JAXSON

ENGINEERING REPORT

FOR:

WASTEWATER FACILITIES
JAXSON ESTATES
ST. CHARLES COUNTY, MISSOURI

APRIL 5, 2005

PREPARED FOR:

TRIAD DEVELOPMENT
135 TRIAD WEST DRIVE
O'FALLON, MO. 63366

PREPARED BY:

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I. SUMMARY

The Jaxson Estates development consists of three proposed developments consisting of 231 single-family homes, 101 multi-family units, and 130,950 sq-ft of commercial buildings located in an unincorporated area of St. Charles County, Hwy 61 & Dietrich Rd., Flint Hill, Missouri, 63346. It is expected that the subdivisions will be developed over a period of at least 5 years, the multi-family units will be developed beginning 2009, and the commercial buildings will be developed beginning 2014. No facilities for sewer or water are available at the site. The owner and developer of the property will be building these facilities and will convey them to Jaxson Estates Homeowners Association upon completion and acceptance by the Missouri Department of Natural Resources.

Sewage from the homes, multi-family units, and commercial buildings will be collected and conveyed by gravity sewers. The treated wastewater will be discharged into an unnamed tributary to Big Creek which discharges into Big Creek.

The treatment facility proposed for Jaxson Estates is a pre-engineered Membrane Bio-Reactor (MBR) system. The plant will treat 150,000 gallons per day. The MBR system was selected primarily for its inherent ability to provide excellent effluent water quality.

All sewer collection lines, pump stations and the treatment plant will be financed and constructed by the developer. At the appropriate time, the facilities will be conveyed to the Jaxson Estates Homeowners Association in accordance with the requirements of the Department of Natural Resources. User charges will be determined by the Jaxson Estates Homeowners Association.

II. EXISTING CONDITIONS AND PROJECTIONS

A. Planning Period

Jaxson Estates will be developed in the next 10 years in three phases with approximately 231 single family homes in phase 1, 101 multi-family units in phase 2, and 130,950 sq-ft of commercial buildings in phase 3.

The construction of the treatment plant (150,000 gpd) will take place immediately upon receipt of a construction permit.

B. Land Use

The proposed treatment plant will serve 89.9 acres of the Big Creek watershed. The area is undeveloped. The Jaxson Estates site is made up of partially cleared pastureland crisscrossed by streams. The entire site steeply slopes to the north. The entire southern portion of the property is forested hillside. Most of the on-site tributaries converge into the on-site blue line stream that crosses the county road on the northern property boundary. This stream discharges directly to Big Creek. The remaining tributaries that originate in the southeastern portion of the site or come through that area discharge into a man made concrete roadside ditch that also discharges into Big Creek.

C. Demographic and Economic Data

Although it is likely the population of St. Charles County will have significant growth over the next 20 years, the only growth relevant to this project is the growth within the Jaxson Estates development itself. That growth is very predictable and the sewage treatment plant will be designed to correspond to final development plan.

D. Location/Geology

The location of the treatment plant site is next to an unnamed tributary to Big Creek. The site will be filled approximately five feet to remove it from the hundred-year flood plain. The resulting site will be graded to drain water away from the treatment plant and provide access at all times.

III. RECEIVING WATER CONSIDERATIONS

The basis for determination of maximum discharge limitations and point of discharge location is the Water Quality Impact Study. It was determined that Big Creek was a suitable receiving stream for the effluent from the proposed sewage treatment facility as long as the effluent limitations would be no greater than those prescribed in the following paragraph.

IV. EFFLUENT LIMITATIONS

The effluent limitations for this facility were determined by the water quality impact study.

V. PROJECT DEVELOPMENT

A.   Collection System

Wastewater will be conveyed through a system of 8-inch PVC gravity sewers to an influent pump station located at the treatment plant. All construction will be in accordance with the Department of Natural Resources standards, specifically 10CSR20-8.120.

B.   Wastewater Characteristics

The wastewater generated at Jaxson Estates will be domestic in nature and amenable therefor to many treatment processes. Our calculations are based on the assumption that there will be approximately 250 milligrams per liter of suspended solids and BOD in the influent wastewater.

C.   Treatment Plant Site Requirements

The location for the treatment plants proposed to be adjacent to an unnamed tributary of Big Creek which discharges into Big Creek. The site selected will provide the best location for screening the treatment plant from the future homes and will be in a relatively central location allowing the most efficient use of gravity sewers and pumping stations. There is a natural tree line on one side and a proposed detention basin on two sides of the treatment plant location, which will isolate it from future homes and minimize potential nuisances to future residents.

The plant will be considerable distance from the water supply for this project and the treatment plant will affect no portion of the water supply system.

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D.   **Alternatives – General**

Since this portion of St. Charles County is relatively undeveloped the only viable alternative for treating sewage at this development was to construct a new treatment facility on the property itself. There are no other regional alternatives due to the sparsity of existing development and population. As previously mentioned, the construction of this plant will be phased consistent with sales of homes in the subdivision. The alternative of using small diameter pressure sewers was briefly considered, however, the location of the treatment plant was such that gravity sewers could be provided economically and any further consideration of a pressure sewer system was abandoned.

E.   **Alternatives – Process**

Three alternatives were originally considered for treatment processes at this site these included: 1) Extended Aeration Treatment Plant, 2) Sequencing Batch Reactor (SBR), and 3) Membrane Bioreactor (MBR). After discussions with personnel at the Missouri Department of Natural Resources it was determined that an extended aeration plant would not likely be acceptable because of the questionable ability to meet ammonia limitations. Additionally, discussions with St. Charles County determined that extended aeration and sequencing batch reactors would not be acceptable. St. Charles County has chosen the MBR system. Therefore, the MBR system was selected that not only could provide excellent BOD and suspended solids reduction, but also reduce ammonia to a level consistent with federal and state effluent limitations. Finally, disinfection is eliminated due to micro filtration in the MBR system. The owner has chosen the MBR system.

F.   **Selected Process & Site**

After consideration of effluent limitations, costs and aesthetic factors, it was determined that this project would be served by a Membrane Bioreactor (MBR) treatment facility equipped with flow equalization, sludge digestion, and sludge holding. The plant will be located adjacent to an unnamed tributary to Big Creek near the north side of the development as indicated on the site location map in APPENDIX A . The treatment facility will be constructed in the first phase. The treatment system will consist of a perforated screen designed for a maximum solids size of 2 mm, an anoxic basin and aeration basin, the MBR system, with two (2) integral membrane-operating tanks, a 50,000 gallon sludge holding tank, and a 50,000 gallon flow equalization tank. Rotating equipment and a control building will be included in accordance with state requirements. The MBR treatment plant will treat an average daily flow of 150,000 gallons per day, maximum daily flow of 200,000 gallons per day, and a peak hourly flow of 300,000 gallons per day, which is being supplied from the flow equalization tank by the MBR pump station.

G.   Project Financing

This project involves no public funding. It will be entirely financed by Triad Development and turned over to Jaxson Estates Homeowners Association in accordance with state requirements for operating authorities. The cost to the customer will be determined by the Jaxson Estates Homeowners Association but will essentially be what ever cost is required to provide the operation, maintenance and capitalization as necessary to meet effluent requirements and provide for future upgrades and other enhancements to be determined in the future.

H.   Implementation

No legislation, ordinances, bond issues or any other legal procedure will be required to start this project. No municipal or county agency will be involved in the review, construction or inspection of this project. Only the Missouri Department of Natural Resources will review this facility. Consequently, the schedule for construction of this facility will be entirely dependent upon the Department of Natural Resources timetable for issuance of Construction Permit and the owner's ability to construct the treatment plant. The construction of the treatment plant (150,000 gpd) will take place immediately upon receipt of a construction permit. Upon completion of construction, the owner will apply for an Operating Permit and upon receipt of such permit, will begin operation.

Appendix A Site Location Map

Jaxson Estates Location Map

Jaxson Estates
Hwy 61 & Dietrich Rd.
Flint Hill, MO. 63346
St. Charles County - Unincorporated

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www.delorme.com

MN (0.0° W)

Data Zoom 13-0
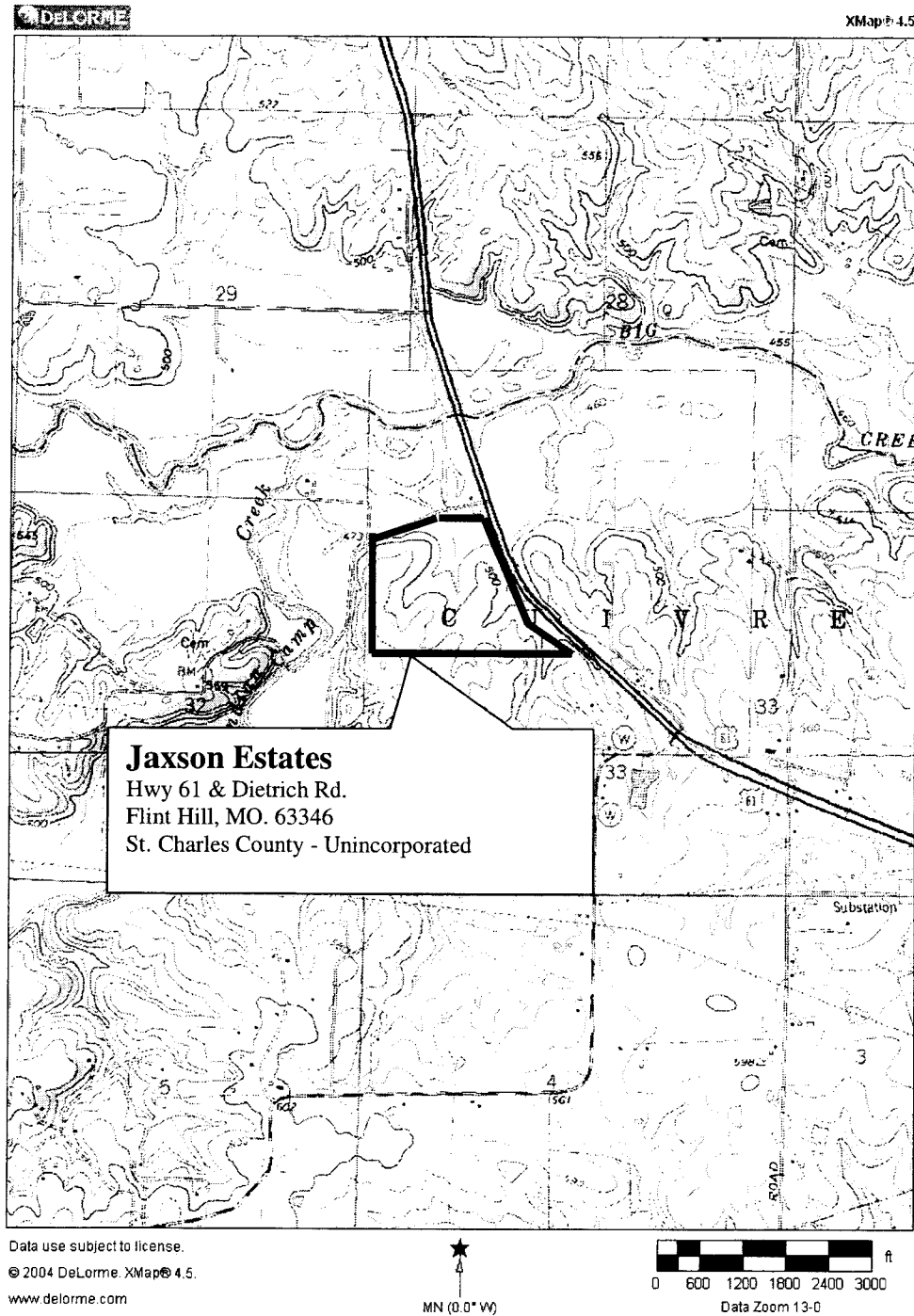
Appendix B Calculations

Project Description

The Jaxson Estates development consists of three proposed developments consisting of 231 single-family homes, 101 multi-family units, and 130,950 sq-ft commercial buildings located in an unincorporated area of St. Charles County, Hwy 61 & Dietrich Rd., Flint Hill, Missouri, 63346.

The influent pump station will serve to pump the entire amount of received waste for the Jaxson Estates development, which will be serviced by the Jaxson Estates wastewater treatment plant.

Sanitary Service

A lift type pump station will service the Jaxson wastewater treatment plant. This station will receive waste tributary flows from the Jaxson Estates. The system will gravity flow sewage into the submersible lift station. The submersible pump will connect to a short force main that will empty into the equalization tank before being pumped to the Jaxson Estates wastewater treatment plant.

Population Equivalent

In determining the population equivalent for the Jaxson Estates Wastewater Facilities Chapter 8 of the DNR design guidelines was used. The commercial buildings are primarily retail with a few restaurants.

231 Residences X 3.7 persons/unit   = 855 people
101 multi-family units X 3.0 persons/unit   = 303 people
<u>130, 950 sq-ft commercial X 2.0 persons/1000 sq-ft = 262 people</u>
Population Equivalent   = 1,420 people

Note: Assume Population Equivalent = 1,500 people

Pump Station and Force Main Design Calculations

In determining the peak and average flows for the Jaxson Estates pump stations a design load of 100 gallons per day per person was used in concordance with Chapter 8 of the DNR design guidelines. The pump station will serve approximately 1,500 people. This includes all of the proposed single family, multi-family, and commercial sewage tributary inflow.

$$\frac{18 + \sqrt{population\_thousands}}{4 + \sqrt{population\_thousands}} = peak \qquad \frac{18 + \sqrt{1.5}}{4 + \sqrt{1.5}} = 3.68$$

Population Equivalent (PE) = 1500
Average Daily Flow (ADF) = PE x 100 GPD (gal/person/day)
ADF = 1500 x 100 = 1500 GPD
ADF = 150000 GPD / 1440 (min./day) = 104.17 gpm
Peak Factor = 3.68
Peak Daily Flow (PDF) = 3.68 x 150000 GPD = 552000 GPD
PDF gpm = 3.68 x 104.17 gpm = 383.35 gpm

Design Summary - Treatment Plant Influent Pump Station

Average Daily Flow	150000 GPD or 104.17 gpm
Peak Daily Flow	383.35 gpm
Static Head	16.0 ft.
System Head Loss	9.3 ft.
Total Dynamic Head	25.3 ft.
Selected Pump Manufacture's Information:	
Manufacturer	Flygt
Model Number	CP3102.180
Curve No.	63-434-00-3730
Impeller Diameter	173 mm (Max) Trim to fit
Type	Submersible
Horsepower	5 hp
RPM	1745
Voltage	460 v
Phase	Three Phase
Average Daily Flow Cycle Times	
Pump On	3.37 min.
Pump Off	9.57 min.
Peak Daily Flow Cycle Times	
Pump On	59.77 min.
Pump Off	2.60 min.

Force Main, Size, Material, Type and Length: 4 inch, Class 52 Ductile Iron Pipe with an equivalent length of 28.3 lineal feet from pump to equalization tank.

Fribis Engineering Inc.
Jaxson Estates 04061 Influent Lift Station
Influent Pump Station Design Data

Flows

ADF (gal/day)	150,000
or (gal/min)	104.17
PHF (gal/min)	383.33
Single Pump Capacity (gpm)	400.00

Elevations

Finished Floor Elevation	456.65
Top Elevation	473.00
Flowline Elevation In	462.65
Flowline Elevation Out	470.00
Flowline of 24 Hr. Storage	N/A
High Water Alarm	462.15
Lag Pump On	461.50
Lead Pump On	460.86
Lead and Lag Pump Off	458.21
Max Storage Elevation	

Volumes

Dia. of Pump Station (ft)	8.00
Storage per foot (gal)	375.99
Normal Operating Volume (gal) (Lead Pump On - Stop)	996.36
Total Storage (Invert - Stop)	1,669.38
Total Storage time at ADF (min.)	9.57
Total Storage time at PDF (min.)	2.60
Total Time - Alarm to overflow	10.64

Starts / Hour

(max. cycling occurs when flow = 1/2 pump capacity) Standard Design is 8 to 10 Starts/hour max.

Flow (gpm) (ADF)	104.17
On Cycle (min)	3.37
Off Cycle (min)	9.57
Total Starts/hour	4.64
Flow (gpm)(PHF)	383.33
On Cycle (min)	59.77
Off Cycle (min)	2.60
Total Starts/hour	0.96
Flow (gpm)(50% PHF)	191.67
On Cycle (min)	4.78
Off Cycle (min)	5.20
Total Starts/hour	6.01
Flow (gpm)(80% PHF)	306.66
On Cycle (min)	10.68
Off Cycle (min)	3.25
Total Starts/hour	4.31

Fribis Engineering Inc.
Jaxson Estates 04061 Influent Lift Station
Influent Pump Station Design Data, Bouyancy Calculations

1   Ww = Weight of concrete wet well
2   Wf = Weight of concrete Bottom slab
3   We = Weight of earth backfill on footing
4   Wt = Ww + We + Wf (or weight of detention chambers and backfill overburden)
5   Ws = Weight of displaced water
6   Wt = Should be greater than Ws

1   Weight of Concrete Wet Well

Top Elevation =	473.00	
Bottom Elevation =	456.65	
Total Height	16.35	Ft.
Wt per Ft. of 96 in RCP	2,710	Lbs./Ft.
Wt. of Wet Well	44,308.50	Lbs.

2   Weight of Bottom Slab

Diameter of Base	11	Ft.
Thickness of Base	15	In.
Wt. Of Conc.	155	Lbs./CF
Wt. Of Base	18,413	Lbs.

3   Weight of Earth on Base

Diameter of Base	11	Ft.
Diameter of Wet Well	9	Ft.
Wt of Soil	110	Lbs./CF
Weight of Earth	53,046	Lbs.

4   Weight Total

Wt = Ww + We + Wf (or weight of detention chambers and backfill overburden)

Wt =	115,767	Lbs.

5   Force Bouyant

Volume Displaced	1,040.14	Cu. Ft.
Weight of Water	62.4	Lbs./Cu. Ft.
Bouyant Force	64,905	Lbs.

6   Check Bouyancy

Wt		Fb	
115,767	>	64,905	OK

Design Summary - Treatment Plant MBR Pump Station

Average Daily Flow	150000 GPD or 104.17 gpm
MBR Average Flow	154 gpm
Static Head	23.7 ft.
System Head Loss	2.4 ft.
Total Dynamic Head	26.1 ft.
Selected Pump Manufacture's Information:	
Manufacturer	Flygt
Model Number	CP3085.180
Curve No.	63-434-00-5330
Impeller Diameter	163 mm (Max) Trim to fit
Type	Submersible
Horsepower	3 hp
RPM	1710
Voltage	460 v
Phase	Three Phase
Average Daily Flow Cycle Times	
Pump On	7.03 min.
Pump Off	3.43 min.
Peak Daily Flow Cycle Times	
Pump On	357.42 min.
Pump Off	2.32 min.

Force Main, Size, Material, Type and Length: 4 inch, Class 52 Ductile Iron Pipe with an equivalent length of 99.7 lineal feet from pump to rotating drum screen on treatment plant.

Jaxson Estates 04061 MBR Lift Station
Influent Pump Station Design Data

Flows

ADF (gal/day)	150,000
or (gal/min)	104.17
PHF (gal/min)	154.00
Single Pump Capacity (gpm)	155.00

Elevations

Finished Floor Elevation	461.45
Top Elevation	473.00
Flowline Elevation In	465.45
Flowline Elevation Out	470.00
Flowline of 24 Hr. Storage	N/A
High Water Alarm	472.50
Lag Pump On	469.00
Lead Pump On	465.60
Lead and Lag Pump Off	463.91
Max Storage Elevation	

Volumes

Dia. of Pump Station (ft)		6.00
Storage per foot (gal)		211.49
Normal Operating Volume (gal) On - Stop)	(Lead Pump	357.42
Total Storage (Invert - Stop)		325.70
Total Storage time at ADF (min.)		3.43
Total Storage time at PDF (min.)		2.32
Total Time - Alarm to overflow		0.69

Starts / Hour

(max. cycling occurs when flow = 1/2 pump capacity)
Standard Design is 8 to 10 Starts/hour max.

Flow (gpm) (ADF)	104.17
On Cycle (min)	7.03
Off Cycle (min)	3.43
Total Starts/hour	5.73
Flow (gpm)(PHF)	154.00
On Cycle (min)	357.42
Off Cycle (min)	2.32
Total Starts/hour	0.17
Flow (gpm)(50% PHF)	77.00
On Cycle (min)	4.58
Off Cycle (min)	4.64
Total Starts/hour	6.50
Flow (gpm)(80% PHF)	123.20
On Cycle (min)	11.24
Off Cycle (min)	2.90
Total Starts/hour	4.24

Fribis Engineering Inc.
Jaxson Estates 04061 MBR Lift Station
Influent Pump Station Design Data, Bouyancy Calculations

1   Ww = Weight of concrete wet well
2   Wf = Weight of concrete Bottom slab
3   We = Weight of earth backfill on footing
4   Wt = Ww + We + Wf (or weight of detention chambers and backfill overburden)
5   Ws = Weight of displaced water
6   Wt = Should be greater than Ws

1   Weight of Concrete Wet Well

Top Elevation =	473.00	
Bottom Elevation =	461.45	
Total Height	11.55	Ft.
Wt per Ft. of 72 in RCP	1,580	Lbs./Ft.
Wt. of Wet Well	18,249.00	Lbs.

2   Weight of Bottom Slab

Diameter of Base	9	Ft.
Thickness of Base	15	In.
Wt. Of Conc.	155	Lbs./CF
Wt. Of Base	12,326	Lbs.

3   Weight of Earth on Base

Diameter of Base	9	Ft.
Diameter of Wet Well	7	Ft.
Wt of Soil	110	Lbs./CF
Weight of Earth	29,167	Lbs.

4   Weight Total

Wt = Ww + We + Wf (or weight of detention chambers and backfill overburden)

Wt =	59,741	Lbs.

5   Force Bouyant

Volume Displaced	444.50	Cu. Ft.
Weight of Water	62.4	Lbs./Cu. Ft.
Bouyant Force	27,737	Lbs.

6   Check Bouyancy

Wt		Fb	
59,741	>	27,737	OK

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Design Summary – Equalization/Sludge Holding Buoyancy

Fribis Engineering Inc.
Jaxson Estates 04061 Equalization and Sludge Holding Tank
Equalization and Sludge Holding Tank Design Data, Bouyancy Calculations

1. W_w = Weight of concrete wet well
2. W_f = Weight of concrete Bottom slab
3. W_e = Weight of earth backfill on footing
4. $W_t = W_w + W_e + W_f$ (or weight of detention chambers and backfill overburden)
5. W_s = Weight of displaced water
6. W_t = Should be greater than W_s

1 Weight of Concrete Wet Well

Top Elevation =	475.50	
Bottom Elevation =	465.50	
Height Sides =	10.00	Ft.
Length Outside =	64.00	Ft.
Width Outside =	36.00	Ft.
Length Inside =	62.00	Ft.
Width Inside =	32.00	Ft.
Wt. Of Conc.	155	Lbs./CF
Wt. of Wet Well	496,000.00	Lbs.

2 Weight of Bottom Slab

Length of Base =	66	Ft.
Width of Base =	38	Ft.
Thickness of Base	1	Ft.
Wt. Of Conc.	155	Lbs./CF
Wt. Of Base	388,740	Lbs.

3 Weight of Earth on Base

Area of Base		
Length of Base =	66	Ft.
Width of Base =	38	Ft.
Area of Wet Well		
Length of Wet Well =	64	Ft.
Width of Wet Well =	36	Ft.
Height Below Ground =	7	Ft.
Wt of Soil	110	Lbs./CF
Weight of Earth	157,080	Lbs.

4 Weight Total

$W_t = W_w + W_e + W_f$ (or weight of detention chambers and backfill overburden)

Wt =	1,041,820	Lbs.

5   Force Bouyant

     Volume Displaced
      Length of Base =   66   Ft.
      Width of Base =   38   Ft.
      Height H2O on Sides =   6.50 Ft.
     Weight of Water   62.4 Lbs./Cu. Ft.

     Bouyant Force   1,017,245 Lbs.

6   Check Bouyancy

        Wt   Fb

    1,041,820   >   1,017,245   OK

Appendix C Manufacturers Calculations

Flow Equalization Tank Sizing – USFilter, 1051 Blake, Edwardsville, KS., 66111 Phone 913.422.7600, fax 913.422.7667, Pages 1 and 2.

Design Calculations for USFilter Memcor Fastpac Membrane Bioreactor Model 72 B10R, 150,000 GPD – USFilter, 1051 Blake, Edwardsville, KS., 66111 Phone 913.422.7600, fax 913.422.7667, Pages 1 thru 11.

JAXSON ESTATES WASTEWATER TREATMENT PLANT

OVERALL PROJECT COSTS

$2,500.000