authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictinal agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, send the following information to the agency(s) seeking this information (see AGENCY CONTACT INFORMATION).

Check-list of *Minimum* Materials to be submitted:

__✓_ **SIGNED** copy of this Project Environmental Review Receipt
__✓_ Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
__✓_ Project location information (name of USGS Quadrangle, Township/Mu?icipality, and County)
__✓_ USGS 7.5-minute Quadrangle with project boundary clearly indicated, and quad name on the map

The inclusion of the following information may expedite the review process.
__✓_ A basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
____ Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
__✓_ Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a preliminary screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Endangered Species Section
315 South Allen Street, Suite 322, State College, PA. 16801-4851
NO Faxes Please.

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name: SAMUEL R. GIBSON
Company/Business Name: KLH ENGINEERS, INC.
Address: 5173 CAMPBELLS RUN RD.
City, State, Zip: PITTSBURGH, PA 15205
Phone:(412) 494-0510 Fax:(412) 494 - 0426
Email: sgibson@klhengineers.com

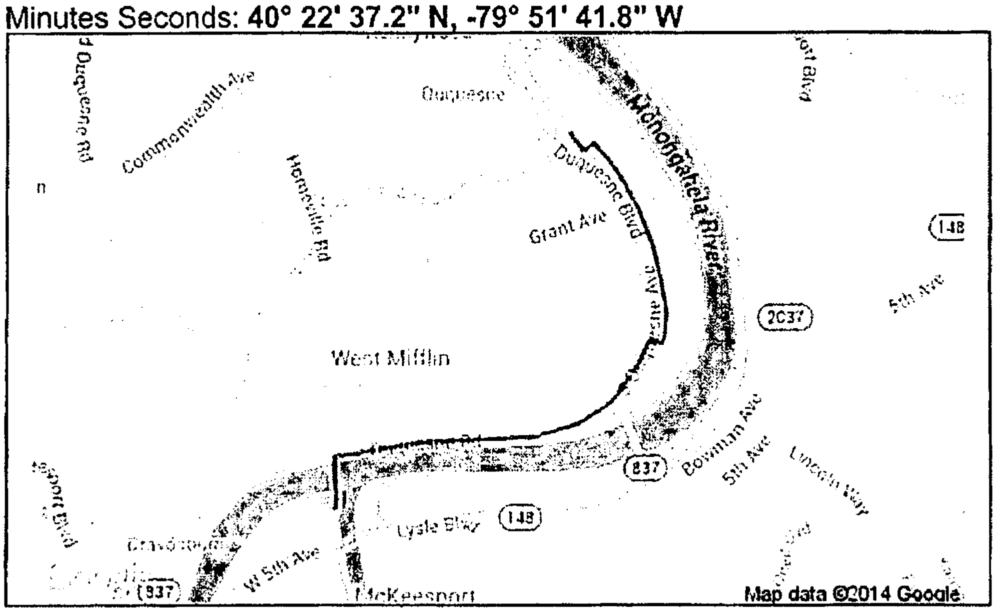
8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

[signature] 9/2/14
applicant/project proponent signature date

1. PROJECT INFORMATION

Project Name: **Duquesne WWTP Force Main**
Date of review: **8/5/2014 1:04:51 PM**
Project Category: **Waste Transfer, Treatment, and Disposal,Liquid waste/Effluent,Sewer line (new - construction in new location)**
Project Length: **17324.4** feet
County: **Allegheny** Township/Municipality: **Duquesne,West Mifflin,Mckeesport**
Quadrangle Name: **BRADDOCK** ~ ZIP Code: **15122,15132,15110,15034**
Decimal Degrees: **40.377006 N, -79.861623 W**
Degrees Minutes Seconds: **40° 22' 37.2" N, -79° 51' 41.8" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate no known impacts to threatened and endangered species and/or special concern species and resources within the project area. Therefore, based on the information you provided, no further coordination is required with the jurisdictional agencies. This response does not reflect potential agency concerns regarding impacts to other ecological resources, such as wetlands.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jursidictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service

RESPONSE: No impacts to federally listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. For cases where a "Potential Impact" to threatened and endangered species has been identified before the application has been submitted to DEP, the application should not be submitted until the impact has been resolved. For cases where "Potential Impact" to special concern species and resources has been identified before the application has been submitted, the application should be submitted to DEP along with the PNDI receipt. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. DEP and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at http://www.naturalheritage.state.pa.us.

5. ADDITIONAL INFORMATION

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6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Endangered Species Section
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PA Fish and Boat Commission
Division of Environmental Services
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NO Faxes Please

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name: Samuel R. Gibson
Company/Business Name: KLH Engineers, Inc.
Address: 5173 Campbells Run Rd.
City, State, Zip: Pittsburgh, PA 15205
Phone:(412) 494-0510 Fax:(412) 494-0426
Email: sgibson@klhengineers.com

8. CERTIFICATION

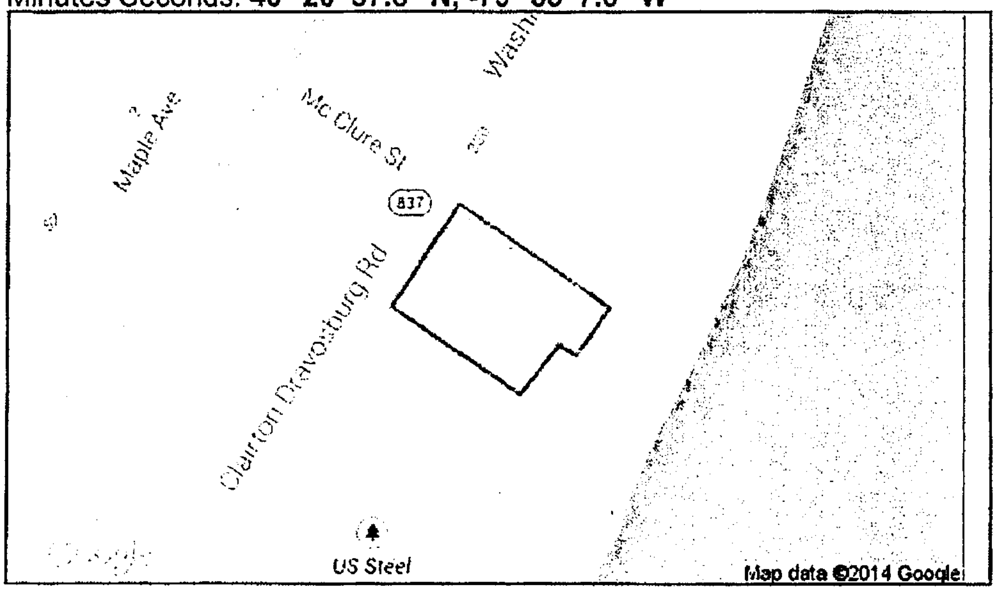
I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

[signature] 9/2/14

applicant/project proponent signature date

1. PROJECT INFORMATION

Project Name: **Dravosburg WWTP**
Date of review: **8/5/2014 2:09:21 PM**
Project Category: **Waste Transfer, Treatment, and Disposal,Liquid waste/Effluent,Wastewater treatment plant (construction, expansion or modification)**
Project Area: **1.2** acres
County: **Allegheny** Township/Municipality: **Dravosburg**
Quadrangle Name: **GLASSPORT** ~ ZIP Code: **15034**
Decimal Degrees: **40.349375 N, -79.885361 W**
Degrees Minutes Seconds: **40° 20' 57.8" N, -79° 53' 7.3" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate no known impacts to threatened and endangered species and/or special concern species and resources within the project area. Therefore, based on the information you provided, no further coordination is required with the jurisdictional agencies. This response does not reflect potential agency concerns regarding impacts to other ecological resources, such as wetlands.

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

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PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service

RESPONSE: No impacts to federally listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

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6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Endangered Species Section
315 South Allen Street, Suite 322, State College, PA. 16801-4851
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PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA. 16823-7437
NO Faxes Please

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA. 17110-9797
Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name: SAMUEL R. GIBSON
Company/Business Name: KLH ENGINEERS INC.
Address: 5173 CAMPBELLS RUN. RD.
City, State, Zip: PITTSBURGH, PA 15205
Phone:(412) 494-0510 Fax:(412) 494-0426
Email: sgibson@klhengrs.com

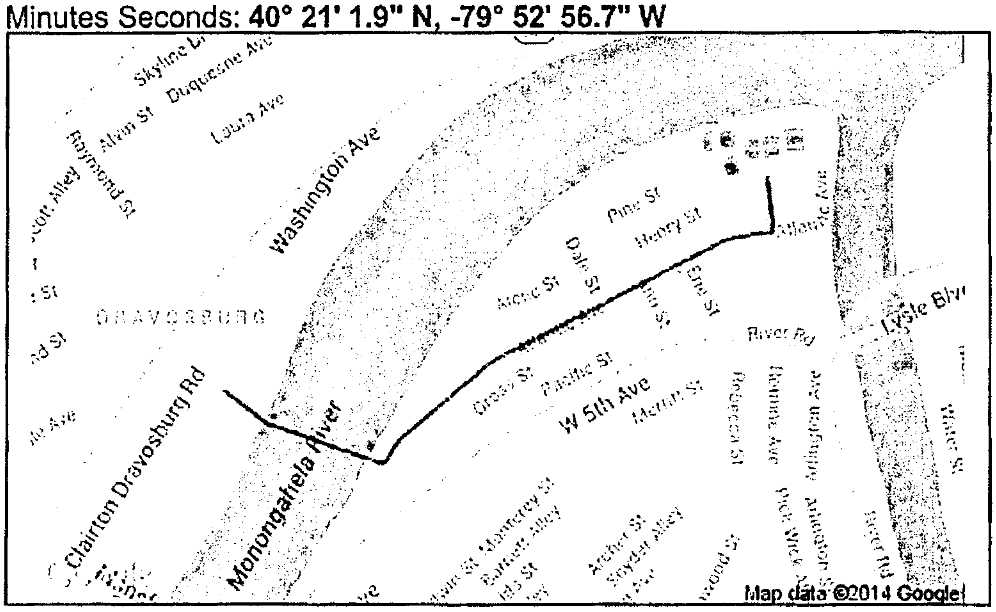
8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

[signature] 9/2/14
applicant/project proponent signature date

1. PROJECT INFORMATION

Project Name: **Dravosburg WWTP Force Main**
Date of review: **8/5/2014 2:07:18 PM**
Project Category: **Waste Transfer, Treatment, and Disposal,Liquid waste/Effluent,Sewer line (new - construction in new location)**
Project Length: **4424.7** feet
County: **Allegheny** Township/Municipality: **Dravosburg,Mckeesport**
Quadrangle Name: **MC KEESPORT** ~ ZIP Code: **15132,15034**
Decimal Degrees: **40.350534 N, -79.882403 W**
Degrees Minutes Seconds: **40° 21' 1.9" N, -79° 52' 56.7" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate no known impacts to threatened and endangered species and/or special concern species and resources within the project area. Therefore, based on the information you provided, no further coordination is required with the jurisdictional agencies. This response does not reflect potential agency concerns regarding impacts to other ecological resources, such as wetlands.

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PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service

RESPONSE: No impacts to federally listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

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6. AGENCY CONTACT INFORMATION

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Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
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U.S. Fish and Wildlife Service
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PA Game Commission
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Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name: SAMUEL R. GIBSON
Company/Business Name: KLH ENGINEERS, INC
Address: 5173 CAMPBELLS RUN RD.
City, State, Zip: PITTSBURGH, PA 15205
Phone:(412) 494 - 0510 Fax:(412) 494 - 0420
Email: sgibson@klhengineers.com

8. CERTIFICATION

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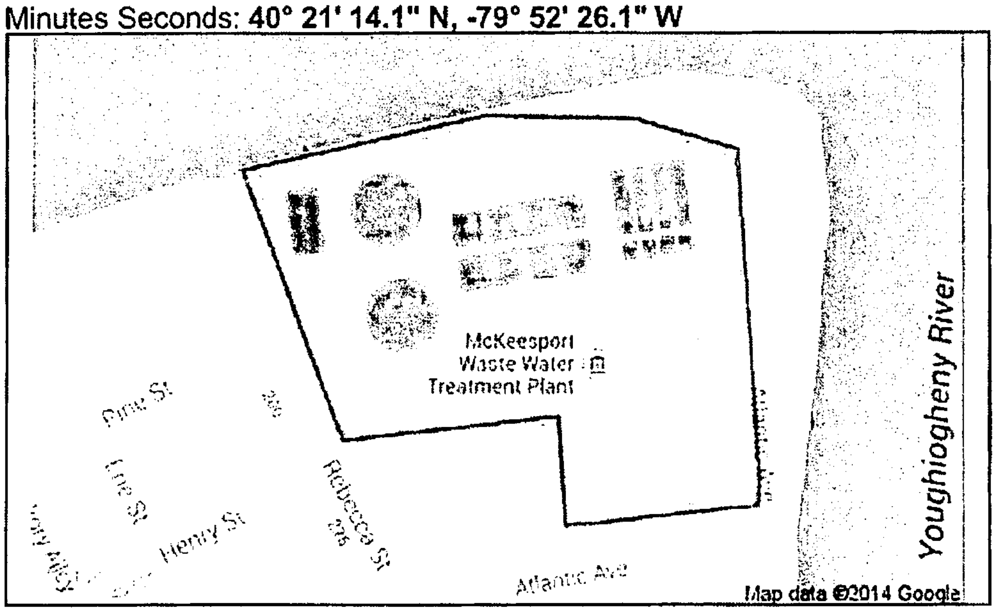
[signature] 9/2/14
applicant/project proponent signature date

1. PROJECT INFORMATION

Project Name: **McKeesport WWTP**
Date of review: **8/5/2014 1:45:21 PM**
Project Category: **Waste Transfer, Treatment, and Disposal,Liquid waste/Effluent,Wastewater treatment plant (construction, expansion or modification)**
Project Area: **8.8 acres**
County: **Allegheny** Township/Municipality: **Mckeesport**
Quadrangle Name: **MC KEESPORT** ~ ZIP Code: **15132**
Decimal Degrees: **40.353911 N, -79.873916 W**
Degrees Minutes Seconds: **40° 21' 14.1" N, -79° 52' 26.1" W**



2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate no known impacts to threatened and endangered species and/or special concern species and resources within the project area. Therefore, based on the information you provided, no further coordination is required with the jurisdictional agencies. This response does not reflect potential agency concerns regarding impacts to other ecological resources, such as wetlands.

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PA Game Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE: No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service

RESPONSE: No impacts to <u>federally</u> listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.* is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

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6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552, Harrisburg, PA. 17105-8552
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U.S. Fish and Wildlife Service
Endangered Species Section
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PA Game Commission
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Fax:(717) 787-6957

7. PROJECT CONTACT INFORMATION

Name: SAMUEL R. GIBSON
Company/Business Name: KLH ENGINEERS, INC.
Address: 5173 CAMPBELLS RUN RD.
City, State, Zip: PITTSBURGH PA 15205
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Email: sgibson@klhengineers.com

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[signature] 9/2/14
applicant/project proponent signature date

APPENDIX K

PHMC GENERAL CORRESPONDENCE

No response has been received from the PHMC to date. The PHMC response will be included in the final submission of the Act 537 Plan.

KLH ENGINEERS, INC

August 28, 2014
Ref. No. 220-53

Pennsylvania Historical and Museum Commission
State Historic Preservation Office
400 North Street
Commonwealth Keystone Building, 2nd Floor
Harrisburg, PA 17120-0093

CERTIFIED RETURN RECEIPT

To Whom It May Concern:

Municipal Authority of the City of McKeesport
Allegheny County, Pennsylvania
Act 537 Sewage Facilities Plan Update – City of Duquesne and Borough of Dravosburg

On behalf of the Municipal Authority of the City of McKeesport (MACM), KLH Engineers, Inc. is providing this correspondence to fulfill the requirements of historical and archaeological resource protection under P.C.S. 37, Section 507 relating to cooperation by public officials with the Pennsylvania Historical and Museum Commission (PHMC). This is being done in an effort to complete the planning required as part of the Act 537 Sewage Facilities Plan Update to evaluate proposed wastewater treatment plant (WWTP) and combined sewer system (CSS) upgrades in the City of Duquesne and the Borough of Dravosburg. The Plan Update was developed to serve as the governing Act 537 Sewage Facilities Plan for the City of Duquesne and Borough of Dravosburg, whose conveyance systems and treatment facilities are now owned and operated by the MACM.

The following alternatives were recommended for the City of Duquesne and the Borough of Dravosburg:

City of Duquesne

In the Duquesne system, two sections of the CSS in the planning area lack capacity to convey the 10-year, 24-hour design storm, causing manhole overflows. In addition, the WWTP lacks treatment capacity to process peak wet weather flows. It was determined that CSS upgrades are required to convey the 10-year, 24-hour design storm flow (without manhole overflows) while maintaining greater than 85% capture of all combined flow during a typical year.

Detailed evaluation of the proposed alternatives led to the recommendation of continued operation of existing processes and construction of new combined sewer overflow (CSO) bypass treatment facilities. The existing WWTP is in good operating condition with adequate capacity for dry weather flows. This alternative utilizes the existing WWTP up to peak flows of 2.5 MGD. Peak flows above 2.5 MGD will receive CSO bypass treatment. This alternative includes construction of new headworks facilities, influent pump station, and CSO bypass treatment facilities, as well as the installation of new clarifier equipment to maximize efficiency. Additionally, this alternative includes CSS upgrades required to convey the 10-year, 24-hour design storm to the WWTP including two gravity relief sewers totaling 1,025 lineal feet.

The following items are included in the project proposed for the City of Duquesne:

- CSS upgrades
- New automatic bar screen and by-pass channel with static screen
- New headworks building
- New raw sewage pump station and controls
- New raw sewage pump station piping and valve vault
- New pump flow meter
- Site gravity and force main piping
- New CSO bypass treatment
- Upgrade final clarifier equipment to maximize efficiency

Borough of Dravosburg

In Dravosburg, it was determined that no CSS upgrades are required to convey the 10-year, 24-hour design storm flow while maintaining greater than 85% capture of all combined flow during a typical year, given a free discharge at the WWTP pump station. The Borough of Dravosburg WWTP, however, does not have capacity to processes peak wet weather flows. Detailed evaluation of the proposed alternatives led to the recommendation to pump flow to the McKeesport WWTP and convert the existing Dravosburg WWTP to peak flow storage. This alternative includes construction of a new raw sewage pump station to convey all flow up to 1.0 MGD to the McKeesport WWTP. All flow above 1.0 MGD will be pumped by separate storm pumps and stored in the existing Dravosburg WWTP aeration basins. The following items are included in the project proposed for the Borough of Dravosburg:

- New automatic bar screen and by-pass channel with static screen
- New headworks building
- New raw sewage pump station and controls
- Average flow pumps and storm pumps
- New raw sewage pump station piping and valve vault
- New pump flow meter
- Site gravity and force main piping
- Force main piping to the MACM WWTP
- Retrofit existing aeration basins to serve as peak flow storage
- New diffusers in the peak flow storage basins

Attached to this correspondence are the following documents:

- PHMC Project Review Form
- USGS 7.5-minute Quadrangle Map showing planning area delineation
- Preliminary, conceptual layout of the proposed projects

All appropriate permits will be obtained before any construction activities, and the project will meet all local, county, state and federal regulations regarding wetlands, prime agricultural areas, erosion and sedimentation pollution control, stormwater management and all other applicable requirements. No impacts on historical and archaeological resources are expected as a result of these projects. Please feel free to contact our office if you have any questions or concerns.

Sincerely,

KLH ENGINEERS, INC.

Samuel R. Gibson, E.I.T.

Enclosure

Pennsylvania Historical & Museum Commission

PROJECT REVIEW FORM

Request to Initiate SHPO Consultation on State and Federal Undertakings

SHPO USE ONLY
DATE RECEIVED:
ER NUMBER:

REV: 5/2012

SECTION A: GENERAL PROJECT INFORMATION

Is this a new submittal? (•) YES ( ) NO OR ( ) This is additional information for ER Number:

Project Name	Act 537 Sewage Facilities Plan Update	County	Allegheny
Project Address			
City/State/ Zip	McKeesport PA	Municipality	Dravosburg and Duquesne

SECTION B: PRIMARY CONTACT INFORMATION

Name	Bryan M. Churilla, P.E.	Phone	(412) 494-0510
Company	KLH Engineers, Inc.	Fax	(412) 494-0426
Street/P.O. Box	5173 Campbells Run Road	Email	bchurilla@klhengineers.com
City/State/Zip	Pittsburgh PA 15205		

SECTION C: PROJECT DESCRIPTION

This project is located on: (check all that apply) ☐ Federal property ☑ State property ☑ Municipal property ☑ Private property

List all Federal and State agencies and programs (funding, permits, licenses) involved in this project	Agency Type	Agency/Program/Permit Name	Project/Permit/Tracking Number (if applicable)

Proposed Work – Attach project description, scope of work, site plans, and/or drawings

Project includes (check all that apply): ☑ Construction ☑ Demolition ☑ Rehabilitation ☐ Disposition

Total acres of project area: Total acres of earth disturbance: 1.34

Are there any buildings or structures within the project area? (•) Yes ( ) No Approximate age:

This project involves properties listed in or eligible for listing in the National Register of Historic Places, or designated as historic by a local government	Yes	No	Unsure	Name of historic property or historic districts	
	( )	( )	(•)		

Please print and mail completed form and all attachments to:

PHMC
State Historic Preservation Office
400 North St.
Commonwealth Keystone Building, 2nd Floor
Harrisburg, PA 17120-0093

Attachments – Please include the following information with this form

- ☑ Map – 7.5' USGS quad showing project boundary and Area of Potential Effect
- ☑ Description/Scope – Describe the project, including any ground disturbance and previous land use
- ☑ Site Plans/Drawings – Indicate the location and age, if known, of all buildings in the project area
- ☐ Photographs – Attach prints or digital photographs showing the project site, including images of all buildings and structures keyed to a site plan

SHPO DETERMINATION (SHPO USE ONLY) SHPO REVIEWER:

- ☐ There are NO HISTORIC PROPERTIES in the Area of Potential Effect
- ☐ The project will have NO ADVERSE EFFECTS WITH CONDITIONS (see attached)
- ☐ The project will have NO EFFECT on historic properties
- ☐ SHPO REQUESTS ADDITIONAL INFORMATION (see attached)
- ☐ The project will have NO ADVERSE EFFECTS on historic properties:

APPENDIX L

USER RATE ANALYSIS

User Cost Analysis

Existing Rate Structure and Revenue

	Flat Fee	Usage Rate	Free Usage	Estimated Usage	Monthly Cost	Yearly Cost	No. Customers	Yearly Revenue
McKeesport	$ 30.00	$ 12.30	2,000	5,055	$ 67.58	$ 810.99	7,564	$ 6,134,300.00
Tributary municipalities	$ -	$ 7.95	0	4,432	$ 35.23	$ 422.77	11,779	$ 4,979,800.00
Duquesne	$ 25.00	$ 7.95	2,000	4,574	$ 45.46	$ 545.55	2,024	$ 1,104,200.00
Dravosburg	$ 25.00	$ 9.75	2,000	4,600	$ 50.35	$ 604.22	640	$ 386,700.00
Elizabeth Surcharge								$ 1,400,000.00
							22,007	$ 14,005,000

Additional Project Costs

City of Duquesne Project Costs =	$ 7,424,000
Borough of Dravosburg Project Costs =	$ 5,503,000
Total Project Costs =	$ 12,927,000
Assume PennVEST Cap Rate =	2.134%
Loan Term =	20 years
Annualized Debt Service =	$ 800,833
Year 2014 Budget =	$ 14,005,000
Additional O&M per Year =	$ 50,000
Total Required Yearly Revenue =	$ 14,855,833

Projected Rate Structure

	Flat Fee	Usage Rate	Free Usage	Estimated Usage	Monthly Cost	Yearly Cost	No. Customers	Yearly Revenue
McKeesport	$ 30.00	$ 12.30	2,000	5,055	$ 67.58	$ 810.99	7,564	$ 6,134,300.00
Tributary municipalities	$ -	$ 8.50	0	4,432	$ 37.67	$ 452.02	11,779	$ 5,324,314.47
Duquesne	$ 30.00	$ 13.50	2,000	4,574	$ 64.75	$ 776.98	2,024	$ 1,572,602.26
Dravosburg	$ 30.00	$ 13.50	2,000	4,600	$ 65.10	$ 781.23	640	$ 499,984.62
Elizabeth Surcharge								$ 1,400,000.00
							22,007	$ 14,931,201

Total Required Yearly Revenue = $ 14,855,833

Yearly Surplus / Deficit = $ 75,368

Summary of Rate Increase

	Flat Increase	Usage Increase	Free Usage	Estimated Usage	Monthly Increase	Yearly Increase	No. Customers	Yearly Revenue Increase
McKeesport	$ -	$ -	2,000	5,055	$ -	$ -	7,564	$ -
Tributary municipalities	$ -	$ 0.55	0	4,432	$ 2.44	$ 29.25	11,779	$ 344,514.47
Duquesne	$ 5.00	$ 5.55	2,000	4,574	$ 19.29	$ 231.42	2,024	$ 468,402.26
Dravosburg	$ 5.00	$ 3.75	2,000	4,600	$ 14.75	$ 177.01	640	$ 113,284.62
Elizabeth Surcharge								$ -
							22,007	$ 926,201

Yearly Project Cost plus O&M = $ 850,833

Yearly Surplus / Deficit = $ 75,368

KLH
ENGINEERS, INC.

5173 CAMPBELLS RUN ROAD
PITTSBURGH, PA 15205
PHONE: 412-494-0510
FAX: 412-494-0426
INFO@KLHENGINEERS.COM
WWW.KLHENGINEERS.COM

March 11, 2008
Ref. No. 220-33

Municipal Authority of the City of McKeesport
Attention: Mr. Joseph E. Rost, Executive Director
100 Atlantic Avenue
McKeesport, PA 15132

Dear Mr. Rost:

Municipal Authority of the City of McKeesport
Act 537 Projects: Feasibility and Preliminary Design Report
Report Transmittal

Enclosed please find three (3) copies of the referenced report, for distribution to you, Mr. Majzer and Mr. Harkins. The report which evaluated the feasibility of the projects identified and recommended by the Act 537 Plan will be utilized as the basis for the detail design which is currently commencing at our McKeesport office.

As you are aware, we have scheduled our first detailed design progress meeting on Tuesday, March 18, 2008 at 10:00am. KLH proposes this meeting take place at our office with subsequent site visits as warranted.

Furthermore, we request that you review the enclosed document prior to this meeting if possible. Provided you and your staff concur with the findings, KLH will submit the report to the PADEP, with a request for a Preliminary Engineering Conference with the Department to fulfill the guidelines of Part II, Section 8 of the PADEP Domestic Wastewater Facilities Manual. It is our hope that upon review of the report, the Department will waive the requirement of this meeting, which is dictated by the water quality management staff.

Should you have any questions regarding this letter, the attached report or require additional information prior to our meeting, please do not hesitate to call.

Sincerely,

KLH Engineers, Inc.

Kevin D. Hoffman, P.E.

cc: S. Greenberg, KLH Engineers, Inc.
M. Majzer, MACM
A. Harkins, MACM

Municipal Authority of the City of McKeesport

Act 537 Projects: Feasibility and Preliminary Design Report

March 2008

KLH
Engineers, Inc.
5173 Campbells Run Road
Pittsburgh, PA 15205-9733

TABLE OF CONTENTS

Appendices

Municipal Authority of the City of McKeesport
Act 537 Projects: Feasibility and Preliminary Design Report
March 2008

1.0 INTRODUCTION

1.1 BACKGROUND

The Municipal Authority of the City of McKeesport (MACM) and its multi-municipal service area initiated an Act 537 Sewage Facilities Study to identify the technical and institutional state of the wastewater infrastructure in the service area, and provide alternatives and recommendations based on existing and future physical and regulatory conditions. The Study and resulting report was completed and formally adopted by all involved parties in November 2006 and approved by the Pennsylvania Department of Environmental Protection (PADEP) on July 20, 2007.

The study and Plan report addressed and evaluated options with respect to the existing and required wastewater infrastructure for the following issues:

- Service Area Extension & Capacity Expansion
- Wet Weather Flow Issues
- Financial and Institutional Issues

The analysis presented in the Act 537 Plan identified that:

- The MACM interceptor system and Wastewater Treatment Plant (WWTP) has adequate capacity to respectively convey and treat average dry weather flow from the existing and proposed service areas. Future projected average daily flows at the WWTP are estimated to be 10.177 Million Gallons per Day (MGD).
- The cumulative maximum peak flow that would occur within the existing and possible expanded MACM service area during a 2-year 24-hour storm would be approximately 42.5 MGD.
- During wet weather situations, current and expected flow rates exceed the hydraulic capacity of the interceptor systems, pumping stations and treatment facility.

In order to comply with the PADEP & the United States Environmental Protection Agency (US EPA) requirements, a Long Term Control Plan (LTCP) was prepared, which works in concert with the ACT 537 Plan. Both plans define the following objectives related to the future MACM CSS operation:

- Capture and convey to the WWTP at a minimum 350% of an average dry weather flow from the combined sewer watersheds.
- Capture and convey 100% of wet weather flow from the sanitary sewer-only watersheds.
- Eliminate Sanitary Sewer Overflow (SSO) at the Long Run Interceptor.
- Capture, convey and provide complete treatment at the WWTP for a minimum of 85% of the total runoff from the entire watershed on an annual average basis.

The conclusion of the study determined that several capital projects must be constructed to accommodate the peak wastewater loadings supplied by the service area and comply with regulatory wet weather flow policies. As a result, the projects recommended by the selected alternative in the plan include:

- Long Run Interceptor Upgrade
- Cliff Street Pump Station Improvements
- 28th Avenue Pump Station Improvements
- Long Run Pump Station and Force Main Upgrade
- West Shore Pump Station and Force Main Construction
- MACM Wastewater Treatment Plant Expansion and Improvements

Plate No. 6-3 is reprinted from the Act 537 Plan in Appendix A to identify the location of these projects with respect to each other and the overall recommended plan.

1.2 DOCUMENT INTENTION

This document is intended to be the Feasibility and Preliminary Design Report for the aforementioned projects proposed in the Act 537 Plan and to serve as an addendum to the plan. Specifically the report will address, identify, and recommend feasible options and concepts for the various facility upgrades, improvement and new construction proposed.

1.3 DOCUMENT DEVELOPMENT

1.3.1 ALTERNATIVES AND CONCEPTS

The options and concepts were developed from the charge and budget estimate set forth in the Act 537 Plan with the goal to comply with the PADEP regulatory guidelines found in the *Domestic Wastewater Facilities Manual: A Guide for the Preparation of Applications, Reports, and Plans*. The concepts developed and evaluated will be presented to include the identification of the equipment required, the analysis of sizing, construction feasibility, and ultimately recommend selection. The recommendations presented will be based on several factors including:

- Construction Cost Estimates: prepared for the various alternatives presented
- Operation and Maintenance Requirements
- Reliability and Redundancy
- Treatment Flexibility
- Future Regulatory Environmental Considerations

Finally, to comprehensively address the feasibility of the concepts proposed herein, utility issues, real estate acquisition, construction scheduling, and additional information required for a detailed design are addressed and identified for the projects respectively and collectively.

1.3.2 Development of Construction Cost Estimates

The respective and comprehensive magnitudes of the individual projects identified by the Act 537 Plan are considered to be a substantial improvement to the MACM collection and treatment system. Likewise, the expectation of a commensurate capital expenditure is realized. Furthermore, the Act 537 Plan proposed a budget estimate for the projects which the MACM and its inter-municipal partners used as the basis for approval of the strategy recommended. Therefore the development of construction cost estimates is considered to be one of the paramount factors in the selection of options recommended by this report. As indicated in Section 1.3.1, each alternative identified for evaluation herein will have an estimated construction cost developed.

For the purposes of this report, cost estimates for construction were prepared based upon approximated quantities using conceptual proposed site plans, preliminary sewer alignments using USGS and Allegheny County mapping, and design calculation results and equipment layout sketches developed during the construction feasibility analysis.

The construction costs applied to the quantities approximated were obtained from the following sources:

- Unit price bid results from recently bid construction projects.
- Historical data from similar projects in which KLH Engineers, Inc. has been involved.
- Applied indices for construction costs as published by the Engineering News Record (ENR).
- The 2008 editions of the RS Means Construction Cost Data series.
- Equipment pricing was secured from various equipment suppliers and representatives specific to this or other recent projects.
- Where not otherwise identified, costs required for electrical work was estimated at 18% of the general and mechanical construction costs.
- Where applicable, installation factors were applied to the unit costs.

Finally, a contingency factor of approximately 10% was applied to the total project construction cost estimate for unrealized construction issues resulting from the preliminary nature of this report. It should be noted that this contingency factor does not apply to comprehensive information unavailable or unrealized at the writing of this report such as requirements for pre-construction environmental remediation, special excavation (i.e. blasting, drilling, etc.), special foundations (i.e. piles, caissons, etc.), or land use or future utility conflict issues. During a detailed design phase, attention will be given to these issues with respect to the required expense for specific materials and construction applicable to incorporate the special construction into design concepts.

2.0 GRAVITY SEWER PROJECTS

2.1 LONG RUN INTERCEPTOR UPGRADE

2.1.1 EXISTING CONDITIONS

The Long Run interceptor is one of five main interceptors owned and operated by the MACM and operates as a separate sanitary sewer. The 18" diameter line accepts and conveys sewage from the areas of McKeesport adjacent to Long Run and portions of White Oak Borough, Versailles Borough and North Versailles Township to the Long Run Pumping Station. The interceptor is joined with a 12" sewer that conveys combined sewage flow from the Eden Park Regulator drainage area in the City of McKeesport. The Long Run Pumping Station further pumps collected sewage through a 12" force main to the Upper Youghiogheny Interceptor.

The design flow capacity of the interceptor sewers between manholes was calculated using Manning's equation. The sewer grade and diameter were obtained from the as-built drawings and field survey information while a Manning's "N" of 0.013 was used for the reinforced concrete sewer. The full flow design capacity of the interceptor is shown in Table 2-1. The tables are organized such that the interceptor segment listed at the top of the table is the most upstream segment and the remaining segments proceed downstream to the interceptor.

The flows during certain wet weather events exceed the design condition causing surcharge conditions within the system and in some cases temporary by-passing through a sanitary sewer overflow into Long Run. Although the population projections published in the Act 537 Plan indicate a decline in contributing population, the sizing of the interceptor remains governed by these sanitary sewer overflows. To this extent, the capacity of the 18" gravity line potion of the interceptor must be upgraded to accommodate peak flows of around 7.0 MGD from White Oak and North Versailles and peak flow rates of 9.7 MGD at the Long Run Pump Station as predicated in the 537 Plan. No improvements to the Eden Park drainage area 12" interceptor are proposed.

2.1.2 PROPOSED DESIGN ALTERNATIVES

2.1.2.1 Construction Constraints

The existing 18 inch diameter interceptor sewer extends approximately 10,200 lineal feet along Long Run Creek and was constructed 1958 / 1959. Development of the watershed through present day has resulted in:

- Realignment, widening and grade adjustment of Long Run Road
- Stream realignment of Long Run Creek resulting in extended 48 inch diameter, 72 inch diameter and various smaller diameter storm sewers discharging to Long Run Creek
- Properties adjacent to Long Run Road receiving deep fill to create buildable parcels extending approximately 2,400 feet between along Long Run Road and Long Run Creek.

Table 2-1

Segment (MH to MH)	Pipe Diameter	Gradient (ft/ft)	Length (ft)	Capacity (MGD)
186 to 185	18"	0.0071	364.2	5.72
185 to 184	18"	0.0038	370.3	4.18
184 to 183	18"	0.0037	371.7	4.13
183 to 182	18"	0.0035	409.7	4.02
182 to 181	18"	0.0031	410.9	3.78
181 to 180	18"	0.0030	353.8	3.72
180 to 178A	18"	0.0039	158.9	4.24
178A to 178	18"	0.0055	229.9	5.03
178 to 177	18"	0.0062	360.3	5.35
177 to 176	18"	0.0057	174.2	5.13
176 to 175	18"	0.0056	295.5	5.08
175 to 174	18"	0.0067	367.0	5.56
174 to 173	18"	0.0066	373.2	5.52
173 to 172	18"	0.0030	414.7	3.72
172 to 188	18"	0.0021	482.5	3.11
188 to 187	18"	0.0029	370.8	3.66
187 to 171	18"	0.0049	240.4	4.75
171 to 170	18"	0.0031	267.9	3.78
170 to 169	18"	0.0028	277.1	3.59
169 to 168	18"	0.0028	280.5	3.59
168 to 167	18"	0.0035	189.6	4.02
167 to 166	18"	0.0068	386.4	5.60
166 to 179	18"	0.0164	127.8	8.69
179 to 165	18"	0.0026	316.0	3.46
165 to 164	18"	0.0065	250.0	5.47
164 to 163A	18"	0.0066	250.9	5.52
163A to 162A	18"	0.0016	100.2	2.75
162A to 162	18"	0.0001	392.9	3.46
162 to 161	18"	0.0000	82.5	-
161 to 160	18"	0.0023	190.5	5.52
160 to 159	18"	0.0033	243.9	3.90
159 to 158	18"	0.0021	205.4	3.11
158 to 157	18"	0.0018	149.5	2.88
157 to 156	18"	0.0024	264.1	3.33
156 to 155	18"	0.0028	152.0	3.59
155 to 154	18"	0.0028	204.1	3.59
154 to 150	18"	0.0000	46.7	-
150 to PS Wet Well	18"	0.0224	12.0	10.16

The development of this area has left MACM with an interceptor sewer buried 20 to 40 feet deep and in close proximity to buildings specifically in two areas. The first area is located approximately 2000 feet from the intersection of Long Run Road and Walnut Street where depths range between 30 to 40 feet. The second area where fill has been placed over the existing sewer for a length is approximately 850 feet further upstream of the first area and the sewer has approximately 20 feet of fill cover in this area.

2.1.2.2 Alternative 1: New Gravity Interceptor Open Cut Construction

To meet the capacity requirements, the design of a new gravity interceptor will require construction of 30 inch diameter interceptor sewer pipe between the Long Run Pump Station and the deep fill area at a point where the Olympia Shopping Center is connected. From this point a 27 inch diameter interceptor sewer will be constructed for the remaining watershed length replacing the existing 18 inch diameter interceptor sewer.

The 30 inch diameter pipe will be constructed at extremely flat grades and have a minimum capacity of 10.0 MGD. Reduction of the pipe size allows for a minimum capacity of 10 MGD in the upper reaches of the watershed. Further reduction of the interceptor size does not provide for the minimum flow requirements. Designing the 27 inch diameter interceptor sewer at minimum slopes is an attempt to reduce the excavation required through the deep fill area however the 48 inch diameter, and 72 inch diameter storm sewers interfere with the continued construction of the new 27 inch diameter interceptor sewer. Also the construction through the deep fill area is reduced by only a couple of feet. Trench excavation 30 to 40 feet deep is not a viable construction solution.

As a result of the infeasibility of the option, no cost estimate has been provided for this alternative.

2.1.2.3 Alternative 2: New Interceptor Open Cut and Trenchless Construction

A second design consideration to overcome constructing the new interceptor through the 30 to 40 feet deep fill and construction past the 48 inch diameter, and 72 inch diameter storm sewer is a combination of design construction techniques to achieve capacity requirements.

The design includes open cut construction of 30 inch diameter interceptor sewer pipe between the Long Run Pump Station and Walnut Street, open cut construction of a 24 inch diameter relief sewer paralleling the existing 18 inch diameter sewer for the remainder of the watershed with exception to the deep fill area where trenchless construction techniques are considered.

The trenchless construction method investigated will implore pipe bursting with excavation 30 to 40 feet deep for access ports. A minimum nine new manholes will be constructed at the pipe bursting access ports. The 18 inch diameter concrete pipes will be burst through the deep fill area and the new pipe installed being 24 inch diameter High Density Polyethylene Pipe (HDPE). Maintaining the existing pipe grades will yield a capacity of 7.9 MGD.

Trenchless construction methods are typically considered to minimize excavation however there are 18 excavations between access ports. In addition there are nine customer service sewers that will require 30 to 40 feet deep excavation for reinstatement. Excavations at these depths could result in excavation openings 20 feet square at the surface. Therefore this construction will be extremely difficult if not prohibitive. Other factors affecting the trenchless construction are:

- The concrete pipe reinforcement must be further investigated as it could prohibit pipe bursting.
- Pipe sections burst should be limited to lengths of approximately 300 feet and;
- The length of the lines improved will require continuous sewage bypass pumping.
- Pipe bursting is recommended for the summer construction season or costs can increase as much as thirty percent.

In addition to these difficult construction issues, interference constructing the 24 inch diameter relief sewer past the 48 inch diameter and 72 inch diameter storm sewer drive the new 24 inch diameter relief sewer alignment to deeper elevations that will not be overcome for downstream connection.

Therefore, the option appears infeasible and no cost estimate has been provided for this alternative.

2.1.2.4 Alternative 3: Interceptor Replacement, White Oak Pump Station and Force Main

The third design alternative develop to overcome the construction obstacles previously presented, includes:

- Open cut construction of a 30 inch diameter interceptor sewer pipe between the Long Run Pump Station and Walnut Street,
- Open cut construction of a 24 inch diameter relief sewer between Walnut Street and the deep fill area at a point where the Olympic Shopping Center connection at Long Run Road,
- The construction of a pump station at the intersection of Long Run Road at Ripple Road and an accompanying 16 inch diameter ductile iron force main to a connection point at the 24 inch diameter relief sewer. (As regards the detail for the proposed White Oak Pump Station and force main, reference section 3.2.2 of this report.)

During construction, the existing 18 inch diameter sewer will remain in operation from Walnut Street upstream throughout the watershed without interruption of service. The existing 18 inch diameter sewer critical section will pass 3 MGD establishing the pump station and force main capacities at 5 MGD. Therefore the combination of the existing 18 inch diameter sewer, new pump station and force main will have a capacity of 8 MGD at the connection point with the new 24 inch diameter relief sewer. The 30 inch diameter interceptor sewer and the 24 inch diameter relief sewer in combination with the existing 18 inch interceptor sewer will have a minimum 10 MGD capacity.

As this is the only feasible option to achieve the capacities required of an upgrade, alternative 3 is the recommended option. The estimated cost to construct the gravity line work portion of the project is approximately $579,660.00. It should be noted that this construction estimate reflects January 2008 dollars and does not include applied contingency factors nor reflect costs for utility services, land acquisition or special construction. A more detailed estimate is provided in Appendix B of this report.

3.0 FORCE MAIN AND PUMP STATION PROJECTS

3.1 UPGRADED PUMP STATIONS

The MACM owns and operates four existing pumping stations. Three of the existing pump stations are proposed to be upgraded within the scope of projects to be undertaken. Two stations, the Cliff Street and 28th Avenue Pump Stations, are considered to be minor upgrades for capacity and updates of existing equipment and infrastructure. The third facility, the Long Run Pump Station, is considered to be a substantial upgrade of capacity.

3.1.1 CLIFF STREET PUMP STATION

3.1.1.1 Existing Facility

The Cliff Street Pump Station pumps wastewater flows from the Crooked Run watershed. Wastewater enters the pump station after passing through an 18-inch regulator and a 42-inch regulator to a drop manhole. From the drop manhole the sewage flows via a 24-inch cast iron pipe sewer to the pump station wet well. From the wet well, the sewage is pumped through an 18-inch cast iron force main to the Lower Monongahela Interceptor.

The firm capacity of the Cliff Street Pumping Station is 6.5 mgd. The Cliff Street Pumping Station contains three (3) centrifugal pumps of the vertical, non-clog type; all three (3) are variable speed pumps. The capacity of the variable speed pumps ranges between 800 gpm to a maximum of 2400 gpm. During 1998 and 1999, the Authority replaced the variable frequency drives (VFDs) and installed Badgermeters on all pumps.

A sluice gate is provided at the point where the raw sewage enters the wet well. The purpose of this gate is to divert the sewage, during emergency, to prevent damage to the station. Following the sluice gate is a bar screen, having 3-inch clear openings, which removes coarse debris from the sewage as it enters the wet well. The pumping station is equipped with an emergency stand-by generator.

3.1.1.2 Capacity Requirements

The peak flow from this combined sewer watershed is limited to 350% of the average dry weather flow, or 7.42 mgd. The pumping station will need to be upgraded to accept and convey the projected peak flows from the existing 6.5 MGD capacity.

3.1.1.3 Force Main Upgrades

Due to the location of the station and existing force main within the city limits, no upgrades outside the pump station are proposed.

3.1.1.4 Pump Station Upgrades

3.1.1.4.1 Mechanical Upgrades

The mechanical upgrades at the Cliff Street Pump Station include the replacement of the pumps and the suction and discharge valves.

The existing pump curves were evaluated to determine if more capacity could be yielded from the pumps by changing impellers or artificially changing the static head by increasing the operating wet well level. Unfortunately neither option provided the required capacity. Also, despite functional operation as a result of a strict maintenance program, the decision was made to replace the existing suction and discharge valves due to their age and given the opportunity to temporarily decommission the station to replace the pumps. Thus, valves will be replaced in kind with new plug valves on the suction and discharge sides of the pump as well as new check valves on the discharge side.

In changing the capacity of the station to 7.42 MGD (5,153 gpm), each new pump must have a capacity of 2,576.5 gpm per pump to ensure two operating with one pump designated as a spare during peak conditions. With no modifications of the existing force main, the total dynamic head (TDH) associated with the peak flow rate was calculated using the Hazen-Williams formula for friction losses in the force main. With a maximum static head of 38.3 feet, the elevation difference the pump must overcome, and utilizing a Hazen-Williams friction factor (C-value) of 80 considering the age of the line resulted in a duty point of 5,153 gpm at 109.6 feet of TDH.

Two types of centrifugal pumps were evaluated for the replacement pumps: vertical shaft (as existing) and dry pit submersible pumps. Physically, the volute and casing for each type of pump is the same for either application however the difference is where the motor is mounted and the pump shaft length. Since either type of pump is essentially the same pump, the decision for the type of pump to be utilized for the replacement pump lies within the level of maintenance, spatial constraints due to the relatively constricted layout of the existing pump room, and capital cost. A table is provided in Appendix C to identify the differences between the various pumps evaluated as candidates for replacement.

Although all pumps evaluated present a level of feasibility as regards capacity, the vertical shaft style as manufactured by Yeomans Chicago presented the most optimal spatial configuration and had the least expensive budgetary price. Furthermore, it is expected that level pump maintenance will not change as the MACM staff is familiar with this style pump as it is the style existing at the station. For these reasons, this report recommends the use of vertical shaft centrifugal pumps, and to this end the associated budget prices are utilized within the cost estimate for the station upgrade.

The last mechanical upgrade proposed at the station is the installation of a flow meter on the pump discharge. The most accurate type of flow meter for this application is a magnetic flow meter installed in the line. The optimal installation of such a meter would allow for the equivalent length of five (5) pipe diameters of straight pipe upstream and three (3) pipe diameters downstream of the meter and a valved bypass of the meter for unit maintenance. Unfortunately the piping arrangement and the overall existing design of the station prohibit the optimal installation. That stated, a magnetic meter can still be installed on the discharge line with the understanding that without the recommended straight pipe on either side of the meter lessens the accuracy of the meter and the lack of a bypass could complicate meter maintenance and overall pump station operation in the event of a meter failure.

3.1.1.4.2 <u>Structural Requirements</u>

The existing station is a structure of four levels, a first floor flat roof structure and three levels below grade. Access to the lower levels from the ground elevation consists of a single stairway to the first basement where the station is divided into the wet well and pump room sides of the structure. From the second level down to the third and fourth levels, separate stair wells are provided for access due to the separation provided.

The existing access arrangement between levels does not conform to PADEP regulations or NFPA codes for the separation of classified areas containing gases with the potential to spark or explode. For this reason, the second floor must be modified to separate this level and to include a separate accesses for the pump and wet well sides of the station. It is proposed that a block wall can be constructed on the second level to permit access to the pump room from the existing stairs originating from the ground floor and separate the wet well area and it's off gases from the pumps, motors, boiler and electrical equipment on the first floor. With this separation, access to the wet well side would be required. It is proposed that an access door could be cut into the foundation wall on the wet well side of the second floor and a below grade stairway constructed. To protect this stair way from climatic elements, it is proposed that the stair way be enclosed with a door at ground level, for ingress-egress.

As regards the roof over this addition to the building it can be included as an expansion of a proposed roof replacement, previously identified by the Authority in the February 2006 Five Year Capital Plan. The roof replacement will be the installation of a wooden truss, shingled roof with gutters and downspouts that will create an attic space above the existing structure.

Finally, the doors, windows, and HVAC equipment of the structure are demonstrating signs of wear and age and recommended for replacement. The materials specified will not only update the aging building but also provide better insulation for heating and ventilation concerns.

3.1.1.4.3 Electrical Upgrades

At a minimum, the electrical upgrades will include replacing the variable frequency drives (VFDs) and pump controls at the station. The existing VFDs are sized to commensurate to the existing 75 HP pumps and will not function properly with the 125 HP motors proposed in Section 3.1.1.4.1.

The increased horse power required of the proposed pumps also renders the emergency generator at the station insufficient. Therefore, it is proposed that a new generator of sufficient size be installed. Understanding the existing generator was installed within the last 10 years, it is recommended that the existing unit be sold as a used generator to offset the cost of the required size generator if it is unable to be utilized for other applications within the overall scope of the Act 537 Projects.

Other electrical upgrades proposed include instrumentation for safety such as gas monitoring and to incorporate a system-wide SCADA (Supervisory Control and Data Acquisition) system for remote monitoring of the station and historical trending of operation.

3.1.1.4.4 Land Acquisition Requirements

No land acquisition is proposed for the Cliff Street Pump Station site as it appears all improvements can be implemented within the existing property lines. That stated, set back variances for the proposed additions may be required.

3.1.1.5 Cost Estimate

The cost to construct the improvements to the Cliff Street Pump Station is based on the following scope of work:

- All required site work to accommodate the remainder of the scope.
- Modification of the existing Pump Station
  1. Replacement of the existing pumps
  2. Separation of the wet well area from the motor and electrical equipment by constructing a building addition.
  3. New roof.
  4. Replace doors and windows
- Generator Replacement
- Gas Monitoring
- New Pump Controls w/SCADA
- Replace Variable Frequency Drives to accommodate new pumps
- Upgraded Electric Utility Service
- Automatic Transfer Switch
- Miscellaneous Electrical construction: power, control, lighting, etc.

The estimated construction cost without contingency is estimated as identified in Table 3-1:

Table 3-1

Construction	Construction Estimate Value[1]
General Mechanical:	$ 432,220.00
Electrical:	$ 422,540.00
Construction Subtotal[2]	$ 854,760.00

Notes:

1. Construction Estimate Values reflect January 2008 dollars.
2. Subtotal does not include contingency factors applied and does not reflect costs for utility services, land acquisition or special construction unrealized herein.

A more detailed construction estimate is provided in Appendix B.

3.1.2 28TH AVENUE PUMP STATION

3.1.2.1 Existing Facility

The 28th Avenue Pumping Station receives raw sewage from the 27-inch Upper Youghiogheny Interceptor and from a regulator on the 60-inch combined 28th Avenue Sewer. Aside from capacity, the 28th Avenue Pumping Station is essentially the same mechanical and structural design as the Cliff Street Pumping Station discussed in Section 3.1.1.

The firm capacity of the existing pumping station is 5.6 MGD. The station contains three (3) pumps to pump the sewage through a 20-inch cast iron force main, which discharges to the Lower Youghiogheny Interceptor. The three (3) pumps are variable speed pumps and each has a capacity that varies from 500 gpm to 2000 gpm. The Authority also replaced the variable frequency drives (VFDs) and installed Badgermeters on all pumps at this pumping station.

3.1.2.2 Capacity Requirements

The 28th Avenue Pump Station must allow for the capture of the projected peak flow from the Versailles Trunk Sewer (flow from Versailles and Elizabeth), along with the flow from the 28th street CSO Regulator drainage area. The total projected peak flow is equal to 7.74 mgd as a sum of 4.2 mgd from Versailles Trunk and 3.54 mgd from the combined sewers' watershed. It should be noted that an additional 0.2 MG should be included in any upgrade of the existing capacity of the pump station to allow for the capture of extra combined flow in case the treatment capacity at the WWTP has not yet reached its maximum. This is important because the location of a potable water intake downstream of the 28th Street CSO By-Pass is designated as a sensitive area. Therefore the pump station must be upgraded to a projected capacity of 7.94 MGD.

3.1.2.3 Force Main Upgrades

Due to the location of the station and existing force main within the city limits, no upgrades outside the pump station are proposed.

3.1.2.4 Pump Station Upgrades

3.1.2.4.1 Mechanical Upgrades

The mechanical upgrades at the 28th Avenue Pump Station include the replacement of the pumps and the suction and discharge valves.

Similar to the evaluation performed for the Cliff Street station, the existing pump curves were evaluated to determine if more capacity could be yielded from the pumps by changing impellers or artificially changing the static head by increasing the operating wet well level. Unfortunately neither option provided the proposed required capacity of the 28th Avenue Station. Again, it was decided to replace the existing suction and discharge valves in kind with new valves due to their age and the opportunity to temporarily decommission the station.

In changing the capacity of the station to 7.94 MGD (5,510 gpm), each pump must have a capacity of 2,755 gpm per pump to ensure two operating with one pump designated as a spare during peak conditions. With no modifications of the existing force main, the total dynamic head (TDH) associated with the peak flow rate was calculated using the Hazen-Williams formula for friction losses in the force main. With a maximum static head of 21.1 feet, the elevation difference the pump must overcome, and utilizing a Hazen-Williams friction factor (C-value) of 80 considering the age of the line resulted in a duty point of 5,510 gpm at 171 feet of TDH.

Vertical shaft and dry pit submersible pumps were also evaluated for the replacement pumps as previously described in 3.1.1.4.1. Again, the decision for the type of pump to be utilized for the replacement pump was rooted in the level of maintenance, spatial constraints due to the relatively constricted layout of the existing pump room, and capital cost. A table is provided in Appendix C to identify the differences between the various pumps evaluated as candidates for replacement.

Although all pumps evaluated in Appendix C present a level of feasibility as regards capacity, the vertical shaft style as manufactured by Yeomans Chicago presented the most optimal spatial configuration and had the least expensive budgetary price. Furthermore, it is expected that level pump maintenance will not change as the MACM staff is familiar with this style pump as it is the style existing at the station. For these reasons, this report recommends the use of vertical shaft centrifugal pumps, and to this end the associated budget prices are utilized within the cost estimate for the station upgrade.

Again similar to the recommendations made for the Cliff Street Station, the installation of a flow meter on the pump discharge is proposed. The magnetic meter would be installed on the discharge line with the understanding that without the recommended straight pipe on either side of the meter available the accuracy of the meter is reduced and the lack of a bypass could complicate meter maintenance and overall pump station operation in the event of a meter failure.

3.1.2.4.2 Structural Requirements

As the 28th Avenue and Cliff Street Pump Stations are sister facilities, the structural improvements proposed are similar to those outlined in Section 3.1.1.4.2 of this report.

Structural improvements at a minimum will include the separation of the wet well from areas housing mechanical and electrical equipment for conformance to regulatory and fire codes. The separation will include the construction of a stairwell addition to the structure, which is proposed to be enclosed and housed with an extension of a replaced roof similar to that previously proposed for Cliff Street. Finally the doors, windows, and HVAC components will be replaced and relocated as warranted by the addition of the building.

3.1.2.4.3 Electrical Upgrades

The electrical updates for the 28th Avenue Pump Station will include new pump controls VFDs and a new standby emergency generator resulting from the increased horse power of the pumps proposed. Again, all electrical components less than 10 years of age are recommended for re-sale to offset the costs of the new equipment.

The 28th Avenue Station will also require upgrades to accommodate the desired safety and monitoring instrumentation for the system-wide SCADA system proposed, as well as any other wiring changes resulting from the separation of the wet well area and building addition.

3.1.2.4.4 Land Acquisition Requirements

No land acquisition is proposed for the 28th Avenue Pump Station site as it appears all improvements can be implemented within the existing property lines. That stated, set back variances for the proposed additions may be required.

3.1.2.5 Cost Estimate

The cost to construct the improvements to the 28th Avenue Pump Station is based on the following scope of work:

- All required site work to accommodate the remainder of the scope.
- Modification of the existing Pump Station
  1. Replacement of the existing pumps
  2. Separation of the wet well area from the motor and electrical equipment by constructing a building addition.
  3. New roof.
  4. Replace doors and windows
- Generator Replacement
- Gas Monitoring
- New Pump Controls w/SCADA
- Replace Variable Frequency Drives to accommodate new pumps

- Upgraded Electric Utility Service
- Automatic Transfer Switch
- Miscellaneous Electrical construction: power, control, lighting, etc.

The estimated construction cost without contingency is estimated as identified in Table 3-2:

Table 3-2

Construction	Construction Estimate Value[1]
General Mechanical:	$ 407,340.00
Electrical:	$ 523,720.00
Construction Subtotal[2]	$ 931,060.00

Notes:

1. Construction Estimate Values reflect January 2008 dollars.
2. Subtotal does not include contingency factors applied and does not reflect costs for utility services, land acquisition or special construction unrealized herein.

A more detailed construction estimate is provided in Appendix B.

3.1.3 Long Run Pump Station and New Force Main

3.1.3.1 Existing Facilities

The Long Run Pump Station receives raw sewage from the Long Run Interceptor including combined sewer flow from the Eden Park Regulator drainage area. There are three (3) pumps in the station to pump the sewage through approximately 650 l.f. of 12-inch cast iron force main discharging to the Upper Youghiogheny Interceptor which ultimately flows to the 28th Avenue Pump Station. All three (3) pumps are of the centrifugal non-clog type, and are controlled automatically by a float control. Each pump is constant speed and each has a capacity of 750 gallons per minute (GPM). Only two of the three pumps are used at one time, with the third pump acting as a standby. This arrangement allows for a peak capacity of 2.16 MGD however the capacity can be increased to 2.67 MGD should the third pump be utilized.

The station is equipped with a sluice gate where the raw sewage enters the wet well to prevent damage to the station during emergency. Following the sluice gate is a bar screen, having 3-inch clear openings, which removes coarse debris from the sewage as it enters the wet well. The pumping station lacks a second emergency stand-by power source.

3.1.3.2 Capacity Requirements

As presented in Section 2.1 of this report, the Act 537 Plan identified that the design storm peak flow from the Long Run watershed is 9.7 mgd at the pump station. Given the capacity requirement, a substantial capacity upgrade is required at the pump station. Moreover the Act 537 Plan recommended that the discharge from this station upgrade be removed from the Upper Youghiogheny Interceptor and 28th Avenue Pump Station load to separate sanitary only and combined sewer flows. As a result it was recommended by the Plan to install a new force main from the Long Run Pump Station to the WWTP by way of the proposed West Shore Pump Station. To convey this flow between the pump stations, a new force main will be required not only for the different discharge point but also for capacity commensurate with the peak design rating of the Long Run Pump Station.

3.1.3.3 Force Main Upgrades

3.1.3.3.1 Sizing and Materials of Construction

To accommodate the peak flow of 9.7 MGD without creating undue friction loss from high velocities within the force main a 20" pipe diameter was selected. The resulting velocity at this flow rate equates to 6.8 feet per second which is near the upper end of the range for published recommended force main velocities. As will be expanded upon later, the station will be equipped with variable frequency drives to ensure that the pump discharge rate does not fall below that required to maintain a minimum velocity of 2.0 feet per second during low and average influent loads to the station.

To further minimize friction loss within the pipe, plastic pipe are preferred over the ductile iron counterpart due a smoother interior wall. Thus, for the majority of the alignment, PVC C-900 series pipe is proposed. For the section of the force main that will cross the Youghiogenhy River, a fused together thick wall high density polyethylene (HDPE) is proposed.

3.1.3.3.2 Alignment

The most direct alignment to the site of the proposed West Shore Pump Station from the Long Run Pump Station Site parallels the Youghiogheny River either by way of Walnut Street (SR 0148) or the Youghiogheny River Trail (YRT). Either alignment will require crossing the Youghiogheny River in the vicinity of the combined sewer overflow regulator at 13th Avenue and just upstream of the existing double barrel siphon lines that connects the flows from the Port Vue area of the service area. This crossing will result in the discharge of the force main within 200 lineal feet of the proposed West Shore Pump Station site, currently owned by ELG Metals, Inc.

A. Option 1: Walnut Street

The alignment in or along Walnut Street (SR 0148) resulted in a force main distance of approximately 8,000 lineal feet to the point where the Youghiogheny River crossing is proposed. Walnut Street is primarily a two lane (two way) street paralleling the Youghiogheny River with substantial residential and commercial property abutting the right-of way. As a result of the private property within the McKeesport City limits, Walnut Street is considered to be a high traffic roadway.

Construction using this alignment could be considered difficult and costly as a result of the high volume of street traffic, the potential for utility conflicts and private property disruption. Furthermore, given that Walnut Street is owned and maintained by the

Pennsylvania Department of Transportation (PADOT), all construction with the limits of the road right-of-way would be subject to PADOT construction requirements. It is expected that such requirements would include placement of select backfill between the pipe zone and the finished ground surface and the replacement of pavement to PADOT standards. Where the alignment would encroach the roadway, it is expected that the paving restoration requirements would at a minimum include resurfacing the entire width of a traffic lane.

B. Option 2: Youghiogheny River Trail

The new force main from the Long Run Pump Station for this alignment resulted in a distance of nearly 6,400 lf to the point where the Youghiogheny River crossing is proposed. Leaving Long Run Pump Station, the line would be located in the same location as the existing force main along Will Street and then paralleling the upper Youghiogheny Interceptor line until it reaches the YRT in the vicinity of the 28th Avenue Pump Station. At this point the proposed line would parallel the existing 18" 28th Avenue force main to the point near the combined sewer overflow regulator at 13th Avenue.

The YRT is a recreational trail constructed along former rail bank within the right of way of the Pittsburgh & Lake Erie Railroad, which is situate between Walnut Street and the Youghiogheny River. Research into current property ownership yielded that CSX Transportation, Inc. claims track rights to the rail bank. As a result, CSXT specifications for utilities within railway limits have the potential to be imposed to ensure adequate protection of the force main as well as future railroad tracks should they be re-laid in this existing rail bed. The CSXT specifications indicate that special construction requirements could include installation of sheet piling and/or casing pipe the length of the alignment within the trail, and placement of select backfill between the pipe zone and the finished ground surface. That stated, the YRT is owned by the Regional Trail Corporation and is currently managed operated by Omega Rails Management. Preliminary discussions with this firm indicate that there would be no special construction requirements for the installation of the force main in the former rail bed, beyond surface restoration of the trail and its surroundings.

C. Youghiogheny River Crossing

The Youghiogheny River crossing is proposed the vicinity of the combined sewer overflow regulator at 13th Avenue and just upstream of the existing double barrel siphon lines that connects the flows from the Port View area of the service area.

Four options for crossing the river were developed and evaluated:

1) Pipe bursting the existing 14" and pushing 20" or 24" HDPE through.
2) Horizontal directional drilling (HDD) of a new line.
3) Open cut excavation of a new line.
4) Suspending the new line from the 15th Street Bridge (pending PADOT approval)

Option 1 above was dismissed immediately due to the difference in the required diameter made pipe bursting infeasible. Option 4 was also quickly dismissed on the basis that suspension of the line on the bridge would increase the static head and inherently increase the size and horsepower required of new pumps at the Long Run Pump Station. Such increases along with obtaining PADOT approval would likely translate into a larger capital cost than expected for the remaining options.

After discussing the matter with the US Army Corps of Engineers (USACE) regarding the installation of a new force main across the Youghiogheny River, the USACE indicated that the portion of the river where the crossing is proposed is considered to be navigatable. Therefore, the USACE would have a preference for horizontal directional drilling (HDD) option as opposed to open cut and side casting the line to minimize disturbance of river traffic. Regardless of the construction method used, USACE would likely require:

- Signage alerting local river traffic of the line during construction and possibly permanent for location purposes.
- The minimum cover required on any new line is 4 feet below the river bed and 2 feet if in rock.
- As regards permits, a joint permit application between PADEP and the USACE (Section 105) would be required which would inherently commence a Section 10 approval on the USACE's part.

USACE has no requirements on the pipe material utilized for the crossing although preliminary indications identify that fusible HDPE or PVC would be acceptable.

Conversations with several contractors have also guided the preference of this report toward HDD installation of the proposed line. HDD construction is a drilling technique increasingly being utilized to install lines crossing rivers and around other obstacles. Although more complicated than identified herein, the technique is essentially a three step process. First a smooth radius pilot hole is drilled using direction guidance equipment. Then, the hole is enlarged using a "pre-reaming" head to a suitable diameter to finally pull back product pipeline through the hole.

Feasibility of this construction method has been verified by at least two contractors, under the caveat of assumed geotechnical conditions under the river bed. As these conditions are unknown, a substantial geotechnical investigation commensurate with the recommendations of the Directional Crossing Contractors Association (DCCA) must be performed prior to final design. Likewise, final design of the line will conform to recommendations of the DCCA and other resources familiar with design requirements.

D. Recommended Alignment

Several Cost estimates were prepared for the various alignments to assist in the evaluation of the preferred option. Each option (identified by the alignment and/or special construction) included the following common scope of work items:

- Construction of a new 20" PVC force main from the Long Run Pump Station to the proposed West Shore Pump Station with a small portion of gravity sewer at the later.
  1. Open cut construction
  2. Concrete blocking where applicable
  3. Installation of air relief valves housed in access manholes where required
  4. Horizontal Directional drill under the Youghiogheny River
  5. Restoration along trench:
     a. PADOT standards where applicable.
     b. To CSX Standards were applicable
     c. Mill and repave one lane of traffic complete with new traffic lines
     d. Seed and mulch where applicable.

The estimated construction cost without contingency is presented in Table 3-3 for the various construction requirements:

Table 3-3

Alignment Construction Option	Estimate Value
YRT Alignment: No special requirements	$ 2,949,360.00
Walnut Street Alignment	$ 4,486,250.00
YRT Alignment: Casing Pipe Only	$ 8,713,580.00
YRT Alignment: Sheet Pile Only	$ 5,046,990.00
YRT Alignment: Sheet Pile and Casing Pipe	$ 10,811,210.00

The YRT alignment with no special requirements option is recommended on the basis of cost and ease of construction over the other options evaluated.

3.1.3.3.3 Land Acquisition Requirements

Temporary construction easements will be required regardless of the proposed force main alignment. As regards permanent easements, preliminary alignments developed for the preparation of this document have attempted to be placed in public right-of-way where possible with the exception of the portions of the line within the limits of the YRT. Preliminary discussions with YRT Management did not indicate what if any right-of-way fees associated with the proposed alignment would be.

3.1.3.3.4 Potential Utility Conflicts

Aside from the requirements that could be imposed from the YRT, there appear to be no substantial issues that could affect the installation of the force main in the recommended alignment. It should be noted that in areas outside the YRT, the potential for interference exist for water, gas, storm and sanitary sewers could exist. That stated, at the writing of this report, it does not appear that such conflicts could not be resolved as a result of relocating the alignment as will be defined during final design.

It should be noted that should the Walnut Street alignment be selected during final design due to special construction requirements by the YRT or land acquisition issues, construction conflicts are expected with all major utilities (water, sewer, gas, electric, telephone and cable).

3.1.3.4 Pump Station Upgrades

The mechanical and structural upgrades proposed for this station essentially reconstruct the pump station to accommodate the substantial capacity increased required.

3.1.3.4.1 Mechanical Upgrades

Similar to the evaluation performed for the other stations assessed in this document, several pumping options were evaluated. Information for vertical shaft, submersible and dry pit submersible pumps were obtained from vendors and evaluated for the replacement pumps. A table is provided in Appendix C to identify the differences between the various pumps evaluated as candidates for replacement.

MACM staff has expressed concern over flooding that has occurred in the past at this station. Therefore, although the vertical shaft pump options are the most economically attractive alternative, they were discounted. As it understood from the capacity increase required that additional wet well space is needed, the submersible pump as manufactured by Flygt was chosen for the basis of design, although other manufactures may be considered during final design. This type of installation would provide the most efficient use of space at the site as the pump can be cost effectively mounted internally to the wet well.

All discharge valves (both isolation and check) will be new and are proposed to be located in the wet well, again in the interest of space, considerably above the liquid level. Each discharge line will convey the pumped wastewater to a common force main header that will exit the station to the upgrades Long Run force main.

Finally a magnetic flow meter is proposed on the force main within the station site boundaries for monitoring. The intention is to provide the recommended straight pipe distances as well as a valved bypass for the unit. The location of the flow meter will be determined during final design when more information is available as regards the site conditions and suitable construction area.

3.1.3.4.2 Structural Upgrades

Given the firm capacity of the existing station is approximately 2.5 MGD; the wet well is undersized to accept the proposed 9.7 MGD peak flows. Therefore, the all mechanical and electrical equipment and piping in the existing building will be removed to create space for a new mechanically cleaned screen and additional wet well throughout the entire area currently occupied by the pump room. The existing manually cleaned screen will be left in place for operation during construction and to function as the bypass for the new screen.

To achieve the required wet well volume, an addition to the basement area to the south of the building will be constructed and house three submersible pumps. Openings in the foundation walls will be cut to make each of the wet well areas common to each other. At the surface the new wet well area will be a covered concrete cap with hatchways to access the pumps using the proposed monorail complete with trolley and outdoor electric hoist.

As the existing building will now be considered wet well, the space will be considered an explosive area as regards all electrical equipment. Therefore, a second addition will be constructed to the west of the existing building to serve a slab on grade an electrical room.

A new common wood truss and shingled roof will be constructed over the existing building and the proposed electrical room. In doing so, the existing roof will be replaced, as prescribed by the MACM 2005 Five Year Capital Plan. It should be noted that, due to the low clearance resulting from the existing roof beams the existing roof will be removed to accommodate the installation of the proposed screen. Finally the doors, windows, and HVAC components will be replaced and relocated as warranted by the additions to the structure. Specifically the windows will be replaced with glass block in fulfillment of directive s of the MACM 2005 Five Year Capital Plan.

3.1.3.4.3 Electrical Upgrades

As indicated in the previous section, a building addition will be constructed to house all electrical gear which is expected to consist of new motor controls, variable frequency drives, pump controls and building instrumentations (HVAC, lighting, etc.).

The station will be electrically overhauled such that the pumps and the monitoring of the pump station will be managed by an electrical control panel with the following features:

- Pump controller with SCADA capabilities
    - Intrinsically safe wiring for wet well circuits
    - Variable Frequency Drive Control (VFD)
    - Pumps seal failure detection w/indicating lights
    - Pumps over temperature detection
    - Pumps running status indicating lights
    - Pumps elapsed time meters
- Transient Voltage Surge Suppression

    - 480 VAC level
    - 120 VAC level
- ➢ Chart recorder
    - Station flow with totalizer
    - Pumps running
- ➢ General alarms

Continuous reading level transducers will be used in conjunction with the VFD's to achieve the desired wet well level and provide monitoring at remote locations.

To ensure compliance with PADEP guidelines, a second emergency power source will be provided in the form of an exterior pad mounted generator.

3.1.3.4.4 <u>Land Acquisition Requirements</u>

No land acquisition is proposed for the Long Run Pump Station site as it appears all improvements can be implemented within the existing property lines with the aid of left in place sheet piling to project structures on adjacent properties. That stated, set back variances for the proposed additions may be required.

3.1.3.5 Cost Estimate

The cost to construct the improvements to the Long Run Pump Station and new force main are based on the following scope of work:

- ➢ All required site work to accommodate the remainder of the scope.
- ➢ Modification of the existing Pump Station
    1. Removal of the existing pumps and conversion of dry well pump room into additional wet well.
    2. Construction of a new wet well addition for new submersible pumps
    3. Construction of a new influent mechanically cleaned screen
    4. Removal of existing roof to accommodate proposed screen.
    5. Installation of new submersible pumps
    6. Installation of a monorail for pump pullout
    7. Construction of a new electrical room building addition
    8. New roof.
    9. Replace doors and windows
- ➢ Furnish generator
- ➢ Gas Monitoring
- ➢ New Pump Controls w/SCADA
- ➢ Replace Variable Frequency Drives to accommodate new pumps
- ➢ Upgraded Electric Utility Service
- ➢ Automatic Transfer Switch
- ➢ Miscellaneous Electrical construction: power, control, lighting, etc.

- Construction of a new 20" PVC force main from the Long Run Pump Station to the proposed West Shore Pump Station with the primary alignment in the YRT, conforming to the scope items presented earlier in Section 3.1.3.3.2 D .

The estimated construction cost without contingency is estimated as identified in Table 3-4:

Table 3-4

Construction	Construction Estimate Value[1]
General Mechanical:	$ 1,018,380.00
Electrical:	$ 540,730.00
Pump Station Construction Subtotal	$ 1,559,110.00
Long Run Force Main	$ 2,949,360.00
Construction Subtotal[2]	$ 4,508,470..00

Notes:

1. Construction Estimate Values reflect January 2008 dollars.
2. Subtotal does not include contingency factors applied and does not reflect costs for utility services, land acquisition or special construction unrealized herein.

A more detailed construction estimate is provided in Appendix B.

3.2 NEW PUMP STATIONS

3.2.1 West Shore Pump Station

3.2.1.1 General Capacity

The West Shore pump station is one of two new pump stations proposed by this document. The station was originally identified as a needed facility in Act 537 Plan as a means to separate sanitary only and combined sewer flows within the MACM service area. Moreover, construction of the station would present the opportunity to remove the aging double barrel siphon from the Port View portion of the interceptor as well as open opportunities to allow other portions of Elizabeth Township to connect to the collection system. When complete and online, the station will convey the flows via a new force main to the expanded WWTP.

Using flow information developed in the Act 537 Plan, the West Shore Pump Station is to have a peak hydraulic capacity of approximately 16.7 MGD. It should be noted that this capacity is based on receiving flows from the Port View collection system and the discharge from the Long Run Pump Station and force main upgrades and does not encompass allotments for future expansion into Elizabeth Township.

3.2.1.2 Force Main

3.2.1.2.1 Sizing and Materials of Construction

To accommodate the peak flow of 16.7 MGD without creating undue friction loss from high velocities within the force main a 24" pipe diameter was selected. The resulting velocity at this flow rate equates to 8.3 feet per second which is near the upper end of the range for published recommended force main velocities. As will be expanded upon later, the station will be equipped with variable frequency drives to ensure that the pump discharge rate does not fall below that required to maintain a minimum velocity of 2.0 feet per second during low and average influent loads to the station.

To further minimize friction loss within the pipe, plastic pipe are preferred over the ductile iron counterpart due a smoother interior wall. Thus, for the majority of the alignment, PVC C-900 series pipe is proposed.

3.2.1.2.2 Alignment

The most direct alignment to the WWTP from the proposed West Shore Pump Station parallels the western shore Youghiogheny River either by way of River Road (SR 2027) until the bend under the 5th Avenue Bridge. From there the most direct route to the WWTP would be through properties currently occupied by Pennsylvania Coach Lines and Duquesne Light to the entrance to the WWTP on Atlantic Avenue. In the interest of conservative preliminary design, cost estimates and pump head calculations were prepared assuming that the most direct route may not be available for either technical or land acquisition issues. Thus, this report evaluated a conservative alignment in River Road to the intersection of Rebecca Street; then down Rebecca Street to Atlantic Avenue; and down Atlantic Avenue to existing WWTP entrance.

The conservative alignment proposed herein resulted in a force main distance of approximately 7,000 lineal feet, with the majority of the distance in or along the eastern side of River Road. The eastern side (abutting the banks of the Youghiogeny River) was selected due to the location of large diameter fiber optic cable aligned along the western right-of-way separating River Road from CSX Transportation, Inc. live rail way.

River Road, Rebecca Street and Atlantic Avenue are primarily two way (two lane) streets with minimal residential and commercial property abutting the right-of-way. The traffic on these roads consist primarily commercial vehicles accessing the businesses of Pennsylvania Coach Lines, Duquesne Light and ELG Metals, Inc. as well as local access to the 10th Ward of McKeesport. As a result of the volume of commercial traffic to the businesses on River Road, and Rebecca Street potential for utility conflicts and other private property disruption, construction using this alignment could be considered difficult and an inconvenience to the public. Furthermore, given that River Road is owned and maintained by PADOT, all construction with the limits of the road right-of-way will likely be subject to PADOT construction requirements which could quickly increase costs. It is expected that such requirements would include placement of select backfill between the pipe zone and the finished ground surface and the replacement of pavement to PADOT standards. Where the alignment encroaches the roadway, it is expected that the paving restoration requirements would at a minimum include resurfacing the entire width of a traffic lane.

A cost estimate was prepared for the various alignments to assist in the evaluation of the preferred option. Each option (identified by the alignment and/or special construction) included the following common scope of work items:

- Construction of a new 24" PVC force main from the West Shore Pump Station to the proposed headworks structure at the MACM WWTP.
    1. Open cut construction
    2. Concrete blocking where applicable
    3. Installation of air relief valves housed in access manholes where required
    4. Restoration along trench:
        - PADOT standards where applicable.
        - Mill and repave one lane of traffic complete with new traffic lines
        - Seed and mulch where applicable.

The estimated construction cost without contingency is $2,600,830.00.

3.2.1.2.3 Land Acquisition Requirements

Temporary construction easements will be required regardless of the proposed force main alignment. As regards permanent easements, preliminary alignments developed for the preparation of this document have attempted to be placed in public right-of-way where possible with the exception of the area near the trestle crossing.

3.2.1.2.4 Potential Utility Conflicts

Aside from the conflicts previously identified, there appear to be no substantial issues that could affect the installation of the force main in the recommended alignment. That stated, the potential for interference exist for water, gas, storm and sanitary sewers could exist. However, at the writing of this report, it does not appear that such conflicts could not be easily resolved as a result of slightly relocating the alignment as will be defined during final design.

3.2.1.3 Pump Station

3.2.1.3.1 Mechanical and Structural Design

In order to convey the expected maximum instantaneous flow of 16.7 MGD to the station, a 36" gravity sewer with two manholes (one for directional change and the other to accept flow from the Long Run force main) will be constructed from the existing manhole prior to the double barrel siphon chamber. The manhole will be reconstructed to accommodate new piping as well as act as an overflow to the siphon chamber in the event the West Shore Pump Station cannot achieve the required capacity.

Generally, the pump station will consist of a structure on the northern part of property now or formerly owned by ELG Metals, Inc. Screening equipment, a wet well, raw sewage pumps, related pump controls, and an electrical equipment room will be installed in a new pump station structure.

Each component of the new station has been preliminarily designed in accordance with PADEP guidelines. For example, the screenings room and wet well areas shall be separated from housed selected mechanical and electrical equipment to ensure the designated equipment is in an explosion proof area of the proposed building. A proper ventilation system for both the explosion proof and equipment areas with monitors and alarms shall be installed as necessary. Finally, an exterior standby emergency generator will also be provided as a secondary means of power supply.

Specifically, wastewater will enter the station through a pneumatically controlled valve. The valve will remain open at all times except when water levels within the influent screen channels rise to a preset level indicating downstream equipment problems or when there is a loss of power to the valve control panel. The valve will be provided with manual override controls.

From the valve the wastewater will flow in the building through a 3 foot wide concrete channel that splits in two channels. One channel will contain an automatic mechanically cleaned bar screen with a manufacturer's rated capacity of 18 MGD. The other channel will be equipped with a manually cleaned bar screen will be provided as a backup in case of a failure of the automated screen. Slide gates at the entrance and exit of each channel will control flow through either screen channel. The screens and the channels are designed to accommodate low, average flows, by maintaining a minimum approach velocity of 1 feet per second for a minimum flow and maximum approach velocity of 2.06 feet per second at peak flow which is outside the recommended range of 1.25 feet per second to 3 feet per second published as Section 51.133 of the DWFM.

The screens proposed for this assignment are "bar and rake" type units, with 1/2" effective bar spacing. The only moving parts of the screen inside the channel are the chain on which the rakes are mounted. The solids caught on the screen will be cleaned from the bars with an automatic rake that will discharge solids through an integral screw conveyor into a compactor that will wash organic material from and dewater the screenings collected. The solids will be discharged from the screen unit into a disposal dumpster. The screenings will be compressed and conveyed to a dumpster for ultimate disposal. Duperon and Vulcan each manufacture screens that meet this configuration. For the purposes of design sketches and cost estimating the Duperon screen was utilized.

Upon exiting either screen channel, the wastewater will flow into the pump station wet well. The wet well will consist of two evenly sized, symmetrical chambers interconnected by a valve to accommodate joint or independent use as selected by the operator. The effective volume of the wet well will have a maximum detention time of 1 minute under peak flow conditions. The intention is to maintain a constant wet well level using variable frequency driven pumps.

Vertical shaft and dry pit submersible pump types were again evaluated for the proposed station. A table is provided in Appendix C to identify the differences between the various pumps evaluated as candidates for replacement.

As with other evaluations in this document the decision for the type of pump to be utilized for the replacement pump lies within the level of maintenance, spatial constraints due and capital cost. The vertical shaft pump option most meets these criteria. Therefore, the pump as manufactured by Yeomans Chicago has been utilized as the basis for preliminary design and all associated calculations and estimates.

It is proposed that wastewater will be evacuated from the wet well using four equally sized vertical non-clog, open-shaft, dry pit pumps with motors located above in a Pump Control Room. Any combination of the pumps with the largest unit out of service will provide adequate pumping capacity utilizing alternating pump starts during low flow conditions, while providing peak instantaneous pumping capacity at 16.7 MGD by three simultaneously running pumps. As alluded to earlier, each pump will be equipped with a variable frequency drive control system located in the Pump Control Room above the dry-pit that will accommodate a wide range of flows.

The pumps will discharge through individual discharge piping complete with isolation and check valves into a common 24" force main header that will transport the flow from the station to the remainder of the West Shore force main as previously discussed.

3.2.1.3.2 Structural Requirements

The pump station structure will be a concrete sub-grade construction with a split face block building on top. The building will be constructed with man doors and windows (both pane and glass block) in the explosion proof and non-classified areas. A garage door will be provided on the northern face of the building for access into the screenings room to remove compacted screenings.

The structure's bond beam for the roof shall be of sufficient height to install pre-cast concrete roof planks to separate the non-classified area of the building from the explosion proof portion of the building. The roof proposed for the structure is a prefabricated steel truss and galvanized standing seam panel construction, with gutters and downspouts.

Structural beams with trolleys and hoists for pump and motor removal will be provided on each level the equipment must be lifted from or to. The beams at the ground floor will be cantilevered beyond the door way for transport of equipment to vehicles.

3.2.1.3.3 Electrical Design

The electrical design of the West Shore pump station will be consistent with the concepts intended for the rehabilitation facilities previously discussed. At a minimum the operation of the pumps and the monitoring of the pump station will be managed by an electrical control panel with the following features:

- Pump controller with SCADA capabilities
  - Intrinsically safe wiring for wet well circuits
  - Variable Frequency Drive Control (VFD)
  - Pumps seal failure detection w/indicating lights
  - Pumps over temperature detection
  - Pumps running status indicating lights
  - Pumps elapsed time meters
- Transient Voltage Surge Suppression
  - 480 VAC level
  - 120 VAC level
- Chart recorder
  - Station flow with totalizer
  - Pumps running
- General alarms

Continuous reading level transducers will be used in conjunction with the VFD's to achieve the desired level in the wet well and provide for monitoring of the level at remote locations.

It is anticipated that the electric supply voltage will be supplied with a 277/480 VAC, 3 phase 4 wire service. By using this common voltage, the electric distribution system will be of a physical size that will be manageable by plant personnel. Higher voltages are impractical and not provided by utilities for loads of this size.

A single high speed broadband access network will be installed to allow for communications from the plant for security and operations monitoring.

While the more economical three-phase system uses less conductor material to transmit electric power than equivalent single-phase system the need for a single phase lighting system still exists. Power will be distributed to the motor loads using 3 phase power that is supplied by the utility and distributed through a 3 phase distribution panel. A circuit will be taken from the distribution panel to feed a transformer which will serve a lighting panel at a level of 120/208 VAC 3 phase. The addition of the transformer allows for the 120 VAC single phase power needed for interior/exterior lighting and general purpose receptacles.

Finally a generator is proposed as a secondary power source. The generator will be sized to operate the required load of three pumps simultaneously operating as well as other miscellaneous load required at the station. A transfer switch must also be provided to handle the power transfer between the utility and the generator.

3.2.1.3.4 Land Acquisition Requirements

Land will need to be acquired for the pump station site from ELG Metals, Inc. for both temporary construction easements and permanent property possession.

3.2.1.4 Cost Estimate

The cost to construct the improvements to the West Shore Pump Station and new force main are based on the following scope of work:

- All required site work to accommodate the remainder of the scope.
- Construction of new Pump Station structure complete
- Construction of a new influent mechanically cleaned screen
- Installation of new vertical shaft pumps
- Generator Installation
- Gas Monitoring
- New Pump Controls w/SCADA
- Installation of Variable Frequency Drives to accommodate new pumps
- Upgraded Electric Utility Service
- Automatic Transfer Switch
- Miscellaneous Electrical construction: power, control, lighting, etc.
- Construction of a new 24" PVC force main from the West Shore Pump Station to the proposed headworks structure at the MACM WWTP conforming to the scope items presented earlier in Section 3.2.1.2.2 .

The estimated construction cost without contingency is estimated as identified in Table 3-5:

Table 3-5

Construction	Construction Estimate Value[1]
General Mechanical:	$ 1,835,970.00
Electrical:	$ 572,720.00
Pump Station Construction Subtotal	$ 2,600,830.00
West Shore Force Main	$ 1,868,110.00
Construction Subtotal[2]	$ 4,468,940.00

Notes:

1. Construction Estimate Values reflect January 2008 dollars.
2. Subtotal does not include contingency factors applied and does not reflect costs for utility services, land acquisition or special construction unrealized herein.

A more detailed construction estimate is provided in Appendix B.

3.2.2 Upper Long Run Pump Station

3.2.2.1 General Capacity

The Upper Long Run Pump Station is the second of two new pump stations proposed by this document. The station was originally not identified as a needed facility in Act 537 Plan and was determined to be required during the evaluation for upgrades of the Long Run Interceptor (reference Section 2.1 of this report).

Using flow information developed in the Act 537 Plan, the Upper Long Run Pump Station is to have a peak hydraulic capacity of approximately 5 MGD. This capacity is based on receiving and conveying flows from the White Oak collection system approximately 7.9 MGD at the upper end of the Long Run interceptor and the limiting capacity of the existing Long Run Pump interceptor (approximately 3 MGD).

3.2.2.2 Force Main

3.2.2.2.1 Sizing and Materials of Construction

To accommodate the peak pumped flow of 5 MGD without creating undue friction loss from high velocities within the force main a 16" pipe diameter was selected. The resulting velocity at this flow rate equates to 5.5 feet per second which is near the upper end of the range for published recommended force main velocities. As will be expanded upon later, the station will be equipped with variable frequency drives to ensure that the pump discharge rate does not fall below that required to maintain a minimum velocity of 2.0 feet per second during low and average influent loads to the station.

To further minimize friction loss within the pipe, plastic pipe are preferred over the ductile iron counterpart due a smoother interior wall. Thus, for the majority of the alignment, PVC C-900 series pipe is proposed.

3.2.2.2.2 Alignment

The most direct alignment to the connection point of the Long Run Interceptor is to follow Long Run Road (SR 0048). Following the road shoulder as an alignment resulted in a force main distance of approximately 6,500 lineal feet.

The portion of Long Run Road proposed as the alignment is primarily two way-four lane highway that follows the path of Long Run, a tributary to the Youghiogheny River. Mostly commercial property abuts the right-of-way along the section of the road proposed for the alignment, which is considered one of the main routes connecting the areas of McKeesport, White Oak and Boston. As a result of the volume of traffic to the businesses along Long Run Road and between the aforementioned areas, potential for utility conflicts and other private property disruption, construction using this alignment could be considered difficult and an inconvenience to the public. Furthermore, given that Long Run Road is owned and maintained by PADOT, all construction with the limits of the road right-of-way will likely be subject to PADOT construction requirements which could quickly increase costs. It is expected that such requirements would include placement of select backfill between the pipe zone and the finished ground surface and the replacement of pavement to PADOT standards. Should the alignment encroach the roadway, it is expected that the paving restoration requirements would at a minimum include resurfacing the entire width of a traffic lane.

A cost estimate was prepared for the various alignments to assist in the evaluation of the preferred option. Each option (identified by the alignment and/or special construction) included the following common scope of work items:

- Construction of a new 16" PVC force main from the White Oak Pump Station to a connection point along the Long Run Interceptor near the Olympia Shopping Center.
  1. Open cut construction
  2. Concrete blocking where applicable
  3. Installation of air relief valves housed in access manholes where required
  4. Restoration along trench:
     - PADOT standards where applicable.
     - Seed and mulch where applicable.

The estimated construction cost without contingency is $922,230.00.

3.2.2.2.3 <u>Land Acquisition Requirements</u>

Temporary construction easements will be required regardless of the proposed force main alignment. As regards permanent easements, preliminary alignments developed for the preparation of this document have attempted to be placed in public right-of-way where possible.

3.2.2.2.4 <u>Potential Utility Conflicts</u>

Aside from the conflicts previously identified, there appear to be no substantial issues that could affect the installation of the force main in the recommended alignment. That stated, the potential for interference exist for water, gas, storm and sanitary sewers could exist. However, at the writing of this report, it does not appear that such conflicts could not be easily resolved as a result of slightly relocating the alignment as will be defined during final design.

3.2.2.3 Pump Station

3.2.2.3.1 <u>Mechanical and Structural Design</u>

Generally, the pump station will consist of comminutor, pumping, and emergency power equipment designed in accordance with PADEP guidelines in two below and one above grade structures on the north western corner at the intersection of Long Run and Ripple Roads. It is believed that this property is now or formerly occupied by PADOT.

In the interest of conserving the site space required of the station, it was decided that the station would be of a submersible pump design. The advantage to this installation is that the pumps are installed within the wet well to minimize the area required to site the pumps, suction lines and valves. Although submersible pump are available through many manufacturers, pumps as manufactured by Flygt were selected as the basis of design to maintain commonality with other submersible pumps selected in this report.

In order to convey flows of up to 5 MGD to the station, a new manhole will be constructed to divert flow to the new pump station as well as act as an overflow to the Long Run Interceptor in the event the Upper Long Run Pump Station cannot achieve the required capacity. From this structure, a 24" diameter gravity sewer will be constructed to an 8'-0" diameter pre-cast manhole vault that will house submersible grinding equipment. For the purposes of layout and cost estimating, a Muffin Monster manufactured by JWC Environmental was selected, although other manufactures may be considered during final design.

Upon exiting the grinder vault, the wastewater will flow into the pump station wet well through a 24" diameter gravity line. The wet well is proposed to be a cast in place concrete structure with a foot print designed to accommodate not only the area required by the effective wet well volume of nearly 930 gallons but also the dimensions to install three (3) evenly sized, variable frequency driven submersible pumps. Any combination of the pumps with the largest unit out of service will provide adequate pumping capacity utilizing alternating pump starts during low flow conditions, while providing peak instantaneous pumping capacity at 5 MGD with two of the three pumps running simultaneously. The pumps will discharge through individual discharge piping that enters a Pump Control Building. Once inside the building, the discharge lines will be turned above the floor to house isolation and check valves before returning below the slab and into a common 16" force main header. It is also proposed that a meter pit internal to the building be constructed such that the appropriate straight runs of pipe are accommodated. If site conditions permit as determined during final design, a valved bypass of the meter will also be constructed. After being conveyed through the flow meter, the force main will exit the building and transport the flow from the station to the remainder of the White Oak force main as previously discussed.

3.2.2.3.2 Structural Requirements

The pump station grinder and wet wells structures are to be sub-grade concrete construction. The grinder manhole is intended to be a pre-cast manhole vault while the wet well structure will be a cast in place concrete construction. Both structures shall have flat tops with locking aluminum hatchways for access.

The Pump Control Building will be a slab on grade structure with a split face block masonry construction. The building will be constructed with man doors, windows (both pane and glass block), and static louvers with actuated dampers as required by the generator set installed. . The roof proposed for the structure is a prefabricated steel truss and galvanized standing seam panel construction, with gutters and downspouts.

A monorail with a trolley and hoist rated for exterior installation for pump and motor removal will be provided over the wet well and grinder manhole. A beam will also be provided inside the Pup Control Building for the handling of valves for maintenance purposes. All beams utilized for lifting will be cantilevered beyond the limits of the structures for transport of equipment to vehicles.

3.2.2.3.3 Electrical Design

The electrical design of the Upper Long Run pump station will be consistent with the concepts previously presented for the West Shore Pump Station. Please reference Section 3.2.1.3.3 for the intended concepts

3.2.2.3.4 Land Acquisition Requirements

Land will need to be acquired for the pump station site apparently from the Commonwealth of Pennsylvania for both temporary construction easements and permanent property possession.

3.2.2.4 Cost Estimate

The cost to construct the improvements to the Upper Long Run Pump Station and new force main are based on the following scope of work:

- All required site work to accommodate the remainder of the scope.
- An emergency overflow in a diversion chamber to the 18" diameter Long Run interceptor for use to prevent property damage in the event the pump station and the emergency generator are not functional when required.
- A comminutor located within an 8'-0" diameter pre-cast concrete manhole.
- Three solids handling submersible pumps housed in a cast in place concrete wet well
- A block control building that will house pump controls, valves, flow metering equipment, and an emergency generator
- Generator Installation
- Gas Monitoring
- New Pump Controls w/SCADA
- Installation of Variable Frequency Drives to accommodate new pumps
- New Electric Utility Service
- Automatic Transfer Switch
- Miscellaneous Electrical construction: power, control, lighting, etc.
- Construction of a new 16 inch diameter PVC force main constructed at minimum depths for conveyance of sewage to a connection point at the 24 inch diameter relief conforming to the scope items presented earlier in Section 3.2.2.2 .

The estimated construction cost without contingency is estimated as identified in Table 3-6.

A more detailed construction estimate is provided in Appendix B.

Table 3-6

Construction	Construction Estimate Value[1]
General Mechanical:	$ 879,620.00
Electrical:	$ 387,400.00
Pump Station Construction Subtotal	$ 1,267,020.00
Upper Long Run Force Main	$ 922,230.00
Construction Subtotal[2]	$ 2,189,250.00

Notes:

1. Construction Estimate Values reflect January 2008 dollars.
2. Subtotal does not include contingency factors applied and does not reflect costs for utility services, land acquisition or special construction unrealized herein.

4.0 WASTEWATER TREATMENT PLANT EXPANSION

4.1 EXISTING FACILITY

The MACM Wastewater Treatment Plant (WWTP) was originally constructed in 1958 and was subsequently expanded in 1972 to provide secondary treatment. Over the years many capital projects have been implemented to update, repair or replace equipment and facilities as warranted. As it exists today, the WWTP provides a preliminary, primary and secondary treatment as well as disinfection prior to the treated effluent discharge to the Monongahela River. The operation and discharge is regulated under the terms of an expired (August 7, 2007) NPDES Permit Number PA0026913. The specific terms of the permit are as presented in Table 4-1. Application to renew the permit has been filed with the PADEP in accordance with the requirements of the NPDES program and to date no determination has been made on the renewal application.

Table 4-1

PARAMETE R	LOADING (lbs)			CONCENTRATION (mg/L)			
	Average Monthly	Average Weekly	Units	Average Monthly	Average Weekly	Instant. Maximum	Units
Flow	-	-	-	Monitor and Report			-
CBOD-5 Day	2,398	3,645	lbs/d	25	38	50	mg/L
Suspended Solids	2,877	4,316	lbs/d	30	45	60	mg/L
Total Residual Chlorine				0.5			mg/L
Fecal Coliform							
May 1 to Sept 30				200			/ 100ml
Oct. 1 to April 30				2,000			/ 100ml
Dissolved Oxygen	Minimum of 6.0 mg/L at all times.						
% Removal (BOD_5 & SS)	In no case shall the arithmetic means of the effluent values of these parameters discharged during a period of 30 days exceed 15% of the respective arithmetic means of the influent vales for the same period.						
pH	Within Limits of 6.0 to 9.0 Standard Units At All Times.						

4.1.1 EXISTING CAPACITY

The facility has an average day design hydraulic capacity of 11.5 MGD, although the WWTP is capable of accepting and treating flows well above its permitted capacity up to approximately 20 MGD. Utilizing the conventional activated sludge process for the secondary treatment process, the WWTP is designed to remove 85% (203 mg/l) of the Biochemical Oxygen Demand (BOD), 90% (247 mg/l) of suspended solids, and 99% (7.8 mg/l) of settable solids, which translates into a rated organic capacity of 19,950 lb. per day of BOD_5, and an apparent solids capacity of 23,690 pounds per day of TSS.

4.1.2 EXISTING LOADS

Past and current plant loadings are annually tabulated and reported to the PADEP in the Chapter 94 Annual Wasteload Management Reports. Utilizing the data from these annual reports, a summary table of loading for the past five operating years (2003–2007) was created and is presented as Table 4-2. Although not covered by Chapter 94 capacity criteria, loadings for the influent solids have also been tabulated for the 2007 operating year and assumed to be representative of average wastewater accepted at the WWTP. Finally it should be noted that the data includes internal plant recycle streams.

Table 4-2

Loading Parameter	2003	2004	2005	2006	2007	5 Year Average	5 Year Maximum
Hydraulic							
Annual Average, MGD	9.30	9.03	8.78	9.98	10.33	9.48	10.33
Maximum Month, MGD	10.87	10.83	11.35	13.04	14.64	12.15	14.64
Three Consecutive Month Average	9.83	10.70	10.24	10.95	12.90	10.92	12.90
Organic							
Annual Average, lb./day	4,751	4,665	4,809	5,626	9,000	5770	9,000
Maximum Month, lb/day	5,833	5,306	6,162	8,244	12,637	7636	12,637
Total Suspended Solids							
Annual Average[1], lb./day	N/A	N/A	N/A	N/A	8,755	N/A	N/A
Maximum Month[1], lb./day	N/A	N/A	N/A	N/A	22,850	N/A	N/A

Notes:

1. 2007 Data reflective of historical data from January 2007 to August 2007 and is assumed to be representative of typical WWTP load conditions.

Upon reviewing and comparing Table 4-2 to the design ratings, the maximum consecutive three-month average has only exceeded the current design rating of 11.50 MGD once (2007) over the past five years. The increased hydraulic flow during the months of January and March can be attributed to the increase in wet weather experienced during those months and causing the designation of a hydraulic overload pursuant to the definitions defined by Chapter 94. More importantly, it is identified that the 5 year hydraulic averages indicate that the hydraulic loads at the facility are typically less than the rated hydraulic capacity.

Further review of Table 4-2 exhibits that the facility has not been organically overloaded with respect to Chapter 94 criteria, nor is the facility projected to be overloaded within the confines of Chapter 94 criteria. Finally there have been no violations of the NPDES effluent permit.

4.1.3 EXISTING PROCESS

Plate 4-1 in Appendix A presents the current WWTP plant flow diagram. As demonstrated on the flow diagram, the existing treatment process commences at a junction manhole where the Upper and Lower Monongahela Interceptors intersect, a 54" sluice gate controls the flow of wastewater into the treatment plant. The gate is regulated manually through the use of a power unit and gear reduction. Due to the implementation of the recommendations of previous CSO related studies, the maximum flow allowed to enter the plant for secondary treatment has been increased to approximately 20 MGD.

Raw sewage enters the WWTP pump station wet well where it is pumped by four-5,000 gpm variable speed pumps. The combined capacity of the four (4) raw sewage pumps is 29 MGD to provide the ability to pump the maximum flow of 20 MGD with only three (3) of the four (4) pumps operating; the fourth pump acting as a standby unit.

The pumps discharge to the Screen and Grit Building via a 30-inch cast iron force main. The grit chambers are of the horizontal flow type and are mechanically cleaned. The velocity of the flow through the chambers is controlled by proportional weirs at the end of each chamber.

After grit removal, the wastewater flows to four (4) diffused air flocculation basins where the sewage is slowly mixed for approximately 37 minutes at a design flow of 11.5 MGD.

The wastewater then settles in four (4) rectangular primary clarifiers with a detention time of two (2) hours at the design flow. The original equipment, weirs and launders, were replaced to improve reliability. The surface is skimmed and the settled solids moved to a hopper using a system of flights and chains. Only two or three of the four primary clarifiers are operated during the summer due to low flows. If the temperature is extreme, say 90° F, only two settling tanks are utilized. With an intense rainfall one of the additional primary clarifiers is placed into operation.

The maximum hourly (wet weather) peak flow is determined in accordance with the requirements for surface overflow rates for the primary clarifiers. The total surface area of the existing four primary tanks is 10,192 sf that, based on the required standard of 2,500 gpd/sf, yields an hourly maximum peak flow of 25.5 mgd for all four tanks, or 19.1 mgd when one unit is out of service.

Originally installed in 1972, screw pumps convey the flow from the primary effluent flume to the secondary treatment system. The three (3) screw pumps, each with a reported capacity of 9 MGD, lift wastewater from the primary effluent channel to the activated sludge tanks. Unless a second screw pump is started the wet weather flow begins to bypass over a weir gate to the abandoned chlorine contact tank at 10 MGD. The standard wet weather operating practice is to operate the second screw pump and provide secondary treatment up to 20 MGD. The Authority has replaced and refurbished all three screw pumps in efforts to maximize efficient operation of the pumps and minimize adverse impacts on downstream processes.

After the screw pumps, flow enters the activated sludge system that consists of aeration tanks constructed during the 1972 expansion. As part of the Authority's maximization of the WWTP's wet weather flow strategy program, the original turbine aerators were replaced with a fine bubble diffusion system. Fine bubble aeration was installed in four of the eight aeration tanks. Aeration tanks No. 1, 2, 5 and 6 have fine bubble diffusion and is currently proposed for the remaining basins. Three (3) process air blowers are provided for process aeration basins each capable of compressing 4000 ICFM of air to a discharge pressure of 8.0 PSIG when operating at an elevation of 740 and 100°F air temperature.

Due to the relatively flat terrain at the site, flow between the aerations basins and the secondary clarifiers is conveyed via open channel mixed liquor troughs. To keep solids in suspension as the mixed liquor flows toward the final clarifiers, a channel aeration system is provided. The channel aeration system also supplies air to the RAS wet well to prevent settlement and to help keep the sludge fresh. There are two (2) channel air blowers. Each blower is capable of compressing 1125 ICFM of air to a discharge pressure of 2.25 PSIG when operated at an elevation of 740 and air temperature of 100°F.

As previously mentioned, two (2) 100-foot diameter circular final clarifiers having a detention time of 4.2 hours at design flow continuously accept the mixed liquor where the solids portion settles to the bottom. Clear supernatant overflows the clarifier weirs and flows to chlorination and discharge. The solids concentrate on the bottom of the clarifiers and are returned by pump to the aeration tanks. This sludge is called return activated sludge (RAS). Excess sludge that is accumulated in the system is wasted to the sludge handling units by the waste sludge pumps. This wasted sludge is referred to as waste activated sludge (WAS) and is handled along with the raw sludge produced in the primary units.

A combination of three (3) horizontal, centrifugal, non-clog return sludge pumps pump return activated sludge to the aeration tanks as dictated by forward flow rates. Each of these pumps are controlled by a variable frequency drive (VFD), which can vary the pump capacity from 2000 gpm (575 rpm) to 4000 gpm (690 rpm) at 26 feet TDH. Normally, the VFD is automatically controlled and is based on the aeration tanks' influent flow. Return sludge is conveyed from the final clarifier to an RAS wet well (which is integrally constructed in the Blower Building basement). RAS volumes and flow rates can be automatically proportioned based on the influent flow rate.

After settling, the effluent is chlorinated and flows to one of two dual compartment chlorine contact chamber having a detention time of more than the required 15 minutes at a peak rate of pumping through the plant.

The new chlorine contact tank is comprised of two (2) separate sections, each section being 51'-0" x 52'-0" x 8'-6" (SWD). The effective capacity of each section is 168,600 gallons for a total capacity of 337,200 gallons. At a design flow of 11.5 MGD, the detention time is 42 minutes. At 20 MGD the detention time is 24.3 minutes.

These original contact tanks are located adjacent to the primary clarifier effluent and are not normally utilized. Each section of the original two-section chlorine contact tank, which may still be used in emergencies, is 30'-0" x 51'-4" x 6'-0" (SWD). Each section has a volume of 69,100 gallons (a total of 138,200 gallons) and provides a detention time of 15 minutes for 13.3 MGD of flow.

Two (2) vacuum-feed chlorinators are provided to feed chlorine, at a set rate, to each of a number of points in the treatment system. The chlorinators are manually paced based on the measured total residual chlorine. The capacity of each chlorinator is 500 pounds of chlorine per day. At the design flow of 11.5 MGD, the capacity of the chlorinators enables the operator to vary the chlorine concentration (before the chlorine demand is exerted) from 0.8 mg/l to 8.3 mg/l. The chlorinators are fed by one (1) one-ton chlorine cylinder.

Chlorine is also added at various points in the treatment system. Six (6) chlorine distributors/flow indicators are provided to split and measure the chlorine being added to various points in the system. The points at which chlorine solution flow is distributed are (corresponding to each distributor-meter):

- Manhole#1 (Head of Plant)
- Digesters and Old Contact Tank
- Pre-aeration - Flocculation Tanks
- Thickeners
- Chlorine Contact Tank
- RAS Wet well and Final Clarifier Influent

The current sludge handling practice is to pump all sludge to one of the two designated aeration tanks, which acts as an aerobic digester. Primary sludge and waste activated sludge can be added to two (2) 32'-dia sludge thickening tanks, having a detention time of 0.4 days at a sludge flow of 0.54 MGD. The thickened sludge is dewatered by a 2.5 meter belt filter press after being mixed with flocculating chemicals. The moisture content of the dewatered sludge is approximately 80%. The dewatered sludge is disposed of by landfilling and is currently hauled by Waste Management to a landfill in Monroeville, PA for ultimate disposal.

4.2 PROPOSED WWTP EXPANSION CAPACITY AND PROCESSES

4.2.1 REQUIRED CAPACITY

4.2.1.1 Hydraulic Capacity

The basic flow management concept of the proposed in the Act 537 Plans was that the future MACM collection system must be capable of capturing, conveying and treating at a minimum 350% of the average dry weather flow from the combined sewage drainage areas and a 2-year 24-hour projected peak wet weather flow from the sanitary-only systems to the WWTP. It is apparent from the information present in the previous section, that the plant does not have the capacity to accept and treat the projected peak storm flow. Therefore, the Act 537 Plan prescribed a WWTP expansion to accept the proposed maximum peak flow from the MACM service area calculated to be approximately 42.5 MGD. The plan did not indicate that a change in average day design hydraulic capacity would be warranted.

4.2.1.2 Organic and Solid Capacity

The existing WWTP has a rated organic capacity of 19,950 lb. per day of BOD_5 and an estimated solids capacity of 23,690 pounds per day of TSS. The construction of new process basins will provide additional organic and solids capacity. However, because existing influent loads evaluated in Section 4.1.2 are substantially less than these rating and were not projected by the Act 537 Plan to increase over the next 20 years, an increase of the rated capacity is not being sought through this expansion.

4.2.2 PROPOSED PROCESSES

4.2.2.1 Split Treatment

The Act 537 Plan evaluated several options for handling wet weather-related peak flows. Of the options evaluate, it was determined that the installation of parallel treatment trains to handle peak was the most viable option.

According to the USEPA, split parallel treatment processes are gaining popularity for facility expansions where the peak capacity expansion requirements substantially outweigh the average day capacity increase. The parallel split processes can utilize combinations of chemical/physical or biological processes. In the case of the MACM WWTP, the Act 537 Plan recommended parallel biological processes to satisfy regulatory requirements and conform to spatial site constraints. The plan recommended a that the existing activated sludge process with it's maximum wet weather capacity of +/- 20 MGD remain intact and be complimented by an SBR plant with a maximum wet weather capacity of +/- 23 MGD. This arrangement of processes would permit all flows to be split in various proportions commensurate with the influent hydraulic load to maintain the biological process in both plants during low flow to ensure the proper biota is available when peak treatment is required.

4.2.2.2 Process Flow Diagram

Drawing 6-2 in Appendix A is reprinted from the approved Act 537 Plan as the recommended alternative's process flow diagram. As will be expanded upon through the remainder of this report in the discussions regarding sizing and process performance, there were several deviations from the split treatment concept projected in the Act 537 Plan.

The report identified that each plant process train would have designated preliminary treatment headworks and common disinfection facilities. However, due to aging equipment, the MACM staff requested that existing headworks be replaced with preliminary treatment equipment common to both treatment processes. Also and as expounded upon later, the designation of common disinfection facilities could not be realized due to regulatory issues and the different hydraulic profiles of the two processes.

The second main deviation recommended herein from the Plan's process flow schematic involves the primary clarifiers. Upon review of the organic, solids, and nutrient sample results monitored at the facility (reference section 4.1.2), it was determined that the influent wastewater composition concentration could be classified as weak. Understanding that the activated sludge systems prescribed by the Act 537 Plan and this report rely on a sustainable organic loads for efficient treatment, it was decided that keeping the primary clarifiers as a unit process in the existing treatment train would hinder the performance of the existing activated sludge system. Further lending grounds to this decision were the following reasons:

- Published data indicates that typical primary clarifier performance removes between 20-35% of organic material and up to 50-60% of solids treated. After splitting the influent load by 50% for the split treatment concept the organic load witnessed at the influent of the existing activated sludge process would be reduced even more.
- Although the Act 537 Plan made reference to the need for sludge stabilization, neither process type was proposed nor was space (in the form of land or existing basin) was designated for this use.
- It is been widely published that primary clarifier sludge is best stabilized in anaerobic environments and that waste activated sludge (as existing and proposed) perform better in aerobic forms of stabilization.
- Typically the capital costs are higher for new anaerobic sludge stabilization systems than that of the aerobic counter part. Given the lack of an unlimited budget preference will be given to aerobic digestion (reference Section 4.3.6)
- There is limited space to construct process basin on the site even with proposed land acquisitions (reference Section 4.6.1) and as noted from Drawing 6-2 in Appendix A, primary clarifiers were not proposed for the SBR side of the parallel process.

These reasons give credence that the existing primary clarifiers do not enhance the overall treatment process and could also hinder the preferred method of sludge stabilization. To this end the removal of the unit process from the treatment train presents basins that could be reutilized to perform sludge stabilization (reference Section 4.3.6).

Applying these changes to the preliminary design process flow diagram the result, is displayed as Plate 4-2 in Appendix A.

4.2.2.3 Biological Nutrient Removal Considerations

Over the past decade a number of reports and technical papers have been published on the water quality in the Gulf of Mexico, specifically dealing with the reducing the level of hypoxia in the body of water and its tributaries. Hypoxia is a condition that occurs when excess nutrients, primarily nitrogen and phosphorous, trigger excessive algae growth that results in reduced sunlight, loss of aquatic habitat and a decrease in oxygen in the water. Excess nutrients can come from both point and non-point sources such as agricultural fertilizers, factory and wastewater treatment plant discharges, and runoff from developed land, atmospheric deposition and soil erosion.

As an effort to reduce nutrient levels, Total Maximum Daily Loads (TMDLs) for nutrients and sediments are being developed for many water bodies throughout the United States. TMDLs and other water quality-drivers have resulted in publicly owned treatment works (POTWs) having to comply with more stringent effluent limitations for parameters such as total nitrogen (TN) and total phosphorus (TP). Witness to this is a similar pollution situation that exists in the central and eastern portions of Pennsylvania that is tributary to the Chesapeake Bay. In that region of the state many discharge permits for treated wastewater from POTWs often include effluent limitations for total levels of nutrients. Preliminary indications from regulatory agencies such as the USEPA and PADEP have suggested that total nutrient discharge limitation could be applied as early as 2011 to all point sources discharging to these impaired water bodies. The MACM WWTP discharge into the Monongahela River classifies the facility as a point source in the Ohio River basin which ultimately flows to the Gulf of Mexico. Therefore, it is considered prudent planning to consider nutrient removal in the expansion design to ensure compliance with potential discharge limits.

Although there are several methods to reduce and remove the nutrients, the basic methodologies are biologically and chemically. The more capital friendly option is biological methods. Consequently, the following biological nutrient removal (BNR) processes are recommended.

4.2.2.3.1 <u>Recommended BNR Treatment</u>

The most common means to reduce nitrogen biologically is through the nitrification/denitrification processes. Nitrification is a biological process that utilizes oxygen to convert ammonia to nitrite and nitrite to nitrate. If standards require that the resulting nitrate be reduced, one treatment alternative is the process of denitrification, in which nitrate is reduced to nitrogen gas that is ultimately released to the atmosphere. In contrast to nitrification, biological denitrification occurs in the absence of oxygen and uses organic compounds present in wastewater as a source of carbon. Energy is obtained by oxidizing the organic substrates. During denitrification, nitrate acts as an electron acceptor in the absence of free oxygen. Since biological denitrification is performed only on the nitrate ion, nitrification is essential for complete nitrogen removal. Comparing the influent TN concentrations to the effluent limitations estimated herein, it has been decided to incorporate both biological processes into the new SBR treatment train. In doing so, the capital will have been well spent if and when a limit is applied.

Phosphorus on the other hand is commonly removed through a combination of biological and chemical processes. In biological treatment, the phosphorus in the wastewater is removed through incorporation into the cell tissue of microorganisms during BOD removal. In other words, certain microorganisms, when subjected to anaerobic (absence of oxygen and nitrates) conditions, assimilate and store fermentation products produced by other facultative bacteria. These microorganisms derive energy for this assimilation from stored polyphosphates, which are hydrolyzed to liberate energy. The free phosphorus that results from the hydrolysis reaction is released to the mixed liquor. These same microorganisms, when subsequently exposed to aerobic conditions, consume both phosphorus and oxygen for energy production and cell synthesis. The phosphorus is finally removed from the process during the normal sludge wasting procedure after the microorganisms are concentrated through settling.

Similar to the prescription for the removal of nitrogen, goals were set to biologically remove TP to the estimated regulatory level for the new SBR process. Should the biological methods employed not fulfill the required limitation, it is recommended that chemical methods should be investigated as warranted.

It is important to note that the biological nutrient removal considerations applied for new processes may or may not achieve future effluent limitations. The intention of employing these techniques and ability to be easily converted when needed is only to minimize process modifications in the future.

4.2.2.3.2 Estimated Nutrient Limits

Estimating future water quality limits is extremely difficult. That stated to ensure that some level of treatment was considered in the proposed expansion process design limitations had to be assumed.

A literature review of technical papers on reduction of hypoxia and nutrient water quality goals identified the following information:

- The Mississippi River/Gulf of Mexico Watershed Nutrient Reduction Task Force, a group comprised of federal and state regulatory agencies, has recommended a dual nutrient strategy targeting a composite 45% reduction TN and TP loads in tributary to the Gulf via the Mississippi Rivers.
- The Task Force has also identified that point sources represent 22% of nitrogen and 34% of phosphorus loads to the Gulf.

- In 1998, the U.S. Geological Survey reports average TN concentrations in the Monongahela River between the West Virginia border and its confluence with the Allegheny River at Pittsburgh to be 1.1 mg N/L.
- USEPA has recommended load reductions of approximately 80% from the Upper Ohio River Basin toward the composite 45% overall goal.
- The river flow rate governing water quality is 319 MGD.

With this information in mind and knowing the minimum water quality river flow rates of the Monongahela River, a prediction of the potential nutrient limits could be made using a dilution calculation. The result of the calculation estimated a 6 mg/L TN limit by assuming the WWTP flow at design capacity of 12 MGD, the Monongahela River flow rate at 319 MGD, and an allowable TN concentration in the river of 0.226 mg/L TN (or 80% of the 1.1 mg/L USGS concentration). A level of confidence is associated with this prediction as it is within the order of magnitude identified by the PADEP for statewide limits as based on nutrient reduction strategy findings in the Chesapeake Bay watershed.

Unfortunately, there is limited published data available for specific phosphorus concentrations in the Monongahela River. Given the minimal variance between the prediction for the TN limit and PADEP indications of statewide limits, it was decided to utilize a TP limit commonly instituted throughout the Mississippi River Basin of 1.0 mg/L TP as the estimated future effluent limit.

4.2.2.3.3 Existing WWTP Nutrient Loads

Currently the MACM has no nutrient limitations in the current operating NPDES permit. For this reason, there is no reason to sample for these parameters. Understanding that there is little to no nutrient data available, a special sampling program was instituted for the preparation of this preliminary design document. Samples were obtained at influent, primary effluent and final effluent sampling points and analyzed for the components of TN and for TP. Specifically TN is comprised of nitrates, nitrites, and Total Kjeldahl Nitrogen (TKN), which is the combination of ammonia nitrogen and free organic nitrogen.

A four (4) month sampling and analysis program yielded results for assumed typical baseline concentrations and percent process removal that will be utilized for the basis of preliminary design. The average and maximum concentrations and percent removals acquired from the limited sampling are presented in Table 4-3:

Table 4-3

Sample Location	Influent	Primary Effluent		Final Effluent		
Parameter	Conc. (mg/L)	Conc. (mg/L)	Percent Removal	Conc. (mg/L)	Aeration Percent Removal	Overall Percent Removal
Ammonia	9.1	7.3	19.8 %	2.5	65.8 %	72.5 %
Free Nitrogen	7.8	5	35.9 %	1.5	70.0 %	80.8 %
Total Kjeldahl Nitrogen	16.9	12.3	27.2 %	4	67.5 %	76.3 %
Nitrates and Nitrites	0.8	0.6	25.0 %	3.3	-450.0 %	-312.5 %
Total Nitrogen	17.7	12.9	27.1 %	7.3	43.4 %	58.8 %
Total Phosphorus	3.1	2.4	22.6 %	1.41	41.3 %	54.5 %

As witnessed from the table the levels of the TN components and TP are consistent with published weak wastewater concentrations. Further evaluation of the table indicates that nitrates and nitrites are formed through the treatment process. This is to be expected as the nitrogen transitions through its various forms and therefore is an indication that the microbiological population in the existing process promoted nitrogen reduction and operating properly.

With a limited sampling window, it is prudent to be conservative with the typical loadings. For this reason, the preliminary process design utilized higher concentrations of ammonia, for the design of TN removal in the WWTP expansion. The removals calculated as typical are also considered conservative. The reason is because the sampling program was performed during late autumn and early winter when colder wastewater temperatures slow the biological kinetic reactions resulting in lower nutrient removal percentages.

4.2.2.3.4 Expected Effluent Concentrations

Finally, a flow and mass balance was performed to predict the effluent concentrations to be expected from the considerations incorporated into the new process. These calculations were performed with the understanding that no capital improvements will be implemented to modify the existing treatment processes beyond that previously identified, and using the baseline organic and nutrient loads obtained from historical WWTP data. Plate 4-3 in Appendix A is provided to identify the results of the calculations for the expected concentrations at various points throughout the WWTP. Also Table 4-4 is provided as a comparison of the expected effluent concentrations to the current and potential effluent limits.

Table 4-4

Parameter	Flow and Mass Balance Calculated Value				Projected Regulatory Limit
	WWTP Influent	SBR Train Effluent	Existing Process	Final Effluent	
Flow, (MGD)	12	4	8	12	Monitor
BOD, (mg/L)	115	15	9.2	11.2	25
TSS, (mg/L)	103	15	7.9	10.4	30
TN, (mg/L)	20	5	8.6	7.3	6
TP, (mg/L)	3.1	1	1.8	1.5	1

Review of Table 4-4 indicates that incorporation of BNR in the new processes alone will not achieve the projected regulatory limits even after the two effluents are combined. Therefore and as indicated earlier, should the nutrient limits be as stringent as estimated in this document, operational changes and possibly capital improvements may be required to achieve the actual limit.

4.3 MAJOR EQUIPMENT SELECTION

Understanding the unit processes of each treatment train of were approved by local government and regulatory agencies through the Act 537 Plan process, a more detailed investigation into equipment alternatives to establish these processes was evaluated by this report.

The foundation for sizing the equipment evaluated was based on a review of historical loadings, assumed future loadings and effluent requirements, and theoretical design calculations for the operation of the respective unit processes. Theoretical calculations for the respective process and equipment sizing is provided in Appendix D. Equipment alternatives that would be compatible to the sizes governed by the sizing calculations were then evaluated for feasibility qualitatively and economically, with respect to process reliability and flexibility, operation and maintenance, and conformance to design guidelines published by the PADEP in the Domestic Wastewater Facilities Manual (DWFM). The equipment ultimately selected as the basis for design yielded preliminary tank and equipment sketches and ultimately a site layout used to develop cost estimates.

As regards the selection specific brands or manufacturers, a minimum of two options were identified as viable alternatives for each process. This report attempts to identify two options that will accommodate the needs of the design concepts and selects one as the favored alternative for the development of the site plan and cost estimates.

4.3.1 PRELIMINARY TREATMENT: NEW HEADWORKS

Originally the Act 537 Plan recommended the installation of new influent structure to proportion flow between the split treatment trains. To this end the flow would be split before entering the WWTP and being pumped or receiving preliminary treatment. Upon meeting with the MACM staff it was determined that the existing screens and grit removal systems, although having been repaired and restored over the years, are at the end of their useful life. For this reason, the concept for the headworks was revised so that the new screen and grit removal facilities handle all flow received at the WWTP. The request that these units be located ahead of influent pumping to protect the pumps from the rags and grit materials typically removed by such equipment was included with this petition. It was agreed to evaluate this alternative and an option consistent with the Act 537: placing the units after pumping.

4.3.1.1 Preliminary Treatment Unit Location

The two process arrangements evaluated were 1) a below grade, pre-pumping option and 2) an above grade post pumping alternative. The order of each unit process for the alternatives are as follows:

Below grade, Pre-pumping

- Influent Gates
- Screens
- Grit Removal
- Wet Well and Pumping
- Force main
- Flow splitting

Above-grade Post-pumping

- Influent Gates on the respective pump stations
- Pumping at the Existing WWTP Pumps Station and the Proposed West Shore Pump Station
- Force mains
- Influent Gates from the force mains
- Screens
- Grit Removal
- Flow splitting

As the selected screen and grit removal equipment are consistent to either option and dictate the footprint of the headworks structure, the only differences between the options are the location of influent pumping facilities and influent gates. However the substantial difference between the two options is the construction cost associated with how the structure is built.

Currently, influent wastewater is pumped to the screens and grit removal tanks. It is surmised that the reason for this is the depth of the influent lines from the collection system (approximately 35 feet from the surface) prohibited the installation of such processes ahead of the pump which is often the preferred location of preliminary treatment units. That stated, evaluation of installing the grit and screens ahead of the influent pumping facilities dictates a deep below grade construction and the installation of pumps to accommodate the peak flow received at the facility. It was estimated that at the deepest excavation would be range between 40 to 50 feet from the existing surface to accommodate construction of the influent and screen channels, grit removal units and wet well associated with the option. Moreover, the foot print of this option was estimated to be 135 feet by 50 feet. Excavation this footprint at that depth would require substantial excavation not to mention sheet piling to protect existing structures and the excavation itself, water protection and hauling of excavated material required in order to complete the excavation. Additionally, in evaluating the two options, it was determined that placing the units ahead of the pumps required more concrete due to the construction of the deep foundation and exterior walls than the post pumping arrangement.

All other things being equal, the construction cost of the deep construction preliminary treatment units prior to pumping option was estimated to be nearly 2.5 times the cost of the post pumping arrangement, which includes upgrades to the existing WWTP pump station and larger pumps installed at the West Shore Station. Aside from cost, the post pumping arrangement allows for an easier construction and is consistent with the concepts put forth in the approved Act 537 Plan. Therefore, the more economical construction arrangement is recommended.

The remainder of the narrative in this section will focus on the selected arrangement and how the respective units will function with respect to each other.

4.3.1.2 Raw Sewage Pumping

Influent pumping to the WWTP will be performed at two locations, the existing WWTP pump station and the West Shore Pump Station (reference Section 3.2.1).

4.3.1.2.1 WWTP Pump Station

A. Capacity and Mechanical Upgrades

Currently the existing pump station has a firm capacity of 20 MGD and discharges to the existing screen and grit facilities. The proposed West Shore Pump Station is to have a capacity of 17 MGD. Understanding that the WWTP must be designed to accept approximately 42.5 MGD at peak flows, the combined capacity of these two stations cannot convey this flow rate. For this reason, the WWTP pump station will need to be modified such that new larger capacity pumps to pump approximately 26 MGD will be installed. Regardless of the capacity, the existing pumps would need to be replaced due to the static head requirement associated with the location of the new screens and grit facilities.

In changing the capacity of the station to 26 MGD (18,055 gpm), it is proposed that each of three operating pumps (a fourth provided for standby) must have a capacity of 6,020 gpm per pump to ensure operation during peak conditions. With modifications of the existing force main, the total dynamic head (TDH) associated with the peak flow rate was approximated at 70 feet of TDH.

Similar to the evaluations performed for the pump stations associated with the overall scope, vertical shaft and dry pit submersible pumps were also assessed for the replacement pumps. The decision for the type of pump to be utilized for the replacement pump was rooted in the level of maintenance, spatial constraints due to the relatively constricted layout of the existing pump room, and capital cost. A table is provided in Appendix D to identify the differences between the various pumps evaluated as candidates for replacement.

Although all pumps evaluated in Appendix D present a level of feasibility as regards capacity, the vertical shaft style as manufactured by Yeomans Chicago appear to present the most optimal spatial configuration and had the least expensive budgetary price. For this reason, this type of pump and the associated budget prices were utilized in the construction cost estimate prepared for this report.

That stated, the operations staff expressed concerns with the minimal protection prior to the wet well and pumps. Currently the only protection at the WWTP pump station is a manually cleaned screen with 3" bar spacing. Concepts to provide additional pump protection proved fruitless. For this reason, efforts to address these concerns will be incorporated into the detailed design.

One option that may be explored further would be the use of the Flygt dry pit submersible pump. The design of this pump is a semi-open flattened and swept back impeller, combined with the relief groove in the volute, has been proven to reduce the risk of clogging from unscreened wastewater and maintain pumping efficiency. As the impeller turns, screenings are forced into the spiral-shaped groove. The combined action helps to tug material from the impeller into the volute where it is free to be pumped away.

Regardless of the pump chosen for this application, all pumps will be equipped with variable frequency drive control system located in the Pump Control Room above the dry-pit that will accommodate a wide range of flows.

B. Structural Upgrades

The existing station is a structure of four levels, a first floor flat roof structure and three levels below grade. Access to the lower levels from the ground elevation consists of a single stairway that splits to two sets of steps to the first basement where the station is divided into the wet well and pump room sides of the structure. From the second level down to the third and fourth levels, separate stair wells are provided for access due to the separation provided.

The existing access arrangement between levels does not conform to PADEP regulations or NFPA codes for the separation of classified areas containing gases with the potential to spark or explode. For this reason, the first and second floors must be modified to separate the levels and to include a separate accesses for the pump and wet well sides of the station. It is proposed that a block wall can be constructed on the first level to permit access to the pump room from the existing stairs originating from the ground floor and separate the wet well area and it's off gases from the pumps, motors, and electrical equipment on the first floor. With this separation, access to the wet well side would be required. It is proposed that the existing steps to the first basement be removed and an access door cut into the foundation wall on the wet well side of the second floor and a below grade stairway constructed. To protect this stair way from climatic elements, it is proposed that the stair way be enclosed with a door at ground level, for ingress-egress.

As regards the roof over this addition to the building it can be included as an expansion of a proposed roof replacement, previously identified by the Authority in the February 2006 Five Year Capital Plan. The roof replacement will be the installation of a wooden truss, shingled roof with gutters and downspouts that will create an attic space above the existing structure.

Finally, the doors, windows, and HVAC equipment of the structure are demonstrating signs of wear and age and recommended for replacement. The materials specified will not only update the aging building but also provide better insulation for heating and ventilation concerns.

4.3.1.3 Screens

To convey flow to the screens, the wastewater will flow into the headworks building from dedicated force mains to a common concrete influent channel. The channel will be equipped with knife gates to shut off flow from either force main and after several feet of length split in three channels. Two channels will contain an automated self-contained sluice gate and an automatic mechanically cleaned bar screen, each with a manufacturer's rated capacity of 24 MGD. Flow through the channels will be controlled by signals from the ultrasonic flow meters installed in the influent channel. When flow exceeds 24 MGD, both gates will automatically open and flow will be directed to both channels. The third channel will accommodate the entire peak flow rate with a manually cleaned bar screen will be provided as a backup in case of a failure of one of the automated screens. Sluice gates at the entrance and exit of each channel will control flow through the bypass channel. The screens and the channels are designed to accommodate low, average flows, by maintaining a minimum approach velocity of 1 ft/s for a minimum flow and maximum approach velocity of 2.06 ft/s at peak flow which is outside the recommended range of 1.25 feet per second to 3 feet per second published as Section 51.133 of the DWFM.

The screens proposed for this assignment are "catenary" type units, with 1/2" effective bar spacing and no moving parts inside the channel. Several screens were investigated for the basis of design. After seeing each unit in person, representatives from the operating staff selected two units, with a preference for one over the other. The selected units were the Vulcan "Mensch-Screen" and the Duperon "Flex-Rake". Both units utilize 316 stainless steel construction with no bearings or sprockets below the water surface in the flow channel. Due to the fact the Duperon unit is driven by explosion proof electric motors it was preferred for maintenance reasons over the Vulcan's hydraulically drives and thus used as the basis of design sketches and cost estimates.

The solids caught on the screen will be cleaned from the bars with the automatic rake and scrapper system that will discharge solids through an integral screw conveyor into a compactor that will wash organic material from and dewater the screenings collected. The solids will be discharged from the compactor unit into a disposal dumpster for ultimate disposal.

4.3.1.4 Grit Removal

After passing through the fine screen, wastewater will enter a grit removal chamber. A total of four (4) vortex type grit removal chambers, each with a maximum capacity of 12.0 MGD, will be provided. This Act 537 Plan recommended the use of a vortex style grit removal system on the basis of reliability and operational flexibility. This document does not deviate from this recommendation.

Each grit removal chamber shall consist of a circular tank having a twelve foot diameter. The inlet channel velocity to each grit chamber will be no less than 2.0 fps at the split low flow and 3.5 fps at the peak flow of 48.0 MGD with all four units online. Daily flows up to 12.0 MGD will be directed through one or two grit chambers as dictated by the operations staff. When flows exceed 12.0 MGD, the second and third girt chamber will be automatically activated and so on in increments of 12 MGD until all four units are in operation.

A mechanically induced vortex shall capture the grit solids in the grit chamber hopper. The grit will be pumped from the grit chamber hopper to a grit concentrator for the secondary treatment of organics and secondary grit dewatering. Excess water and residual organic material will flow out the top of the concentrator and be returned to the inlet of the grit chamber. Grit will discharge at the bottom of the concentrator into a dewatering screen conveyor. Grit will be further dewatered in the screw conveyor which will then discharge onto a belt conveyor and transported to a dumpster to await ultimate disposal. In order to have complete redundancy, two (2) grit concentrators and two (2) dewatering screw conveyors will be provided. Similar to the screen channels, a bypass channel will be located between the sets of two grit removal units in the event one or more of the units are out of service.

Gates shall be provided ahead of each treatment unit in order to provide bypassing of units that may be out of service and also to allow the alternate operation of duplicate units.

4.3.2 Flow Control Diversion Structure

The proposed flow splitting chamber will consist of a metering device on the influent lines above a weir and three (3) effluent pipes. The first effluent pipe will be a 24" line to the existing WWTP process train and shall have a capacity of 0-8 MGD under average day flow conditions and up to 20 MGD at peak flows. The other two effluent pipes will flow to the proposed SBR process train and are preliminarily sized to be 24" and 36" diameter lines that combined shall have a capacity of 0-4 MGD at average flow conditions and up to 24 MGD at peak flow. The purpose for the dual lines is to minimize friction head loss and to constrain the minimum velocity to alleviate settlement in the line. The Splitter Box will be equipped with a chamber that will make the flow spill over a weir into a chamber that will be proportionally divided by 6 automatically operated weir gates. The placement of the gates in the effluent troughs will be strategically placed to divide the flow proportionately for various flow rates. Table 4-6 is provided to identify the proportion of the flow split based on the influent flow. It should be noted that the percentages identified in the table correspond to the placement of the gate along the weir length.

Table 4-6

Influent Flow		Existing Process Split Percentage	New Process Split Percentage
Base Point 1	0-12	100	0
Base Point 2	0-24	0	100
Base Point 3	12-32	25	75
Base Point 4	12-40	50	50
Base Point 5	12-44	45	55

4.3.2.1 Operation

A Programmable Logic Controller (PLC) with five (5) program modes shall be provided to control the weir gates. The various modes must be hand selected by the operations staff and will provide automated operation of the splitting chamber on the basis of flow signal set points. The operations staff shall have the ability to set the various flow points in the PLC that will operate the gates. Once a flow set point is consistently metered or exceeded for a period of 15 minutes the PLC will send a signal to open and close the gates with the matching flow set points. The basis of design set points as displayed in Table 4-6 above will likely be the default settings however may be modified during final design or startup through the use of the PLC.

4.3.3 SEQUENCING BATCH REACTORS

One of the most common processes for biological treatment is one of the various versions of the activated sludge process. The version selected for the new treatment train by the approved Act 537 Plan is the Sequential Batch Reactor (SBR).

This modular design is an activated sludge process consisting primarily of parallel reactor tanks with aeration/mixing systems, decanters and sludge withdrawal facilities. The advantages of an SBR system over other aeration system include its ability to handle peak flows without equalization, consistent quality of effluent, relatively low operation and maintenance costs from potential energy conservation and minimum manpower requirements, and limited space requirements since both biological treatment and sedimentation occur in the same tank. The treatment process also controls filamentous sludge bulking and can provide greater flexibility with shock organic loads and nutrient removal than other activated sludge processes.

4.3.3.1 Sizing and Recommended Operational Parameters

The treatment process typically involves a five-stage cycle that occurs in the reactor tank. The first stage is the fill stage when the wastewater influent fills the tank and mixes with mixed liquor settled during the fifth stage. Aeration characterizing the second or react stage can also occur during the initial stage. The react stage results in organic and nitrogenous oxidation. Aeration and mixing are terminated and the third or settle stage allows the settling of solids. The fourth or draw stage involves the decanting of effluent after settling. During the last stage the tank remains idle and solids are withdrawn from the bottom. Once the fill, and aerated mixing cycles are complete, a parallel reactor tank is also in the fill stage at this time.

Some SBR systems involve a semi-batch process where all stages occur in one tank as influent is continually accepted and baffled in an effort to reduce short-circuiting equalized flow and prevent disturbance of quiescent settling conditions. The five cycle stages of the true SBR cycle are combined into three in the semi-batch mode of operation. The first two stages of the true batch process comprise the first stage of the semi-batch version. Sedimentation is considered the second stage of the semi-batch cycle, while the last is a combination of the decanting and idle stages of the true batch method.

For either process system the cycle times can be adjusted to accommodate incorporating alternating phases of oxic-anoxic/anaerobic (air on-air off) conditions in the cycles for BNR capabilities.

Both SBR process systems with BNR capacity were considered in the preparation of this report. Both systems provide a high degree of treatment by eliminating the negative impacts caused by extreme flow fluctuations and are considered viable options at the preliminary design stage. The two manufacturers investigated the most for each process style were Siemens Jet-Tech for the true batch and ITT-ABJ for the continuous flow style. Each manufacturer's system has a proven ability to provide the required treatment of wet weather related flows in the most efficient and flexible way. The final selection of the type of the SBR system will need to consider various factors better determined during final design such as process loading, land availability, hydraulics, cost effectiveness, system flexibility and operational preferences. For the purpose of developing the cost estimates for the proposed flow management alternatives, the continuous flow system by ITT-ABJ was given preference. The reasons for the partiality include:

- Continuous flow type provides a more flexible adjustment to the sudden changes in flow. True batch characteristics are maintained for flows up to 3.5 times the design flow whereas continuous flow units allowing for "fill decant" mode during peak flow conditions over 3.5 times the design flow without disturbing the sludge blanket.
- As a result of the continuous acceptance of influent, the overall volume of the system are typically reduced by 20-30% of the true batch counter part which needs the additional volume to equalize peak flows.

- The continuous flow system can be converted to a true batch system with the appropriate valving at low flows
- The ITT-ABJ system utilizes a fine bubble membrane disc aeration system and static mixers to provide the required oxygen and mixing for the BOD and nutrient removal fed by positive displacement type air blowers versus jet aeration for aeration and mixing.
- Conservative Cost Estimating: The budget price for each system slightly favors the true batch SBR system. Using the price of the continuous batch system even with the reduced volume, allows for some protection from escalating material costs.

The SBR basins for this report are designed to accommodate either a conventional or continuous flow modes of operation to treat average and peak day hydraulic loadings of 4.0 MGD and 24 MGD respectively, with average day influent loadings of 115 mg/L of BOD_5, 102.5 mg/L TSS, and 25 mg/L NH_3-N. The specified effluent quality parameters that must be guaranteed by the manufacturer are concentrations of 15 mg/L for BOD_5, 15 mg/L TSS and 1 mg/L of NH_3-N.

The basins were sized with an assigned Food to Microorganism (F:M) ratio of 0.035, Mixed Liquor Suspended Solids (MLSS) concentration of 4,800 mg/L and the anticipation of complete nitrification and denitrification.

An important factor in the nitrification process is alkalinity, or pH buffering capacity of the wastewater. Published literature about biological treatment has stated that a minimum residual alkalinity of 50 mg/L as $CaCO_3$ is required to provide adequate buffering capacity and maintain a constant pH of approximately 7.0 pH units in the aeration basin. As nitrification occurs, alkalinity concentrations decrease at a ratio of approximately 7 mg/L $CaCO_3$ to 1 mg/L NH_3-N. Therefore, complete nitrification of 25 mg/L NH_3-N will remove influent alkalinity and may require special buffering provisions to maintain a constant pH in the SBR. If buffering capacity is required to maintain the pH of the basins during the nitrification/denitrification processes, it is proposed that 50% concentrated caustic soda (NaOH) be dosed at the influent of the basins at the proposed splitter box. To attempt to minimize the chemical addition, denitrification is incorporated into the design. Denitrifying wastewater has the ability to recover approximately 50% of the alkalinity destroyed during nitrification, which should reduce the chemical addition proportionally.

Four SBR basins are proposed. The dimensions of each basin are 111 feet long by 75 feet wide with a low water level depth of 10.0 feet and a high water depth of 15 feet. Each basin will be aerated through a grid of fine bubble membrane diffusers with air supplied by four - 75 HP positive displacement process air blower rated at a capacity of approximately 1,250 cfm. A fifth identical blower unit will be provided for backup service to provide capacity with the largest unit out of service. The blowers will be controlled with variable speed drives to proportion air flow to monitored dissolved oxygen levels in each basin and maintain a minimum dissolved oxygen level of 2 mg/L.

The peak day design flow and storm flow cycle times govern the tank decant rate of 8,333 gpm which equates to approximately 12 MGD per basin. However, as a function of the BNR cycles and also under peak conditions, decant cycle will overlap, requiring the downstream hydraulics to be governed by a peak flow rate of 24 MGD.

The decants are to be controlled by a programmable logic controller system which is designed to function with six three-stage process cycles under normal flow conditions and eight cycles for storm flow situations, and twelve cycles for "extreme" storm events. Such events may occur when one tank is out of service and the other basin must hydraulically accept all influent flow. The basins may still operate in a conventional batch mode if desired by the operations staff.

Other provisions to ensure that the tanks will not overflow due to high influent rates are to be made with the basins in service. One provision is that all decanter units are raised to the park (or up) position and the air is to be shut off until the flow rate is reduced should the liquid level in the tank exceed the high water level by 6 inches. The decanter in the park position would act as a weir to evacuate flow from the tanks before overflowing the walls of the basin. Other measures include inter tank over flow connections in common walls, and piping to utilize the sludge feed pumps to transfer wastewater from one SBR to the other, or waste to the digesters.

The sludge generated by the process is expected to settle to a low sludge blanket at the bottom of the reactor when the air supply is off. The sludge will be transferred to aerobic digesters by submersible waste sludge pumps located in the SBR during the settling or idle phase. Each SBR basin shall house one 3-HP pump capable of pumping 100 gpm at 20 feet TDH to the digesters

The tanks will be concrete construction and provide for protection and operation during flood events. Also constructed with the tanks will be effluent collection boxes common to two basins that will centralize SBR effluent for transport to the UV light disinfection system. Flow from the boxes will flow by gravity to a common 36" diameter pipe to the disinfection system.

4.3.4 DISINFECTION

Currently disinfection is accomplished at the WWTP utilizing chlorine gas dissolved into one or both chlorine contact tanks on site (Reference Section 4.1.3). Primarily the forward flow to be disinfected uses the two parallel symmetrical chlorine contact tanks following the secondary clarifiers. Obviously these basins alone do not have the capacity to disinfect the required peak flow rates that for this reason, the expansion of the disinfection system is required.

The Act 537 Plan evaluated several disinfection methods and combinations there of. The plan prescribed a combination of two methods to achieve the required capacity: a UV disinfection system with the existing chlorination process. In this alternative, flow up to 20 mgd would be treated at the new UV disinfection facility. Wet weather flow up to 23 mgd would be treated utilizing the existing chlorination facilities. As witnessed from the recommended Act 537 Plan Process Flow Diagram Plate 6-4 in Appendix A and reprinted from the Act 537 Plan, it was intended that the forward disinfection of the flow from the two process trains could be common and interchangeable for flexibility. However, upon investigating the hydraulic profile of the existing facility with respect to regulatory requirements for flood protection and the increased peak discharge rates, it was determined that the two methods would have to be dedicated to their respective split treatment processes. For a more in-depth discussion of the hydraulic restrictions and the resulting hydraulic profile, please see Section 4.3.5 of this document.

Although the dedicated disinfection arrangement presents the disadvantage of always utilizing chlorine, there are several advantages that result from this decision, including:

- Promotes gravity hydraulic flow through the facility.
- Provides a source for WWTP effluent water.
- Provides a source for UV bulb cooling water.

4.3.4.1 Chlorination

As the chlorination system is currently dedicated to the existing treatment train, no major process changes are required beyond updating the chlorine feed system.

Upon evaluating the current feed system, it was determined that the equipment is outdated and located on the opposite end of the property. The room that houses the equipment is located in the C and I Building and is not considered air tight, thereby creating safety concerns in the event of a gas leak. For these reasons, a new chlorine feed building is proposed.

The building would be a concrete block, truss roof structure constructed adjacent to the chlorine contact tanks to minimize chlorine solution piping required to feed the contact tanks. The building would be constructed to building codes and all applicable safety measures for chlorine storage included. The preliminary concept of the building footprint also includes a contained non-classified room for any electrical equipment needed in the area.

Finally the chlorine contact basins will be responsible for the generation of all effluent water utilized at various points throughout the facility.

4.3.4.2 UV Light Disinfection

4.3.4.2.1 <u>Capacity</u>

The capacity of the UV channel and light system was designed on the basis of the peak flow expected through the unit. In the case of the UV channel, this is governed by the decant rate of the SBR system. Thus, the proposed unit consists of one channel with six reactor banks of UV lights and is designed to accommodate a flow of 24 MGD. The specified manufacturer of the final design will be required to guarantee that the system is capable of disinfecting the effluent wastewater below the projected permitted effluent level of 200 Fecal Coliforms per 100 ml.

4.3.4.2.2 UV Light System

The concept behind UV disinfection relies upon supplying lethal doses of UV radiation energy to microorganisms present in wastewater effluents to stop the reproduction and completely destroy cells. The method is most effective with a quality effluent (low turbidity), and produces no residual toxicity. Typically a completely submerged set of lights are installed in an open channel that operates in a plug flow fashion. The natural turbulence of the water through the channel provides internal mixing past the lights creating an opportunity for complete disinfection. However, with this type of disinfectant, there is no immediate measure to determine adequate disinfection.

The ultraviolet disinfection system proposed for either alternative would include the following components: UV lamp modules, system controls, automatic level controller, and module removal system.

A. UV Lamp Modules

There are basically two types of elemental high intensity types of lamps utilized in UV disinfection modules: medium pressure and low pressure. Both systems have compatible initial capital construction costs and both are considered viable options for installation. For the purposes of this report, designs and estimates have been based on the low pressure alternative. The low-pressure mercury vapor lamp has been the more commonly used lamp for wastewater disinfection. The low-pressure mercury arc lamp principle that is employed in standard fluorescent lighting is translated to germicidal lamps. While florescent lamps use a phosphor-coated tube to convert UV light to visible light, the arc lamp principal occurs in a transparent tube for ultraviolet lamps which allows light irradiation directly to passing cells for lysing.

Low-pressure lamp systems are available in several open-channel modular configurations that fall into two major categories: horizontal and vertical bulb systems. Open-channel, modular, horizontal UV lamp configurations are the most prevalent systems in the municipal wastewater industry. Open-channel, modular, vertical UV systems have been operating in the municipal wastewater field since 1987. Vertical systems were brought to the market as an alternative to modular, horizontal, open-channel systems. Again both systems are considered viable options. When investigating various manufacturer offerings for each type of system, the MACM staff expressed a preference for the vertical bulb configuration. The preference was based in the apparent simpler maintenance associated with bulb replacement. Vertical systems allow the modules to be re-lamped with the module in place, unlike the horizontal lamp modules which requires the entire module to be removed from the channel.

Vertical lamp systems consist of lamp bundles, often referred to as a module. Each UV lamp is housed in a quartz tube in a single open-ended test-tube-like shell. The lamp/quartz assembly is secured at the top to the module rack by an o–ring and socket connector. The bulbs in the module are supported throughout their length in an open rectangular frame. The frame rests on the channel bottom in an upright position (lying on one of its short faces), such that the lamps are perpendicular to the channel floor.

A vertical lamp system module typically consists of 40 lamps mounted in a frame in an eighty-by-five lamp array. Traditionally, these modules employ a staggered lamp array, in which alternating rows of lamps are parallel to one another but are essentially "out of phase" by one-half of the lamp spacing distance. In theory, this design should result in increased radial turbulence with minimal added axial turbulence.

There are two major manufacturers of the vertical systems on the market today: Siemens-Sunlight System and Infilco Degremont Inc. Both systems are viable options for the installation and the final decision made during the final design phase. To fulfill the goals of this document, sizing and cost estimates were based on the Siemens-Sunlight System because of the level of familiarly gained during the investigation phase of this report.

B. Cleaning

Everyday lamp cleaning is generally accomplished employing mechanical wiping system. The wiping systems can be used under process operation. Current options to the wiping system include air-scouring systems engaged in place and under pressure conditions. Everyday cleaning is used to increase the interval between chemical lamp-cleaning cycles, which are often performed at manufacturer recommendation. Chemical cleaning can either be done in situ (isolating the channel if available) or by transferring the module to a dip tank. As only one channel is proposed, a chemical dip tank will be required for this type of maintenance.

Regardless of the configuration, both vertical and horizontal modules require an overhead crane for removal from the channel. The overhead crane lift height is set by the lamp length which dictates the liquid depth of the channel. Typically, vertical bulb configurations are substantially deeper than used with horizontal systems and offer less tolerance to level control in the channel.

C. Level Control Device

Level-control devices currently in use are designed to maintain a target level within approximately 0.25 in. This promotes the distribution of a relatively uniform dose to all fluid elements being treated. The level-control device also prevents the liquid level from dropping below the top set of lamps, which could result in both safety and operating problems. Liquid-level control and system monitoring and controls include fixed and motorized weirs and counterbalanced flap gate systems. The simplest method of the aforementioned options is the fixed weir. Given the wide range of flows expected through the system, a launder-like system of weirs will be required to ensure that the loss over the weir does not drastically fluctuate. Hydraulic calculations indicate that the total length required for the fixed weir level control is 51.75 feet.

D. *Dose Flow- Pacing and Controls*

The wide range of flows also requires that the system be flow paced for economic energy use. Vertical systems often afford better flow-pacing potential because lamp rows can be turned off in each bank without reducing the required dose of UV radiation. To maximize this advantage, vertical system manufactures offer rapid start lamps that allow more frequency on-off cycles than the instant-start lamps used in horizontal systems. Many systems also offer electronic ballasts that allow lamp dimming. The electronic ballast's ability to dim lamps allows better and more cost-effectively flow pace the UV system.

The introduction of electronic ballasts, which have become standard and are used in most new systems today, are solid state, and energy efficient. The electronic ballasts are also significantly lighter, more compact, and due to their modular (plug-in) design lower maintenance efforts for replacement.

The controls for the unit will be housed in the non-classified area of the chlorine storage and feed building discussed in the previous section.

4.3.4.2.3 UV Channel

The UV channel will consist of an open concrete rectangular flume that will house the UV disinfection modules. The Siemens system, which was selected as the basis for the design incorporated herein, will require six modules in a common open channel. The modules will be stacked three across and two deep. The manufacturer represents that each 30" wide by 42" deep 40 lamp module will disinfect a flow rate of 10 MGD creating adequate treatment and backup capacity. As was discussed in the previous section wiping mechanisms, a flow pacing controls, an overhead crane and chemical dip cleaning tank is provided with this system.

The overall dimensions of the open channel UV reactor zone are predicted to be 90" wide and a minimum of 204" long. Additional length is recommended by the manufacturer ahead and after the zone to create quiescent flow conditions into the zone and before spilling over the level control device. These dimensions will be determined during final design and are dictated by the overall hydraulic profile of the WWTP.

4.3.5 WWTP Outfall and Hydraulic Profile

Due to the site location at the confluence of the Monongahela and Youghiogheny Rivers, the existing hydraulic profile is considered relatively flat. This statement is further evidence by the existence of screw pumps prior to the aeration basins.

As was discussed in previous sections and based on historical occurrence, flood protection and damage are concerns at the facility. According to PADEP regulations (Section 41.3 of the PADEP DWFM), the facility must remain operational during a 25-year flood and all mechanical equipment must be protected from a 100-year flood (i.e. the tops of walls and first floors should be above the 100-year flood elevation). Flood level elevations utilized for compliance with this guidance and as the basis for the hydraulic profile calculations were determined from Federal Emergency Management Agency Flood Insurance Studies for the City of McKeesport and the US Army Corp of Engineers.

Surveys performed for this and other past reports reveal that the first floor of several buildings as well as wall top for many treatment tanks on site are at or just below the 100-year flood elevation of 745.0 feet, thus partially violating the first part of the regulation. Furthermore, it is noted that these same surveys identify several effluent weirs, specifically on both chlorine contact tanks and the secondary clarifiers at or below the 25-year flood elevation approximated of 740.5 feet. With tank and first floors below the 100-year flood elevation, effluent weirs at or below the 25-year flood elevation and a gravity discharge to the Monongahela River, the facility does not conform to the PADEP flood operation and protection requirement. As such any detailed expansion design must consider this issue and offer provisions to comply with the PADEP guidance.

Since the receiving water elevation most profoundly affects the hydraulic profile of a WWTP, calculations for loss and elevation are best started from the discharge point and working backwards through the process flow scheme. Therefore, the first potential hydraulic bottleneck in the facility is the outfall pipe and structure. Currently, the facility has two outfalls for treated effluent with lines originating from the respective chlorine contact tanks. The main outfall line is a 36" diameter HDPE line with a headwall along the Monongahela River. At the present slope of the line, the existing capacity than can be conveyed is 87 MGD with a free discharge to the river. However if the river is at the 25 year flood elevation the capacity of the line is reduced to 0 MGD because the river will surcharge the line because the elevation of the chlorine contact wall will overflow as water seeks it own level.

Further impacting the discharge structure is how flow is conveyed to it. The intention of the Act 537 Plan was to split flow between the existing process and proposed SBRs with common disinfection through continuous UV disinfection and only utilize chlorination when hydraulic loads exceeded the capacity of the UV channel. When considering the fact that the flow that must be discharged from the facility more than doubles, and understanding that the additional head losses associated with this flow will increase surcharged water elevations, it was determined that some course of action must be taken to accommodate the flow and minimize overall head loss and more importantly as it affected the existing process.

After performing several iterations of calculations, it was determined that the hydraulic losses through the proposed UV system and conveyance structures to and from the channel would create more head loss at high flows than could be accommodated within the available head between the outfall and the existing process, such that the CCT could not be bypassed through gravity flow. For this reason and as previously proposed earlier in Section 4.3.4, it was decided that the disinfection systems would have to be dedicated to their respective processes.

Although this decision assists in reducing the losses and associated water elevations at peak flows during the 25 year flood stage, some structural measure must be taken to accommodate the additional flow and associated losses through the outfall.

To reduce the hydraulic bottleneck and minimize the hydraulic loss in the outfall pipe and structure, several options were investigated. Hydraulic profile calculations determined that only two of the alternatives developed would be viable. The first option was the construction of an effluent pump station that would operate only when discharge elevations and flows necessitated. The second option developed was the construction of an open concrete flume from the discharge of the respective disinfection units to the Monongahela River. Although the second option would allow the river at flood stages to surcharge the flume, the loss to the discharge point would be substantially reduced as a result of less closed piping.

Although a proven alternative at other facilities, the effluent pump station was eliminated from consideration due to economic reasons. The capital cost of the pumps alone (i.e. not including structures and piping) substantially outweighed the construction cost of the flume by a ratio of nearly 4 to 1. Consequently, the open flume has been chosen as the WWTP outfall and discharge conveyance alternative.

The preliminary design has assumed that the top of the flume walls will exceed the 100 year flood elevation and be a common wall extension of the flume housing the UV channel. The end of the flume as well as the tops are expected to be protected by fencing to prohibit unwanted access into the flume from over the walls or the river itself. The common wall construction means that the width of the UV system dictated the width of the flume at 90". It is proposed that a baffle wall with a weir be installed after the confluence of the existing and new process flows for flow measurement using an ultrasonic flow metering device.

It is further proposed that this weir elevation be set based on a free discharge over the weir when the river is at the 25 year flood elevation. As a result, the hydraulic profile for the existing process will not need to be altered as a result of the expansion. All process flows through the existing and proposed treatment basins will be conveyed via gravity such that the water elevation in each process will be determined by the flows dictated by the controlled splitter box. The controlled splitter box will receive the total peak flows generated at the WWTP by gravity flow through the screens and grit removal systems. The channels that house this equipment will be designed to minimize the losses static head required of the pumped discharge on the new raw wastewater pumps and the proposed force main from the West Shore Pump Station.

The tabular calculations of the proposed hydraulic profile for the expanded facility are provided in Appendix D of this report. It should be noted that the hydraulic profile could be altered during detailed design to accommodate details not realized herein to conform to actual design conditions.

4.3.6 SLUDGE STABILIZATION AND DISPOSAL

4.3.6.1 Aerobic Digestion

Due to the ever-increasingly more stringent regulations promoting the land application of WWTP sludge and increased sludge production from an expanded activated sludge system, the existing basins designated for sludge holding do not have the volumetric capacity to comply with stabilization criteria. For the facility to be considered in compliance with the regulations imposed by the Commonwealth sludge handling methods supporting the liquid treatment units must also conform to the policies governing wastewater treatment and the ultimate fate of the pollutants removed. With this in mind, a brief review of the requirements of sludge stabilization is warranted.

In December 2000, the PADEP adopted revisions to the regulations governing the ultimate disposal of wastewater sludges. In accordance with 40 CFR Part 503 published by the USEPA, the Pennsylvania Code Title 25 Section 271.932 provides numerous treatment alternatives for sludge stabilization and requires that sewage (wastewater) sludge must meet one of the accepted Vector Attraction Reduction (VAR) standards and one of the acceptable processes to significantly reduce pathogens (PSRP) applicable to wastewater sludge applied to land surfaces for either Class A or Class B sludge. The PSRP requirements determines the acceptable levels of treatment to limit the disease causing bacteria that may be present in wastewater sludge, while the VAR standards are based on the level of stabilization as measured by physical analysis, which render the level of acceptability for disposal without causing a nuisance at the ultimate disposal site. In other words, Class A sludge must meet more stringent pathogen reduction requirements for land application while the Class B counterpart is suitable for disposal within more restricted areas, such as municipal landfills.

Recently, the MACM has received verbal notifications that the PADEP is currently evaluating wasted dewatered sludge as it arrives at municipal landfills for volatile solids content for vector control. As the MACM desires to continue municipal landfill sludge disposal, the design of stabilization processes that meets or exceeds the volatile solids reduction and VAR requirements of a Class B sludge will be the focus of the remainder of this section.

Traditionally, aerobic digestion has been the most viable stabilization option for wastewater treatment plants operating at a capacity less than 5 MGD, however the process has been gaining popularity for larger plants due for the same reasons it was employed at smaller facilities. The advantages of using aerobic digestion include: lower organic concentrations in supernatant liquor, relatively easy operation, odorless and biologically stable product, and low capital cost. Aerobically digested sludge is easy to control and produces a quality supernatant having less impact on the treatment facilities when recycled through a treatment facility. Aerobic digestion is also more applicable to dilute biological solids such as waste mixed liquor and waste activated sludge, which is the type of sludge produced in both the conventional activated sludge processes.

Preliminary design calculations from the activated sludge system designed earlier in this document were utilized to estimate the quantity of waste sludge produced daily. Using typical published values kinetic biological relationship and for the physical parameters of municipal wastewater, the estimated quantity of wasted sludge was calculated to be approximately 5,750 pounds per day (4,522 pounds per day at 1% solids from the existing process and 1,227 pounds per day at approximately 0.8% solids from the SBR process), with approximately 60% of the waste as readily degradable volatile solids. Assuming that the solids concentration of the combined settled sludge is about 0.9%, this quantity of sludge relates to a volume of approximately 72,600 gallons wasted for digestion per day.

There are no design formulas or models to predict the required level of treatment for PSRP, thus aerobic digesters must be sized by volume and solids retention time. Regulations associated with stabilization by aerobic digestion suggest at a minimum 40 days SRT to achieve both PSRP and VAR when the digester is operated a minimum temperature of 59°F and 60 days for temperatures near 50°F. The volume is then based upon the storage time required and the sludge flow rate.

To select a design sludge age, a widely published curve was consulted that derives the sludge age based on temperature and the volatile solids reduction desired. Based on a VSS reduction of 40% (a minimum of 38% is required) and the cold weather temperature of 10°C, a temperature-sludge age value of 480 degree-days was determined from the curve. Dividing by the temperature resulted in a design sludge age of 48 days. This parameter was then applied to a design formula to obtain the volume of the digester. The formula accounts for thickening during the digestion process. In the interest of conservatism, it was assumed that the influent solids concentration to the digester would be approximately 1% and have an effluent concentration of roughly 1.8%. The resulting volume was calculated to be 1,166,980 gallons (156,002 ft^3).

The PADEP guidance suggests that a minimum of 30 cfm per 1,000 ft^3 of volume. The preliminary calculation performed for the unit sizing determined that mixing governed the air required for the digesters. The calculations yielded that two operating 150 HP blowers with one standby unit (for a total of three units) each rated for approximately 2,620 scfm should provide sufficient air for both endogenous respiration and mixing purposes.

As was previously discussed, the without the need for primary clarifier basins, the unused equity can be converted to basins for aerobic digestion. Preliminary volume calculations indicated that the volume of the existing primary clarifiers exceeds the volume required for full aerobic digesters. Moreover, these basins are equipped with air feed lines for the pre-aeration portion of the structure and sludge draw-off lines and associated pumps located in the Control and Incinerator Building, which would be required of any digester construction. Therefore, this report proposes the removal of primary clarifier chain and flight mechanisms and the installation of a coarse bubble aeration system. The recently installed FRP baffles are to stay in place to create zones for settling and supernatant removal.

Structurally the basins are considered to be in sound condition. However the top of wall elevation does not protect the basins from the 25 nor 100 year flood stages of the Monongahela and Youghiogheny Rivers. Therefore, it is proposed the exterior walls of the structure be raised approximately 5 feet to an elevation one foot greater than that of the 100 year flood elevation. Access to the basins over the exterior walls will be provided by constructing structural stairs and platforms as necessary at locations near the front and back of the basins.

4.3.6.2 Dewatering

Sludge will continue to be dewatered prior to landfill disposal employing the belt filter presses currently operated at the facility. The frequency of operation will remain dependant upon process sludge production and wasting practices.

4.3.7 ELECTRICAL IMPROVEMENTS

4.3.7.1 Power Requirements

The WWTP is currently supplied by a utility owned substation located within the plant and attached to the WWTP garage. The substation is composed of three (3) 500KVA single phase transformers which are capable of supplying 1.5 MVA to the plant. At 480 volts, the transformers are capable of supplying 1,800 amps. The plant is supplied with a standard 1,600 amp service. The historical peak WWTP energy demand is approximately 750 KW with a current draw of 842 amps, which translates into 47% of the service transformers capacity and 53% of the 1,600 amp service. With this reserve capacity, the service is adequately sized to meet the existing WWTP loads and includes a buffer for incremental future increases.

The proposed expansion of the WWTP will require additional power from the utility and will overload the capacity of the existing transformers. The proposed loads are identified on the following page in Table 4-7.

The calculated total connected load identified in Table 4-7 is 2.055 MVA and when distributed at 480 volts , the current draw is expected to be 2,472 amps. The power required by the recommended equipment within the unit processes for the proposed expansion combined with the peak kilowatt load of the existing WWTP renders the existing service transformers and entrance cables insufficient in size. Therefore, the capacity of the electric utility service and transformers must be increased to meet the demands of the additional power loads.

Table 4-7

QTY	Loads	Unit Rating	Units	Voltage	Phase
1	Influent Knife Gate	5	Hp	480 V	3
10	Slide Gates 1-10	0.25	Hp	480 V	3
2	Screen	0.5	Hp	480 V	3
4	Grit Paddle 1-4	1	Hp	480 V	3
4	Grit Pump 1-4	15	Hp	480 V	3
4	Grit Classifier 1-4	1	Hp	480 V	3
4	Pump 1-4	300	Hp	480 V	3
5	Modulating Gate 1-5	0.25	Hp	480 V	3
5	SBR Blower 1-5	40	Hp	480 V	3
4	SBR Decanter 1-4	0.75	Hp	480 V	3
4	Sludge Pump 1-4	3	Hp	480 V	3
8	Mixer 1-8	12	Hp	480 V	3
1	UV System	20	Hp	240 V	3
3	Digester Blower 1-3	150	Hp	480 V	3
1	Lighting	100,000	VA	120 V	3
1	HVAC	100,000	VA	480 V	3

4.3.7.2 Power Distribution

4.3.7.2.1 Proposed Substation Construction

The WWTP is currently supplied by a dual utility source as furnished by Duquesne Light. The source originates above ground on a utility pole located on Atlantic Avenue at the treatment plant entrance. From this point, medium voltage cables are routed underground, parallel with the main facility driveway and serve as the service entrance conductors for the utility owned substation located adjacent to the WWTP garage. As presented earlier, the existing transformers that reside in the substation will be insufficient in capacity to serve the additional load required by the proposed WWTP expansion.

In order to increase the capacity of the existing substation, Duquesne Light proposed changing three (3) single phase transformers with one (1) three phase transformer which is now the standard method of design. Duquesne Light has indicated that changing the transformers will require a minimum of 2 month power shut down of the substation to change out the gear and construct the required structural modifications to the building. The WWTP would need to be supplied with an alternate source of power during this upgrade. Moreover, due to the location of the service entrance conductors and methods of installation used at the time of the installation the entire service is at risk of failure from being exposed or damaged during the construction of the WWTP expansion. Therefore the upgrade of the existing substation is infeasible and cannot be implemented.

To minimize power outages and eliminate failure of existing wiring during the construction of the WWTP expansion a new utility substation and WWTP electrical building is proposed. A new substation and building can be designed and constructed while the existing plant remains in operation. The advantages of a new substation are listed below.

- The new substation will be positioned such that the power is easily distributed to the proposed electrical distribution system.
- Outages during construction will be minimized during construction with the exception of a short amount of time while power is transferred from the old service to the new service.
- The substation will be designed to handle the capacity of the existing and proposed loads.
- The existing substation will be removed enabling the space for which it currently resides to be more efficiently utilized.
- All existing cables contained in the original service entrance feed will be eliminated and removed.

When the power is successfully transferred to the new substation and the existing loads are re-energized, the construction of the WWTP expansion can begin.

4.3.7.2.2 Electrical Building

Power from the new substation will be routed to the existing screen and grit building which will become the central electrical distribution point for both the existing and proposed unit processes throughout the WWTP. The switchgear located in the central distribution electrical building will include at a minimum the following loads.

- MCC-1 (currently located in the C&I Building), which is the existing central distribution point
- Main Pump Station, Which is currently fed from MCC-1
- Proposed SBR System
- Proposed UV System
- Proposed Electrical Building Lighting Panel And Transformer

The proposed electrical building will also consist of the central hub for communications for a "SCADA System" which will be utilized throughout the plant and all Authority owned pump stations. The SCADA system will monitor and control operations throughout the plant as well as be linked to the pump stations. Video Surveillance will be integrated into the system to provide a level of security at each site.

4.3.7.3 Instrumentation and Controls

Past upgrades to the wastewater treatment plant have added advanced digital controls to many of the process areas. Where once simple on/off switches were used to control continuous functions, there is now a technologically advanced control loop consisting of electronic level sensors, variable frequency motor drives and microprocessor-based controllers to provide continuous control. With all of this precise control, the amount of information available to the plant operator is significant. A SCADA system can communicate with all of these new controls and processes and aid the operator with process monitoring, alarm monitoring and data logging for the entire plant.

An operator's interface or an HMI (Human Machine Interface) consisting of one or more desktop digital computers will be located throughout the WWTP at locations designated by the operations staff. From these computers, the entire wastewater treatment plant and pump stations will be graphically represented with custom designed screens. At a glance, the status of all critical data will be displayed on the monitor. Further screens will be developed for alarm monitoring, data logging, report generation and graphical trending. For the MACM treatment plant expansion, the SCADA system will be designed with more emphasis on data monitoring, gathering, logging and alarming. A digital power meter will be installed at the key distribution points. These meters contain vast amounts of information regarding electrical power usage and quality.

Essentially all of the process control loops will be independent systems with little need for operator intervention. Adding additional control logic would only tend to complicate operations for operators. The only type of control that may be added to existing processes is to give an operator the ability to digitally change control set points. Even this may be further controlled by placing limits on the operators' available choices.

Using the SCADA system, all incorporated processes will be capable of being monitored for any physical problems and alerting the operations staff that attendance is required. As part of the alarming features of the system, all alarms will be displayed in real-time on the monitor. Also, all historical alarms can be retrieved and either displayed or printed for further investigation. An advanced alarming feature will be the ability to send or announce alarms over the plant's paging system, telephones, pagers, faxes or e-mail. During non-staffed hours the SCADA system will act as a lone sentry that will be programmed to alert the appropriate personnel when an alarm is encountered.

All of the above mentioned features will also be available to designated operators from any remote computer that has access via the internet by the installation of proposed remote connection software on that computer.

Another feature of the system will be a remote controlled, video camera system. The cameras will be provided with full 360° rotation along with tilt, pan and zoom capabilities. Being remote controlled, the cameras will allow designated personnel to visually check the status of the various facilities to look for evidence of flooding, intrusion or fire from any connected computer in the world via a standard internet connection.

4.4 SUPPLEMENTAL AND OTHER CONSTRUCTION

Regardless of the alternatives selected by this document, supplemental construction will be required to support the proposed operational scheme. As discussed in the various options for expansion, additional blowers, upgrades to the disinfection feed system, process controls, and associated required electrical equipment will be needed with the new facilities.

4.4.1 SBR BLOWER BUILDING

As previously indicated, several blowers will be required for the new processes. Given the size and number of the blowers, placement of these units in existing open spaces in the plant, although considered feasible, it is not optimal. The potential existing open spaces are old electrical rooms in the C&I Building, under the belt filter press room. The location of this room in the basement and access to the dewatering building, make installation of the blowers in this area less than desirable. Understanding that the blowers are PD frame mounted packages, there is not a point where the floor could be opened to permit installation or access for installation or removal. Furthermore the access points to the belt filter press room preclude, installation of the air handling facilities required for blower intake and cooling.

For this reason, a new blower building is proposed. The structure will be sited adjacent to the existing garage and nearby the proposed SBR basins. The structure will be a slab on grade concrete block, steel truss roof, construction. The floor plan will include the area for the blowers which will be constructed of acoustical block to minimize noise from the blowers and an area designated for the SBR controls, blower VFDs and other electrical gear.

4.4.2 DOOR WINDOW AND ROOF REPLACEMENT

The existing roofs throughout the facility are deteriorated, some of which already leak. Also the windows and doors in the plant pump station, the screen & grit building, and the administration building are old and inefficient, making these buildings costly to heat. For these reasons, it is proposed that replacement of these items on the aforementioned structures is prudent at this time. Similar to the construction proposed at the rehabilitated pump stations, new wood truss roofs will be installed to replace the existing roof systems. New doors will be installed on these structures to match the doors on the new proposed buildings and where applicable, the windows will be replaced with glass block.

4.5 WWTP CONSTRUTCTION COST ESTIMATE

The construction cost of the treatment plant without contingency is estimated at nearly $17.98 million. This value is the summation of individual estimates prepared for the various chosen or recommended equipment and installations for the unit processes affected by the expansion. Table 4-8 identifies a more detailed breakdown of the estimated construction cost for the unit processes and other required construction. The values provided in Table 4-8 are summaries of more detailed estimates provided in Appendix B.

Table 4-8

Item	Construction Estimate Value[1]
General Conditions	$ 1,067,790.00
Headworks	$ 3,080,110.00
Existing Pump Station Modifications	$ 665,190.00
Splitter box	$ 357,020.00
SBR	$ 5,749,810.00
UV System and Flume	$ 613,590.00
Effluent Flume	$ 218,230.00
Digesters	$ 627,250.00
Blower Building	$ 602,360.00
Chlorine Building and Chlorine Feed Equipment	$ 277,400.00
Grit Building Renovations	$ 197,600.00
Administration Building Improvements	$ 208,660.00
Site Work / Yard Piping	$ 871,880.00
Subtotal	$ 14,536,890.00
Electrical	$ 3,440,180.00
Construction Subtotal[2]	$ 17,977,970.00

Notes:

1. Construction Estimate Values reflect January 2008 dollars.
2. Subtotal does not include contingency factors applied and does not reflect costs for utility services, land acquisition or special construction unrealized herein.

The scope of work for the items summarized in Table 4-8 includes:

- All required site work to accommodate the remainder of the scope.
- Modification of the existing WWTP Raw Sewage Pump Station
  1. Replacement of the existing pumps
  2. Separation of the wet well area from the motor and electrical equipment by constructing a building addition.
  3. New roof.
  4. Replace doors and windows
- Construction of a new headworks facility:
  1. Construction of a new structure to house treatment equipment, and required electrical and HVAC gear.
  2. Installation of 2 -24 MGD bar screens
  3. Installation of 4-12 MGD grit removal systems
  4. Construction of a flow control splitter box to regulate flow to the existing and new treatment trains.
- Construction of 4 new SBR basins with the following flow capacities: average day 4 MGD; peak 24 MGD.
- Construction of a new blower building to house blowers for the SBR process.
- Construction of a new UV Disinfection Channel, with a peak capacity of 24 MGD.
- Construction of a new effluent flume structure to accommodate compliance with PADEP operational requirements for flood conditions.
- Replacement of the existing digester blowers, and expansion of the blower room,

- Conversion of the primary clarifiers to aerobic digesters.
- Construction of a new chlorine storage building with updated chlorine feed equipment.
- Electrical construction: power, control, lighting, gas monitoring, and SCADA system installation.

4.6 LAND ACQUISITION AND PROPOSED SITE LAYOUT

4.6.1 LAND ACQUISITION

The existing WWWP property is somewhat "L" shaped. The property is bordered to the north and east by the Monongahela River and the Youghiogheny River, respectively. In the northwest corner of the property, the site is bordered to the west by Rebecca Street. In the southeast corner of the property, the site is bordered to the south by Atlantic Avenue. The southwest corner is bordered by the TICO Electric, Inc. property. Plate 4-4 is provided in Appendix A to assist this description.

Currently the available property owned by the Authority, has been essentially maximized by the existing WWTP treatment basins and buildings. The limited space available for expansion within the current property exists between the WWTP access road from Atlantic Avenue and the existing WWTP pump station, and between the newer chlorine contact basins, and the southern border with the TICO Electric, Inc. property. Given the limited area available to expand within the existing confines of the property, and the need to construct large process basins as previously discussed herein, property acquisition will be required. At a minimum, it is recommended that the TICO property, southwest of the WWTP be acquired.

Upon acquisition of that property, it is recommended that the existing structure be evaluated to determine if the building is of value to the Authority. At the writing of this report, if the building is considered to be in poor conditions, it is recommended that the structure be demolished to make room for the large SBR units and possibly new Authority offices. If the structure is determined to be in fair to good condition, then this report recommends saving and renovating the building for various uses of the Authority such as new offices or additional storage or garage space. For the purposes of the WWTP estimate in Section 4.5, it was assumed that the building had value to the Authority and costs were included to account for sheet piling along the western wall to protect the structure from excavations associated with the construction of the proposed SBRs.

In the event the building is in good condition and of use to the Authority and without prior knowledge of the existing floor plan or construction, it is estimated that design and construction of renovations could be performed for approximately $2,500,000.00.

4.6.2 PROPOSED SITE LAYOUT

Using the selected alternatives, and required treatment volumes and surface areas, a site plan layout was developed. The proposed site layout is included in Appendix A on Plate 4-4.

5.0 CONSTRUCTION SCHEDULING

As with any capital project, the construction schedule is paramount to a successful project. When several mutually exclusive projects are proposed, the sequence of the projects is just as important as the construction schedules of the individual jobs. This section identifies the sequence of the projects to ensure that the facilities can accommodate the proposed flows to achieve the goal of reducing the CSO events as well as preventing the stoppage of service to any existing or potential customers.

5.1 SEQUENCE OF PROJECTS

As identified earlier the projects must be sequenced to capture and treat the proposed peak flows and prevent the interruption of service to customers. Based on these goals the critical path of the projects is as follows:

1. WWTP Expansion
2. West Shore Pump Station and Force Main Construction
3. Long Run Pump Station Expansion and Force Main Construction
4. 28th Avenue Pump Station Improvements

Not listed above are the Cliff Street Pump Station Improvements and Long Run Gravity Sewer Augmentation Projects. While not on the critical path, it is recommended that the Cliff Street Pump Station project commence anytime after the completion of the WWTP Expansion and the Long Run Interceptor work begin once the Long Run Pump Station and Force Main is operational as proposed herein.

Since the WWTP is the point where all flow ultimately is transported to, the expansion of the facility must be completed first to achieve the capture and treatment goal. Upon the completion of the WWTP Expansion, the West Shore force main and pump station is second. By putting this project second, the pump station and force main will provide a conduit to the WWTP on the west shore which will also convey flows discharged from the Long Run Pump Station and Force Main. Once these flows are removed from the East Youghiogheny Interceptor, average day dry weather flows will be reduced at the 28th Avenue Pump station. The reduced average day dry weather flows will then provide an opportunity for the pump station to be decommissioned for the proposed improvements and minimize to possibility of peak temporary pumping.

Inherent to each individual rehabilitation project, are the construction issues that must be better defined. Such items such as coordination of trades, temporary power, dewatering, and timing will be addressed during the final design, however it must be understood that these issues can significantly affect the project schedule and cost.

5.2 CONTRACT TIMES AND OVERALL PROJECT SCHEDULE

Table 5-1 identifies the expected bid phase and project construction contract times based on aggressive start and finish design and permitting phase dates.

Table 5.1

Project	Duration	Start Date	Finish Date
Design Phase			
Detail Design	18 months	March 2008	September 2009
Permitting	6 months	October 2009	March 2010
WWTP Expansion Bid Phase	3 months	April 2010	July 2010
WWTP Expansion Contract Time	24 months	August 2010	August 2012
West Shore Pump Station and Force Main Construction	15 months	May 2011	August 2012
Long Run Pump Station Improvements and Force Main Construction	12 months	August 2011	August 2012
28th Avenue Pump Station Improvements	9 months	September 2012	June 2013
Long Run Interceptor Augmentation and White Oak Pump Station	12 months	September 2012	June 2013
Cliff Street Pump Station Improvements	9 months	August 2010	August 2012

6.0 PROJECT COSTS

6.1 PROJECT COST COMPONENTS

To complete the feasibility investigation of the various expansion alternatives an economic analysis must be performed. The economic evaluation herein investigates the estimated total project costs required, which include estimates for construction and other project costs such as engineering financial, administrative, legal and contingency. A more detailed discussion of each component is as follows:

- Construction - The costs to be paid to the contractors who will build the required facilities.
- Construction Contingency - A contingency of nearly 10 % is added to the construction cost to account for unforeseen special construction, and unrealized construction conflicts and construction cost estimate omissions that are respective of the preliminary nature of this report.
- Engineering - The costs to be paid to professional engineers to design the facilities, observe construction and provide other required services such as assistance in operations and financing. Engineering services may include the following:
  - Topographic Survey
  - Preparation of Contract Documents
  - Preparation of Regulatory Agency Permitting Procedures
  - General Project Services such as approving payments, answering questions, site visits, attending meetings, preparing change orders, etc.
  - Preparation of a Financing Report to support a bond issue
  - Resident Observation to observe construction
  - As-built and Record construction drawings
  - Preparation of Operation and Maintenance Manuals
  - Administration
- Financing/Administration/Legal - The costs to be paid attorneys and financial consultants for professional services relating to financing the project and development of service agreements, rights of way, etc.
- Property – The funds allocated for the acquisition of land and easements required to complete the project.
- Permits - Funds set aside to pay for regulatory review of the project to garner the required approvals for implementation and construction.
- Utility Costs – The costs paid to provide other utility services (electric, water, gas, telephone, etc.) to the required properties.
- Specialized Investigations – The cost paid to specialized engineers for the geotechnical investigations, wetland delineations, environmental assessment, etc.

The total of the above costs is termed the "Estimated Total Project Cost". For the purposes of this report, cost estimates for each of the aforementioned items were prepared based upon the summation of the individual construction estimates, proposed engineering fees, identified property permits and special investigations required to complete the project using historical cost information from similar projects. Table 6-1 presents a summary of these costs and identifies the total estimated project cost at $39,803,070.00.

Table 6-1

Item	Estimated Cost	Extended Total
WWTP Expansion	$ 17,977,070	
Cliff Street Pump Station Upgrade	$ 854,760	
28th Avenue Pump Station Upgrade	$ 931,060	
Long Run Pump Station Upgrade	$ 1,559,110	
West Shore Pump Station	$ 2,408,690	
West Shore Force Main	$ 1,868,110	
Long Run Force Main	$ 2,949,360	
Long Run Interceptor Upgrades	$ 2,768,910	
Construction Subtotal		$ 31,317,070
Construction Contingency		$ 3,000,000
Total Construction		$ 34,317,070
Engineering	$ 3,486,000	
Legal	$ 250,000	
Property	$ 500,000	
Utility Costs	$ 1,000,000	
Special Investigation	$ 240,000	
Permits	$ 10,000	
Total Project Costs		$ 5,486,000
Total Project Estimate		**$ 39,803,070**

7.0 SUMMARY AND CONCLUSION

The goal of this document was to identify, and recommend feasible options and concepts for the various facility upgrades studied and recommended by the Act 537 and to supply a more detailed estimate of cost.

As a result of the evaluations made herein, the concepts of the Act 537 Plan have been determined to be feasible. For the most part the recommendations made in this document for the various projects are commensurate with decisions proposed in the Act 537 Plan. The more in depth investigation of the projects identified construction issues, land acquisition requirements and resulted in detailed sizing calculations for the projected and selected equipment.

In general, the following information was recommended:

- The capacity improvements to the Long Run Interceptor are best made by constructing a submersible pump station within the McKeesport limits and a force main to address needs along the upper portion of the interceptor, and the installation of a parallel relief interceptor and replacement of the bottom portion of the line.
- The Cliff Street and 28th Avenue Pump Stations should be upgraded by replacing the pumps in kind, renovating the pump controls and electrical gear, and remodeling the structure to meet regulatory codes for classified areas.
- The Long Run Pump Station will be completed overhauled. The scope of work to achieve the capacity increase includes the installation of screening facilities, submersible pumps and additions constructed for wet well capacity and electrical gear.
- The Long Run Force main is proposed to be increased from 12" ductile iron pipe to 20" PVC pipe and aligned in properties occupied by the Youghiogheny River Trail to a point where it will cross the Youghioghney River by horizontal directional drilling methods and discharging to the proposed West Shore Pump Station.
- The proposed West Shore Pump Station and accompanying force main will be constructed with below grade screening facilities, wet well and vertical shaft dry pit pumps sized to discharge directly to the WWTP headworks building through a 24" PVC force main aligned mostly in River Road.
- The WWTP will be upgraded to accommodate peak capacities of up to 44 MGD. This will be achieved by implementing a split treatment process. The influent will be preliminarily treated through screens and grit before being split to the existing activated sludge and disinfection process and a new SBR and UV disinfection process before being combined to one common outfall in an open flume that will discharge into the Monongahela River. Considerations for biological nutrient removal will be incorporated into the project as well as addressing several items in need of repair from the recent capital plan developed prior to this document.

More specifically, equipment and sizes were identified for the above recommendations to develop the cost estimates required by the objective of this document. As a result, the estimated total project construction cost of the above recommendations is approximately $39.8 million with, roughly $34.3 million representing the estimated construction costs using January 2008 valuations of cost.

8.0 REFERENCES

The following listing of manuals and references were utilized in the in the preliminary design of the expansion alternatives proposed herein and the preparation of this feasibility analysis report.

- Manual of Practice No. 8: Wastewater Treatment Plant Design published by the W.E.F.; 1998
- Nitrogen Control published by the U.S. Environmental Protection Agency Technology Transfer; 1990
- Wastewater Engineering by Metcalf and Eddy; 1991
- Biological Process Design for Wastewater Treatment by Benefield and Randall; 1980
- Biological Wastewater Treatment by Grady, Daigger and Lim; 1999
- Upgrading Existing Wastewater Treatment Plants published by the U.S. Environmental Protection Agency Technology Transfer; 1974
- Manual of Practice FD-7: Nutrient Control published by the W.E.F.; 1983
- Environmental Engineering by Peavy, Rowe and Tchobanoglaus; 1985
- Manual of Practice No. 11: Operation of Municipal Wastewater Treatment Plant (Fourth Edition) published by the W.E.F.; 1990
- Pumping Station Design (Third Edition) by Jones, Sanks, Tchobanoglaus, and Bosserman; 2006
- Manual of Practice FD-4: Design of Wastewater and Stormwater Pumping Stations published by the W.E.F.; 1993
- Manual of Practice No. 30 Biological Nutrient Removal (BNR) Operation in Wastewater Treatment Plants published by the W.E.F., ASCE, and EWRI; 2005
- Domestic Wastewater Facilities Manual (DWFM) published by the PADEP; 1997
- Federal Emergency Management Agency Flood Insurance Studies for the City of McKeesport
- Wastewater Management Fact Sheet (EPA 832-F-07-016): In-plant Wet Weather Peak Flow Management, published by the U.S. Environmental Protection Agency Office of Water; 2007
- Wastewater Management Fact Sheet (EPA 832-F-07-017): Side Stream Nutrient Removal, published by the U.S. Environmental Protection Agency Office of Water; 2007
- Municipal Authority of the City of McKeesport Five Year Capital Plan, prepared by KLH Engineers Inc.; February 2006
- EPA's Nutrient Criteria Recommendations and Their Application in Nutrient Ecoregion XI, by: Hansen and Christ; May, 2001

- Gulf Hypoxia Action Plan 2008 for Reducing Mitigating and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin, Draft Version, Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; November 2007

A

APPENDIX A

FIGURES

MAP

1

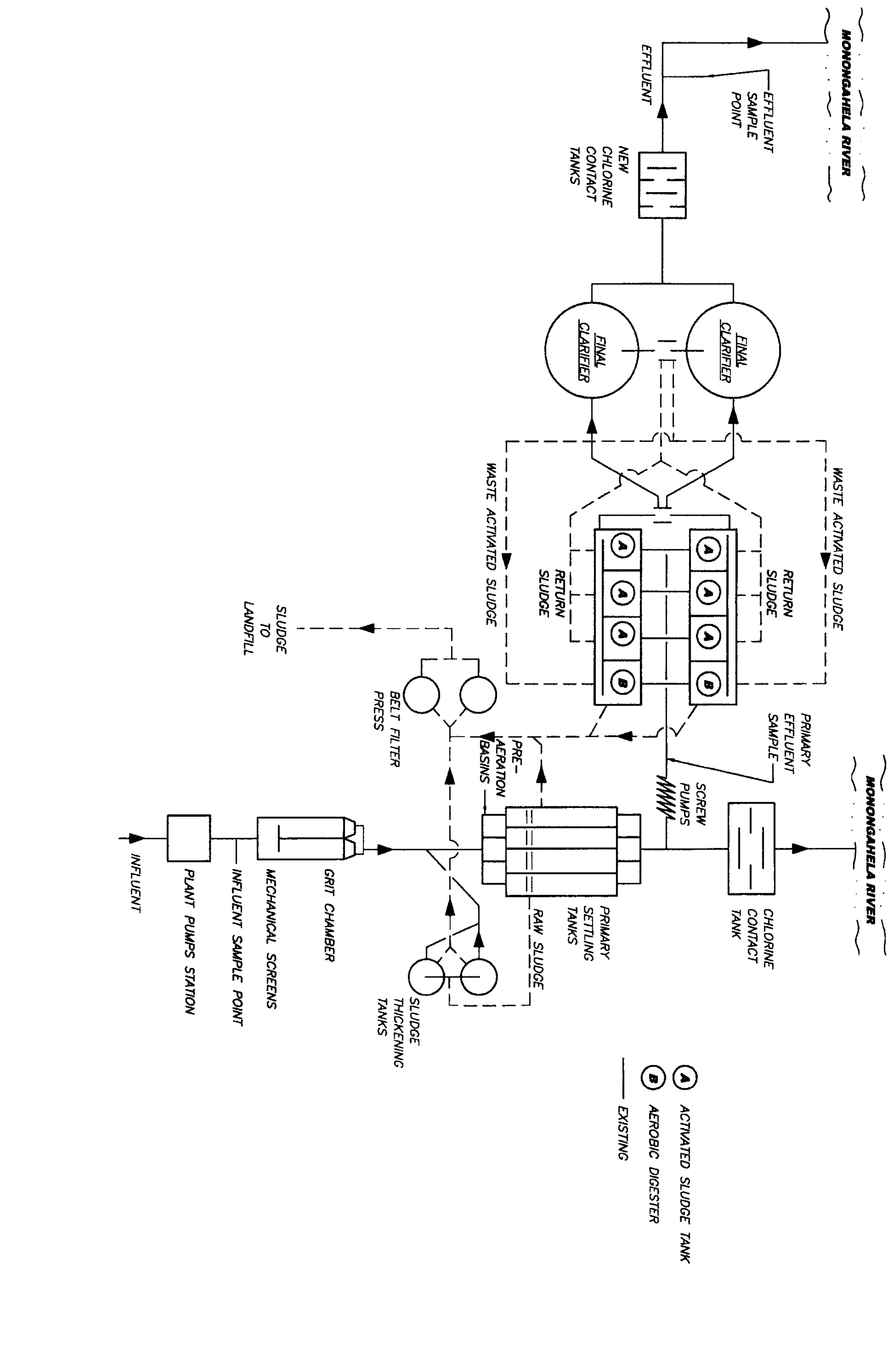
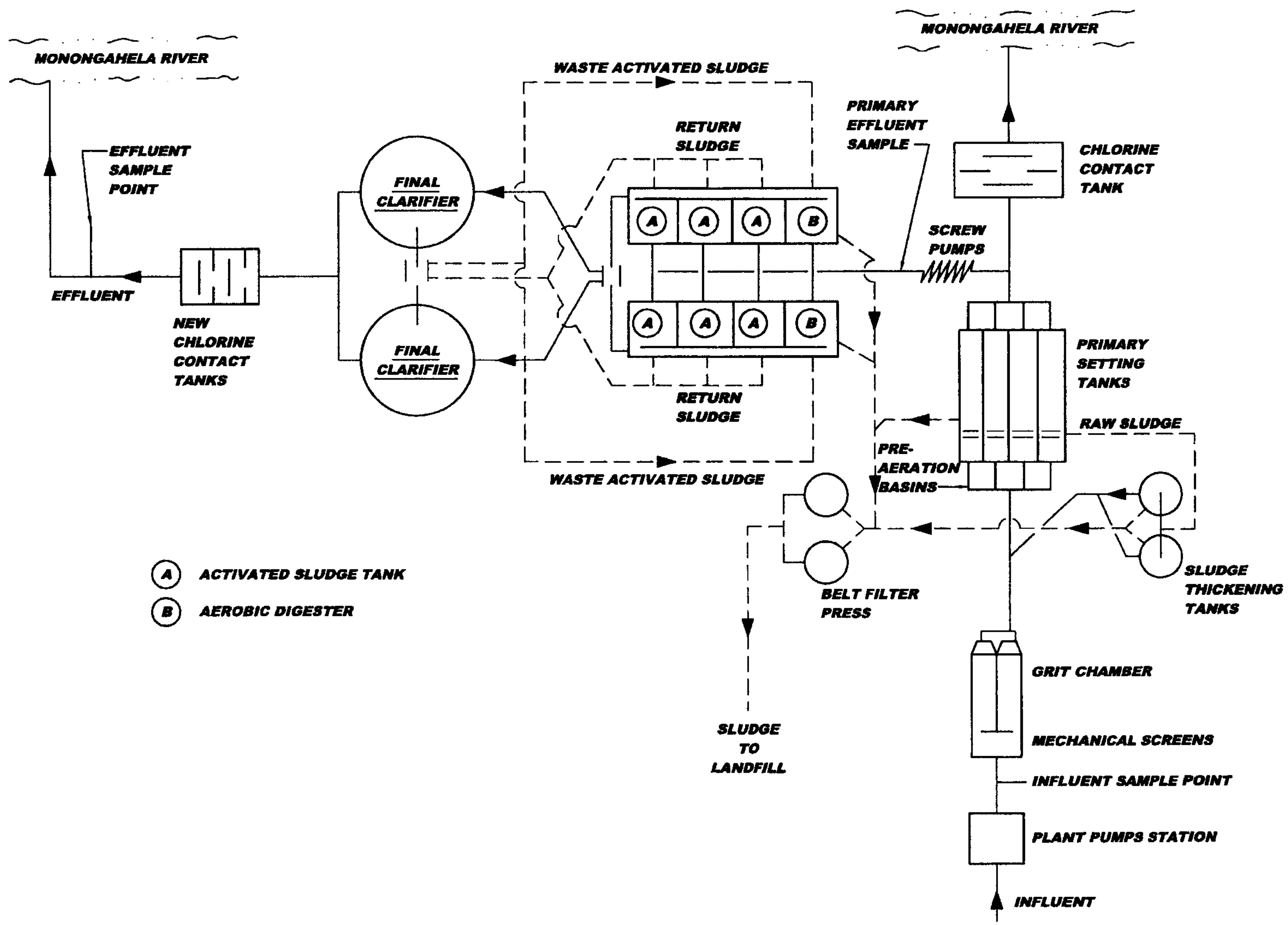


Plate No. 4-1	Sheet No. 2 of 6	Scale: As Shown Date: JAN. 2006 Drawn By: WBM Checked By: K.N. Approved By: K.N.	**MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT** **ALLEGHENY COUNTY, PENNSYLVANIA** **THE MCKEESPORT WASTEWATER TREATMENT PLANT** **PLANT FLOW DIAGRAM**	KLH ENGINEERS, INC. 5173 Campbells Run Road Pittsburgh, PA 15205 Phone: 412-494-0510 Fax: 412-494-0426 info@klhengineers.com	Date / Revisions	Date / Revisions



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Date	Revisions	Date	Revisions

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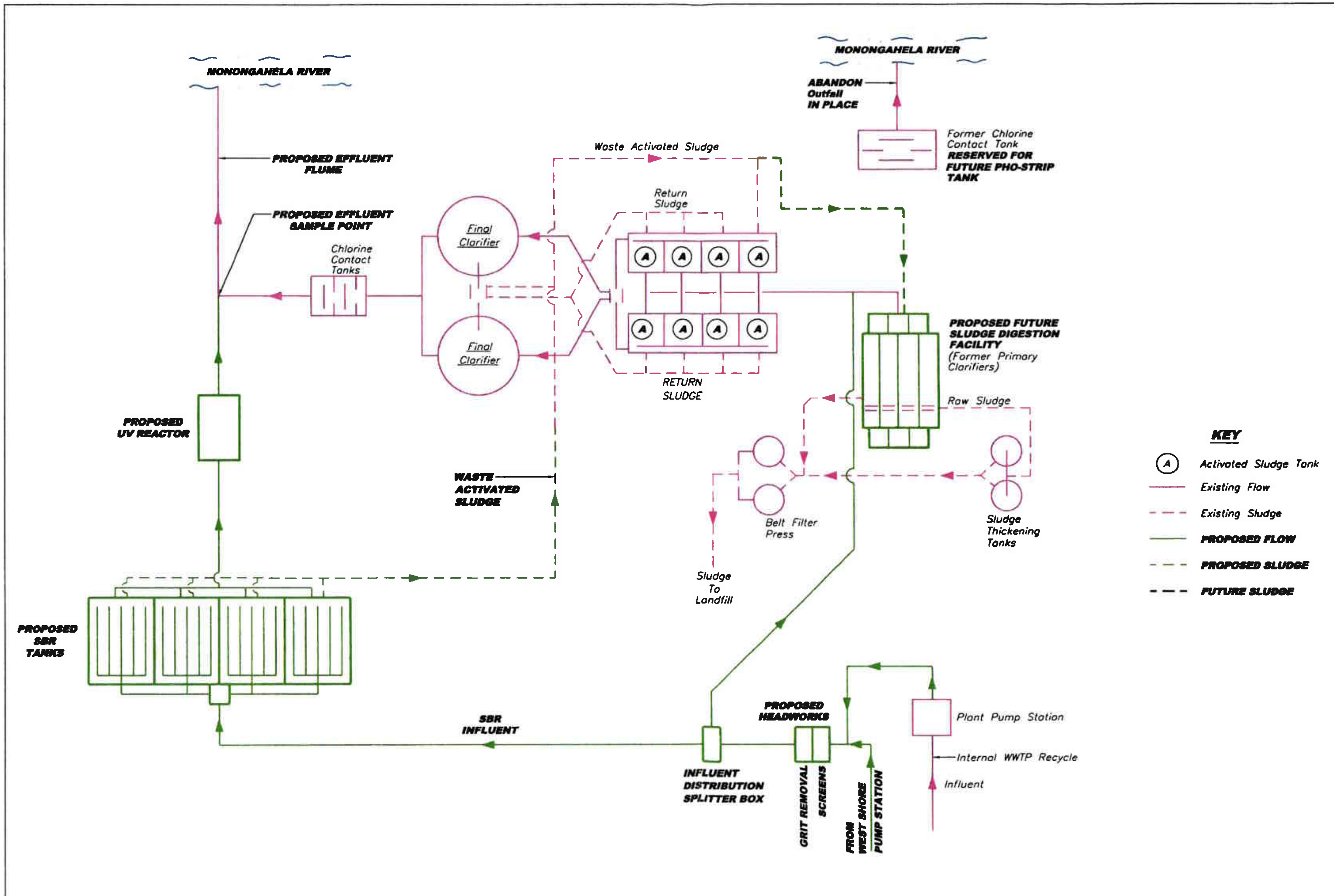
MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
EXISTING PROCESS FLOW DIAGRAM
THE MCKEESPORT WASTEWATER TREATMENT PLANT

Scale:	As Shown
Date:	JAN. 2006
Drawn By:	WBM
Checked By:	K.N.
Approved By:	K.N.

Sheet No. 3 of 6

Drawing No. 6-2



Date	Revisions	Date	Revisions

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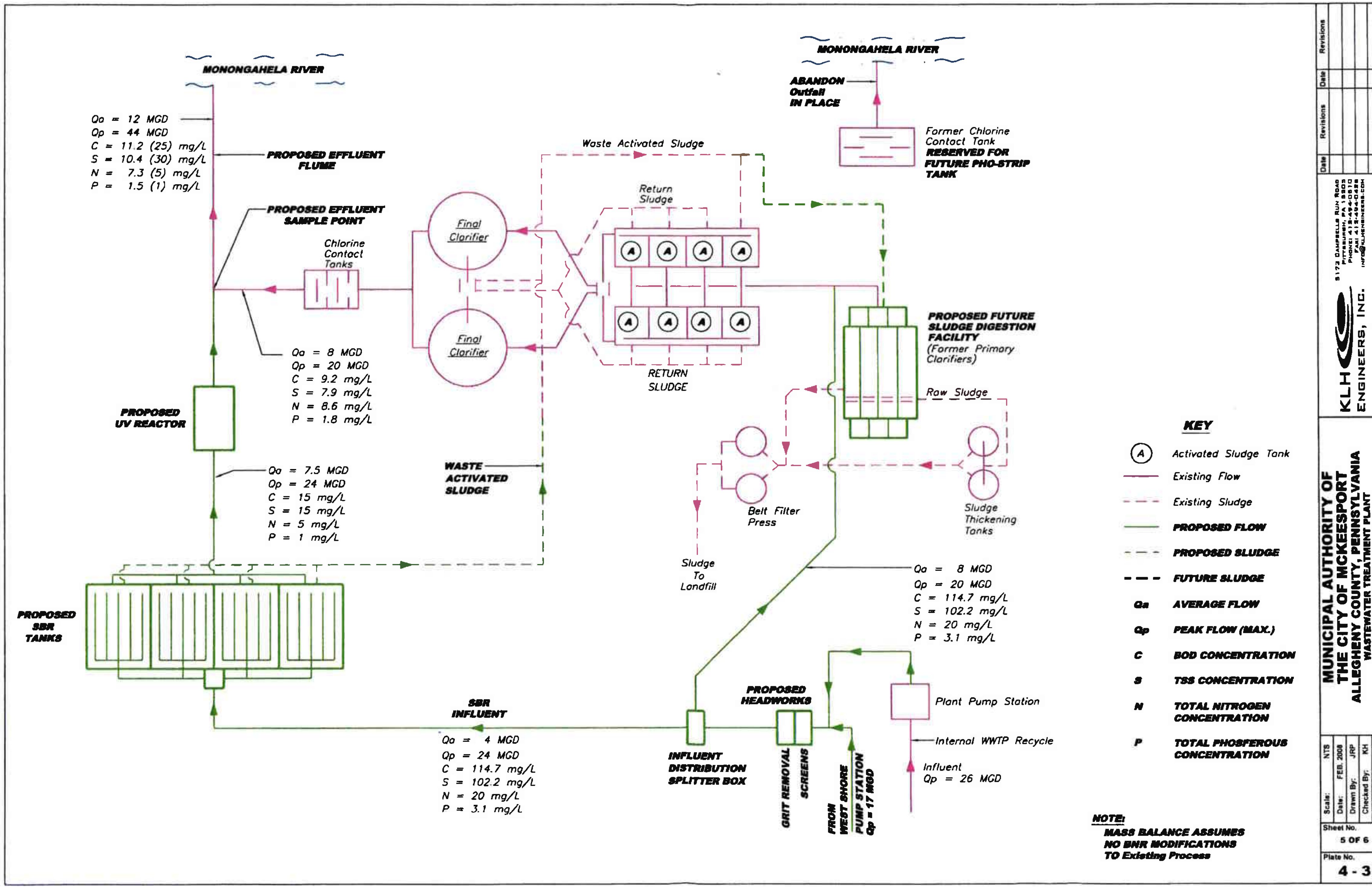
WASTEWATER TREATMENT PLANT
PROPOSED PROCESS FLOW DIAGRAM

Scale:	NTS
Date:	FEB. 2008
Drawn By:	JRP
Checked By:	KH
Approved By:	SHG

Sheet No. 4 OF 6

Plate No. **4 - 2**


MONONGAHELA RIVER
Qa = 12 MGD
Qp = 44 MGD
C = 11.2 (25) mg/L
S = 10.4 (30) mg/L
N = 7.3 (5) mg/L
P = 1.5 (1) mg/L
PROPOSED EFFLUENT FLUME
PROPOSED EFFLUENT SAMPLE POINT
Chlorine Contact Tanks
Qa = 8 MGD
Qp = 20 MGD
C = 9.2 mg/L
S = 7.9 mg/L
N = 8.6 mg/L
P = 1.8 mg/L
PROPOSED UV REACTOR
Qa = 7.5 MGD
Qp = 24 MGD
C = 15 mg/L
S = 15 mg/L
N = 5 mg/L
P = 1 mg/L
WASTE ACTIVATED SLUDGE
PROPOSED SBR TANKS
SBR INFLUENT
Qa = 4 MGD
Qp = 24 MGD
C = 114.7 mg/L
S = 102.2 mg/L
N = 20 mg/L
P = 3.1 mg/L
Final Clarifier
Final Clarifier
Waste Activated Sludge
Return Sludge
RETURN SLUDGE
MONONGAHELA RIVER
ABANDON Outfall IN PLACE
Former Chlorine Contact Tank
RESERVED FOR FUTURE PHO-STRIP TANK
PROPOSED FUTURE SLUDGE DIGESTION FACILITY
(Former Primary Clarifiers)
Raw Sludge
Belt Filter Press
Sludge Thickening Tanks
Sludge To Landfill
Qa = 8 MGD
Qp = 20 MGD
C = 114.7 mg/L
S = 102.2 mg/L
N = 20 mg/L
P = 3.1 mg/L
INFLUENT DISTRIBUTION SPLITTER BOX
PROPOSED HEADWORKS
GRIT REMOVAL
SCREENS
FROM WEST SHORE PUMP STATION Qp = 17 MGD
Plant Pump Station
Internal WWTP Recycle
Influent
Qp = 26 MGD
KEY
Activated Sludge Tank
Existing Flow
Existing Sludge
PROPOSED FLOW
PROPOSED SLUDGE
FUTURE SLUDGE
Qa AVERAGE FLOW
Qp PEAK FLOW (MAX.)
C BOD CONCENTRATION
S TSS CONCENTRATION
N TOTAL NITROGEN CONCENTRATION
P TOTAL PHOSPHEROUS CONCENTRATION
NOTE: MASS BALANCE ASSUMES NO BNR MODIFICATIONS TO Existing Process
Revisions
Date
KLH ENGINEERS, INC.
MUNICIPAL AUTHORITY OF THE CITY OF MCKEESPORT
ALLEGHENY COUNTY, PENNSYLVANIA
WASTEWATER TREATMENT PLANT
PROPOSED PROCESS FLOW DIAGRAM WITH FLOW & MASS BALANCE
Scale: NTS
Date: FEB. 2008
Drawn By: JRP
Checked By: KH
Approved By: SHG
Sheet No. 5 OF 6
Plate No. 4 - 3

MAP
2

B

APPENDIX B

COST ESTIMATES

APPENDIX B: COST ESTIMATES

The detailed estimates contained within this Appendix identify the summation of values for the various construction divisions that are consistent with the 1995 Construction Specification Institute Masterformat numbering system.

Table B-1: Long Run Interceptor Upgrade

Division		Estimated Value
1	General	$ 43,770
2	Site Work	$ 1458,120
3	Concrete	$ 0
4	Masonry	$ 0
5	Metal	$ 0
6	Woods and Plastics	$ 0
7	Thermal and Moisture Protection	$ 0
8	Doors and Windows	$ 0
9	Finishes and Coatings	$ 0
10	Specialties	$ 0
11	Equipment	$ 0
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 0
15	Mechanical	$ 0
Estimated General and Mechanical Construction Subtotal		$ 1,501,890
16	Electrical	$ 0
Estimated Construction Subtotal		**$ 1,501,890**

Table B-2: Cliff Street Pump Station

Division		Estimated Value
1	General	$ 35,370
2	Site Work	$ 101,190
3	Concrete	$ 20,160
4	Masonry	$ 16,200
5	Metal	$ 21,800
6	Woods and Plastics	$ 5,380
7	Thermal and Moisture Protection	$ 35,920
8	Doors and Windows	$ 10,740
9	Finishes and Coatings	$ 1,810
10	Specialties	$ 12,640
11	Equipment	$ 128,030
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 0
15	Mechanical	$ 42,980
Estimated General and Mechanical Construction Subtotal		$ 432,220
16	Electrical	$ 422,540
Estimated Construction Subtotal		**$ 854,760**

Table B-3: 28th Avenue Pump Station

Division		Estimated Value
1	General	$ 33,330
2	Site Work	$ 95,040
3	Concrete	$ 21,770
4	Masonry	$ 16,200
5	Metal	$ 21,800
6	Woods and Plastics	$ 5,380
7	Thermal and Moisture Protection	$ 35,920
8	Doors and Windows	$ 10,740
9	Finishes and Coatings	$ 1,810
10	Specialties	$ 12,640
11	Equipment	$ 125,930
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 0
15	Mechanical	$ 26,780
Estimated General and Mechanical Construction Subtotal		$ 407,340
16	Electrical	$ 523,720
Estimated Construction Subtotal		$ 931,060

Table B-4: Long Run Pump Station Upgrade

Division		Estimated Value
1	General	$ 83,330
2	Site Work	$ 34,670
3	Concrete	$ 98,270
4	Masonry	$ 24,370
5	Metal	$ 25,760
6	Woods and Plastics	$ 4,650
7	Thermal and Moisture Protection	$ 30,500
8	Doors and Windows	$ 10,800
9	Finishes and Coatings	$ 5,380
10	Specialties	$ 10,210
11	Equipment	$ 341,740
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 4,650
15	Mechanical	$ 144,050
Estimated General and Mechanical Construction Subtotal		$ 1,018,380
16	$ 540,730.00	$ 540,730
Estimated Construction Subtotal		**$ 1,559,110**

Table B-5: Long Run Force Main Upgrade

Division		Estimated Value
1	General	$ 218,470
2	Site Work	$ 2,571,130
3	Concrete	$ 106,990
4	Masonry	$ 0
5	Metal	$ 760
6	Woods and Plastics	$ 0
7	Thermal and Moisture Protection	$ 0
8	Doors and Windows	$ 0
9	Finishes and Coatings	$ 0
10	Specialties	$ 0
11	Equipment	$ 0
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 0
15	Mechanical	$ 52,000
Estimated General and Mechanical Construction Subtotal		$ 2,949,350
16	Electrical	$ 0
Estimated Construction Subtotal		**$ 2,949,350**

Table B-6: West Shore Pump Station Construction

Division		Estimated Value
1	General	$ 150,230
2	Site Work	$ 350,080
3	Concrete	$ 35,940
4	Masonry	$ 50,460
5	Metal	$ 142,290
6	Woods and Plastics	$ 0
7	Thermal and Moisture Protection	$ 8,470
8	Doors and Windows	$ 10,620
9	Finishes and Coatings	$ 37,360
10	Specialties	$ 5,800
11	Equipment	$ 461,180
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 14,720
15	Mechanical	$ 268,820
Estimated General and Mechanical Construction Subtotal		$ 1,835,970
16	Electrical	$ 572,720
Estimated Construction Subtotal		**$ 2,600,830**

Table B-7: West Shore Force Main Construction

Division		Estimated Value
1	General	$ 138,380
2	Site Work	$ 1,617,940
3	Concrete	$ 52,300
4	Masonry	$ 0
5	Metal	$ 2,290
6	Woods and Plastics	$ 0
7	Thermal and Moisture Protection	$ 0
8	Doors and Windows	$ 0
9	Finishes and Coatings	$ 0
10	Specialties	$ 0
11	Equipment	$ 0
12	Furnishings	$ 0
13	Special Construction	$ 0
14	Conveying Systems	$ 0
15	Mechanical	$ 57,200
Estimated General and Mechanical Construction Subtotal		$ 1,868,110
16	Electrical	$ 0
Estimated Construction Subtotal		**$ 1,868,110**

Table B-8: Upper Long Run Pump Station Construction

Division		Estimated Value
1	General	$ 71,980
2	Site Work	$ 203,230
3	Concrete	$ 176,300
4	Masonry	$ 50,440
5	Metal	$ 24,630
6	Woods and Plastics	$ 4,860
7	Thermal and Moisture Protection	$ 32,970
8	Doors and Windows	$ 9,000
9	Finishes and Coatings	$ 8,350
10	Specialties	$ 37,390
11	Equipment	$ 152,970
12	Furnishings	$ 0
13	Special Construction	$ 20,040
14	Conveying Systems	$ 15,030
15	Mechanical	$ 72,430
Estimated General and Mechanical Construction Subtotal		$ 879,620
16	Electrical	$ 387,400
Estimated Construction Subtotal		$ 1,267,020

Table B-9: Wastewater Treatme

Division		Headworks	Existing Pump Station	Splitter Box	SBR System	UV System	Effluent Flume
2	Site Work	$57,110	$41,450	$7,820	$869,080	$15,450	$50,460
3	Concrete	$759,760	$22,870	$75,160	$2,177,420	$55,640	$161,990
4	Masonry	$217,480	$22,640	$0	$0	$0	$0
5	Metal	$234,580	$26,040	$12,250	$347,820.00	$10,450	$5,350
6	Woods and Plastics	$0	$7,350	$0	$0	$0	$430
7	Thermal and Moisture Protection	$20,010	$52,090	$0	$0	$0	$0
8	Doors and Windows	$27,050	$12,350	$0	$0	$0	$0
9	Finishes and Coatings	$17,660	$2,700	$0	$0	$0	$0
10	Specialties	$59,070	$24,080	$1,050	$0	$0	$0
11	Equipment	$1,303,970	$335,840	$0	$1,986,480	$532,050	$0
12	Furnishings	$0	$0	$0	$0	$0	$0
13	Special Construction	$0	$0	$0	$0	$0	$0
14	Conveying Systems	$11,970	$0	$0	$4,060	$0	$0
15	Mechanical	$371,450	$117,780	$260,740	$364,950	$0	$0
Estimated Totals		$3,080,110	$665,190	$357,020	$5,749,810	$602,360	$218,230

Table B-1: Wastewater T

Division	
1	General
2-15	Reference Table B-9
16	Electrical
	Estimated Construction Subtot

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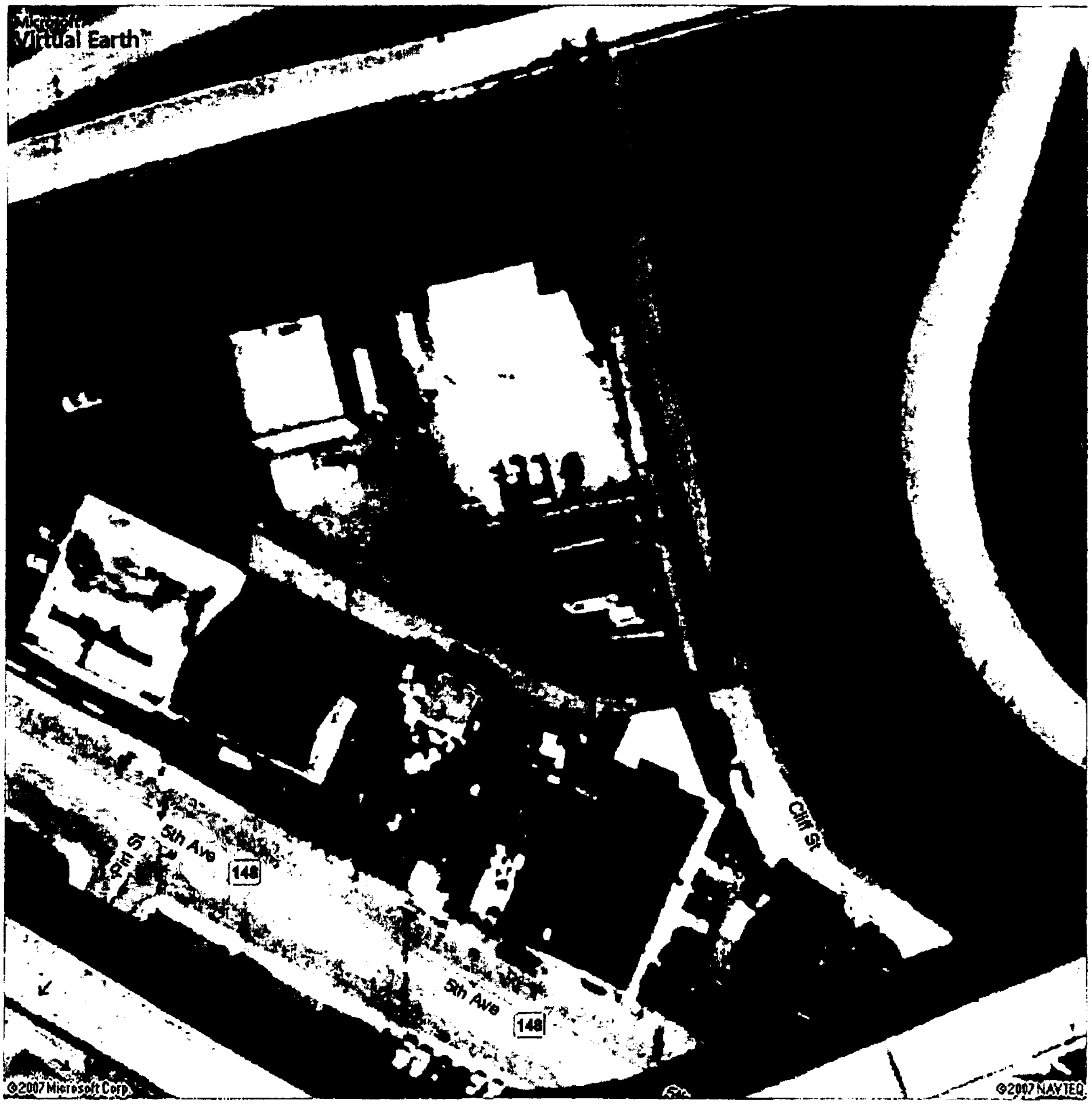
APPENDIX C

PUMP STATIONS, PUMP CURVES AND CATALOG CUTS

Live Search Maps



MACM: Cliff Street Pump Station
Side-by-Side Pump Comparison

Required Duty Point 5,200 gpm at 112 feet TDH
Required Duty Point per Pump 2,600 gpm at 112 feet TDH

Manufacturer (Model)	Flygt	Wilo - EMU	Yeomans Chicago	Yeomans Chicago
Type of Pump	Dry Pit Submersible	Dry Pit Submersible	Dry Pit Submersible	Verticle Shaft
Number of Pumps	3 Total - 2 Operating	3 Total - 2 Operating	3 Total - 2 Operating	3 Total - 2 Operating
Model	CT 3306/705 HT	FA 20.78D	No Option Avaialble	8518-4B
Mfr. Curve No.	63-466-00-0150		No Option Avaialble	40091A
Impeller Type	N- Series	GGG40.3	No Option Avaialble	Y-5058
No. of Impeller Vanes	2	3	No Option Avaialble	????
Impeller Diameter, in. (mm)	16.93 (430)	17.7	No Option Avaialble	17.25
Max. Impeller Dia. in. (mm)	17.32 (440)	19.3	No Option Avaialble	18
Percentage of Max Impeller	97.7%	91.7%	No Option Avaialble	95.8%
Nearest Duty Point	2,604 gpm at 117 feet TDH	2,600 gpm at 112 feet TDH	No Option Avaialble	2,600 gpm at 112 feet TDH
Best Efficiency Point	5,786 gpm at 77.3 feet TDH	3,350 gpm at 95 feet TDH	No Option Avaialble	2,901 gpm at 105 feet TDH
Rated Horsepower[2]	150	135	No Option Avaialble	91
Motor Horspower	150	150	>125 HP	125
Pump Speed[2]	1185	1140 rpm	No Option Avaialble	1200 rpm
Pump Efficiency[2]	59.9%	73.8%	No Option Avaialble	81.0%
NPSHr	19.4	17.9	No Option Avaialble	15.8
Power Requirement	460 Volt, 3 Phase, 60 Hz	460 Volt, 3 Phase, 60 Hz	No Option Avaialble	460 Volt, 3 Phase, 60 Hz
Solids Capability	4.1" diameter	????	No Option Avaialble	5" diameter
Suction	14" diameter	10" diameter	No Option Avaialble	8" diameter
Discharge	12" diameter	8" diameter	No Option Avaialble	8" diameter
Front to Back Dimension (in)	41.375	37.3125	No Option Avaialble	33
Base Width (in)	39	31.5	No Option Avaialble	30
Height - Suction CL to Top (in)	96	89.6875	No Option Avaialble	52.375
Weight, lb.	3530	2965.2	No Option Avaialble	1520
Estimate Budget Price[3]	$60,267	$50,740	No Option Avaialble	$42,153

1. All series data is total for the pumping system as one entity.
2. At duty point.
3. Cost per pump determined from manufacturer representative quotes.

OVERALL SELECTION - YEOMANS VERT. SHAFT

DRY PIT SUBMERSIBLE SELECTION - WILO - EMU

Pipe Diameter	Pipe Length	Inlet	Valves	Check Valve	90	45	Side of Tee	Run of Tee	Increaser	Outlet	Equivilent Length
2											0
4											0
6											0
8											0
10											0
12											0
14											0
16											0
18	1377.5				3	2.75					1573.25
20											0
22											0
24											0
30											0
36											0
42											0
48											0

Pipe 1573.25

Pipe Diameter	Pipe Length	Inlet	Valves	Check Valve	90	45	Side of Tee	Run of Tee	Increaser	Outlet	Equivilent Length
2											0
4											0
6											0
8											0
10					1				2		56
12	11		1	1	2						161.7
14											0
16											0
18	24.75				3			2			226.75
20											0
22											0
24											0
30											0
36											0
42											0
48											0

Pipe 444.45

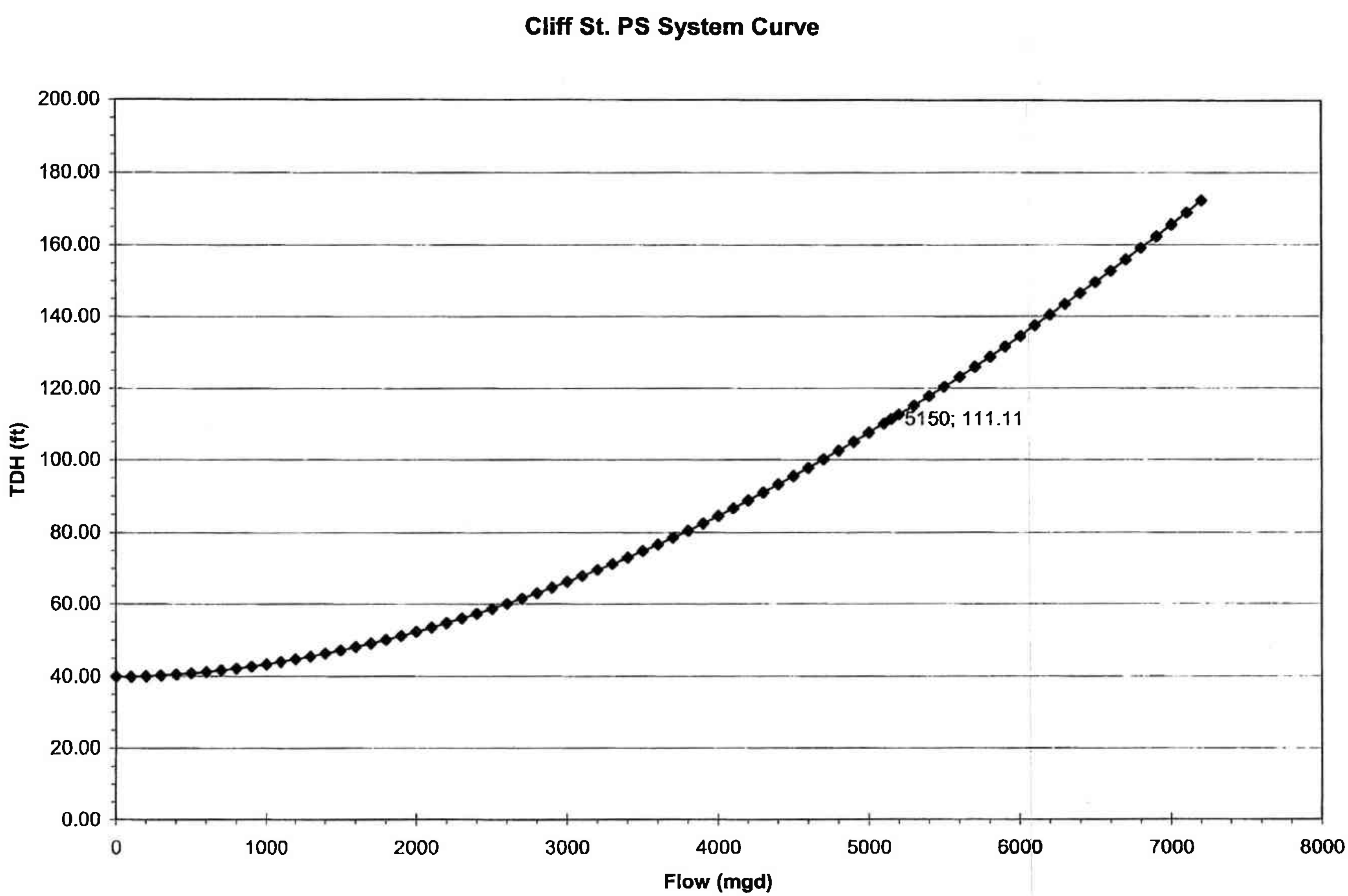
PUMP SELECTION CALCUATION

Client: MACM
Pump Station: Cliff Street Pump Station

Pipe Diameter	18	in
Length of Pipe	[redacted]	ft
Friction Factor "C"	80	
Pump Suction El	713.65	ft
Pump Discharge El	753.5	ft
Static Head	39.85	ft
Flow Rate Increment	100	GPM
Design Pump rate	7.42	MGD
Design Pump rate	5153	GPM
Velocity	6.50	ft/sec
V^2/2g	0.66	ft/sec
Friction Headloss	28.48	ft
TDH Required	[redacted]	ft

8	10	12	18
[redacted]			
80	80	80	80

Flow Rate GPM	Velocity ft/sec	18 V^2/2g ft/sec	Friction Headloss Ft	Velocity ft/sec	8 V^2/2g ft/sec	Friction Headloss Ft	Velocity ft/sec	10 V^2/2g ft/sec	Friction Headloss Ft	Velocity ft/sec	12 V^2/2g ft/sec	Friction Headloss Ft	Velocity ft/sec	18 V^2/2g ft/sec	Friction Headloss Ft	Total Friction Headloss	Total Dynamic Headloss Ft
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	39.85
100	0.13	0.00	0.02	0.64	0.01	0.00	0.41	0.00	0.01	0.28	0.00	0.01	0.13	0.00	0.00	0.05	39.90
200	0.25	0.00	0.07	1.28	0.03	0.00	0.82	0.01	0.04	0.57	0.00	0.05	0.25	0.00	0.01	0.17	40.02
300	0.38	0.00	0.15	1.91	0.06	0.00	1.23	0.02	0.09	0.85	0.01	0.11	0.38	0.00	0.02	0.37	40.22
400	0.50	0.00	0.25	2.55	0.10	0.00	1.63	0.04	0.16	1.13	0.02	0.19	0.50	0.00	0.04	0.63	40.48
500	0.63	0.01	0.38	3.19	0.16	0.00	2.04	0.06	0.24	1.42	0.03	0.28	0.63	0.01	0.05	0.95	40.80
600	0.76	0.01	0.53	3.83	0.23	0.00	2.45	0.09	0.33	1.70	0.04	0.39	0.76	0.01	0.08	1.34	41.19
700	0.88	0.01	0.71	4.47	0.31	0.00	2.86	0.13	0.44	1.99	0.06	0.52	0.88	0.01	0.10	1.78	41.63
800	1.01	0.02	0.91	5.11	0.40	0.00	3.27	0.17	0.56	2.27	0.08	0.67	1.01	0.02	0.13	2.27	42.12
900	1.13	0.02	1.13	5.74	0.51	0.00	3.68	0.21	0.70	2.55	0.10	0.83	1.13	0.02	0.16	2.83	42.68
1000	1.26	0.02	1.37	6.38	0.63	0.00	4.08	0.26	0.85	2.84	0.12	1.01	1.26	0.02	0.20	3.44	43.29
1100	1.39	0.03	1.64	7.02	0.77	0.00	4.49	0.31	1.02	3.12	0.15	1.21	1.39	0.03	0.24	4.10	43.95
1200	1.51	0.04	1.92	7.66	0.91	0.00	4.90	0.37	1.19	3.40	0.18	1.42	1.51	0.04	0.28	4.81	44.66
1300	1.64	0.04	2.23	8.30	1.07	0.00	5.31	0.44	1.39	3.69	0.21	1.65	1.64	0.04	0.32	5.58	45.43
1400	1.77	0.05	2.56	8.94	1.24	0.00	5.72	0.51	1.59	3.97	0.24	1.89	1.77	0.05	0.37	6.40	46.25
1500	1.89	0.06	2.90	9.57	1.42	0.00	6.13	0.58	1.80	4.26	0.28	2.15	1.89	0.06	0.42	7.27	47.12
1600	2.02	0.06	3.27	10.21	1.62	0.00	6.54	0.66	2.03	4.54	0.32	2.42	2.02	0.06	0.47	8.20	48.05
1700	2.14	0.07	3.66	10.85	1.83	0.00	6.94	0.75	2.28	4.82	0.36	2.71	2.14	0.07	0.53	9.17	49.02
1800	2.27	0.08	4.07	11.49	2.05	0.00	7.35	0.84	2.53	5.11	0.40	3.01	2.27	0.08	0.59	10.19	50.04
1900	2.40	0.09	4.50	12.13	2.28	0.00	7.76	0.94	2.79	5.39	0.45	3.32	2.40	0.09	0.65	11.26	51.11
2000	2.52	0.10	4.94	12.77	2.53	0.00	8.17	1.04	3.07	5.67	0.50	3.65	2.52	0.10	0.71	12.39	52.24
2100	2.65	0.11	5.41	13.40	2.79	0.00	8.58	1.14	3.36	5.96	0.55	4.00	2.65	0.11	0.78	13.56	53.41
2200	2.77	0.12	5.90	14.04	3.06	0.00	8.99	1.25	3.67	6.24	0.60	4.36	2.77	0.12	0.85	14.77	54.62
2300	2.90	0.13	6.40	14.68	3.35	0.00	9.40	1.37	3.98	6.52	0.66	4.73	2.90	0.13	0.92	16.04	55.89
2400	3.03	0.14	6.93	15.32	3.64	0.00	9.80	1.49	4.31	6.81	0.72	5.12	3.03	0.14	1.00	17.35	57.20
2500	3.15	0.15	7.47	15.96	3.95	0.00	10.21	1.62	4.64	7.09	0.78	5.52	3.15	0.15	1.08	18.72	58.57
2600	3.28	0.17	8.03	16.60	4.28	0.00	10.62	1.75	4.99	7.38	0.84	5.94	3.28	0.17	1.16	20.12	59.97
2700	3.40	0.18	8.62	17.23	4.61	0.00	11.03	1.89	5.35	7.66	0.91	6.37	3.40	0.18	1.24	21.58	61.43
2800	3.53	0.19	9.22	17.87	4.96	0.00	11.44	2.03	5.73	7.94	0.98	6.81	3.53	0.19	1.33	23.08	62.93
2900	3.66	0.21	9.83	18.51	5.32	0.00	11.85	2.18	6.11	8.23	1.05	7.27	3.66	0.21	1.42	24.63	64.48
3000	3.78	0.22	10.47	19.15	5.69	0.00	12.25	2.33	6.51	8.51	1.12	7.74	3.78	0.22	1.51	26.22	66.07
3100	3.91	0.24	11.12	19.79	6.08	0.00	12.66	2.49	6.91	8.79	1.20	8.22	3.91	0.24	1.60	27.86	67.71
3200	4.03	0.25	11.80	20.42	6.48	0.00	13.07	2.65	7.33	9.08	1.28	8.72	4.03	0.25	1.70	29.55	69.40
3300	4.16	0.27	12.49	21.06	6.89	0.00	13.48	2.82	7.76	9.36	1.36	9.23	4.16	0.27	1.80	31.28	71.13
3400	4.29	0.29	13.20	21.70	7.31	0.00	13.89	3.00	8.20	9.65	1.44	9.75	4.29	0.29	1.90	33.06	72.91
3500	4.41	0.30	13.92	22.34	7.75	0.00	14.30	3.17	8.65	9.93	1.53	10.29	4.41	0.30	2.01	34.88	74.73
3600	4.54	0.32	14.67	22.98	8.20	0.00	14.71	3.36	9.12	10.21	1.62	10.84	4.54	0.32	2.11	36.74	76.59
3700	4.66	0.34	15.43	23.62	8.66	0.00	15.11	3.55	9.59	10.50	1.71	11.41	4.66	0.34	2.22	38.65	78.50
3800	4.79	0.36	16.21	24.25	9.13	0.00	15.52	3.74	10.08	10.78	1.80	11.98	4.79	0.36	2.34	40.61	80.46
3900	4.92	0.38	17.01	24.89	9.62	0.00	15.93	3.94	10.57	11.06	1.90	12.57	4.92	0.38	2.45	42.61	82.46
4000	5.04	0.39	17.83	25.53	10.12	0.00	16.34	4.15	11.08	11.35	2.00	13.17	5.04	0.39	2.57	44.65	84.50
4100	5.17	0.41	18.66	26.17	10.63	0.00	16.75	4.36	11.60	11.63	2.10	13.79	5.17	0.41	2.69	46.74	86.59
4200	5.30	0.44	19.51	26.81	11.16	0.00	17.16	4.57	12.13	11.91	2.20	14.42	5.30	0.44	2.81	48.87	88.72
4300	5.42	0.46	20.38	27.45	11.70	0.00	17.57	4.79	12.66	12.20	2.31	15.06	5.42	0.46	2.94	51.04	90.89
4400	5.55	0.48	21.26	28.08	12.25	0.00	17.97	5.02	13.21	12.48	2.42	15.72	5.55	0.48	3.06	53.26	93.11
4500	5.67	0.50	22.17	28.72	12.81	0.00	18.38	5.25	13.78	12.77	2.53	16.38	5.67	0.50	3.19	55.52	95.37
4600	5.80	0.52	23.09	29.36	13.39	0.00	18.79	5.48	14.35	13.05	2.64	17.06	5.80	0.52	3.33	57.82	97.67
4700	5.93	0.55	24.02	30.00	13.97	0.00	19.20	5.72	14.93	13.33	2.76	17.75	5.93	0.55	3.46	60.17	100.02
4800	6.05	0.57	24.98	30.64	14.58	0.00	19.61	5.97	15.52	13.62	2.88	18.46	6.05	0.57	3.60	62.56	102.41
4900	6.18	0.59	25.95	31.28	15.19	0.00	20.02	6.22	16.13	13.90	3.00	19.18	6.18	0.59	3.74	64.99	104.84
5000	6.30	0.62	26.94	31.91	15.82	0.00	20.42	6.48	16.74	14.18	3.12	19.91	6.30	0.62	3.88	67.47	107.32
5100	6.43	0.64	27.94	32.55	16.45	0,00	20.83	6.74	17.37	14.47	3.25	20.63	6.43	0.64	4.03	69.99	109.84
5150	6.49	0.65	28.45	32.87	16.78	0.00	21.04	6.87	17.68	14.61	3.31	21.03	6.49	0.65	4.10	71.26	111.11
5200	6.56	0.67	28.96	33.19	17.11	0.00	21.24	7.01	18.00	14.75	3.38	21.41	6.56	0.67	4.17	72.55	112.40
5300	6.68	0.69	30.00	33.83	17.77	0.00	21.65	7.28	18.65	15.03	3.51	22.17	6.68	0.69	4.32	75.15	115.00
5400	6.81	0.72	31.06	34.47	18.45	0.00	22.06	7.56	19.30	15.32	3.64	22.95	6.81	0.72	4.48	77.79	117.64
5500	6.93	0.75	32.13	35.11	19.14	0.00	22.47	7.84	19.97	15.60	3.78	23.75	6.93	0.75	4.63	80.48	120.33
5600	7.06	0.77	33.22	35.74	19.84	0.00	22.88	8.13	20.65	15.89	3.92	24.55	7.06	0.77	4.79	83.21	123.06
5700	7.19	0.80	34.33	36.38	20.55	0.00	23.28	8.42	21.33	16.17	4.06	25.37	7.19	0.80	4.95	85.97	125.82
5800	7.31	0.83	35.45	37.02	21.28	0.00	23.69	8.72	22.03	16.45	4.20	26.20	7.31	0.83	5.11	88.79	128.64
5900	7.44	0.86	36.59	37.66	22.02	0.00	24.10	9.02	22.74	16.74	4.35	27.04	7.44	0.86	5.27	91.64	131.49
6000	7.56	0.89	37.74	38.30	22.77	0.00	24.51	9.33	23.46	17.02	4.50	27.89	7.56	0.89	5.44	94.53	134.38
6100	7.69	0.92	38.91	38.93	23.54	0.00	24.92	9.64	24.18	17.30	4.65	28.76	7.69	0.92	5.61	97.47	137.32
6200	7.82	0.95	40.10	39.57	24.32	0.00	25.33	9.96	24.92	17.59	4.80	29.64	7.82	0.95	5.78	100.44	140.29
6300	7.94	0.98	41.31	40.21	25.11	0.00	25.74	10.28	25.67	17.87	4.96	30.53	7.94	0.98	5.95	103.46	143.31
6400	8.07	1.01	42.53	40.85	25.91	0.00	26.14	10.61	26.43	18.16	5.12	31.43	8.07	1.01	6.13	106.52	146.37
6500	8.20	1.04	43.77	41.49	26.73	0.00	26.55	10.95	27.20	18.44	5.28	32.35	8.20	1.04	6.31	109.62	149.47
6600	8.32	1.08	45.02	42.13	27.56	0.00	26.96	11.29	27.98	18.72	5.44	33.27	8.32	1.08	6.49	112.76	152.61
6700	8.45	1.11	46.29	42.76	28.40	0.00	27.37	11.63	28.77	19.01	5.61	34.21	8.45	1.11	6.67	115.94	155.79
6800	8.57	1.14	47.58	43.40	29.25	0.00	27.78	11.98	29.57	19.29	5.78	35.16	8.57	1.14	6.86	119.16	159.01
6900	8.70	1.18	48.88	44.04	30.12	0.00	28.19	12.34	30.38	19.57	5.95	36.13	8.70	1.18	7.04	122.43	162.28
7000	8.83	1.21	50.20	44.68	31.00	0.00	28.59	12.70	31.20	19.86	6.12	37.10	8.83	1.21	7.23	125.73	165.58
7100	8.95	1.24	51.53	45.32	31.89	0.00	29.00	13.06	32.03	20.14	6.30	38.09	8.95	1.24	7.43	129.07	168.92
7200	9.08	1.28	52.88	45.96	32.79	0.00	29.41	13.43	32.87	20.42	6.48	39.08	9.08	1.28	7.62	132.45	172.30



Cliff Street Pump Station Design.XLS
Cliff St. System Curve

10/3/2007

Kevin Hoffman

From: Mark Robinson [mrobinson@daman-superiorllc.net]
Sent: Tuesday, October 30, 2007 3:51 PM
To: Kevin Hoffman
Subject: MACM Pump Station
Attachments: mckeesport.pdf; mck2.pdf

Kevin,
Following is pricing on the Vertical Shafted Yeoman's pumps. I also attached a basic spec and drawing.

Cliff Street: 8518-4B/4A with 125 hp TEFC, 1200 RPM, 460/3/60
motor..$28,760.00 (wt. – 3035#)
SAME but with Explosion Proof
motor..$29,287.00 (wt. – 3770#)

Adder Options: Mechanical Seal..............................$1,020.00
SS Impeller or Case Wear Ring...........$598.00 Each
Non-Witnessed Performance Test.........$1,218.00

28th Avenue: 6317LC-4BHT with 200 hp, TEFC, 1800 rpm, 460/3/60
motor...$29,196.00 (wt. – 2840#)
SAME but with Explosion Proof
motor..$30,048.00 (wt. – 3575#)

Adder Options: Same as above.

Note; I have not quoted the shafting at this point, I am waiting for Yeoman's quote because they go to an outside vendor.

Please let me know if you require any additional information.

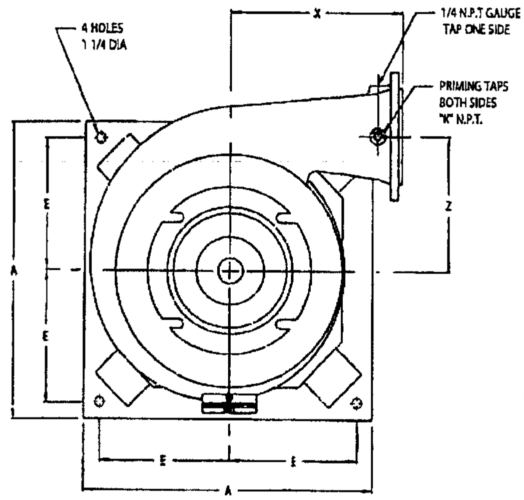
Best regards,
Mark

YEOMANS

SERIES 6250

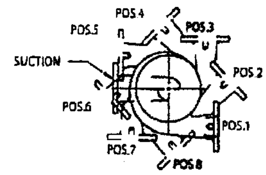
VERTICAL LINE-SHAFT SOLIDS-HANDLING PUMPS

OUTLINE DWG #	102900	
S.O.		
JOB:		
ISSUE	REVISION	DATE

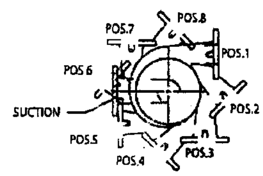


RELATIVE POSITION OF SUCTION AND DISCHARGE (AS VIEWED FROM THE MOTOR END)

LEFT HAND ROTATION



RIGHT HAND ROTATION



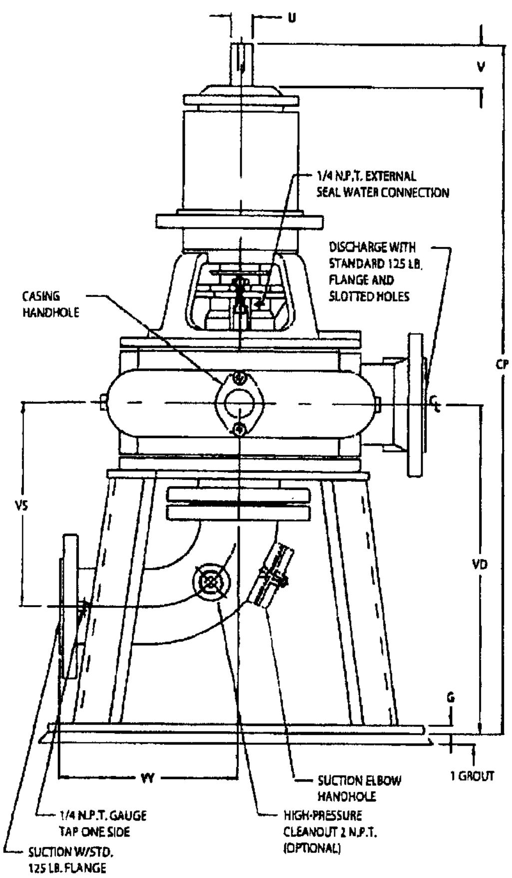
NOTE: DISCHARGE IN POSITION NO.1 FURNISHED AS STANDARD. OTHER POSITIONS AVAILABLE FROM FACTORY WHEN SPECIFIED.

LIST OF EQUIPMENT FURNISHED:

___ Model ___________________ Pump
Rated for ________ GPM at ________ Ft.TDH.
___ ________ HP, ________ RPM, ______ Volts
____ Phase, ____ Hz Vertical C-Face
Motor In ____________________ NEMA
enclosure complete with pedestal
___ ROTATION ________ POSITION # ______
___ ROTATION ________ POSITION # ______

OPTIONAL ACCESSORIES:

- ☐ Anchor Bolts
- ☐ Mechanical Seal
- ☐ Bronze or S.S. Impeller
- ☐ Bronze or S.S. Wear Rings
- ☐ 416 S.S. Pump Shaft
- ☐ Safety Guard



NOTES: 1. ALL DIMENSIONS ARE IN INCHES
2. WEIGHT IS IN POUNDS.

TABLE OF DIMENSIONS

✓	PUMP MODEL	DIS	SUC	A	E	G	K	X	Z	CP	U	KEY	V	VD	VS	WY	WEIGHT
	4317-4A/4BHT	4		30	13 3/4	5/8	1/2	13	10 1/4	61 7/8	2 1/8	5/8x5/8x3	4 1/4	27	13 1/8	14	1175
	4317-4A/4BHT		8														
	6315-4A/4BHT	6	6	24	10 3/4	1/2		16	11	60				26	16 7/8	14	1160
	6315-4A/4BHT		8														
✓	6317-4A/4BHT	6	8	30	13 3/4	5/8		17	11 3/4	62 1/4				28 3/16	17 1/2	15	1325
✓	6317-4A/4BHT		10												18 1/2	16	
	8317-4A/4BHT	8	8	30	13 3/4	5/8		17	11 3/4	62 1/4				28 3/16	17 1/2	15	1325
	8317-4A/4BHT		10												18 1/2	16	
	8417-4A	8	8	30	13 3/4	5/8		18	13	63 1/8				28 3/4	18	15	1520
	8417-4A		10												19	16	
	8515-4A	8	8	30	13 3/4	5/8		16 1/2	11 9/16	63 1/8				28 1/4	18	15	1420
	8515-4A		10												19	16	
✓	8518-4A/4B	8	8	30	13 3/4	5/8		18	13	63 1/8				28 3/4	18	15	1520
✓	8518-4A/4B		10												19	16	
	10522-4B	10	10	38	16 1/2	1	3/4	22	17	75 1/8				39 7/8	21 11/16	18	3500
	10522-4B		12												22 11/16	20	
	10522-5/6	10	10	38	16 1/2	1		22	17	84	2 7/8	3/4x3/4x5	6 1/4	39 7/8	21 11/16	18	3590
	10522-5/6		12												22 11/16	20	
	12515-4A	12	12	38	16 1/2	1		15 1/2	12	69	2 3/8	5/8x5/8x3	4 1/4	33 1/2	22	20	1760
	12622-4B	12	12	38	16 1/2	1		24	18	76 1/8				40 5/16	25 1/16	20	4500
	12622-4B		14													22	
	12622-5/6	12	12	38	16 1/2	1		24	18	84 3/4	2 7/8	3/4x3/4x5	6 1/4	40 5/16	25 1/16	20	4600
	12622-5/6		14													22	
	12624-4B	12	12	38	16 1/2	1		24	18	76 1/8	2 3/8	5/8x5/8x3	4 1/4	40 5/16	25 1/16	20	4520
	12624-4B		14													22	
	12624-5/6	12	12	38	16 1/2	1		24	18	84 3/4	2 7/8	3/4x3/4x5	6 1/4	40 5/16	25 1/16	20	4620
	12624-5/6		14													22	
	14518-4B/4BHT	14	14	38	16 1/2	1		20	18	74	2 3/8	5/8x5/8x3	4 1/4	38 1/16	24 3/16	22	4600
	14518-4B/4BHT		16												25 3/16	15	
	14620-4B	14	14	38	16 1/2	1		20	18	77 1/2	2 3/8	5/8x5/8x3	4 1/4	41 7/8	26 1/16	22	4800
	14620-5									86 1/8	2 7/8	3/4x3/4x5	6 1/4				
	16620-4B	16	14	38	16 1/2	1		22	18	77 1/2	2 3/8	5/8x5/8x3	4 1/4	41 7/8	26 1/16	22	4820
	16620-5									86 1/8	2 7/8	3/4x3/4x5	6 1/4				
	16622-5B/6B	16	18	43 1/2	20	1		22	19 1/2	97 1/4	2 7/8		6 1/4	52 1/2	32 1/2	16 1/2	4900
	16624-5B/6B	16	18	43 1/2	20	1	1	22	19 1/2	97 1/4	2 7/8		6 1/4	52 3/16	32 1/2	16 1/2	4930
	18530-6B/6BHT	18	20	48	20	1 1/4		27	22	98 5/8	2 7/8		6 1/4	53 3/16	36 3/16	18	5600
	18624-5B/6B	18	20	43 1/2	20	1		27	19 1/2	97 1/4	2 7/8		6 1/4	52 3/16	32 1/2	16 1/2	4950
	18622-5B	18	18	43 1/2	20	1		22	19 1/2	100 1/4	2 7/8		6 1/4	54 3/8	33 1/2	16 1/2	4920
	20724-6B	20	20	43 1/2	20	1		22	24	98	2 7/8		6 1/4	52 1/2	42 1/2	18	5700

Live Search Maps

MACM: 28TH aVENUE Pump Station
Side-by-Side Pump Comparison

Required Duty Point 5,520 gpm at 167 feet TDH
Required Duty Point per Pump 2,760 gpm at 167 feet TDH

Manufacturer (Model)	Flygt	Wilo - EMU	Yeomans Chicago	Yeomans Chicago
Type of Pump	Dry Pit Submersible	Dry Pit Submersible	Dry Pit Submersible	Verticle Shaft
Number of Pumps	3 Total - 2 Operating	3 Total - 2 Operating	3 Total - 2 Operating	3 Total - 2 Operating
Model	CT 3306/705 HT	FA 20.78D	No Option Avaialble	6317LC-4BHT
Mfr. Curve No.	63-466-00-0150		No Option Avaialble	3530A
Impeller Type	N- Series	GGG40.3	No Option Avaialble	Y-4704
No. of Impeller Vanes	2	3	No Option Avaialble	????
Impeller Diameter, in. (mm)	14.96 (380)	15	No Option Avaialble	15.625
Max. Impeller Dia. in. (mm)	14.96 (380)	18.5	No Option Avaialble	17
Percentage of Max Impeller	100.0%	81.1%	No Option Avaialble	91.9%
Nearest Duty Point	2,767 gpm at 168 feet TDH	2,760 gpm at 166.6 feet TDH	No Option Avaialble	2,760 gpm at 169 feet TDH
Best Efficiency Point	3,656 gpm at 141 feet TDH	3,950 gpm at 132.5 feet TDH	No Option Avaialble	2,902 gpm at 165 feet TDH
Rated Horsepower[2]	167	241	No Option Avaialble	152
Motor Horspower	175	250	>125 HP	200
Pump Speed[2]	1780	1740	No Option Avaialble	1750 rpm
Pump Efficiency[2]	70.4%	65.8%	No Option Avaialble	77.0%
NPSHr	22.4	26.3	No Option Avaialble	19.2
Power Requirement	460 Volt, 3 Phase, 60 Hz	460 Volt, 3 Phase, 60 Hz	No Option Avaialble	460 Volt, 3 Phase, 60 Hz
Solids Capability	3.5" diameter	????	No Option Avaialble	3" diameter
Suction	10" diameter	10" diameter	No Option Avaialble	8" diameter
Discharge	8" diameter	10" diameter	No Option Avaialble	6" diameter
Front to Back Dimension (in)	39	37.3125	No Option Avaialble	32
Base Width (in)	39	31.5	No Option Avaialble	30
Height - Suction CL to Top (in)	96	89.6875	No Option Avaialble	51.5625
Weight, lb.	3,155	2,965.20	No Option Avaialble	1,325
Estimate Budget Price[3]	$57,562	$79,740	No Option Avaialble	$34,048

1. All series data is total for the pumping system as one entity.
2. At duty point.
3. Cost per pump determined from manufacturer representative quotes.

OVERALL SELECTION - YEOMANS VERT. SHAFT
DRY PIT SUB. SELECTION - FLYGT

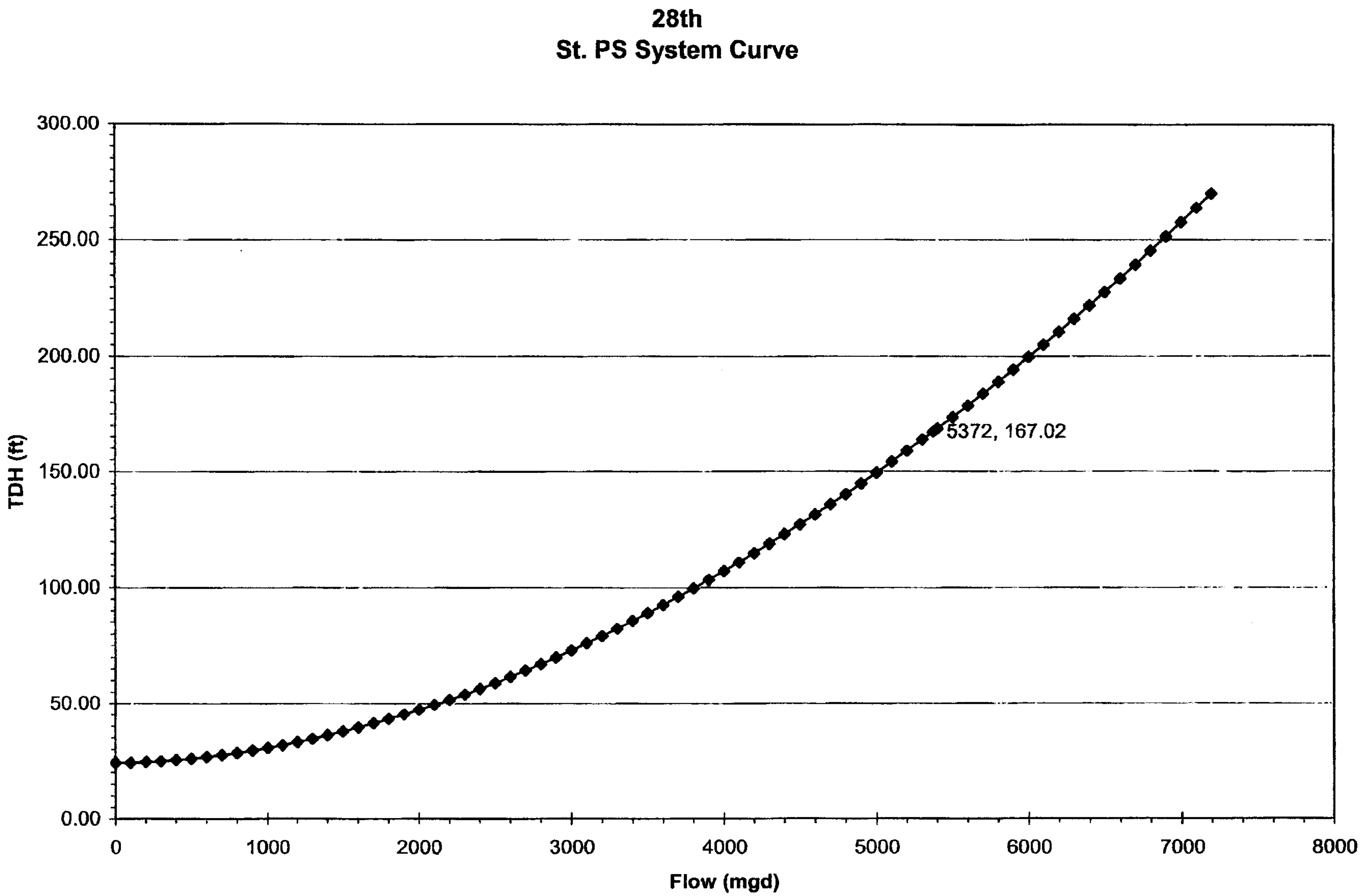
PUMP SELECTION CALCUATION

Client	MACM
Pump Station	28th Street Pump Station

Pipe Diameter	20	in
Length of Pipe	[redacted]	ft
Friction Factor "C"	80	
Pump Suction El	723.5	ft
Pump Discharge El	747.59	ft
Static Head	24.09	ft
Flow Rate Increment	100	GPM
Design Pump rate	7.74	MGD
Design Pump rate	5372	GPM
Velocity	5.49	ft/sec
V^2/2g	0.47	ft/sec
Friction Headloss	73.06	ft
TDH Required	[redacted]	ft

8	10	12	18
[redacted]			
80	80	80	80

Flow Rate GPM	20 Velocity ft/sec	20 V^2/2g ft/sec	20 Friction Headloss Ft	8 Velocity ft/sec	8 V^2/2g ft/sec	8 Friction Headloss Ft	10 Velocity ft/sec	10 V^2/2g ft/sec	10 Friction Headloss Ft	12 Velocity ft/sec	12 V^2/2g ft/sec	12 Friction Headloss Ft	18 Velocity ft/sec	18 V^2/2g ft/sec	18 Friction Headloss Ft	Total Friction Headloss	Total Dynamic Headloss Ft
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	24.09
100	0.10	0.00	0.05	0.64	0.01	0.02	0.41	0.00	0.02	0.28	0.00	0.00	0.13	0.00	0.00	0.09	24.18
200	0.20	0.00	0.17	1.28	0.03	0.06	0.82	0.01	0.09	0.57	0.00	0.01	0.25	0.00	0.00	0.32	24.41
300	0.31	0.00	0.35	1.91	0.06	0.12	1.23	0.02	0.19	0.85	0.01	0.02	0.38	0.00	0.01	0.69	24.78
400	0.41	0.00	0.60	2.55	0.10	0.20	1.63	0.04	0.32	1.13	0.02	0.04	0.50	0.00	0.02	1.17	25.26
500	0.51	0.00	0.90	3.19	0.16	0.30	2.04	0.06	0.48	1.42	0.03	0.06	0.63	0.01	0.03	1.77	25.86
600	0.61	0.01	1.27	3.83	0.23	0.42	2.45	0.09	0.67	1.70	0.04	0.08	0.76	0.01	0.04	2.48	26.57
700	0.71	0.01	1.68	4.47	0.31	0.56	2.86	0.13	0.90	1.99	0.06	0.11	0.88	0.01	0.05	3.29	27.38
800	0.82	0.01	2.16	5.11	0.40	0.72	3.27	0.17	1.15	2.27	0.08	0.14	1.01	0.02	0.06	4.22	28.31
900	0.92	0.01	2.68	5.74	0.51	0.89	3.68	0.21	1.43	2.55	0.10	0.17	1.13	0.02	0.08	5.24	29.33
1000	1.02	0.02	3.26	6.38	0.63	1.08	4.08	0.26	1.73	2.84	0.12	0.21	1.26	0.02	0.09	6.37	30.46
1100	1.12	0.02	3.89	7.02	0.77	1.29	4.49	0.31	2.07	3.12	0.15	0.25	1.39	0.03	0.11	7.60	31.69
1200	1.23	0.02	4.57	7.66	0.91	1.52	4.90	0.37	2.43	3.40	0.18	0.29	1.51	0.04	0.13	8.93	33.02
1300	1.33	0.03	5.29	8.30	1.07	1.76	5.31	0.44	2.82	3.69	0.21	0.34	1.64	0.04	0.15	10.36	34.45
1400	1.43	0.03	6.07	8.94	1.24	2.02	5.72	0.51	3.23	3.97	0.24	0.39	1.77	0.05	0.17	11.88	35.97
1500	1.53	0.04	6.90	9.57	1.42	2.29	6.13	0.58	3.67	4.26	0.28	0.44	1.89	0.06	0.20	13.49	37.58
1600	1.63	0.04	7.77	10.21	1.62	2.58	6.54	0.66	4.14	4.54	0.32	0.49	2.02	0.06	0.22	15.21	39.30
1700	1.74	0.05	8.70	10.85	1.83	2.89	6.94	0.75	4.63	4.82	0.36	0.55	2.14	0.07	0.25	17.01	41.10
1800	1.84	0.05	9.67	11.49	2.05	3.21	7.35	0.84	5.14	5.11	0.40	0.61	2.27	0.08	0.27	18.91	43.00
1900	1.94	0.06	10.68	12.13	2.28	3.55	7.76	0.94	5.68	5.39	0.45	0.68	2.40	0.09	0.30	20.90	44.99
2000	2.04	0.06	11.75	12.77	2.53	3.90	8.17	1.04	6.25	5.67	0.50	0.75	2.52	0.10	0.33	22.98	47.07
2100	2.14	0.07	12.86	13.40	2.79	4.27	8.58	1.14	6.84	5.96	0.55	0.82	2.65	0.11	0.36	25.15	49.24
2200	2.25	0.08	14.01	14.04	3.06	4.65	8.99	1.25	7.46	6.24	0.60	0.89	2.77	0.12	0.40	27.41	51.50
2300	2.35	0.09	15.21	14.68	3.35	5.05	9.40	1.37	8.09	6.52	0.66	0.97	2.90	0.13	0.43	29.76	53.85
2400	2.45	0.09	16.46	15.32	3.64	5.47	9.80	1.49	8.76	6.81	0.72	1.05	3.03	0.14	0.47	32.19	56.28
2500	2.55	0.10	17.75	15.96	3.95	5.89	10.21	1.62	9.44	7.09	0.78	1.13	3.15	0.15	0.50	34.72	58.81
2600	2.66	0.11	19.08	16.60	4.28	6.34	10.62	1.75	10.16	7.38	0.84	1.21	3.28	0.17	0.54	37.33	61.42
2700	2.76	0.12	20.47	17.23	4.61	6.80	11.03	1.89	10.89	7.66	0.91	1.30	3.40	0.18	0.58	40.03	64.12
2800	2.86	0.13	21.89	17.87	4.96	7.27	11.44	2.03	11.65	7.94	0.98	1.39	3.53	0.19	0.62	42.82	66.91
2900	2.96	0.14	23.36	18.51	5.32	7.76	11.85	2.18	12.43	8.23	1.05	1.48	3.66	0.21	0.66	45.69	69.78
3000	3.06	0.15	24.87	19.15	5.69	8.26	12.25	2.33	13.23	8.51	1.12	1.58	3.78	0.22	0.71	48.65	72.74
3100	3.17	0.16	26.42	19.79	6.08	8.77	12.66	2.49	14.06	8.79	1.20	1.68	3.91	0.24	0.75	51.69	75.78
3200	3.27	0.17	28.02	20.42	6.48	9.31	13.07	2.65	14.91	9.08	1.28	1.78	4.03	0.25	0.79	54.81	78.90
3300	3.37	0.18	29.66	21.06	6.89	9.85	13.48	2.82	15.79	9.36	1.36	1.88	4.16	0.27	0.84	58.03	82.12
3400	3.47	0.19	31.35	21.70	7.31	10.41	13.89	3.00	16.68	9.65	1.44	1.99	4.29	0.29	0.89	61.32	85.41
3500	3.57	0.20	33.08	22.34	7.75	10.98	14.30	3.17	17.60	9.93	1.53	2.10	4.41	0.30	0.94	64.70	88.79
3600	3.68	0.21	34.85	22.98	8.20	11.57	14.71	3.36	18.54	10.21	1.62	2.21	4.54	0.32	0.99	68.16	92.25
3700	3.78	0.22	36.66	23.62	8.66	12.17	15.11	3.55	19.51	10.50	1.71	2.33	4.66	0.34	1.04	71.70	95.79
3800	3.88	0.23	38.51	24.25	9.13	12.79	15.52	3.74	20.49	10.78	1.80	2.45	4.79	0.36	1.09	75.33	99.42
3900	3.98	0.25	40.41	24.89	9.62	13.42	15.93	3.94	21.50	11.06	1.90	2.57	4.92	0.38	1.15	79.04	103.13
4000	4.08	0.26	42.34	25.53	10.12	14.06	16.34	4.15	22.53	11.35	2.00	2.69	5.04	0.39	1.20	82.83	106.92
4100	4.19	0.27	44.32	26.17	10.63	14.72	16.75	4.36	23.59	11.63	2.10	2.81	5.17	0.41	1.26	86.70	110.79
4200	4.29	0.29	46.34	26.81	11.16	15.39	17.16	4.57	24.66	11.91	2.20	2.94	5.30	0.44	1.31	90.65	114.74
4300	4.39	0.30	48.41	27.45	11.70	16.07	17.57	4.79	25.76	12.20	2.31	3.07	5.42	0.46	1.37	94.69	118.78
4400	4.49	0.31	50.51	28.08	12.25	16.77	17.97	5.02	26.88	12.48	2.42	3.21	5.55	0.48	1.43	98.80	122.89
4500	4.60	0.33	52.65	28.72	12.81	17.48	18.38	5.25	28.02	12.77	2.53	3.34	5.67	0.50	1.49	102.99	127.08
4600	4.70	0.34	54.84	29.36	13.39	18.21	18.79	5.48	29.18	13.05	2.64	3.48	5.80	0.52	1.56	107.27	131.36
4700	4.80	0.36	57.07	30.00	13.97	18.95	19.20	5.72	30.37	13.33	2.76	3.62	5.93	0.55	1.62	111.62	135.71
4800	4.90	0.37	59.33	30.64	14.58	19.70	19.61	5.97	31.57	13.62	2.88	3.77	6.05	0.57	1.68	116.06	140.15
4900	5.00	0.39	61.64	31.28	15.19	20.47	20.02	6.22	32.80	13.90	3.00	3.91	6.18	0.59	1.75	120.57	144.66
5000	5.11	0.40	63.99	31.91	15.82	21.25	20.42	6.48	34.05	14.18	3.12	4.06	6.30	0.62	1.81	125.16	149.25
5100	5.21	0.42	66.37	32.55	16.45	22.04	20.83	6.74	35.32	14.47	3.25	4.21	6.43	0.64	1.88	129.83	153.92
5200	5.31	0.44	68.80	33.19	17.11	22.85	21.24	7.01	36.61	14.75	3.38	4.37	6.56	0.67	1.95	134.58	158.67
5300	5.41	0.45	71.27	33.83	17.77	23.67	21.65	7.28	37.92	15.03	3.51	4.53	6.68	0.69	2.02	139.41	163.50
5372	5.49	0.47	73.07	34.29	18.26	24.26	21.94	7.48	38.88	15.24	3.61	4.64	6.77	0.71	2.07	142.93	167.02
5400	5.51	0.47	73.78	34.47	18.45	24.50	22.06	7.56	39.26	15.32	3.64	4.68	6.81	0.72	2.09	144.31	168.40
5500	5.62	0.49	76.32	35.11	19.14	25.34	22.47	7.84	40.61	15.60	3.78	4.85	6.93	0.75	2.16	149.29	173.38
5600	5.72	0.51	78.91	35.74	19.84	26.20	22.88	8.13	41.99	15.89	3.92	5.01	7.06	0.77	2.24	154.35	178.44
5700	5.82	0.53	81.54	36.38	20.55	27.08	23.28	8.42	43.39	16.17	4.06	5.18	7.19	0.80	2.31	159.49	183.58
5800	5.92	0.54	84.20	37.02	21.28	27.96	23.69	8.72	44.81	16.45	4.20	5.35	7.31	0.83	2.39	164.71	188.80
5900	6.03	0.56	86.91	37.66	22.02	28.86	24.10	9.02	46.25	16.74	4.35	5.52	7.44	0.86	2.47	170.00	194.09
6000	6.13	0.58	89.65	38.30	22.77	29.77	24.51	9.33	47.71	17.02	4.50	5.69	7.56	0.89	2.54	175.37	199.46
6100	6.23	0.60	92.44	38.93	23.54	30.70	24.92	9.64	49.19	17.30	4.65	5.87	7.69	0.92	2.62	180.81	204.90
6200	6.33	0.62	95.26	39.57	24.32	31.63	25.33	9.96	50.69	17.59	4.80	6.05	7.82	0.95	2.70	186.34	210.43
6300	6.43	0.64	98.12	40.21	25.11	32.58	25.74	10.28	52.21	17.87	4.96	6.23	7.94	0.98	2.78	191.93	216.02
6400	6.54	0.66	101.02	40.85	25.91	33.55	26.14	10.61	53.76	18.16	5.12	6.41	8.07	1.01	2.87	197.61	221.70
6500	6.64	0.68	103.96	41.49	26.73	34.52	26.55	10.95	55.32	18.44	5.28	6.60	8.20	1.04	2.95	203.36	227.45
6600	6.74	0.71	106.94	42.13	27.56	35.51	26.96	11.29	56.91	18.72	5.44	6.79	8.32	1.08	3.03	209.18	233.27
6700	6.84	0.73	109.96	42.76	28.40	36.51	27.37	11.63	58.51	19.01	5.61	6.98	8.45	1.11	3.12	215.08	239.17
6800	6.94	0.75	113.01	43.40	29.25	37.53	27.78	11.98	60.14	19.29	5.78	7.18	8.57	1.14	3.21	221.06	245.15
6900	7.05	0.77	116.11	44.04	30.12	38.56	28.19	12.34	61.78	19.57	5.95	7.37	8.70	1.18	3.29	227.11	251.20
7000	7.15	0.79	119.24	44.68	31.00	39.60	28.59	12.70	63.45	19.86	6.12	7.57	8.83	1.21	3.38	233.24	257.33
7100	7.25	0.82	122.41	45.32	31.89	40.65	29.00	13.06	65.14	20.14	6.30	7.77	8.95	1.24	3.47	239.44	263.53
7200	7.35	0.84	125.62	45.96	32.79	41.71	29.41	13.43	66.85	20.42	6.48	7.98	9.08	1.28	3.56	245.72	269.81


28th
St. PS System Curve
300.00
250.00
200.00
150.00
100.00
50.00
0.00
TDH (ft)
5372, 167.02
0
1000
2000
3000
4000
5000
6000
7000
8000
Flow (mgd)

Kevin Hoffman

From: Mark Robinson [mrobinson@daman-superiorllc.net]
Sent: Tuesday, October 30, 2007 3:51 PM
To: Kevin Hoffman
Subject: MACM Pump Station
Attachments: mckeesport.pdf; mck2.pdf

Kevin,
Following is pricing on the Vertical Shafted Yeoman's pumps. I also attached a basic spec and drawing.

Cliff Street: 8518-4B/4A with 125 hp TEFC, 1200 RPM, 460/3/60 motor..$28,760.00 (wt. – 3035#)
SAME but with Explosion Proof motor..$29,287.00 (wt. – 3770#)

Adder Options: Mechanical Seal..............................$1,020.00
SS Impeller or Case Wear Ring............$598.00 Each
Non-Witnessed Performance Test.........$1,218.00

28th Avenue: 6317LC-4BHT with 200 hp, TEFC, 1800 rpm, 460/3/60 motor...$29,196.00 (wt. – 2840#)
SAME but with Explosion Proof motor..$30,048.00 (wt. – 3575#)

Adder Options: Same as above.

Note; I have not quoted the shafting at this point, I am waiting for Yeoman's quote because they go to an outside vendor.

Please let me know if you require any additional information.

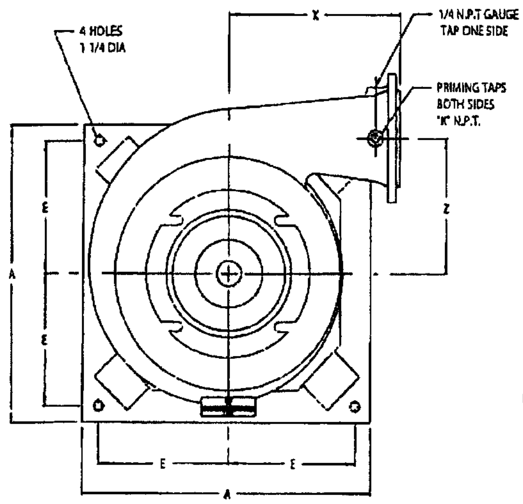
Best regards,
Mark

PER CONVERSATION w/ M. ROBINSON.
YEOMANS HAS NO DRY-PIT SUBMERSIBLE OPTION B/C MAX HP AVAILABLE IS 150HP.

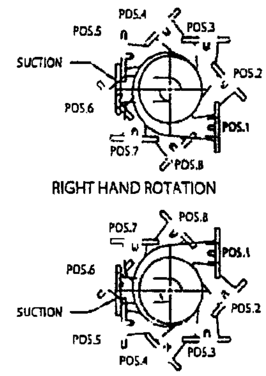
YEOMANS

SERIES 6250

VERTICAL LINE-SHAFT SOLIDS-HANDLING PUMPS



RELATIVE POSITION OF SUCTION AND DISCHARGE (AS VIEWED FROM THE MOTOR END)



NOTE: DISCHARGE IN POSITION NO.1 FURNISHED AS STANDARD. OTHER POSITIONS AVAILABLE FROM FACTORY WHEN SPECIFIED.

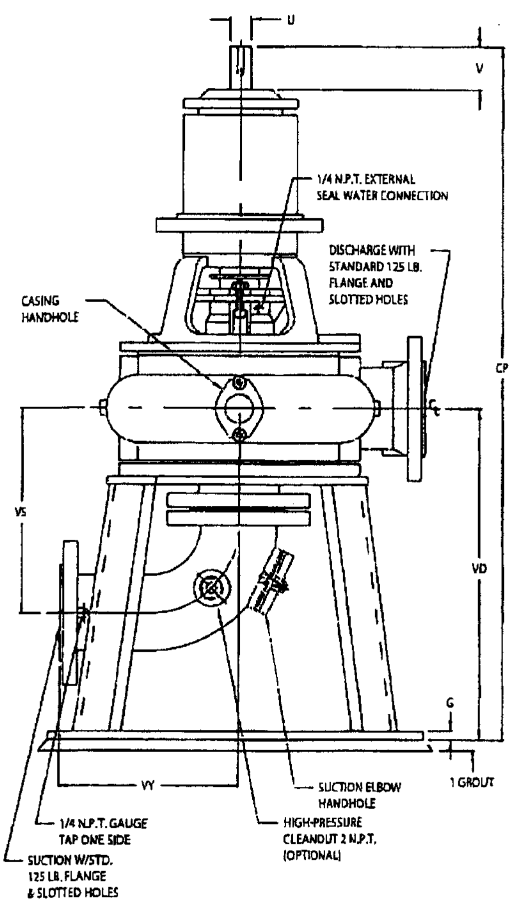
OUTLINE DWG #	102900	
S.O.		
JOB:		
ISSUE	REVISION	DATE

LIST OF EQUIPMENT FURNISHED:

__ Model ______________ Pump
Rated for ______ GPM at ______ Ft.TDH.
__ ______ HP, ______ RPM, ______ Volts
____ Phase, ____ Hz Vertical C-Face
Motor in ______________ NEMA
enclosure complete with pedestal
__ ROTATION ______ POSITION # _____
__ ROTATION ______ POSITION # _____

OPTIONAL ACCESSORIES:

- ☐ Anchor Bolts
- ☐ Mechanical Seal
- ☐ Bronze or S.S. Impeller
- ☐ Bronze or S.S. Wear Rings
- ☐ 416 S.S. Pump Shaft
- ☐ Safety Guard



NOTES: 1. ALL DIMENSIONS ARE IN INCHES.
2. WEIGHT IS IN POUNDS.

TABLE OF DIMENSIONS

✓	PUMP MODEL	DIS	SUC	A	E	G	K	X	Z	CP	U	KEY	V	VD	VS	VY	WEIGHT
	4317-4A/4BHT	4		30	13 3/4	5/8	1/2	13	10 1/4	61 7/8	2 3/8	5/8x5/8x3	4 1/4	27	13 1/8	14	1175
	4317-4A/4BHT		8														
	6315-4A/4BHT	6	6	24	10 3/4	1/2		16	11	60				26	16 7/8	14	1160
	6315-4A/4BHT		8														
✓	6317-4A/4BHT	6	8	30	13 3/4	5/8		17	11 3/4	62 1/4				28 3/16	17 1/2	15	1325
✓	6317-4A/4BHT		10												18 1/2	16	
	8317-4A/4BHT	8	8	30	13 3/4	5/8		17	11 3/4	62 1/4				28 3/16	17 1/2	15	1325
	8317-4A/4BHT		10												18 1/2	16	
	8417-4A	8	8	30	13 3/4	5/8		18	13	63 1/8				28 3/4	18	15	1520
	8417-4A		10												19	16	
	8515-4A	8	8	30	13 3/4	5/8		16 1/2	11 1/16	63 7/8				28 1/4	18	15	1420
	8515-4A		10												19	16	
✓	8518-4A/4B	8	8	30	13 3/4	5/8		18	13	63 1/8				28 3/4	18	15	1520
✓	8518-4A/4B		10												19	16	
	10522-4B	10	10	38	16 1/2	1	3/4	22	17	75 3/8				39 7/8	21 [illegible]	18	3500
	10522-4B		12												22 [illegible]	20	
	10522-5/6	10	10	38	16 1/2	1		22	17	84	2 7/8	3/4x3/4x5	6 1/4	39 7/8	21 [illegible]	18	3590
	10522-5/6		12												22 [illegible]	20	
	12515-4A	12	12	38	16 1/2	1		15 [illegible]	12	69	2 3/8	5/8x5/8x3	4 1/4	33 1/2	22	20	1760
	12622-4B	12	12	38	16 1/2	1		24	18	76 1/8				40 5/16	25 1/16	20	4500
	12622-4B		14													22	
	12622-5/6	12	12	38	16 1/2	1		24	18	84 3/4	2 7/8	3/4x3/4x5	6 1/4	40 5/16	25 1/16	20	4600
	12622-5/6		14													22	
	12624-4B	12	12	38	16 1/2	1		24	18	76 1/8	2 3/8	5/8x5/8x3	4 1/4	40 5/16	25 1/16	20	4520
	12624-4B		14													22	
	12624-5/6	12	12	38	16 1/2	1		24	18	84 3/4	2 7/8	3/4x3/4x5	6 1/4	40 5/16	25 1/16	20	4620
	12624-5/6		14													22	
	14518-4B/4BHT	14	14	38	16 1/2	1		20	18	74	2 3/8	5/8x5/8x3	4 1/4	38 1/16	24 [illegible]	22	4600
	14518-4B/4BHT		16												25 [illegible]	15	
	14620-4B	14	14	38	16 1/2	1		20	18	77 1/2	2 3/8	5/8x5/8x3	4 1/4	41 7/8	26 1/16	22	4800
	14620-5									86 1/8	2 7/8	3/4x3/4x5	6 1/4				
	16620-4B	16	14	38	16 1/2	1		22	18	77 1/2	2 3/8	5/8x5/8x3	4 1/4	41 7/8	26 1/16	22	4820
	16620-5									86 1/8	2 7/8		6 1/4				
	16622-5B/6B	16	18	43 1/2	20	1		22	19 1/2	97 1/4	2 7/8	3/4x3/4x5	6 1/4	52 1/4	32 1/2	16 1/2	4900
	16624-5B/6B	16	18	43 1/2	20	1	1	22	19 1/2	97 1/4	2 7/8		6 1/4	52 3/16	32 [illegible]	16 1/2	4930
	18530-6B/6BHT	18	20	48	20	1 1/4		27	22	98 1/4	2 7/8		6 1/4	53 [illegible]	36 [illegible]	18	5600
	18624-5B/6B	18	20	43 1/2	20	1		27	19 1/2	97 1/4	2 7/8		6 1/4	52 [illegible]	32 [illegible]	16 1/2	4950
	18622-5B	18	18	43 1/2	20	1		22	19 1/2	100 7/8	2 7/8		6 1/4	54 [illegible]	33 [illegible]	16 1/2	4920
	20724-6B	20	20	43 1/2	20	1		22	24	98	2 7/8		6 1/4	52 1/4	42 [illegible]	18	5700

Live Search Maps

MACM: Long Run Pump Station
Side-by-Side Pump Comparison

Required Duty Point 6,750 gpm at 151 feet TDH
Required Duty Point per Pump 3,375 gpm at 151 feet TDH

Manufacturer (Model)	Flygt	Wilo - EMU	Yeomans Chicago	Yeomans Chicago
Type of Pump	Dry Pit Submersible	Dry Pit Submersible	Dry Pit Submersible	Verticle Shaft
Number of Pumps	3 Total - 2 Operating	3 Total - 2 Operating	3 Total - 2 Operating	3 Total - 2 Operating
Model	CT 3231/705	FA 20.78D	No Option Avaialble	6317LC-4BHT
Mfr. Curve No.	63-430		No Option Avaialble	3530A
Impeller Type	C- Series	GGG40.3	No Option Avaialble	Y-4704
No. of Impeller Vanes	2	3	No Option Avaialble	????
Impeller Diameter, in. (mm)	15.15 (385)	15	No Option Avaialble	15.875
Max. Impeller Dia. in. (mm)	15.35 (390)	18.5	No Option Avaialble	17
Percentage of Max Impeller	97.4%	81.1%	No Option Avaialble	93.4%
Nearest Duty Point	3415 gpm at 154 feet TDH	3355 gpm at 151 feet TDH	No Option Avaialble	3,375 gpm at 155 feet TDH
Best Efficiency Point	3679 gpm at 146 feet TDH	3975 gpm at 134 feet TDH	No Option Avaialble	2,902 gpm at 165 feet TDH
Rated Horsepower[2]	185 HP	241	No Option Avaialble	172
Motor Horspower	185 HP	250	>125 HP	200
Pump Speed[2]	1780 rpm	1740	No Option Avaialble	1750 rpm
Pump Efficiency[2]	70.2%	67.4%	No Option Avaialble	77.0%
NPSHr	23.2	25.7	No Option Avaialble	25.6
Power Requirement	460 Volt, 3 Phase, 60 Hz	460 Volt, 3 Phase, 60 Hz	No Option Avaialble	460 Volt, 3 Phase, 60 Hz
Solids Capability	3.5" diameter	????	No Option Avaialble	3" diameter
Suction	10" diameter	10" diameter	No Option Avaialble	8" diameter
Discharge	8" diameter	10" diameter	No Option Avaialble	6" diameter
Front to Back Dimension (in)	39	37.3125	No Option Avaialble	32
Base Width (in)	39	31.5	No Option Avaialble	30
Height - Suction CL to Top (in)	96	89.6875	No Option Avaialble	51.5625
Weight, lb.	3,155	2,965.20	No Option Avaialble	1,325
Estimate Budget Price[3]	$57,562	$79,740	No Option Avaialble	$34,048

1. All series data is total for the pump operating alone.
2. At duty point.

3. From manufacturer representative quotes.

OVERALL SELECTION - YEOMANS VERT. SHAFT
DRY PIT SUB. SELECTION - FLYGT

KLH
ENGINEERS, INC.
5173 CAMPBELLS RUN ROAD
PITTSBURGH, PA 15205

SUBJECT MACM: ACT 537 PROJECTS JOB NO. 220-33
LONG RUN PUMP STATION SHEET NO. 1 OF
COMPUTED BY KDH DATE 12-21-07

EXISTING WET WELL VOLUME

OPERATING VOLUME.

HWL - 725.25
LWL - 721.75 > 3.5 FT.

WIDTH - 5'-9"
LENGTH - 17'-0"

VOL = 5.75 X 17 X 3.5 = 342. FT^3
= 2560 GAL.

AT 9.7 MGD t_d =

$$\frac{2560}{9{,}700{,}000 \text{ GPD}} \left(\frac{24 \text{ hr}}{1 \text{ d}}\right)\left(\frac{60 \text{ min}}{1 \text{ hr}}\right) = 0.37 \text{ MIN} = 23 \text{ SEC.}$$

IF USE ENTIRE AREA

WIDTH - 12'-0"
LENGTH - 17'-0"

VOL = 12 X 17 X 3.5 = 714 FT^3
= 5341 GAL.

TOTAL 2560 + 5341 = 7901. GAL

$$\frac{7901}{9.7 \times 10^6}\left(\frac{24 \times 60}{1}\right) = 1.2 \text{ MIN}$$

VOL & DET. BEFORE OVERFLOW

736.38 - 725.75 =

5.75 X 17 X 10.63 = 3207 FT^3

12 X 17 = 23,994 GAL.

$$\frac{23{,}994}{9.7 \times 10^6}(1440) = 3.56 \text{ MINUTES.}$$ BEFORE SSO OCCURS

HOLD CONST. EL.

770,000 GPD. = 534 GPM. @ LOW W/ 1 PUMP

9.7×10^6 GPD = 6736. GPM → 3368.05 GPM EACH PUMP

KLH
ENGINEERS, INC.
5173 Campbells Run Road
Pittsburgh, PA 15205

SUBJECT .... JOB NO. ....
.... SHEET NO. 1A OF ......
COMPUTED BY .... DATE 1-7-08

18.5 x 19 x 3.5 = 1230.25 CFT
9203 GAL

~~TOTAL = 2560 + 9203 = 11,763 GAL~~

~~VOL & DET TIME BEFORE OVERFLOW.~~

~~5.75 x 17 x 10.63 = 1040 FT³~~
~~18.5 x 19 x 10.63 = 3736 FT³~~
~~4775 FT³~~
~~= 35,723 GAL~~

~~$\frac{35,723}{9.7 \times 10^6} \times 1440 = 5.3$ MIN BEFORE SSO OCCURS~~

1/8/08
18 x 12 x 3.5 SO. → SAY CLOSE TO ORIGINAL ESTIMATE

KLH
ENGINEERS, INC.
5173 CAMPBELLS RUN ROAD
PITTSBURGH, PA 15205

SUBJECT MACM: ACT 537 PROJECTS JOB NO. 220-33
LONG RUN PUMP STATION SHEET NO. 2 OF
COMPUTED BY KBH DATE 1-2-08

REVIEW OF PUMP CURVES

FLYGT w/ 1 PUMP ON VFD - @ 30% SPEED
DELIVERS 1800 GPM @ 38 TDH

SEE ATTACHED CYCLE TIME SHEET (SHEET 3)

AT APPROX. 500 GPM / 770,000 GPD HOLD TIME BETWEEN STARTS IS 22 MIN (APPROX.) AT FULL WET WELL

SAY HOLD LEVEL 1 FT. ABOVE LWL - 722.75.
VOL = (12 X 17) + (5.75 X 17) = 301.75 FT³ = 2257.24
CYCLE TIME REDUCES TO 6.0 MINUTES, WHICH WHEN USING ALTERNATING STARTS PROVIDES 12 MIN OR 5 STARTS/HR. ✓ SEE REVISE CYCLE TIME SHEET. (SHEET 4)

Wet Well Pump Cycling	Client	MACM
	Job	Long Run PS

Cycle Time (time between pump starts) per pump (pump and fill):

$$T = V/(Q-S) + V/S$$

where:

T = Time between Starts
V = Working Volume in Wet Well (gal)
Q = Pumping rate (gpm)
S = Flow into the Wet Well (gpm)

If Q = 1800 If V = 8000

S	T	S	T
0		2010	-34.12
100	84.71	2020	-32.40
200	45.00	2030	-30.84
300	32.00	2040	-29.41
400	25.71	2050	-28.10
500	22.15	2060	-26.89
600	20.00	2070	-25.76
700	18.70	2080	-24.73
800	18.00	2090	-23.76
900	17.78	2100	-22.86
1000	18.00	2110	-22.01
1100	18.70	2120	-21.23
1200	20.00	2130	-20.49
1300	22.15	2140	-19.79
1400	25.71	2150	-19.14
1500	32.00	2160	-18.52
1600	45.00	2170	-17.93
1700	84.71	2180	-17.38
1800	#DIV/0!	2190	-16.86
1900	-75.79	2200	-16.36
2000	-36.00	2210	-15.89

Wet Well Pump Cycling

Client MACM
Job Long Run PS

Cycle Time (time between pump starts) per pump (pump and fill):

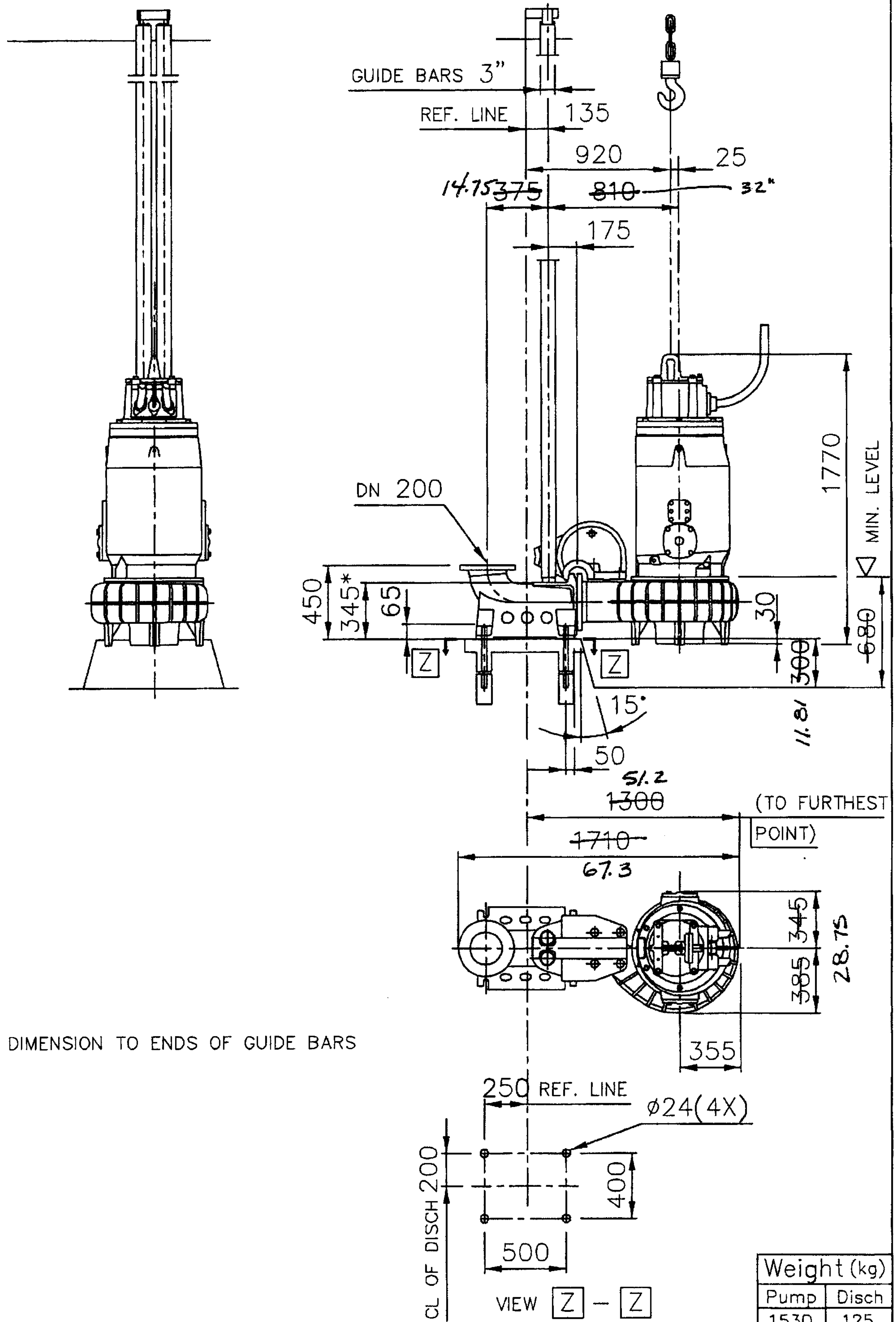
$$T = V/(Q-S) + V/S$$

where:

T = Time between Starts
V = Working Volume in Wet Well (gal)
Q = Pumping rate (gpm)
S = Flow into the Wet Well (gpm)

If Q = 1800 If V = 2257

S	T	S	T
0		2010	-9.62
100	23.90	2020	-9.14
200	12.70	2030	-8.70
300	9.03	2040	-8.30
400	7.25	2050	-7.93
500	6.25	2060	-7.59
600	5.64	2070	-7.27
700	5.28	2080	-6.98
800	5.08	2090	-6.70
900	5.02	2100	-6.45
1000	5.08	2110	-6.21
1100	5.28	2120	-5.99
1200	5.64	2130	-5.78
1300	6.25	2140	-5.58
1400	7.25	2150	-5.40
1500	9.03	2160	-5.22
1600	12.70	2170	-5.06
1700	23.90	2180	-4.90
1800	#DIV/0!	2190	-4.76
1900	-21.38	2200	-4.62
2000	-10.16	2210	-4.48



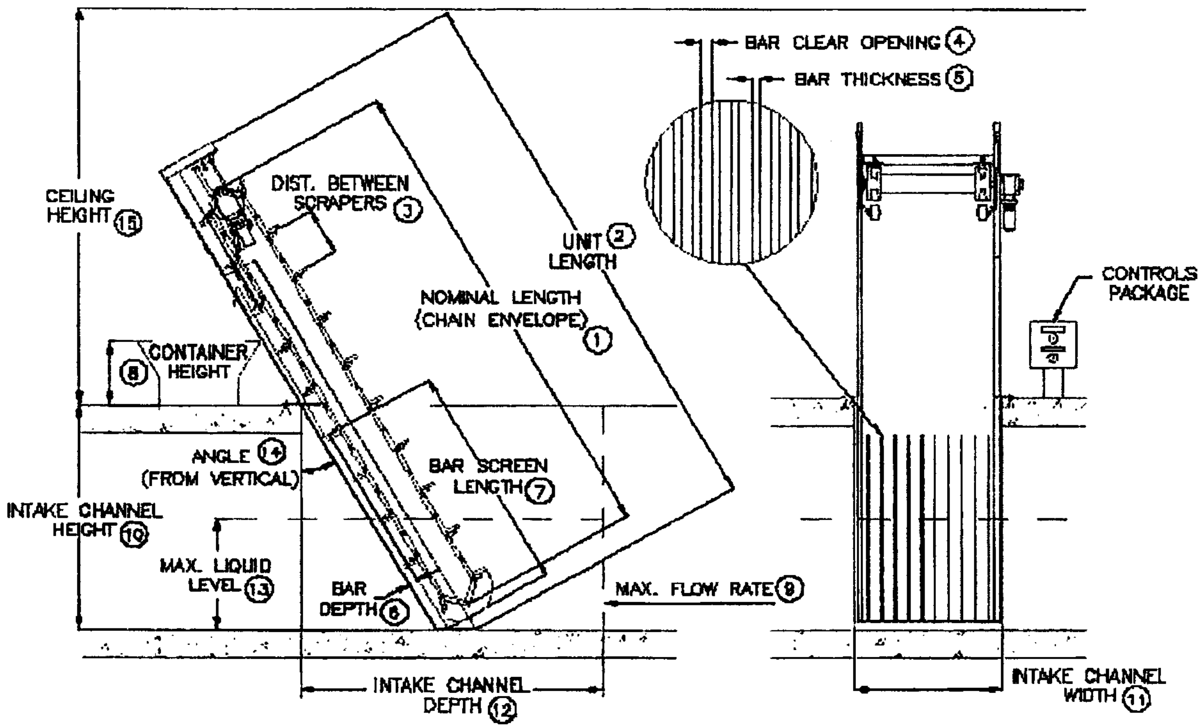
* DIMENSION TO ENDS OF GUIDE BARS

Weight (kg)	
Pump	Disch
1530	125

AUTOCAD	Denomination: Dimensional drwg CP,NP 3231 705/715	Drawn by: OHn	Checked by: Sors
		Scale: 1:30	Date: 980820
			Reg no: 5399

February 4, 2008

City of Mckeesport
Long Run Pump Station
Duperon Corporation Budgetary Proposal No. 4157



EQUIPMENT SUMMARY	
Model	Full Penetration, Fine Screen Model
1. Nominal Size	3 ft x 15 ft
2. Unit Length	15 ft
3. Dist. Between Scrapers	2 Link (21 in)
4. Bar Clear Opening	0.50 in
5. Bar Thickness	0.25 in
6. Bar Depth	0.75 in
7. Bar Screen Length	Approx. 5.75 ft
8. Container Height	Estimated 4 ft
9. Max. Flow Rate	10 MGD
10. Intake Channel Height	5 ft
11. Intake Channel Width	3 ft
12. Intake Channel Depth	TBD
13. Max. Liquid Level	TBD
14. Angle (From Vertical)	30 Degrees
15. Ceiling Height	Unknown
Drive Side (L/R)	Unknown
Material of Construction	304 SSTL

ACCESSORIES	
Channel Closeouts	YES
Enclosure/Cover	OPTIONAL
Debris Chute	NO
Controls Package	Range

SCREENINGS	
Gravity Feed or Pumped?	Unknown
Typical Debris?	Unknown

DUPERON corporation

February 4, 2008

City of McKeesport
Long Run Pump Station
Duperon Corporation Proposal No. 4157

FLOW CALCULATIONS												
							Head Loss		@ 25% Blockage		@ 50% Blockage	
MAX. FLOW 10 MGD per channel	Slot (in)	Bar (in)	Intake Width (ft)	Req'd. Liquid Level (ft)	Approach Velocity (fps)	Slot Velocity (fps)	(ft)	(in)	(ft)	(in)	(ft)	(in)
	0.50	0.25	3.00	3.75	1.65	2.78	0.12	1.40	0.24	2.93	0.63	7.51

NOTE: These calculations are a rough estimation based upon the information available at this time in order to maintain approximately a 3 fps slot velocity for peak flow. Flow characteristics calculated for clean water and not derated for debris.

NOTE: Duperon strongly recommends a minimum of 1 ft water depth at all times the unit is in operation to get an optimal amount of screening area.

Client / Job MACM: Long Run Pump Station

Pipe Diameter	20	in
Length of Pipe	[redacted]	ft
Friction Factor "C"	130	
Pump Suction El.	721	ft
Pump Discharge El.	750	ft
Static Head	29	ft
Flow Rate Incremer	250	GPM
Design Pump rate	9.7	MGD
Design Pump rate	6736	GPM
Velocity	6.88	ft/sec
V^2/2g	0.73	ft/sec
Friction Headloss	76.44	ft
TDH Required	[redacted]	ft

Low

	10	12	20 in
	[redacted]		ft
	100	100	100
Pump Suction		725 High	
Pump Dischar		755	
Static Head		30 ft	

		24			10			12			20		
Flow Rate GPM	Velocity ft/sec	V^2 2g ft/sec	Friction Headloss Ft	Velocity ft/sec	V^2 2g ft/sec	Friction Headloss Ft	Velocity ft/sec	V^2 2g ft/sec	Friction Headloss Ft	Velocity ft/sec	V^2 2g ft/sec	Friction Headloss Ft	Total Dynamic Headloss Ft
0	0	0	0	0	0	0	0	0	0	0	0	0	29.00
250	0.26	0.00	0.172575624	1.02	0.02	0.043408776	0.71	0.01	0.051622993	0.26	0.00	0.006029418	29.27
500	0.51	0.00	0.622135445	2.04	0.06	0.156488718	1.42	0.03	0.186100986	0.51	0.00	0.021736062	29.99
750	0.77	0.01	1.317206225	3.06	0.15	0.331323212	2.13	0.07	0.394019307	0.77	0.01	0.046020326	31.09
1000	1.02	0.02	2.24279943	4.08	0.26	0.564142119	2.84	0.12	0.670894399	1.02	0.02	0.078358543	32.56
1250	1.28	0.03	3.389018668	5.11	0.40	0.852456153	3.55	0.20	1.013765926	1.28	0.03	0.118404954	34.37
1500	1.53	0.04	4.748530877	6.13	0.58	1.194420792	4.26	0.28	1.420440332	1.53	0.04	0.165903359	36.53
1750	1.79	0.05	6.315544901	7.15	0.79	1.588579361	4.96	0.38	1.889185293	1.79	0.05	0.220651427	39.01
2000	2.04	0.06	8.085296096	8.17	1.04	2.033733384	5.67	0.50	2.418575549	2.04	0.06	0.282482691	41.82
2250	2.30	0.08	10.05375032	9.19	1.31	2.528868135	6.38	0.63	3.007404356	2.30	0.08	0.351256208	44.94
2500	2.55	0.10	12.21741857	10.21	1.62	3.073106008	7.09	0.78	3.65462804	2.55	0.10	0.426850079	48.37
2750	2.81	0.12	14.57323341	11.23	1.96	3.665675436	7.80	0.94	4.359329029	2.81	0.12	0.509157135	52.11
3000	3.06	0.15	17.1184626	12.25	2.33	4.305889167	8.51	1.12	5.120690025	3.06	0.15	0.598081917	56.14
3250	3.32	0.17	19.85064647	13.28	2.74	4.993128506	9.22	1.32	5.937975259	3.32	0.17	0.69353849	60.48
3500	3.57	0.20	22.76755105	14.30	3.17	5.726831535	9.93	1.53	6.810516477	3.57	0.20	0.795448803	65.10
3750	3.83	0.23	25.86713218	15.32	3.64	6.506484072	10.64	1.76	7.737702203	3.83	0.23	0.903741438	70.02
4000	4.08	0.26	29.14750739	16.34	4.15	7.331612612	11.35	2.00	8.718969328	4.08	0.26	1.018350625	75.22
4250	4.34	0.29	32.60693349	17.36	4.68	8.201778686	12.06	2.26	9.753796413	4.34	0.29	1.139215463	80.70
4500	4.60	0.33	36.24378851	18.38	5.25	9.116574307	12.77	2.53	10.84169827	4.60	0.33	1.266279281	86.47
4750	4.85	0.37	40.05655676	19.40	5.85	10.07561823	13.47	2.82	11.9822215	4.85	0.37	1.399489126	92.51
5000	5.11	0.40	44.04381655	20.42	6.48	11.07855285	14.18	3.12	13.17494085	5.11	0.40	1.538795326	98.84
5250	5.36	0.45	48.20422982	21.45	7.14	12.12504159	14.89	3.44	14.41945604	5.36	0.45	1.684151133	105.43
5500	5.62	0.49	52.5365334	22.47	7.84	13.21476673	15.60	3.78	15.71538922	5.62	0.49	1.835512414	112.30
5750	5.87	0.54	57.0395315	23.49	8.57	14.34742748	16.31	4.13	17.0623827	5.87	0.54	1.992837391	119.44
6000	6.13	0.58	61.71208934	24.51	9.33	15.52273841	17.02	4.50	18.46009702	6.13	0.58	2.156086418	126.85
6250	6.38	0.63	66.55312754	25.53	10.12	16.74042802	17.73	4.88	19.9082093	6.38	0.63	2.325221782	134.53
6500	6.64	0.68	71.56161726	26.55	10.95	18.00023751	18.44	5.28	21.4064118	6.64	0.68	2.500207538	142.47
6750	6.89	0.74	76.73657597	27.57	11.81	19.30191974	19.15	5.69	22.95441059	6.89	0.74	2.68100936	150.67
7000	7.15	0.79	82.07706368	28.59	12.70	20.64523828	19.86	6.12	24.5519245	7.15	0.79	2.867594406	159.14
7250	7.40	0.85	87.58217965	29.62	13.62	22.02996656	20.57	6.57	26.19868409	7.40	0.85	3.059931206	167.87
7500	7.66	0.91	93.25105939	30.64	14.58	23.45588712	21.28	7.03	27.89443076	7.66	0.91	3.257989556	176.86
7750	7.91	0.97	99.08287205	31.66	15.56	24.92279099	21.99	7.51	29.63891598	7.91	0.97	3.461740429	186.11
8000	8.17	1.04	105.0768181	32.68	16.58	26.43047703	22.69	8.00	31.43190056	8.17	1.04	3.671155889	195.61
8250	8.43	1.10	111.232127	33.70	17.64	27.97875147	23.40	8.50	33.27315405	8.43	1.10	3.886209019	205.37
8500	8.68	1.17	117.5480556	34.72	18.72	29.56742734	24.11	9.03	35.16245412	8.68	1.17	4.106873851	215.38
8750	8.94	1.24	124.0238861	35.74	19.84	31.19632411	24.82	9.57	37.09958606	8.94	1.24	4.33312531	225.65
9000	9.19	1.31	130.6589246	36.76	20.99	32.86526725	25.53	10.12	39.08434232	9.19	1.31	4.564939151	236.17
9250	9.45	1.39	137.4524998	37.79	22.17	34.57408786	26.24	10.69	41.11652204	9.45	1.39	4.802291918	246.95
9500	9.70	1.46	144.4039613	38.81	23.39	36.32262236	26.95	11.28	43.1959307	9.70	1.46	5.045160888	257.97
9750	9.96	1.54	151.5126786	39.83	24.63	38.11071219	27.66	11.88	45.32237971	9.96	1.54	5.293524038	269.24
10000	10.21	1.62	158.7780402	40.85	25.91	39.93820351	28.37	12.50	47.49568613	10.21	1.62	5.547359998	280.76
10250	10.47	1.70	166.1994522	41.87	27.22	41.80494695	29.08	13.13	49.71567232	10.47	1.70	5.806648022	292.53
10500	10.72	1.79	173.7763377	42.89	28.57	43.71079737	29.79	13.78	51.98216569	10.72	1.79	6.071367951	304.54
10750	10.98	1.87	181.5081356	43.91	29.94	45.65561366	30.50	14.44	54.29499842	10.98	1.87	6.341500184	316.80
11000	11.23	1.96	189.3943001	44.93	31.35	47.63925851	31.20	15.12	56.65400721	11.23	1.96	6.617025649	329.30
11250	11.49	2.05	197.4342997	45.96	32.79	49.66159824	31.91	15.82	59.05903309	11.49	2.05	6.897925778	342.05
11500	11.74	2.14	205.6276166	46.98	34.27	51.72250263	32.62	16.53	61.50992119	11.74	2.14	7.184182483	355.04
11750	12.00	2.24	213.9737462	48.00	35.77	53.82184472	33.33	17.25	64.00652054	12.00	2.24	7.475778131	368.28
12000	12.25	2.33	222.4721963	49.02	37.31	55.9595007	34.04	17.99	66.54868391	12.25	2.33	7.772695525	381.75
12250	12.51	2.43	231.1224865	50.04	38.88	58.13534977	34.75	18.75	69.13626761	12.51	2.43	8.074917884	395.47
12500	12.77	2.53	239.9241479	51.06	40.49	60.34927398	35.46	19.52	71.76913138	12.77	2.53	8.382428826	409.42
12750	13.02	2.63	248.8767225	52.08	42.12	62.60115809	36.17	20.31	74.44713819	13.02	2.63	8.695212345	423.62
13000	13.28	2.74	257.9797626	53.10	43.79	64.89088951	36.88	21.12	77.17015414	13.28	2.74	9.013252802	438.05
13250	13.53	2.84	267.2328306	54.13	45.49	67.21835817	37.59	21.94	79.93804831	13.53	2.84	9.336534908	452.73
13500	13.79	2.95	276.6354984	55.15	47.22	69.58345638	38.30	22.77	82.75069265	13.79	2.95	9.665043704	467.63
13750	14.04	3.06	286.187347	56.17	48.99	71.98607877	39.01	23.62	85.60796185	14.04	3.06	9.998764558	482.78

Pipe Diameter	Pipe Length	Inlet	Valves	Check Valve	90	45	Side of Tee	Run of Tee	Increaser	Outlet	Equivilent Length	
2											0	
4											0	
6											0	
8											0	
10											0	
12											0	
14											0	
16											0	
18											0	
20	5698				3	1		6			6087	28th Ave FM
20	4100				6	2					4458	Proposed LR
22											0	
24											0	
30											0	
36											0	
42											0	
48											0	

Pipe 10545

Pipe Diameter	Pipe Length	Inlet	Valves	Check Valve	90	45	Side of Tee	Run of Tee	Increaser	Outlet	Equivilent Length
2											0
4											0
6											0
8									2		24
10	9.5		2	1	1						113.9
12	1				1						33
14											0
16											0
18	3				1			1	1		106
20	13.75				2			1			152.75
22											0
24											0
30											0
36											0
42											0
48											0

Pipe 429.65

Kevin Hoffman VENDOR SELECTION

From: Joe Felix [jfelix@rammotors.com]

Sent: Friday, November 09, 2007 10:06 AM

To: Kevin Hoffman

Cc: Mike Presutti

Subject: MACM Pump Stations Project

Attachments: NT3301 466 Imp Cut Sheets.pdf; NT3301 466 Imp Drawing.DWG; NT3301 466 Imp Specifications.doc; CT3300 460 Imp 350 DIA Cut Sheets.pdf; CT3300 605 Drawing.DWG; CT3300 460 350 mm Specifications.doc; NT3306 705-670 430inch 150hp Cut Sheets.pdf; NT3306 705 430 Drawing.DWG; NT3306 670 430MM Specs.doc; CT3231 705 430 385 Cut Sheets.pdf; CT3231 705 385 Drawing.DWG; CT3231 705 430mm Specifications.doc

Kevin,

Attached are the cut sheets for our pump selections for the above mentioned project. The cut sheets are for the Cliff Street, 28th Avenue, West Shore, and Long Run stations. I will be sending you the pricing and control information as soon as it is completed. Feel free to contact Mike Presutti or myself with any questions.

--
Joe Felix, Inside Sales
Ram Industrial Services, Inc.
Phone: 814-344-6591 extension #1300
Fax: 814-344-8020

PERFORMANCE CURVE

FLYGT	PERFORMANCE CURVE	PRODUCT: CT 3231 /705	TYPE:
DATE: 2007-11-09	PROJECT: Long Run	CURVE NO: 63-430	ISSUE: 8

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.85	0.81	0.71
EFFICIENCY	92.5 %	93.0 %	92.0 %
MOTOR DATA	—	—	—

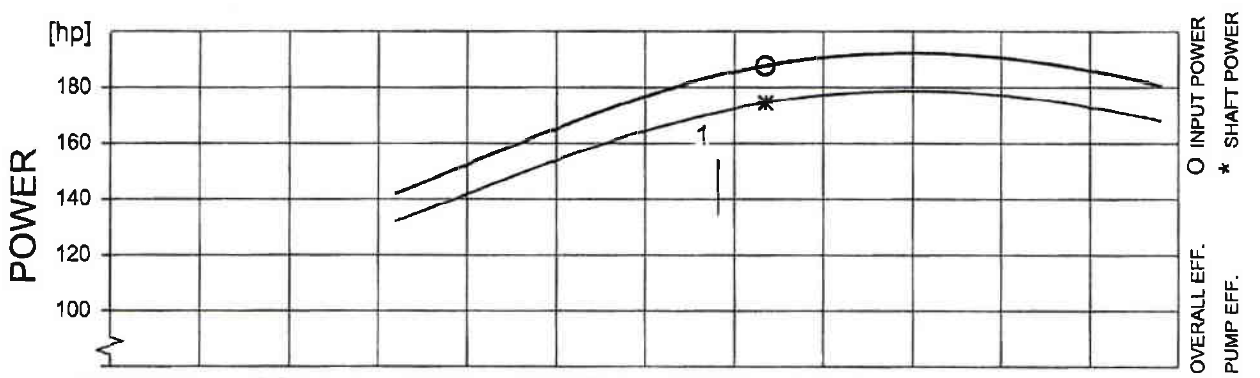
RATED POWER	185	hp
STARTING CURRENT ...	1525	A
RATED CURRENT ...	220	A
RATED SPEED	1780	rpm
TOT.MOM.OF INERTIA ...	1.9	kgm2
NO. OF BLADES	2	

COMMENTS

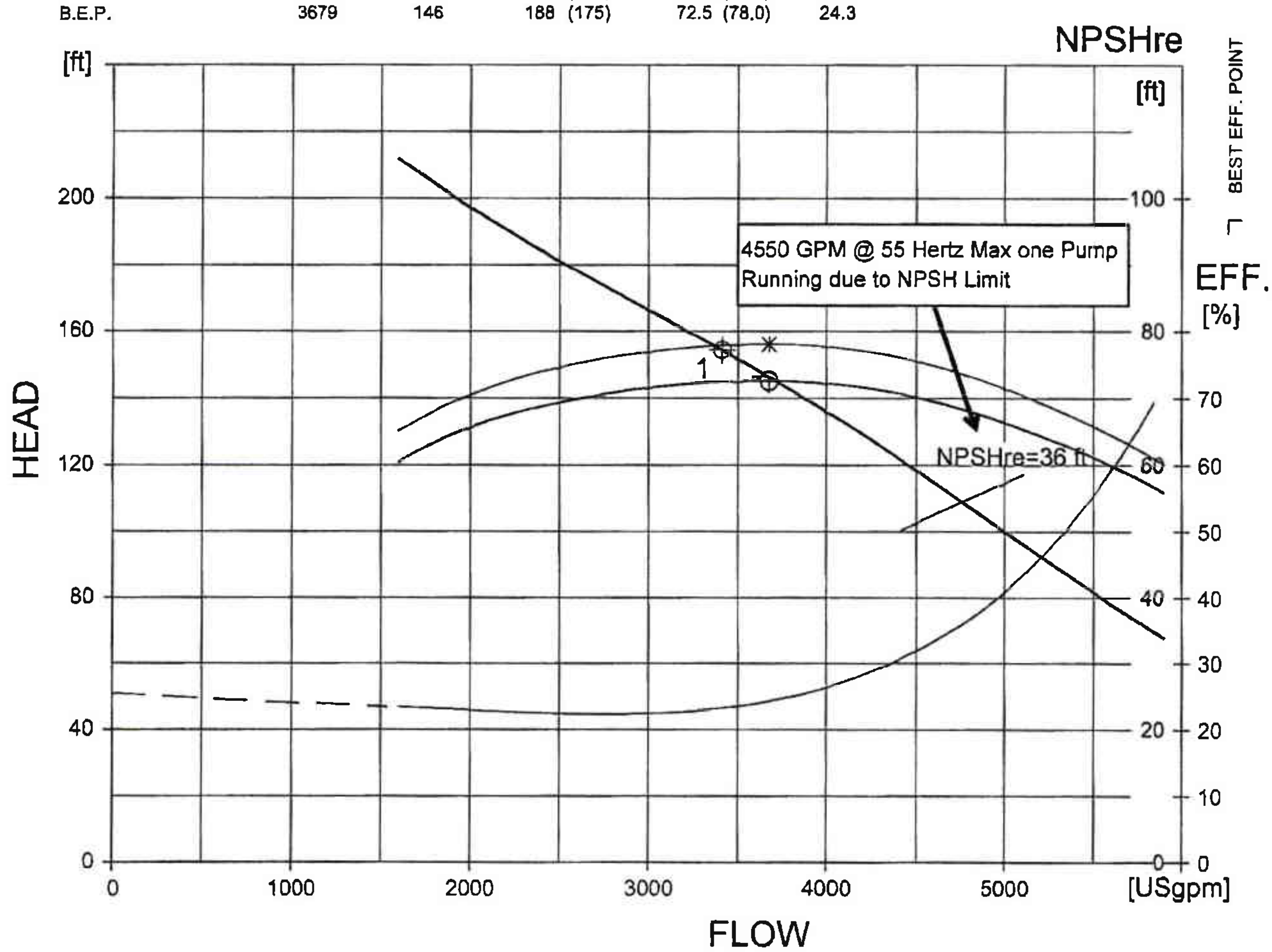
INLET/OUTLET: 10/ 8 inch

IMP. THROUGHLET: 3.5 inch

IMPELLER DIAMETER: 385 mm			
MOTOR #: 43-30-4AA	STATOR: 01D	REV: 13	
FREQ.: 60 Hz	PHASES: 3	VOLTAGE: 460 V	POLES: 4
GEARTYPE: ---	RATIO: ---		



DUTY-POINT	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSHre[ft]
1	3415	154	185 (172)	72.4 (77.8)	23.2
B.E.P.	3679	146	188 (175)	72.5 (78.0)	24.3



FLYPS3.1.5.9 (20060531)

NPSHre = NPSH3% + min. operational margin

Performance with clear water and ambient temp 40 °C

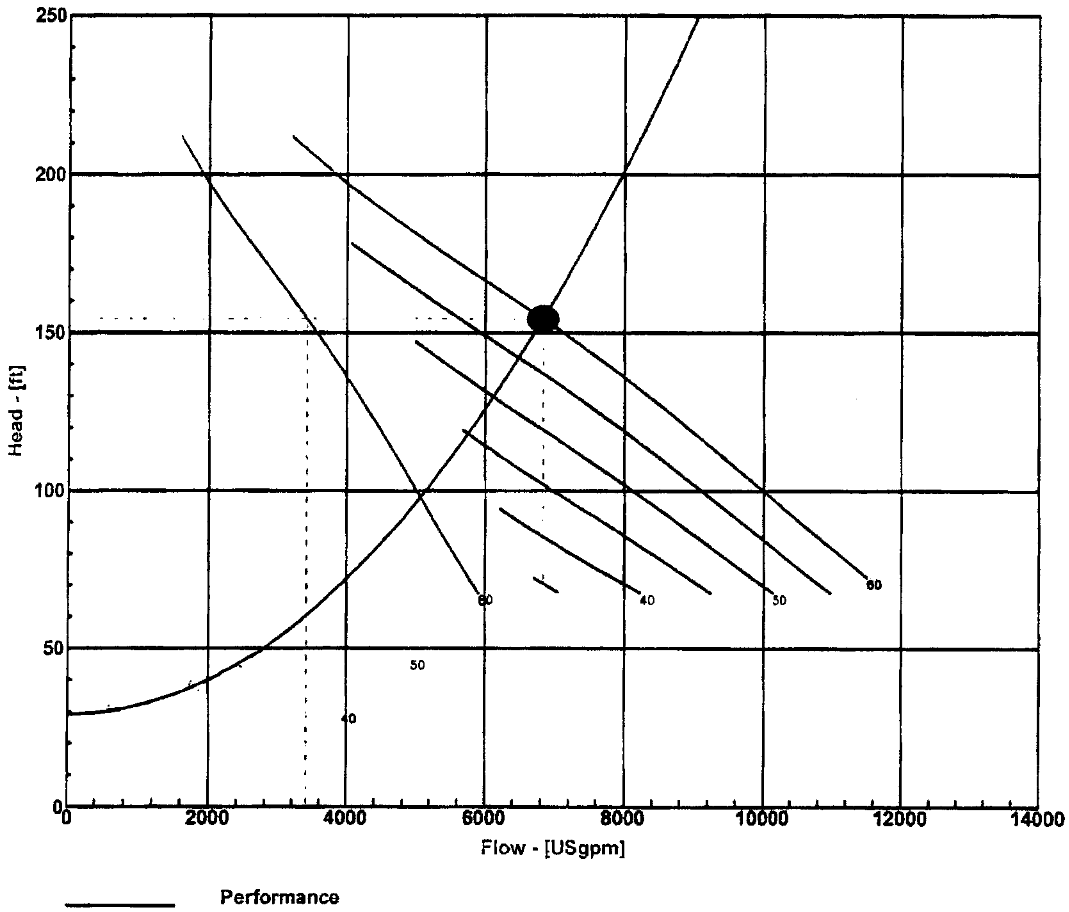
FLYGT

HI B Curve

VFD-Analysis - Performance

Project: Long Run

Created by:: JOE



Pump: C 3231 63-430

PRODUCT DATA

Imp. diam.: 385 mm

Rtd. pwr.: 185 hp

Vanes: 2

Throughlet: 3.5 inch

Connection: Parallel

VFD connection: 1-VFD pump

No of pumps: 2

Frequency: 60 Hz

Flow: 6826.3 USgpm

Head: 154.3 ft

Pwr cons.: 283.0 kW

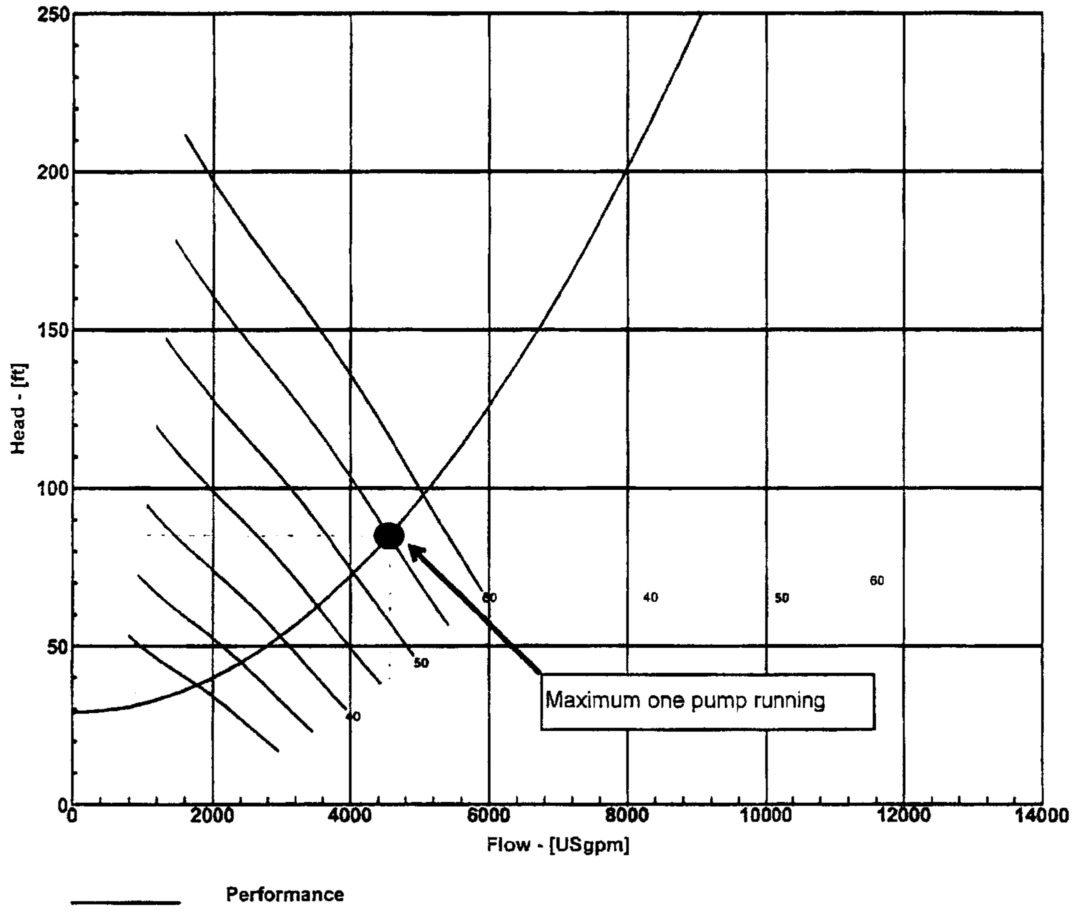
Overall eff: 70.2 %

Spec. energy: 689.6 kWh/Mg

VFD-Analysis - Performance

Project: Long Run

Created by:: JOE



Pump: C 3231 63-430

PRODUCT DATA

Imp. diam.: 385 mm

Rtd. pwr.: 185 hp

Vanes: 2

Throughlet: 3.5 inch

Connection: Parallel

VFD connection: 1-VFD pump

No of pumps: 1

Frequency: 55 Hz

Flow: 4557.8 USgpm

Head: 84.9 ft

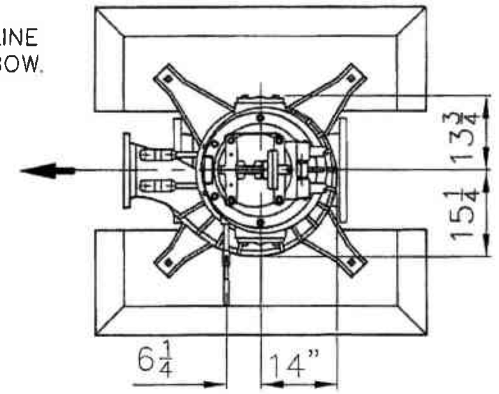
Pwr cons.: 116.4 kW

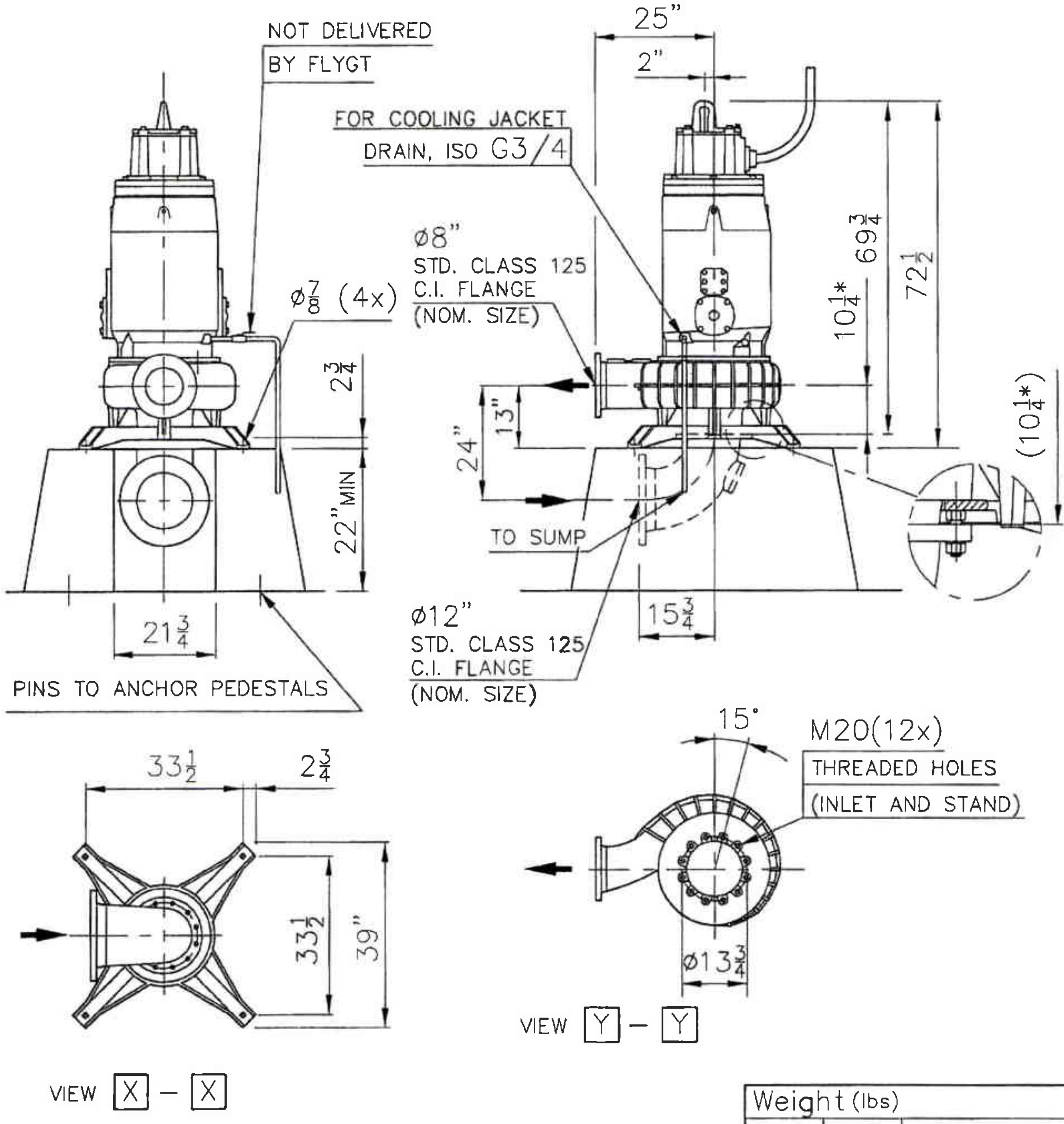
Overall eff: 62.7 %

Spec. energy: 424.7 kWh/Mg

NOTE:
PUMP CAN BE ROTATED ABOUT ITS CENTERLINE TO 4 POSITIONS RELATIVE TO THE INLET ELBOW. INCREMENTS ARE 90°.

*DIMENSION TO INLET ELBOW FLANGE.





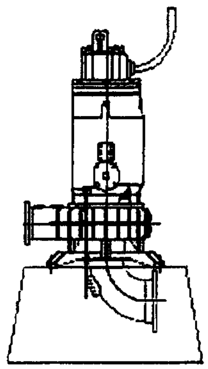
Weight (lbs)		
Pump	Stand	Inlet Elbow
3155	180	235

FLYGT AUTOCAD DRAWING	Denomination: Dimensional drwg CT,NT 3231 705/715 ø12"/ ø8"	Drawn by OHn	Checked by Sors
		Date 980629	Scale 1:30
		Reg no 5399	6437000
			2

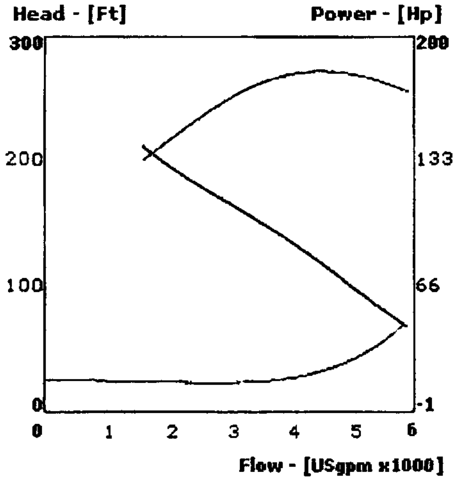
FLYGT

ᐟRODUCT: CT 3231 / 705

Product picture



Curves ⊕ **Enlarge** Available impeller diam: 385 mm



Pump Data

Curve id: 63-430 Impeller: 430 Poles: 4 - pole Motor: 43-30-4AA Frequency: 60 Hz

Motor Data

Rated output power Hp (kW)	Ø	Nominal voltage (V)	Full load current (A)	Locked rotor current (A)	Locked rotor kVA	Locked rotor code letter kVA/Hp	Poles/rpm
185 (138)	3	460	220	1525	1214	H	4/1780

Pump motor Hp	Efficiency			Power factor		
	100% load	75% load	50% load	100% load	75% load	50% load
185	92.5	93	92	0.85	0.81	0.71

Cable Data

HP	Cables	Volts	Max. length (Ft)	Cable size/Nominal OD.	Conductors (In one cable)	Type	Part number
185	2	460	480	4 G 50 1.69"-(43mm)	(3) 50 mm² (PWR) (1) 50 mm² (GND)	STD	**942066**
Pilot cable				S12 X 1.5 30.0 mm (1.18")	(12) 1.5 (CTRL)		94 08 94

Available Outlet and Inlet Sizes	
Outlet Drilled Flange	8"
Inlet Drilled Flange	12"

Engineered for life

CT 3231 705 430 mm SPECS.

REQUIREMENTS
Furnish and install 3 submersible non-clog wastewater pumps. Each pump shall be equipped with an close coupled 185 HP, submersible electric motor connected for operation on 460 volts, 3 phase, 60 hertz, with 40 linear feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. Also, 40 linear feet of multi-conductor submersible cable (SUBCAB) will be used to convey pump monitoring device signals.

PUMP DESIGN CONFIGURATION (Dry pit installation)
Pump shall be capable of operating in a continuous non submerged condition in vertical (CT) position in a dry pit installation and permanently connected to inlet and outlet pipes. Pump shall be of submersible construction and will continue to operate satisfactorily should the dry pit be subjected to flooding.

PUMP CONSTRUCTION
Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate **metal-to-metal contact** between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific bolt torque limit. Rectangular cross sectioned rubber, paper or synthetic gaskets that require specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

COOLING SYSTEM
Each pump/motor unit shall be provided with an integral, self-supplying cooling system. The motor water jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B. The water jacket shall thus provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. After passing through a classifying labyrinth, the impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the filtered pump media, through the cooling system. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket, shall supply the cooling liquid to the jacket. An air evacuation tube shall be provided to facilitate air removal from within the jacket. Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided. The internals to the cooling system shall be non-clogging by virtue of their dimensions. Drilled and threaded provisions for external cooling and, seal flushing or air relief are to be provided. The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports of not less than 4"Ø located 180° apart. The cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 40°C (104°F), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 40°C are not acceptable.

CABLE ENTRY SEAL
The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. **The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.**

MOTOR

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of at least 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Pumps using 9xx series drive units are capable of 8 evenly spaced starts per hour.
Thermal switches shall be embedded in the stator end coils to monitor the temperature of each phase winding. One PT-100 type temperature sensor shall be installed in the stator winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. A mechanical float switch (FLS) shall be mounted in the junction chamber to signal if there is water intrusion. A pump memory module shall be provided and mounted in the junction chamber to record pump run time, number of starts as well as contain the motor unit performance and manufacturing data and service history. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

PILOT CABLE

The pilot cable shall be designed specifically for use with submersible pumps and shall be type SUBCAB (SUBmersible CABle). The cable shall be multi-conductor type with stainless steel braided shielding, a chlorinated polyethylene rubber outer jacket and tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 600 Volts and 90°C (194°F) with a 40°C (104°F) ambient temperature and shall be approved by Factory Mutual (FM). The cable length shall be adequate to reach the junction box without the need for splices.

BEARINGS

The pump shaft shall rotate on at least three grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearings shall consist of at least one roller bearing for radial forces and one or two angular contact ball bearings for axial thrust.

The minimum L_{10} bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

The lower bearing housing shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

MECHANICAL SEAL
Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. The seals shall operate in an lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** seal ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance or adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

Should both seals fail and allow fluid to enter the stator housing, a port shall be provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come into contact with the lower bearings.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with an lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. **The motor shall be able to operate continuously while non-submerged without damage while pumping under load.**

Seal lubricant shall be FDA Approved, nontoxic.

PUMP SHAFT
Pump and motor shaft shall be a solid continuous shaft. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of carbon steel ASTM A 572 and shall be completely isolated from the pumped liquid. Shaft material on 6x5 and 7x5 drive units shall be stainless steel – ASTM A479 S43100-T.

IMPELLER (for C-Pumps)
The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, multiple-vane, double shrouded non-clogging design having long throughlets without acute turns. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Impeller(s) shall be keyed to the shaft, retained with an expansion ring and shall be capable of passing a minimum 3.5 inch diameter solid. All impellers shall be coated with an acrylic dispersion zinc phosphate primer.

WEAR RINGS (for C-Pumps)
A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the rotating impeller. Each pump shall be equipped with a replaceable stationary nitrile rubber coated steel or brass ring that is drive fitted to the volute suction inlet.

This pump shall also have a stainless steel impeller rotating wear ring, heat-shrink fitted onto the suction inlet of the impeller.

VOLUTE (for C-Pumps)
Pump volute(s) shall be single-piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

PROTECTION

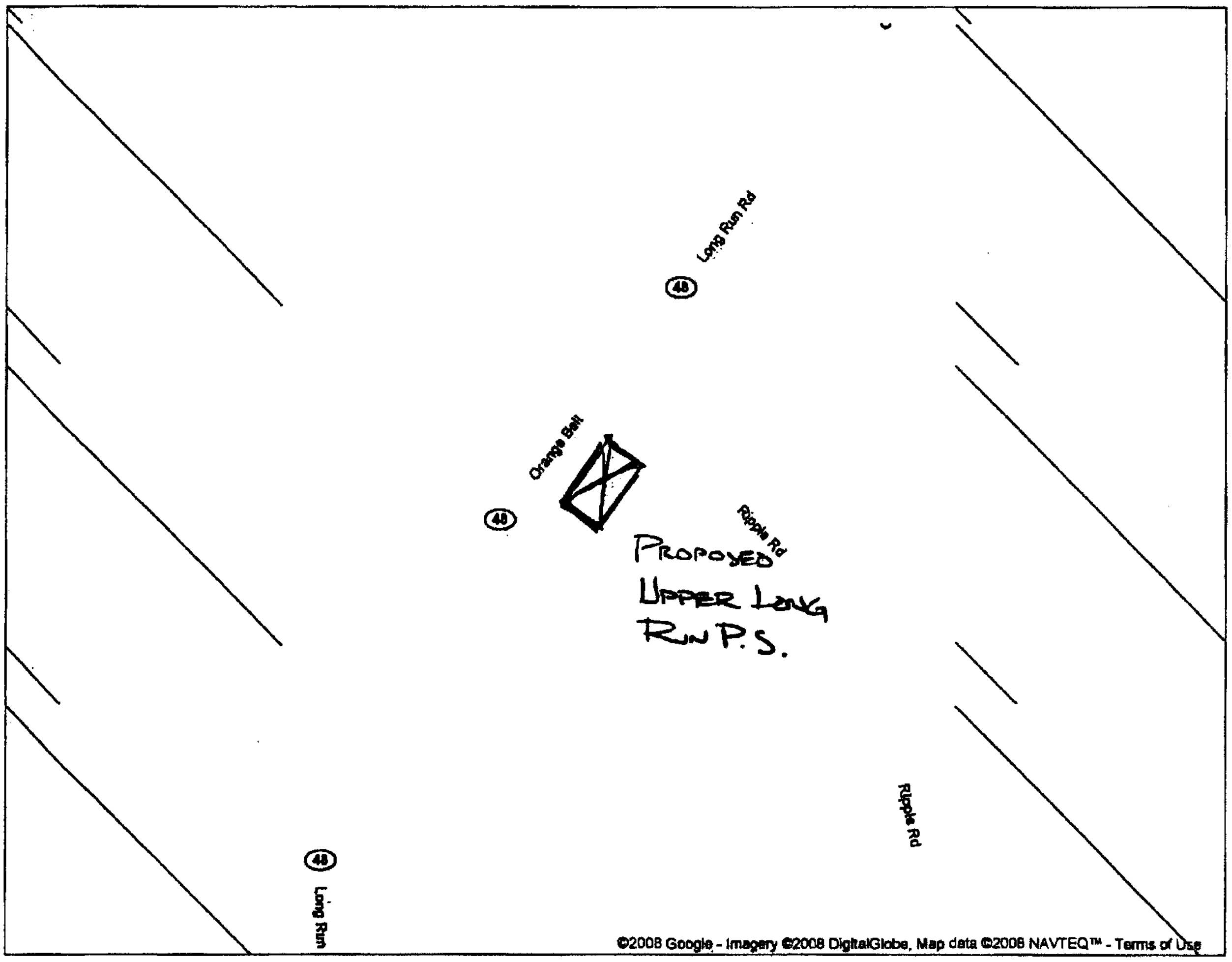
All stators shall incorporate three thermal switches, connected in series, to provide over temperature protection of the motor winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm. The stator shall also include one PT-100 type temperature probe to provide for monitoring of the stator temperature

A lower bearing temperature sensor shall be provided. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.

Two leakage sensors shall be provided to detect water intrusion into the stator chamber and junction chamber. A Float Leakage Sensor (FLS), a small float switch, shall be used to detect the presence of water in either the stator chamber or junction chamber. When activated, the FLS will stop the motor and activate an alarm. **USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS SHALL NOT BE ALLOWED.**

The solid-state pump memory unit, three thermal switches, two FLS switches, PT-100 stator temperature monitor and the lower bearing PT-100 temperature monitor shall all be connected to a MAS (Monitoring and Status) monitoring unit. The MAS shall be designed to be mounted in the control panel and shall come with an Operator Panel that is dead-front panel mounted. The Operator Panel shall have soft-touch operator keys and provide local indication of the status of the alarms within the connected pump unit by means of an LCD screen read-out. Local MAS system change shall be made by use of the soft-touch keypad or local connection by means of a laptop computer. Remote indication of pump unit status shall be possible with connection to customer PLC or via LAN.

Address **McKeesport, PA**



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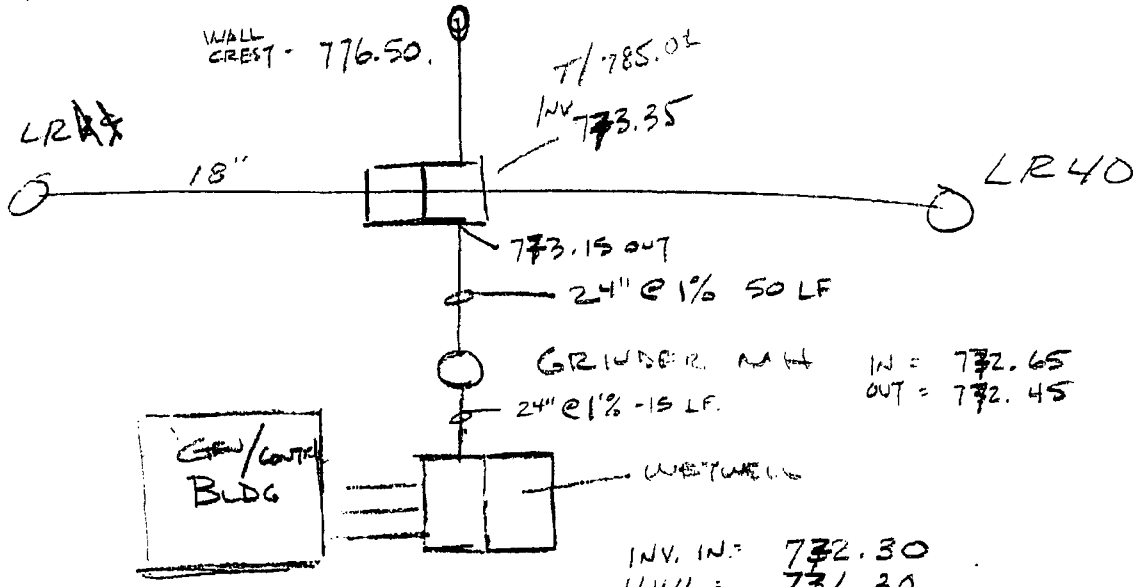

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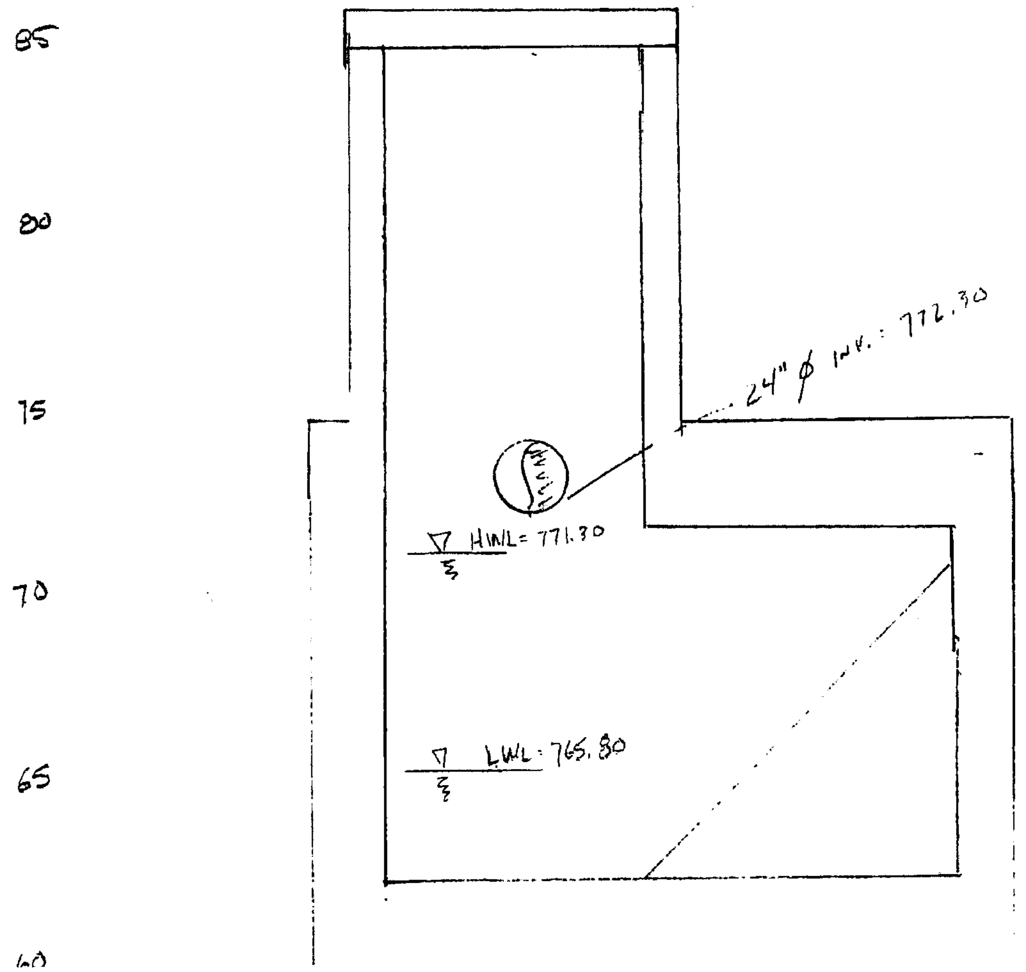

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