR 15 onto the main interstate route serving the area, 1-16. The most direct route from 1-16 to the proposed site is via SR 15 to Commerce Drive. However, SR 29 provides an alternate route to the site from 1-16 and some traffic originating west of Soperton travels via SR 29. SR 15 is a North-South rural arterial between Soperton and 1-16. The roadway consists of two twelve foot travel lanes, two foot paved shoulders, one foot grass shoulders and ditches. The traffic capacity of this section of SR 15 for its given level of service is 1,600 vehicles per hour in each direction. For this section of SR 15, the peak hour use over the past ten years would be 204 vehicles in each direction, which is 12.75 percent of the capacity of SR 15 for its given level of service. SR 29 is a North-South rural arterial between Soperton and 1-16. The roadway consists of two 12-foot travel lanes, 2-foot paved shoulders, 1-foot grass shoulders, and ditches. The intersection used to access State Route 29 is a "Y" intersection with the acute angle near 45 degrees (45°) and a large turning radius on the northern corner. The traffic capacity of SR 29 for its given level of service is 1,600 vehicles per hour in each direction. For this section of SR 29, the peak hour use over the past 10 years would be 389 vehicles in each direction, which is 24.31 percent of the capacity of SR 29 for its given level of service.</p>	<p>Will not exceed capacity. No additional facilities required.</p>	<p>Will not exceed capacity. No additional facilities required.</p>
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15 **15. Utility Infrastructure**

<p>Natural Gas: Natural Gas pipelines, supplied by Atlanta Gas Light, currently run immediately adjacent to Commerce Drive along a portion of the southern border of the parcel for the proposed plant. Additional four inch lines would be installed by Atlanta Gas Light along Commerce Drive and onto the facility.</p> <p>Potable Water: Range Fuels signed a Memorandum of Understanding with the Soperton Municipal Water Supply to receive up to 0.72 mgd of municipal water. Four-inch water lines are in place in the Industrial Park to provide potable and process water and fire protection for planned industrial development.</p> <p>Wastewater: The City of Soperton WWTP receives flow from the sewer system installed in the Industrial Park. The City has indicated that its WWTP has between 0.1 and 0.2 mgd of available capacity to process wastewater from the project.</p> <p>Power: Regionally, the existing power infrastructure was adequate to support the requirements of the proposed plant. No power lines were on the site and a 115 kV to 25 kV substation had to be built on-site to accommodate the Range Fuels project. New 115 kV transmission lines were constructed to connect the substation to the electrical</p>	<p>Atlanta Gas Light installed new gas lines. Georgia Power completed construction of new 115 kV transmission lines and a new substation.</p>	<p>No new power, water or natural gas requirements (see "Inputs & Outputs" table).</p>
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16 **16. Aesthetics**

<p>The proposed location of the Range Fuels facility is predominately within an existing Industrial Park containing seven current businesses. Most of the buildings in the Industrial Park have metal exteriors, with the exception of the Easter Seals and County Training facilities, which have brick facades. None of the existing buildings in the Industrial Park exceed 35 feet in height. There is a water tower located in the Industrial Park that is approximately 120 feet tall.</p>	<p>Plant and support facilities are minimally visible to all but neighboring businesses and not readily visible to closest residences. Plant structures < 100 feet, reducing visibility. Georgia Power infrastructure had negligible impacts on aesthetics. Facility and security lighting is unavoidable long-term adverse impact to night sky views in immediate vicinity.</p>	<p>Unchanged. Maximum height of new units is 25 meters, which is below Range Fuels' planned maximum of 100 feet.</p>
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17 **17. Socioeconomic Factors**

<p>See page 16 of the accompanying excerpt from the DOE EA.</p>	<p>The project's job creation and economic impact, both during construction and plant operation, are expected to have a positive influence on all key socioeconomic factors. Minority residents are not expected to be negatively impacted by construction or</p>	<p>Unchanged.</p>
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Table 8-1**Hazards and Hazardous Materials**

	With Range	With LanzaTech	Comments
High temperature & pressure operations	Syngas production at high T, P	Unchanged	Existing safety plan suffices
Syngas	Mixture of PAHs	Unchanged	Existing safety plan suffices
Methanol	Toxic, flammable	N/A	Methanol replaced by 2,3-BDO. See Table 8-2 for comparison of relative hazards from methanol and 2,3-BDO
Ethanol	Toxic, flammable	Unchanged	Existing safety plan suffices
2,3-BDO	N/A	Non-toxic, non-hazardous	Replaces methanol, with reduced handling requirements relative to existing safety plan. See Table 8-2 for comparison of relative hazards from methanol and 2,3-BDO.
Solid inorganic catalysts	Non-toxic, generate dust	N/A	N/A

Biocatalyst

N/A

Non-toxic, non-GMO, naturally-occurring, anaerobic

See file "Safety of LanzaTech Biocatalyst" summarizing containment of biocatalyst in bioreactors, Health Risk Assessment of organism, and safety data sheet (SDS) of freeze-dried bacteria (method of delivery to site).

Summary of System Input and Output Streams

	Range Fuels Plan (from Oct 07 EA from unless otherwise	LanzaTech Plan	Comments
Feedstock (tpd, dry)	2,650*	125	
Water requirements, process - from groundwater (gpd)	316,800	0	Not required
Water requirements, process - from municipal supply	N/A	66,870	City commitment to supply 200 gal/minute (288,000 gal/24 hour day) is sufficient
Water requirements, potable - from municipal supply (gpd)	5,000	≤5,000	Potable water for offices and restrooms
Natural gas demand (cubic ft/day)	11,400 (OSBL) & 3,900 (avg ISBL)	11,400 (OSBL) & 3,900 (avg ISBL)	OSBL is natural gas to flares. ISBL is natural gas demand based on yearly average for plant startup only. Atlanta Gas line can supply 32,430 cubic ft/hr.
Electricity (kWh/year)	290,832,000	13,680,000	Site has infrastructure for full Range Fuels plan
Wastewater treatment (gpd to onsite WWTP) - to municipal treatment	864,000	75,000	Existing WWTP capacity is 100,000 gpd. Wastewater is discharged to local POTW
Sanitary wastewater - to municipal treatment	5,000	≤5,000	Determined by staffing

Solid waste

unknown

134.1 ton/year sulfatreat waste
2 402 8
Assumes biomass sludge recycled to gasifier feed.

* From Jan 09
Supplemental EA

Table 8-1 Comparison of Co-Products based on MSDS Information

2,3-Butanediol

CAS-No.513-85-9

EC-No.208-173-6

Hazard Rating

Comment: hazard rating is significantly lower than Methanol

Not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008.

Not a hazardous substance or mixture according to EC-directives 67/548/EEC or 1999/45/EC.

Prevention

Comment: Plant and operational controls are significantly lower than methanol

Provide appropriate exhaust ventilation at places where dust is formed.

Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

Toxicological information

Comment: Toxicology effects are significantly lower than methanol

Acute toxicity

no data available

LD50 Intraperitoneal - mouse - 6.075 mg/kg

Skin corrosion/irritation

no data available

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as

probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

Specific target organ toxicity - single exposure

no data available

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

Potential health effects

Inhalation May be harmful if inhaled. May cause respiratory tract irritation.

Ingestion May be harmful if swallowed.

Skin May be harmful if absorbed through skin. May cause skin irritation.

Eyes May cause eye irritation.

Signs and Symptoms of Exposure

Gastrointestinal disturbance, Nausea, Headache, Vomiting

Transportation

Comment: Significantly lower environmental impact and transport requirements

UN number

ADR/RID: - IMDG: - IATA: -

14.2 UN proper shipping name

ADR/RID: Not dangerous goods

IMDG: Not dangerous goods

IATA: Not dangerous goods

14.3 Transport hazard class(es)

ADR/RID: - IMDG: - IATA: -

14.4 Packaging group

ADR/RID: - IMDG: - IATA: -

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA: no

Regulatory requirements

Comment: Significantly lower regulatory requirements noted

Methanol

Cas No: 67-56-1

EC-NO.200-659-6

Hazard rating

Flammable Liquids (Category B)

Acute toxicity, Oral (Category C)

Acute toxicity, Inhalation (Category C)

Acute toxicity, Dermal (Category C)

Skin irritation (Category A)

Eye irritation (Category A)

Specific Target Organ Toxicity (Category A)

Prevention

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P233 Keep container tightly closed.

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P240 Ground/bond container and receiving equipment.

P241 Use explosion-proof electrical/ ventilating/ lighting/ equipment.

P242 Use only non-sparking tools.

P243 Take precautionary measures against static discharge.

P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

P264 Wash skin thoroughly after handling.

P270 Do not eat, drink or smoke when using this product.

P271 Use only outdoors or in a well-ventilated area.

P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

Toxicological information

Acute toxicity

LD50 Oral - rat - 5,628 mg/kg

LC50 Inhalation - rat - 4 h - 64000 ppm

LD50 Dermal - rabbit - 15,800 mg/kg

Skin corrosion/irritation

Skin - rabbit - Irritating to skin. - 24 h

Serious eye damage/eye irritation

Eyes - rabbit - Eye irritation - 24 h

Respiratory or skin sensitization

no data available

Sigma - M3641 Page 6 of 8

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

no data available

Specific target organ toxicity - single exposure

Causes damage to organs.

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

Potential health effects

Inhalation Toxic if inhaled. Causes respiratory tract irritation.

Ingestion Toxic if swallowed.

Skin Toxic if absorbed through skin. Causes skin irritation.

Eyes Causes serious eye irritation.

Signs and Symptoms of Exposure

Methyl alcohol may be fatal or cause blindness if swallowed., Cannot be made non-poisonous., Effects due to ingestion may include:, Nausea, Headache, Vomiting, Gastrointestinal disturbance, Dizziness, Weakness, Confusion., Drowsiness, Unconsciousness, May cause convulsions.

Additional Information

RTECS: PC1400000

Transportation

UN number

ADR/RID: 1230 IMDG: 1230 IATA-DGR: 1230

14.2 UN proper shipping name

ADR/RID: METHANOL

IMDG: METHANOL

IATA-DGR: Methanol

14.3 Transport hazard class(es)

ADR/RID: 3 (6.1) IMDG: 3 (6.1) IATA-DGR: 3

14.4 Packaging group

ADR/RID: II IMDG: II IATA-DGR: II

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA-DGR: no

Regulatory requirements

Table 11-1

Criteria Pollutants

**Maximum Annual (PTE) Criteria Pollutant
Emissions* (maximum operation)**

	With Range	With LanzaTech	<i>Emissions dominated by existing units at site</i>
PM _{2.5}	41.2	Unchanged	
PM	93	Unchanged	
NO _x	95.5	Unchanged	
SO _x	0.72	Unchanged	
CO	86.6	Unchanged	
VOC	26.2	Unchanged	
HAPs (total)	9	Unchanged	
HAPs (individual)	all < 10	Unchanged	

*Air Toxics also will be unchanged from those listed in Range EA.

Attachment 2

Safety of the LanzaTech Biocatalyst

The biocatalyst to be used in the syngas fermentation process is LanzaTech's proprietary microbe, LZ1561. LZ1561 is a naturally selected, and therefore **not** genetically modified or GMO, strain of *Clostridium autoethanogenum*. This microbe has been classified as a Risk Group 1 organism by the World Health Organization (WHO). The definition of WHO Risk Group 1 is that the organism poses no or low individual and community risk and is therefore a microorganism that is unlikely to cause human or animal disease.

LZ1561 is also a strict anaerobe, which means that small quantities of oxygen, <100 parts per million (ppm), are fatally toxic to the organism.

In the fermentation process, the microbe is contained both physically and environmentally:

Physical containment: The specialized gas fermentation bioreactors developed by LanzaTech to cultivate LZ1561 are designed to US ASME 8 standards, enabling the handling and containment of gases, liquids, and vapors under pressure. This design standard thus ensures that the microbes, held within this vessel, are also securely physically contained and separated from the external environment in the same manner as the liquids, gases, and vapors processed within the facility.

Environmental containment: The microbe is a strict anaerobe. Any unintentional release of the microbe into the environment results in exposure of the microbe environmental oxygen levels (21% OXYGEN OR 210,000ppm). Exposure to this level of oxygen is fatal to the organism. In this way, the organism is environmentally contained within the bioreactor due to its oxygen-free (anaerobic) conditions.

The following document provides a Health Risk Assessment for the *C. autoethanogenum* organism. The microbe is delivered to site in freeze-dried form, for which the Safety Data Sheet is also provided.

Auckland 02 August 2011

Health Risk Assessment of *Clostridium autoethanogenum*.

Risk Group Classification

The World Health Organisation (WHO) classifies the agents within a country by Risk Group 1, to 4, equivalent to Bio-safety Level 1 (BSL-1) to Level 4 (BSL-4), based on pathogenicity of the organism, modes of transmission and host range of the organism. Group 1 (BSL-1): low individual and community risk, Group 2 (BSL-2): moderate individual risk, limited community risk, Group 3 (BSL-3): high individual risk, limited community risk, Group 4 (BSL-4): high individual and community risk. This is a worldwide adopted and trusted classification.

The WHO classification of *Clostridium autoethanogenum* is Risk Group 1 (BSL-1). This is the lowest nomination possible confirming *Clostridium autoethanogenum* has no or low individual and community risk and is a microorganism that is unlikely to cause human disease or animal disease. The equivalent BSL-1 definition is a "well characterized agents not consistently known to cause disease in healthy adult humans of minimal potential hazard to laboratory personnel and the environment"

<http://www.absa.org/riskgroups/index.html>

Strain availability

The German Resource Centre for Biological Material (DSMZ) provides internationally renowned services for the collection, maintenance, storage and worldwide shipment of microorganisms and their identification and characterization.

The strain *Clostridium autoethanogenum* is readily available from DSMZ for a small fee. Strain details such as isolation and growth procedure, associated publications and Risk Group are available on their website under strain identification number DSM10061.

<http://www.dsmz.de/microorganisms/html/strains/strain.dsm010061.html>

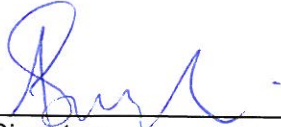
Origin of strain *C. autoethanogenum*

The original isolation paper published by Abrini et al, 1994, '*Clostridium autoethanogenum*, sp. nov., an anaerobic bacterium that produces ethanol from carbon monoxide' is readily available. In this publication the original isolation of *Clostridium autoethanogenum* from hybrid rabbit feces is described. The research was performed in Belgium, European Union.

In summary: *Clostridium autoethanogenum* is:

- Non spore forming
- Strictly anaerobic

- Has no toxin coding genes
- Risk Group 1 classification
- Environmental isolate
- Not genetically modified



Signature

02 AUGUST 2011

Date

AJIT SURJUPERSAD

Name

Director of Environmental Health and
Safety

Title

Section 1. Identification of the material and the supplier

Product: Freeze Dried Bacteria
 Synonyms:
 Product Code:
 Product Use: Industrial: chemical industry and laboratory reagent
 New Zealand Supplier: LanzaTech NZ Ltd
 Address: 24 Balfour Road
 Parnell, Auckland
 New Zealand
 Telephone: +64 9 304 2110
 Fax Number: +64 9 929 3038

Emergency Telephone:
New Zealand 0800 764 766 (NZ Poisons and Hazardous Chemicals)
Australia 13 11 26 (Poisons Information Centre)
USA 800 424 9300 (CHEMTREC)
Canada 613 996 6666 (CANUTEC)

Date of MSDS Preparation: 7 June 2011 version 1

Section 2. Hazards Identification

This substance is freeze dried bacteria Risk Group 1. No health hazard

Section 3. Composition / Information on Ingredients

Ingredients	Wt%	CAS NUMBER.
Clostridium autoethanogenum	98-100	not available

Section 4. First Aid Measures

Swallowed: Not likely to require attention. If patient continues to vomit or is distressed seek medical advice.
Eyes: Flush eye with water for a minimum of 15 minutes. Seek medical attention promptly if irritation persists or any loss of vision occurs.
Skin: Not likely to require attention. Wash skin with soap and water. Launder contaminated clothing before re-use.
Inhaled: Not likely to require attention
First Aid Facilities: Safety showers, eye wash stations and First Aid kits.
Advice to Doctor: Treat symptomatically

Section 5. Fire Fighting Measures

Hazard Type	Not flammable or combustible
Hazards from decomposition products	None
Suitable Extinguishing	All forms of extinguishing media.

media	
Precautions for firefighters and special protective clothing	Treat according to storage and surroundings
HAZCHEM CODE (UK, Australia, NZ)	2T (no violent reaction or explosion, dilute)

Section 6. Accidental Release Measures

- Emergency Procedure:** All microbial cultures whether hazardous or not should be handled in an emergency by qualified microbiologists using appropriate safety procedures and precautions.
- Containment Procedure:** Actions must be taken on the assumption that the culture may be a pathogen. The release area must be sealed to prevent escape to the wider environment and HAZMAT personnel trained in biological products called to advise on containment.
- Clean Up Procedure:** Seek advice on appropriate disinfection procedures for Clostridium species.

Section 7. Handling and Storage
--

- Approved Handlers: (New Zealand):** Not Required.
- Handling** Advisable to wear gloves and particulate cartridge mask when handling bulk quantities or for liquid transfer.
- Storage:** Store refrigerated in tightly closed containers.
Store away from oxidizing agents.
Keep containers closed at all times - check regularly for leaks.
Do not eat, drink or smoke in areas of use or storage.
Do not store next to food or animal feeds

Section 8 Exposure Controls / Personal Protection
--

Use Personal Protective Equipment;
Goggles, chemical resistant gloves and appropriate clothing to prevent skin exposure.

Engineering Controls:

Local exhaust ventilation and/or mechanical (general) exhaust is recommended.

Personal Protective Equipment:

- Personal Hygiene** Protective clothing (gloves, overalls, boots, etc.) should be worn to prevent skin contact. Always wash hands before smoking, eating, drinking or using the toilet.
Wash contaminated clothing and other protective equipment before storing or re-using.
- Skin Protection:** Avoid skin contact by the use of approved chemical resistant gloves PVC or Neoprene (AS 2161) and biological protection coveralls.
- Eye Protection:** Avoid eye contact by wearing chemical goggles with side-shields or face-shield (AS/NZS 1336) whenever exposed to vapour or mist or if there is a risk of splashing liquid in the eyes.

Respiratory Protection: Wear respirator mask with particulate filters when handling freeze dried material.

Thermal Protection: None should be needed under normal circumstances.

Section 9 Physical and Chemical Properties

Appearance: Straw colored powder or cake
Odour: odourless.
pH: Not applicable
Vapour Pressure: Not applicable
Vapour Density: Not applicable
Boiling Point/range (°C): Not applicable
Flash Point: Not applicable
Freezing Point (°C): Not applicable
Solubility: Infinitely soluble in water
Specific Gravity (H₂O = 1): Approximately 1.0
Flammable (Explosive) Limit - Upper: Not applicable
Flammable (Explosive) Limit - Lower: Not applicable
Autoignition Temperature: Not applicable
Evaporation Rate: Not applicable

Section 10. Stability and Reactivity

Chemical Stability: Stable
Incompatible Materials: Strong oxidizing agents.
Conditions to avoid: Heat
Hazardous Decomposition Products: Nil. May form moulds and fungi if not refrigerated for several days.
Hazardous Reactions: Containers should be regularly vented.
Hazardous polymerisation will not occur.

Section 11 Toxicological Information

Toxicological Data: LD50 oral (rat): not known
LC50 inhalation (rat): not known

Acute Effects

Swallowed: May induce nausea
Eyes: Powder will cause temporary eye irritation
Skin: Contact with skin unlikely to have any more than temporary irritation
Inhaled: Unlikely to have any effect

Chronic Effects

Long term chronic skin exposure could cause sensitivity or dermatitis.

Additional Notes: Whilst this strain is not hazardous it should be treated with caution

Section 12. Ecotoxicological Information

NZ HSNO Classifications: Not known

Persistence and Degradability: Likely to be biodegradable and not persist in the environment

Section 13. Disposal Considerations

Empty containers and wastes must be decontaminated by steam sterilization or chemical disinfection before disposal

Section 14 Transport Information

This substance is classified as NOT a dangerous good for Land Transport according to NZS5433: 2007 and is NOT a dangerous good for rail, air, or sea transport.

Section 15 Regulatory InformationFor New Zealand:

ERMA Approval Code: Not Hazardous

HSNO Trigger quantities for this substance

	<u>Quantity</u>
Approved Handler	No
Tracking	No
Location Certificate (containers)	No
Signage	No
Emergency Response Plan	No
Secondary containment	No

For USA

TSCA 8(b) Inventory : No data available
SARA listed: No data available

For EU

Risk Phrases	R36	Irritating to eyes
Safety Phrases	S-2	Keep out of reach of children
	S-7	Keep container tightly closed

Section 16 Other Information

1 HSNO Approved Code of Practice: Preparation of Safety Data Sheets, September 2006.

Disclaimer

This document has been compiled by TCC Ltd on behalf of the manufacturer of the product and serves as the manufacturer's Safety Data Sheet ('SDS'). It is based on information concerning the product which has been provided to TCC by the manufacturer or obtained from third party sources and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer. While TCC has taken all due care to include accurate and up-to-date information in this SDS, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, TCC accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this SDS. The information herein is given in good faith, but no warranty, express or implied is made.

Please contact the New Zealand proprietor, LanzaTech NZ Ltd, if further information is required.

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