gasifier system purging. The tube trailer will be designed for a maximum withdrawal rate of 15,000 SCFM for 15 minutes, i.e. 225,000 SCF storage capacity.

1.9 PRODUCT GAS HANDLING

1.9.1 Gas Compression

The clean fuel gas from the Stretford plant is compressed to 40 psig and cooled to 100°F prior to dehydration and distribution. The product gas leaves the Stretford absorber at 105°F and 1.5 psig saturated with water vapor. The gas is compressed in a set of parallel compressors. The compressors are centrifugal machines with aftercoolers.

The compressors will be driven by condensing steam turbines using excess low pressure steam from the gasifier jackets. The steam is superheated prior to entering the turbines at 25 psig and 322°F (55°F superheat). There is sufficient steam to provide 100 percent of the compression duty. Because of the high specific volume of the steam, two turbines will be needed to handle the steam available. A third compressor driven by electric motor will provide 50 percent of the plant output and will be used for startup and standby duty.

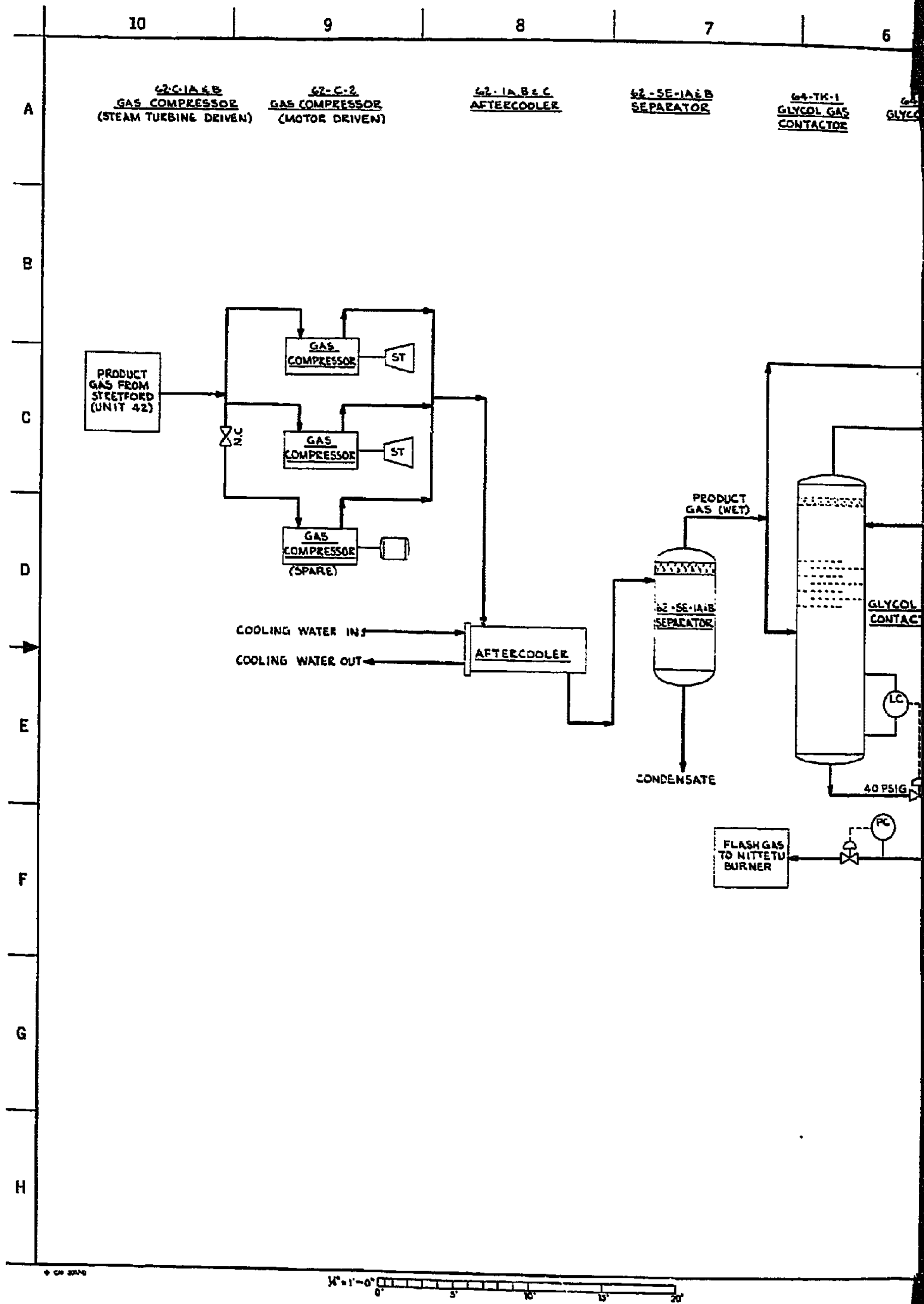
The outlet gas from the compressor will be cooled in a shell and tube heat exchanger to 100°F with cooling water in order to condense as much water as possible. It is intended to minimize the load on the dehydration unit. The condensate from the compressor aftercoolers will be used as make-up to the plant main cooling tower.

1.9.2 Gas Dehydration

In the gas dehydration unit (Unit 64), excess water from the desulfurized and compressed gas (40 psig) is removed to meet the selected medium-Btu pipeline gas specifications of water content not to exceed 53.3 lb H_2O/MM SCF. Most natural gas pipelines specifications require a water content specification not to exceed 7.0 lb H_2O/MM SCF because of long distances and pipeline pressures up to 1000 psig. However, the PGW application requires only short distance transmission and a relatively low pressure of 35 psig. Therefore, very low water content specification is not necessary and economic considerations led to the selection of 53.3 lb H_2O/MM SCF (or 20°F dew point) limit. The wet compressed gas at 40 psig and dew point of 100°F has a water content of 851.1 lb/MM SCF. Dehydration unit will remove the excess water (797.8 lb/MM SCF) to prevent gas freeze-ups and gas transmission problems such as pipe line corrosion. In most newer plants triethylene glycol (TEG) system has been utilized, as in the present design.

A process flow diagram of a typical gas dehydration plant is shown in Figure 1-9. The wet inlet gas enters the bottom of the absorber and flows upward through trays countercurrent to the concentrated (99.7 percent) glycol flowing downward through the column. 97.8 percent of the water in the gas is absorbed by glycol flowing at a rate of 1.55 gallons/ lb H_2O removed. The dry gas with a water content of 53.3 lbs/MM SCF leaves the top of the absorber through mist eliminator which aids in removing any entrained glycol droplets. It then flows through a glycol cooler and is heated from 100 to 160°F by the incoming regenerated hot glycol which is cooled from 250 to 110°F.

The dilute glycol (93.6 percent) leaves the bottom of the absorber and enters a heat exchanger coil (in the glycol still) where it is preheated before being flashed in the flash tank. The diluted glycol stream then passes through a glycol filter which removes any foreign solid particles. The clean glycol is further heated in the accumulator/heat exchanger to about 260°F and enters the glycol still (stripper) for regeneration, which is mounted on the top of a reboiler operating at 400°F.



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G
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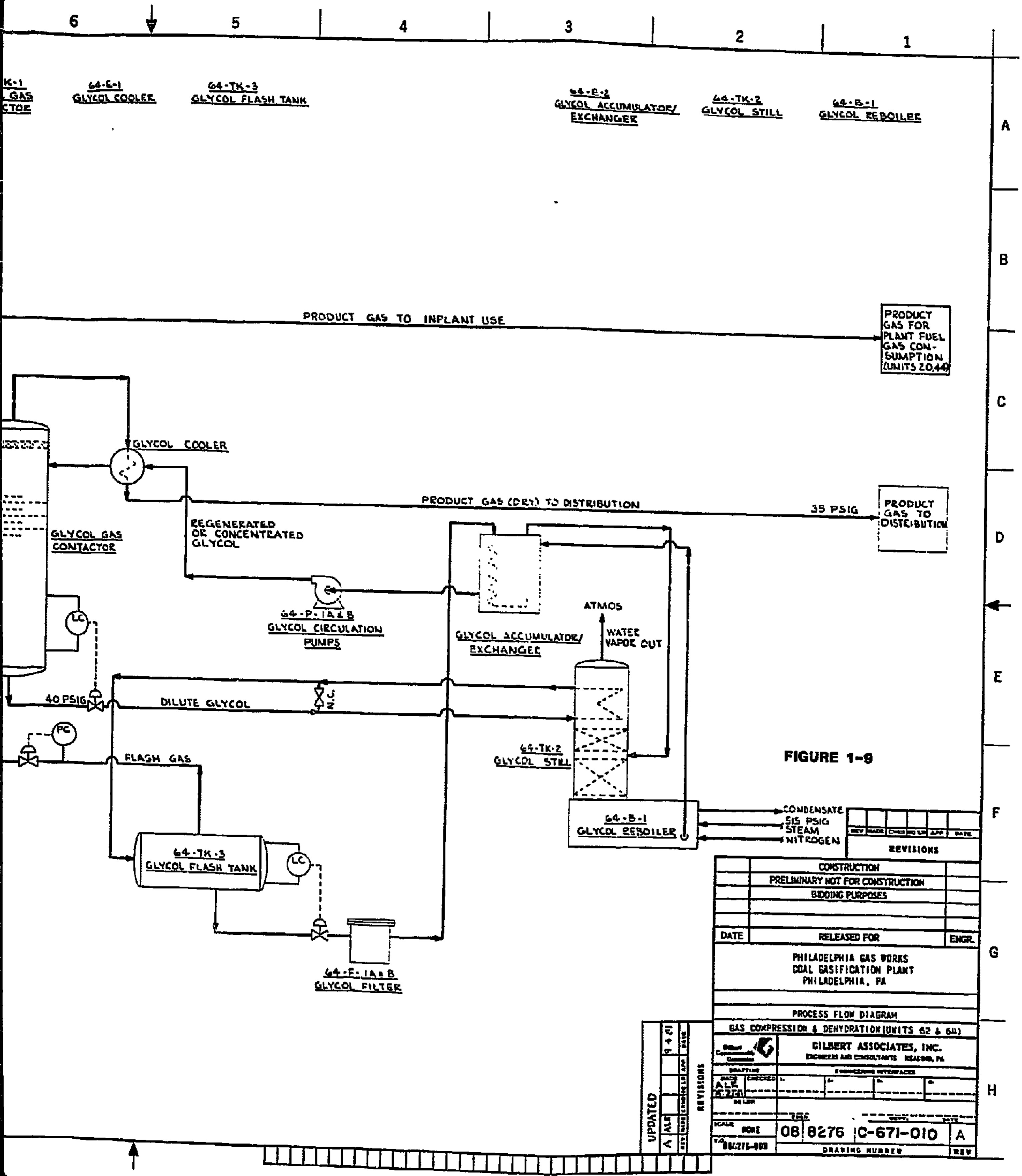
62-C-1A & B
GAS COMPRESSOR
(STEAM TURBINE DRIVEN)
62-C-2
GAS COMPRESSOR
(MOTOR DRIVEN)
62-1A, B & C
AFTERCOOLER
62-SE-1A & B
SEPARATOR
64-TK-1
GLYCOL GAS
CONTACTOR
PRODUCT GAS FROM STRETFORD (UNIT 42)
N.C
GAS COMPRESSOR
ST
GAS COMPRESSOR
ST
GAS COMPRESSOR
(SPARE)
COOLING WATER IN
COOLING WATER OUT
AFTERCOOLER
PRODUCT GAS (WET)
62-SE-1A & B SEPARATOR
CONDENSATE
LC
40 PSIG
PC
FLASH GAS TO NITTETU BURNER
¼" = 1'-0"
0'
5'
10'
15'
20'



64-E-1
GLYCOL COOLER
64-TK-3
GLYCOL FLASH TANK
64-E-2
GLYCOL ACCUMULATOR/ EXCHANGER
64-TK-2
GLYCOL STILL
64-B-1
GLYCOL REBOILER
PRODUCT GAS TO INPLANT USE
PRODUCT GAS FOR PLANT FUEL GAS CONSUMPTION (UNITS 20,44)
GLYCOL COOLER
PRODUCT GAS (DRY) TO DISTRIBUTION
35 PSIG
PRODUCT GAS TO DISTRIBUTION
GLYCOL GAS CONTACTOR
REGENERATED OR CONCENTRATED GLYCOL
64-P-1A & B
GLYCOL CIRCULATION PUMPS
GLYCOL ACCUMULATOR/ EXCHANGER
ATMOS
WATER VAPOR OUT
40 PSIG
DILUTE GLYCOL
N.C.
FLASH GAS
64-TK-2
GLYCOL STILL
64-B-1
GLYCOL REBOILER
CONDENSATE
515 PSIG STEAM
NITROGEN
64-TK-3
GLYCOL FLASH TANK
64-F-1A & B
GLYCOL FILTER
REVISIONS
CONSTRUCTION
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PROCESS FLOW DIAGRAM
GAS COMPRESSION & DEHYDRATION (UNITS 62 & 64)
GILBERT ASSOCIATES, INC.
UPDATED
A
REVISIONS
08 8276 C-671-010 A
DRAWING NUMBER

FIGURE 1-9

The dilute glycol passing downward through the stripper is contacted by hot rising water vapors passing upward through the column. The water vapor released in the reboiler and stripped from the glycol in the stripper is discharged to the atmosphere.

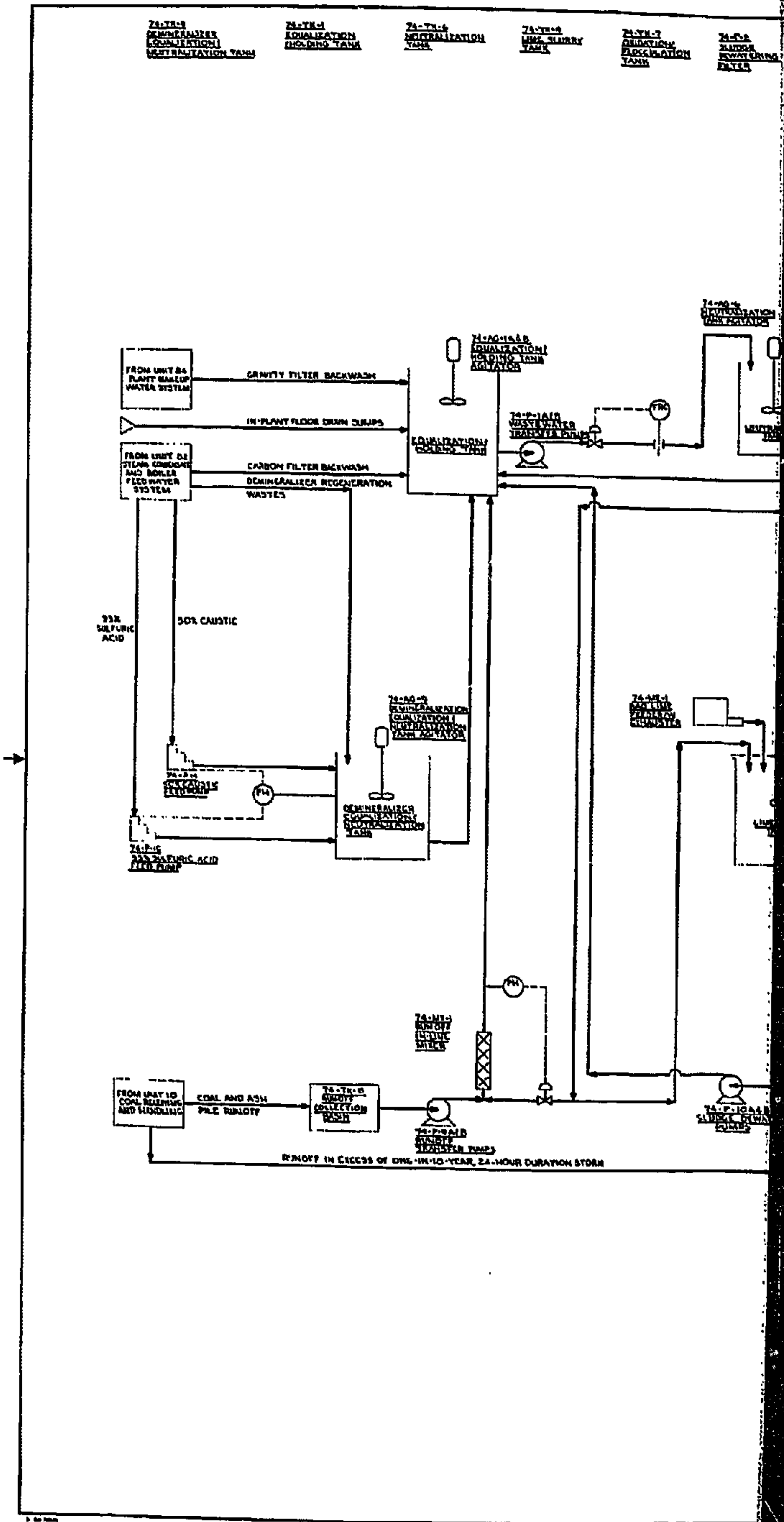
In the reboiler, glycol is concentrated to 99.7 percent by adding 1 ft^3/gallon of stripping gas (nitrogen) through a sparger. The nitrogen aids in removing any water vapor pockets which might otherwise remain in the glycol solution. The concentrated glycol from the reboiler flows to the glycol accumulator/heat exchanger, passes through the glycol cooler, and returns to the absorber to complete the cycle. A glycol makeup of 7 gal/day is required.

1.10 WASTEWATER TREATMENT

Plant industrial wastewaters are collected and treated before discharge to the Delaware River so that the effluent meets applicable discharge regulations of the U.S. Environmental Protection Agency, Pennsylvania Department of Environmental Resources, Delaware River Basin Commission and City of Philadelphia. The process flow diagram shown in Figure 1-10 schematically represents the wastewater treatment system (Unit 74). Plant industrial waste sources are as follows:

1. Travelling water screen backwash
2. In-plant floor drains
3. Gravity filter backwash
4. Carbon filter backwash
5. Demineralizer regeneration wastes
6. Coal and ash pile runoff
7. River water clarifier sludge
8. Cooling towers blowdown

Travelling water screens are backwashed to an adjacent dewatering chamber where solids are separated and the water allowed to drain



DEMINERALIZER EQUALIZATION/ NEUTRALIZATION TANK
EQUALIZATION HOLDING TANK
NEUTRALIZATION TANK
LIME SLURRY TANK
OXIDATION/ FLOCCULATION TANK
SLUDGE DEWATERING FILTER
NEUTRALIZATION TANK AGITATOR
EQUALIZATION/ HOLDING TANK AGITATOR
FROM UNIT 84 PLANT MAKEUP WATER SYSTEM
GRAVITY FILTER BACKWASH
IN-PLANT FLOOR DRAIN SUMPS
FROM UNIT 82 STEAM CONDENSATE AND BOILER FEEDWATER SYSTEM
CARBON FILTER BACKWASH
DEMINERALIZER REGENERATION WASTES
EQUALIZATION/ HOLDING TANK
WASTEWATER TRANSFER PUMPS
93% SULFURIC ACID
50% CAUSTIC
DEMINERALIZER EQUALIZATION/ NEUTRALIZATION TANK AGITATOR
DEMINERALIZER EQUALIZATION/ NEUTRALIZATION TANK
50% CAUSTIC FEED PUMP
93% SULFURIC ACID FEED PUMP
RUNOFF IN-LINE MIXER
FROM UNIT 10 COAL RECEIVING AND HANDLING
COAL AND ASH PILE RUNOFF
RUNOFF COLLECTION BASIN
RUNOFF TRANSFER PUMPS
RUNOFF IN EXCESS OF ONE-IN-10-YEAR, 24-HOUR DURATION STORM

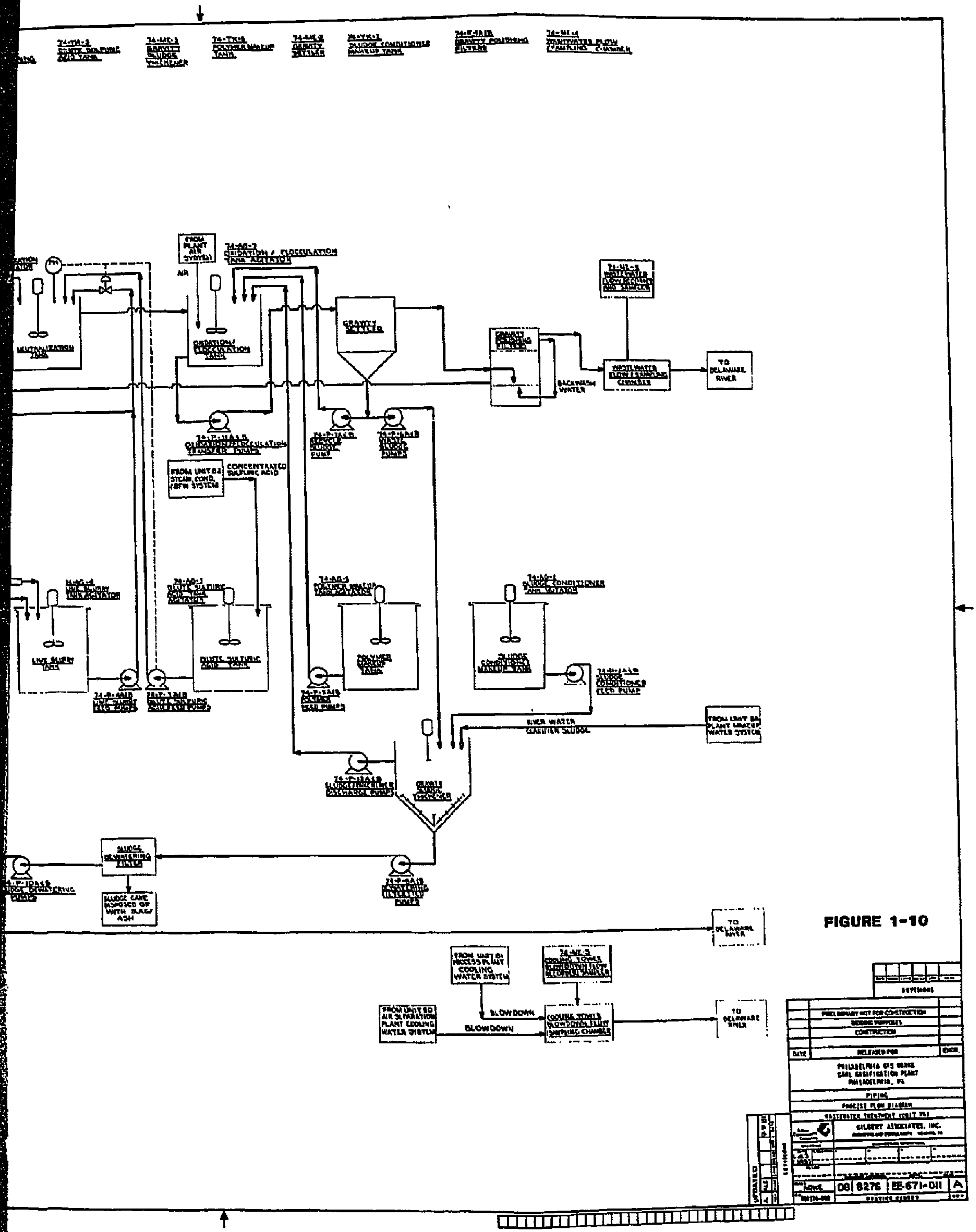

GRAVITY SETTLER
GRAVITY POLISHING FILTERS
WASTEWATER FLOW SAMPLING CHAMBER
TO DELAWARE RIVER
BACKWASH WATER
NEUTRALIZATION TANK
OXIDATION/ FLOCCULATION TANK
FROM PLANT AIR SYSTEM
AIR
CONCENTRATED SULFURIC ACID
LIME SLURRY TANK
DILUTE SULFURIC ACID TANK
POLYMER MAKEUP TANK
SLUDGE CONDITIONER MAKEUP TANK
RIVER WATER
CLARIFIER SLUDGE
GRAVITY SLUDGE THICKENER
SLUDGE DEWATERING FILTER
SLUDGE CAKE DISPOSED OF WITH SLAG/ ASH
TO DELAWARE RIVER
COOLING WATER SYSTEM
BLOWDOWN
BLOWDOWN
TO DELAWARE RIVER
REVISIONS
DATE
RELEASED FOR
CONSTRUCTION
PIPING
GILBERT ASSOCIATES, INC.
NONE
08
8276
EE-671-D11
A

FIGURE 1-10

back to the intake structure. Solids are collected in a dumpster for haulaway.

Wastes from the in-plant floor sumps, gravity filter backwash and carbon filter backwash are directed to an equalization and holding tank. Demineralizer regeneration wastewater is collected in a separate tank, where the acid and alkaline wastes are allowed to self-equalize before being "rough" neutralized and conveyed to the equalization and holding tank. Coal and ash pile runoff are collected and pumped at a controlled rate to the equalization and holding tank. An in-line mixer and pH monitor are provided in the pump discharge line. A pH controller adjusts the feed of lime slurry to neutralize the runoff to a minimum pH of 6.0, before it enters the equalization and holding tank. Rainfall in excess of the once-in-ten-year, 24-hour storm overflows directly to the outfall.

Wastewaters collected in the equalization and holding tank are mixed and pumped at a flow-controlled rate to the neutralization tank. A pH control system feeds either lime slurry or sulfuric acid solution, as required, to adjust the pH within 6.0-9.0 range. Neutralization tank overflow enters the oxidation/flocculation tank where polymer is added to the wastewater to aid in floc formation and air supplied to oxidize any iron. Overflow from the oxidation/flocculation tank enters a Lamella type gravity settler where suspended solids are separated from the wastewater. Settler overflow enters the gravity polishing filters and is then directed to the effluent flow and sampling chamber, prior to discharge to the Delaware River.

The settler sludge is periodically blown down to the sludge thickener where it combines with the river water clarifier sludge. Thickened sludge is pumped to the dewatering filter. The sludge cake is disposed of with the gasifier slag/ash in an approved landfill.

Cooling tower blowdown is generally acceptable for discharge without treatment due to the high degree of treatment provided for tower makeup water. In the final design phase, cooling tower blowdown may be used for gasifier quench or coal dust suppression, thereby eliminating the need for a direct blowdown discharge.

1.11 UTILITY SUPPORT SYSTEMS

The proper and efficient operation of the GKT gasification plant requires the following utility and offsite support systems in addition to the process units described in Sections 1.4 through 1.9.

<u>Utilities</u>

- Plant & Potable Water System (Unit 84)
- Cooling Water System (Unit 81)
- Steam, Condensate, & Boiler Feedwater System (Unit 82)
- Firewater System (Unit 83)
- Plant & Instrument Air (Unit 85)
- Sewer & Sanitary Drain (Unit 86)
- Auxillary Steam Generation (Unit 87)

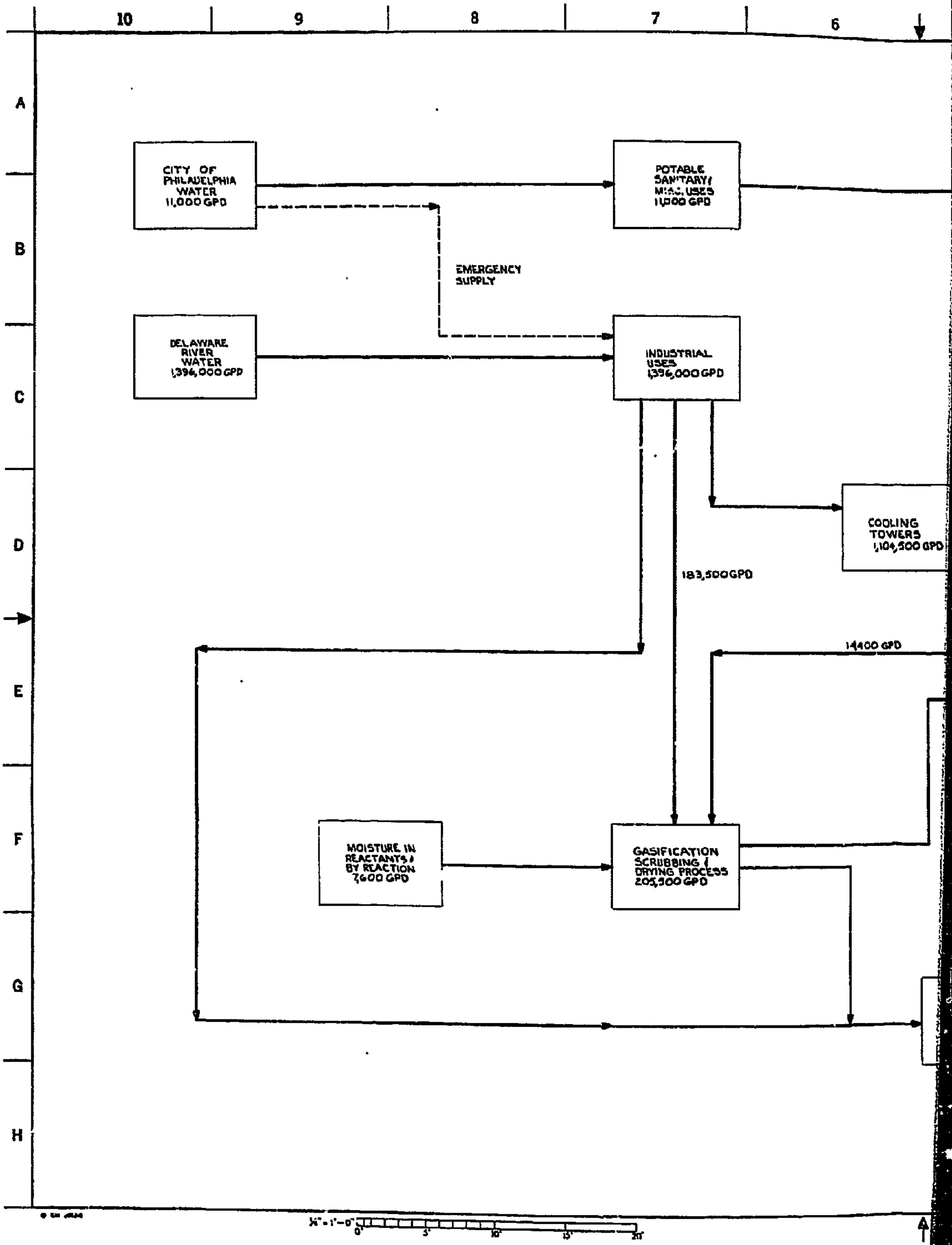
<u>Offsites</u>

- Main Process Flare & Relief (Unit 91)
- Fly Ash Removal and Storage (Unit 92)
- Slag Removal and Storage (Unit 94)

This section will describe the utility and offsite support systems essential to the operation of the plant.

1.11.1 Plant and Potable Water System

The block flow diagram shown in Figure 1-11 schematically represents the distribution of the average daily water use for the plant.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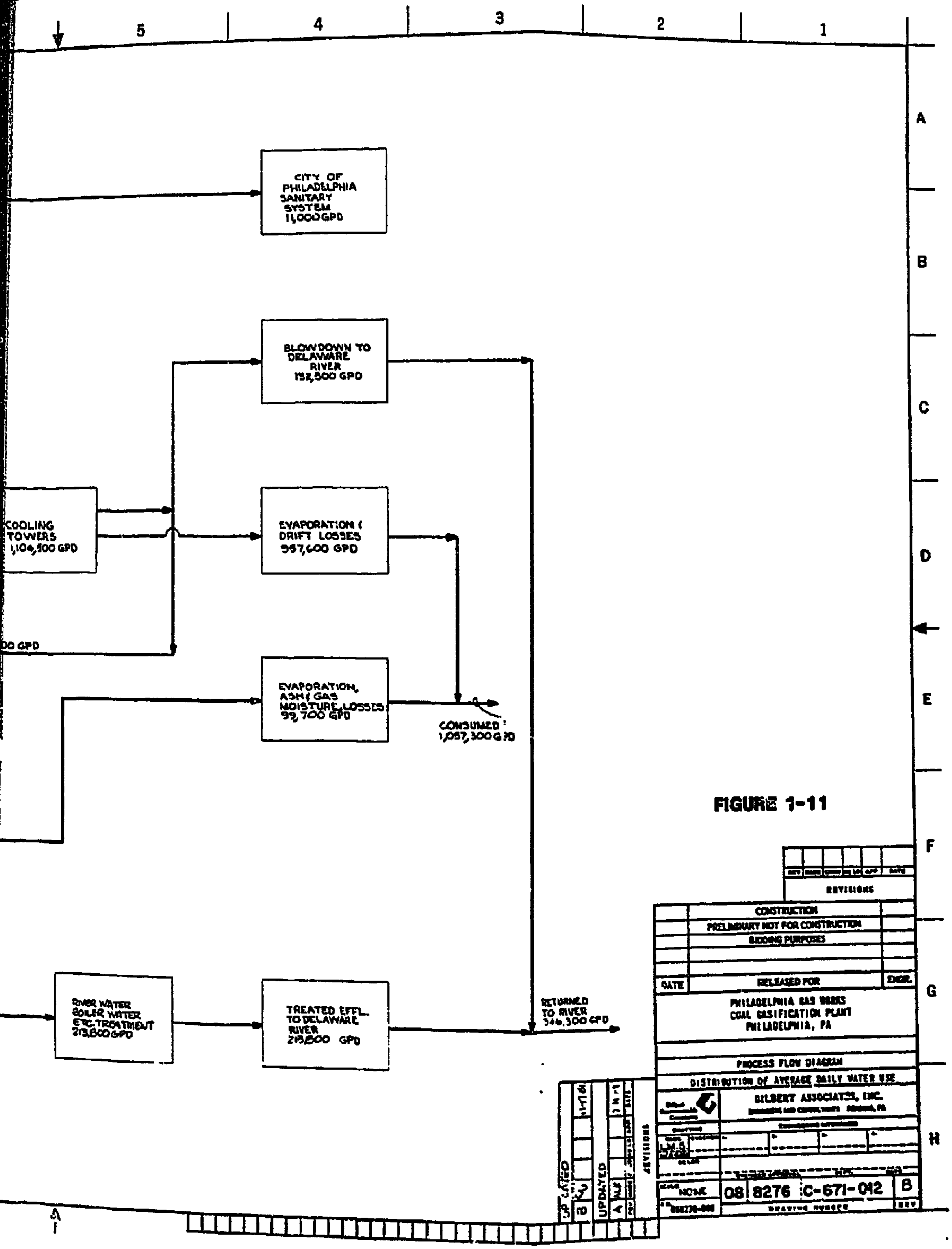
CITY OF PHILADELPHIA WATER 11,000 GPD
POTABLE SANITARY/ MISC. USES 11,000 GPD
EMERGENCY SUPPLY
DELAWARE RIVER WATER 1,396,000 GPD
INDUSTRIAL USES 1,396,000 GPD
COOLING TOWERS 1,104,500 GPD
183,500 GPD
14400 GPD
MOISTURE IN REACTANTS & BY REACTION 7,600 GPD
GASIFICATION SCRUBBING & DRYING PROCESS 205,500 GPD



5
4
3
2
1
A
B
C
D
E
F
G
H
CITY OF PHILADELPHIA SANITARY SYSTEM 11,000 GPD
BLOWDOWN TO DELAWARE RIVER 152,500 GPD
COOLING TOWERS 1,104,500 GPD
EVAPORATION & DRIFT LOSSES 957,600 GPD
00 GPD
EVAPORATION, ASH & GAS MOISTURE LOSSES 99,700 GPD
CONSUMED 1,057,300 GPD
RIVER WATER BOILER WATER ETC. TREATMENT 213,800 GPD
TREATED EFFL. TO DELAWARE RIVER 213,800 GPD
RETURNED TO RIVER 346,300 GPD
REVISIONS
CONSTRUCTION
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PROCESS FLOW DIAGRAM
DISTRIBUTION OF AVERAGE DAILY WATER USE
GILBERT ASSOCIATES, INC.
NONE
08 8276 C-671-012
B
DRAWING NUMBER
REV
UPDATED

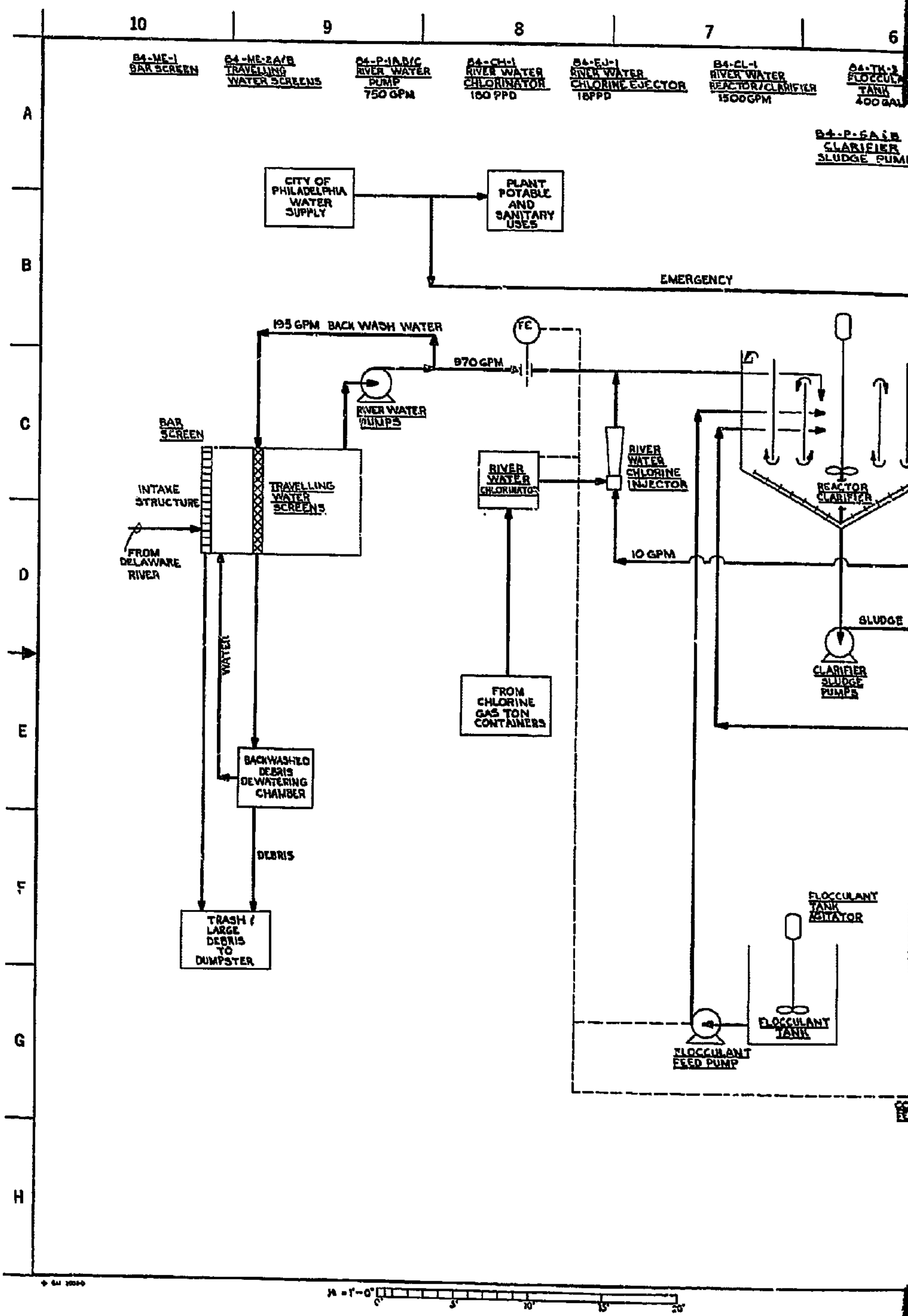
FIGURE 1-11

Potable water is required for drinking water supply and sanitary services including showers. City of Philadelphia - Water Department supply is the exclusive source of potable water. All plant water requirements are supplied from the on-site, Delaware River water treatment system.

The process flow diagram shown in Figure 1-12 schematically represents the plant makeup water treatment system (Unit 84). All flow rates shown are based on normal two gasifier operation at 100% design capacity. Plant water is drawn from the Delaware River. An intake structure is provided with a bar screen to remove sticks, leaves and other large debris from the water. This debris is collected in a dumpster and removed as trash. Travelling water screens are provided to remove smaller particles down to approximately 3/8 inch size, and are provided with an automatic screen backwash system. Backwashed debris is directed to a dewatering chamber - the water being drained back to the intake structure. River water pumps convey water to the reactor/clarifier. Three 50 percent design capacity pumps are provided, two operating and one spare.

Chlorine solution is injected into the common river water pump discharge header. River water enters the center well of the reactor/clarifier where it is mixed with recirculated sludge and coagulant. Water proceeds through a flocculation zone where a flocculant (or coagulant aid) is added. The water rises up through the sludge blanket for clarification. The clarifier overflow feeds the gravity filters for removal of any fine material. The filters are provided with an integral backwash system. A filtered water storage tank is provided to hold approximately 30 minutes supply at design flow. Three 50 percent design capacity filtered water pumps supply the process plant.

Filtered water directly from the filters is fed by gravity to the process cooling water system. All other plant services are supplied



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84-ME-1 BAR SCREEN
84-ME-2A/B TRAVELLING WATER SCREENS
84-P-1A,B/C RIVER WATER PUMP 750 GPM
84-CH-1 RIVER WATER CHLORINATOR 180 PPD
84-EJ-1 RIVER WATER CHLORINE EJECTOR 18PPD
84-CL-1 RIVER WATER REACTOR/CLARIFIER 1500GPM
84-P-6A&B CLARIFIER SLUDGE PUMP
A
B
C
D
E
F
G
H
CITY OF PHILADELPHIA WATER SUPPLY
PLANT POTABLE AND SANITARY USES
EMERGENCY
195 GPM BACK WASH WATER
FE
970 GPM
RIVER WATER PUMPS
BAR SCREEN
INTAKE STRUCTURE
TRAVELLING WATER SCREENS
FROM DELAWARE RIVER
RIVER WATER CHLORINATOR
RIVER WATER CHLORINE INJECTOR
REACTOR CLARIFIER
10 GPM
SLUDGE
CLARIFIER SLUDGE PUMPS
WATER
FROM CHLORINE GAS TON CONTAINERS
BACKWASHED DEBRIS DEWATERING CHAMBER
DEBRIS
TRASH & LARGE DEBRIS TO DUMPSTER
FLOCCULANT TANK AGITATOR
FLOCCULANT TANK
FLOCCULANT FEED PUMP

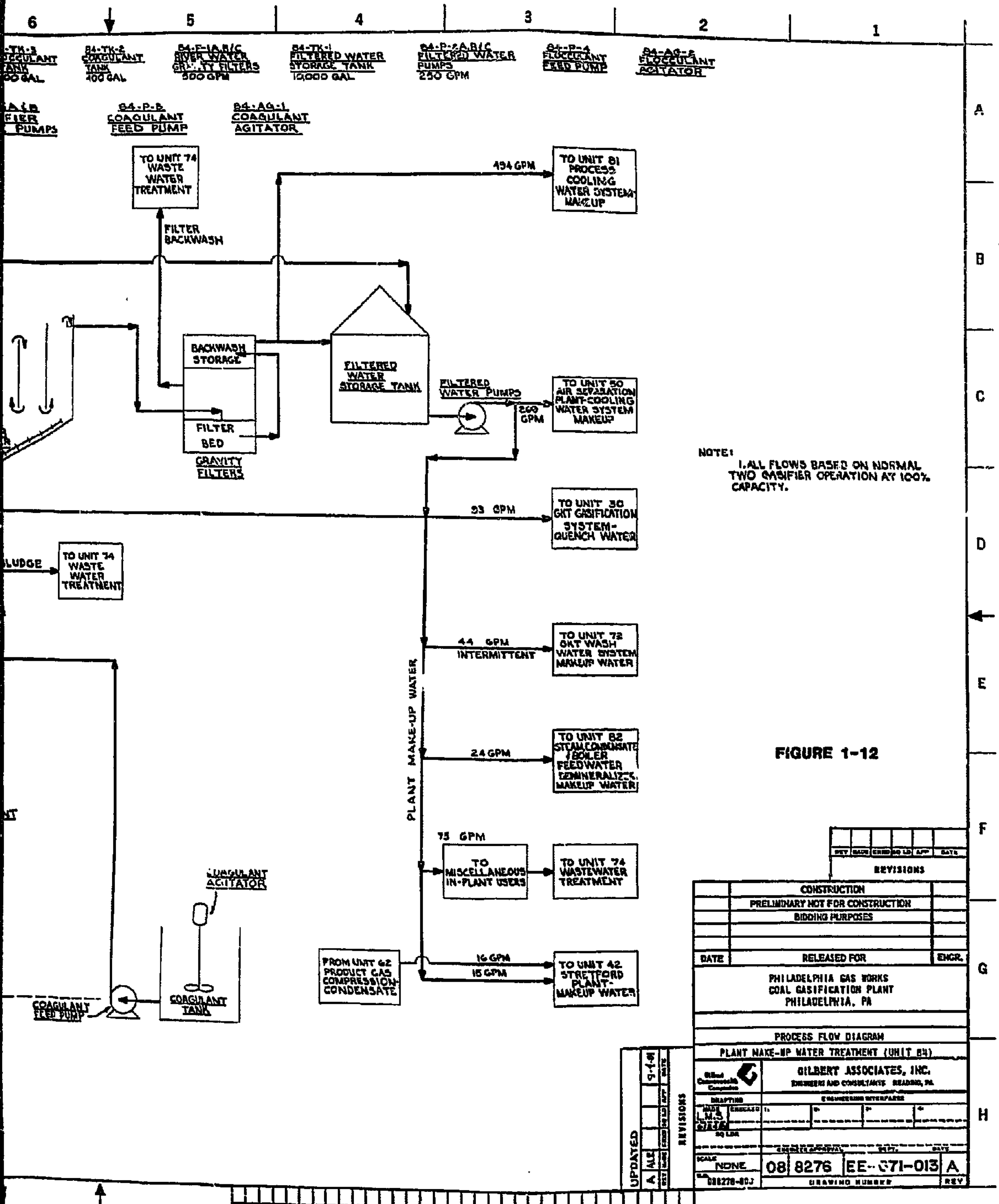

84-TK-2
COAGULANT TANK
400 GAL
84-F-1A,B/C
RIVER WATER GRAVITY FILTERS
500 GPM
84-TK-1
FILTERED WATER STORAGE TANK
10,000 GAL
84-P-2A,B/C
FILTERED WATER PUMPS
250 GPM
84-P-4
FLOCCULANT FEED PUMP
84-AG-2
FLOCCULANT AGITATOR
84-P-3
COAGULANT FEED PUMP
84-AG-1
COAGULANT AGITATOR
TO UNIT 74 WASTE WATER TREATMENT
FILTER BACKWASH
494 GPM
TO UNIT 81 PROCESS COOLING WATER SYSTEM MAKEUP
BACKWASH STORAGE
FILTER BED
GRAVITY FILTERS
FILTERED WATER STORAGE TANK
FILTERED WATER PUMPS
200 GPM
TO UNIT 50 AIR SEPARATION PLANT-COOLING WATER SYSTEM MAKEUP
NOTE:
1. ALL FLOWS BASED ON NORMAL TWO GASIFIER OPERATION AT 100% CAPACITY.
53 GPM
TO UNIT 30 GKT GASIFICATION SYSTEM-QUENCH WATER
SLUDGE
TO UNIT 74 WASTE WATER TREATMENT
44 GPM INTERMITTENT
TO UNIT 72 GKT WASH WATER SYSTEM MAKEUP WATER
PLANT MAKE-UP WATER
24 GPM
TO UNIT 82 STEAM CONDENSATE / BOILER FEEDWATER DEMINERALIZER MAKEUP WATER
75 GPM
TO MISCELLANEOUS IN-PLANT USERS
TO UNIT 74 WASTEWATER TREATMENT
COAGULANT AGITATOR
FROM UNIT 62 PRODUCT GAS COMPRESSION CONDENSATE
16 GPM
15 GPM
TO UNIT 42 STRETFORD PLANT-MAKEUP WATER
COAGULANT FEED PUMP
COAGULANT TANK
REVISIONS
CONSTRUCTION
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PROCESS FLOW DIAGRAM
PLANT MAKE-UP WATER TREATMENT (UNIT 84)
GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS READING, PA
UPDATED
SCALE NONE
08 8276
EE-071-013
A
DRAWING NUMBER
REV

FIGURE 1-12

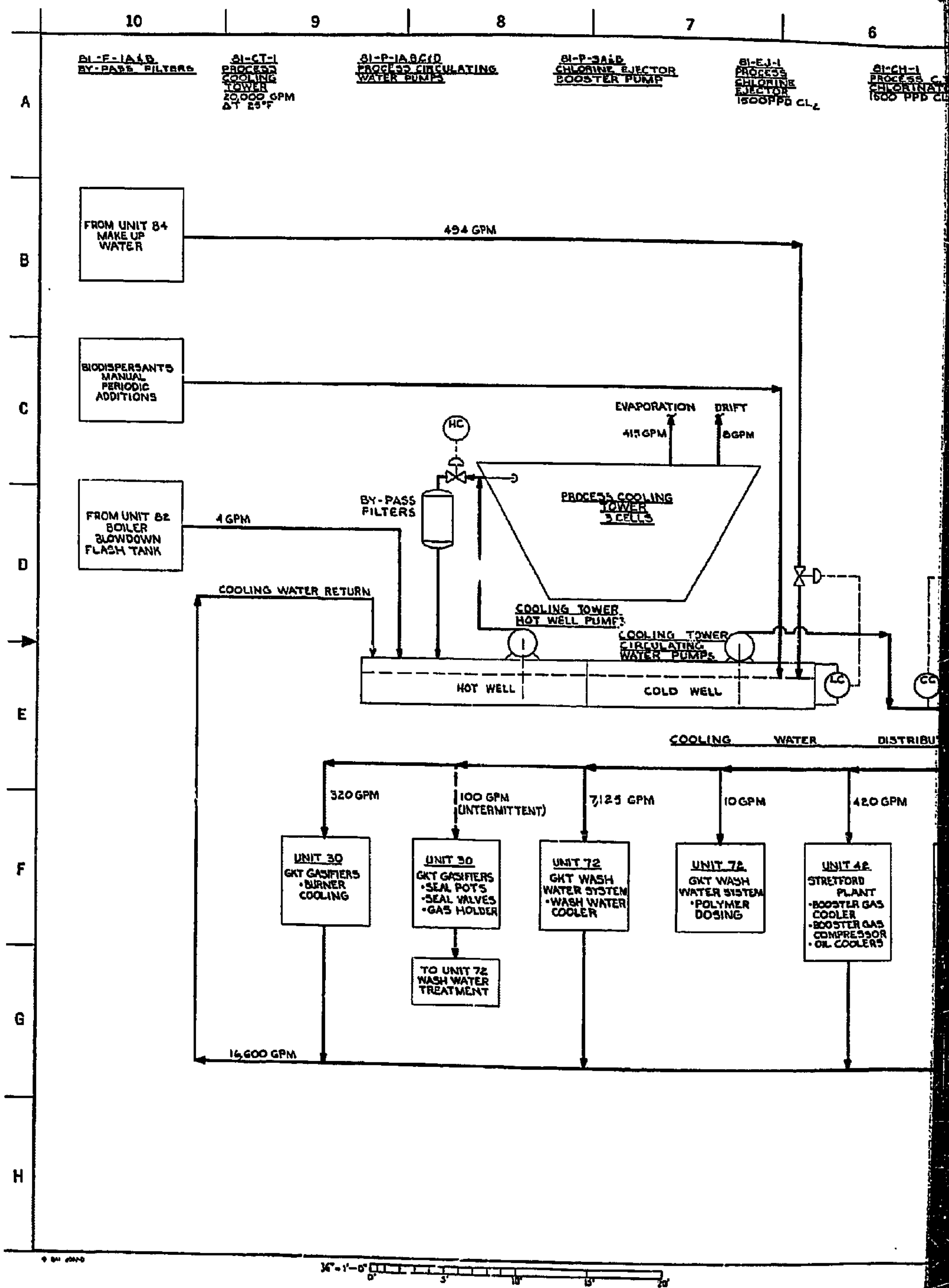
by the filtered water pumps. Filtered water is provided to the air separation plant cooling water system, to the GKT gasifier quench system, to the GKT wash water system, to the boiler feedwater makeup demineralizer system, to the Stretford plant, to the river water chlorine ejector and to the various in-plant users such as the water and wastewater treatment makeup chemical tanks.

1.11.2 Cooling Water System - Process Plant

The process flow diagram shown in Figure 1-15 represents the cooling water system (Unit 81) for the process plant. A circulating water system is provided to supply cooling water users in Unit 30-GKT coal gasification plant, Unit 72-GKT wash water system, Unit 42-Stretford plant, Unit 44-Nittetu plant, Unit 62-product gas compression, plant air compressor and other smaller use service areas.

A three-cell mechanical draft cooling tower with integral cold-well and hot-well is provided to normally dissipate approximately 220 million Btu/hr. Hot water return (110°F summer temperature) is delivered from the hot well to the top of the cooling tower. Water is cooled by evaporation of approximately 2.5 percent of the circulating flow to yield 85°F water (summer conditions) at the cold well. Makeup water from Unit 84 (Plant and Potable Makeup Water System) is automatically added to the cold well by level control. Steam blowdown also serves as makeup water to the circulating system. Four process cold well pumps are provided, three operating and one spare, to supply cooling water to the individual users throughout the process plant. All cooling water is normally returned to the cooling tower with the exception of 10 gpm used for polymer dosing in Unit 72 and intermittent flows used for seal pots, quick seal valves and the gas holder seal in Unit 30.

Makeup water for the circulating water system is treated Delaware River water which has been screened, clarified and filtered. Cooling tower blowdown is regulated via a conductivity controller



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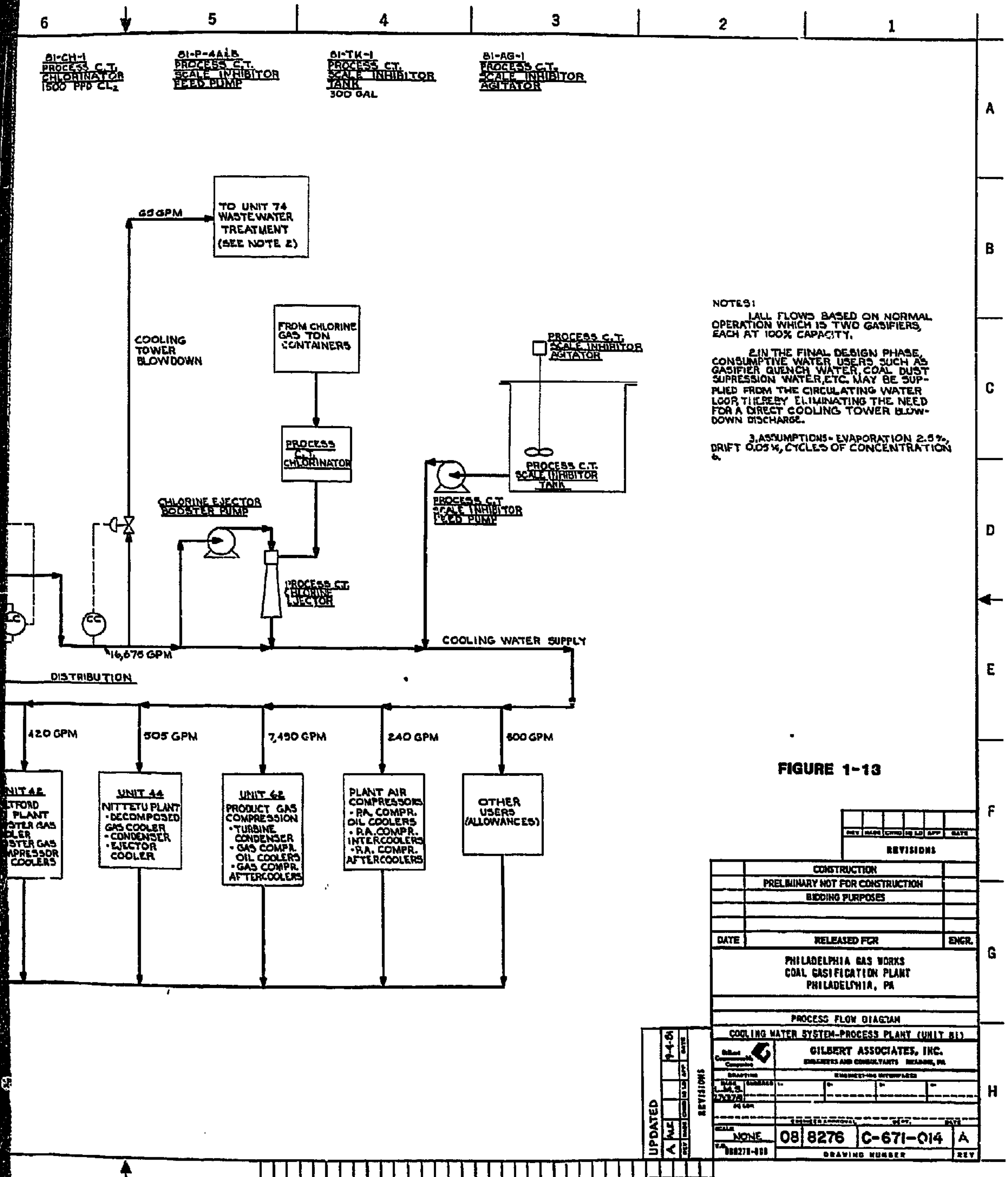
H
81-F-1A&B BY-PASS FILTERS
81-CT-1 PROCESS COOLING TOWER 20,000 GPM ΔT 25°F
81-P-1A,B,C&D PROCESS CIRCULATING WATER PUMPS
81-P-3A&B CHLORINE EJECTOR BOOSTER PUMP
81-EJ-1 PROCESS CHLORINE EJECTOR 1500PPD CL2
FROM UNIT 84 MAKE UP WATER
494 GPM
BIODISPERSANTS MANUAL PERIODIC ADDITIONS
EVAPORATION
415 GPM
DRIFT
8 GPM
HC
BY-PASS FILTERS
PROCESS COOLING TOWER 3 CELLS
FROM UNIT 82 BOILER BLOWDOWN FLASH TANK
4 GPM
COOLING WATER RETURN
COOLING TOWER HOT WELL PUMPS
COOLING TOWER CIRCULATING WATER PUMPS
HOT WELL
COLD WELL
LC
COOLING WATER
320 GPM
100 GPM (INTERMITTENT)
7,125 GPM
10 GPM
420 GPM
UNIT 30 GKT GASIFIERS •BURNER COOLING
UNIT 30 GKT GASIFIERS •SEAL POTS •SEAL VALVES •GAS HOLDER
UNIT 72 GKT WASH WATER SYSTEM •WASH WATER COOLER
UNIT 72 GKT WASH WATER SYSTEM •POLYMER DOSING
UNIT 42 STRETFORD PLANT •BOOSTER GAS COOLER •BOOSTER GAS COMPRESSOR •OIL COOLERS
TO UNIT 72 WASH WATER TREATMENT
16,600 GPM


6
5
4
3
2
1
81-CH-1 PROCESS C.T. CHLORINATOR 1500 PPD CL_2
81-P-4A&B PROCESS C.T. SCALE INHIBITOR FEED PUMP
81-TK-1 PROCESS C.T. SCALE INHIBITOR TANK 300 GAL
81-AG-1 PROCESS C.T. SCALE INHIBITOR AGITATOR
A
B
C
D
E
F
G
H
65 GPM
TO UNIT 74 WASTE WATER TREATMENT (SEE NOTE 2)
COOLING TOWER BLOWDOWN
FROM CHLORINE GAS TON CONTAINERS
PROCESS C.T. CHLORINATOR
PROCESS C.T. SCALE INHIBITOR AGITATOR
PROCESS C.T. SCALE INHIBITOR TANK
PROCESS C.T. SCALE INHIBITOR FEED PUMP
CHLORINE EJECTOR BOOSTER PUMP
PROCESS C.T. CHLORINE EJECTOR
LC
CC
16,676 GPM
COOLING WATER SUPPLY
DISTRIBUTION
420 GPM
505 GPM
7,490 GPM
240 GPM
600 GPM
UNIT 42 ...LTFORD PLANT ...STER GAS ...OLER ...OSTER GAS ...MPRESSOR COOLERS
UNIT 44 NITTETU PLANT •DECOMPOSED GAS COOLER •CONDENSER •EJECTOR COOLER
UNIT 62 PRODUCT GAS COMPRESSION •TURBINE CONDENSER •GAS COMPR. OIL COOLERS •GAS COMPR. AFTERCOOLERS
PLANT AIR COMPRESSORS •P.A. COMPR. OIL COOLERS •P.A. COMPR. INTERCOOLERS •P.A. COMPR. AFTERCOOLERS
OTHER USERS (ALLOWANCES)
NOTES:
1. ALL FLOWS BASED ON NORMAL OPERATION WHICH IS TWO GASIFIERS, EACH AT 100% CAPACITY.
2. IN THE FINAL DESIGN PHASE, CONSUMPTIVE WATER USERS SUCH AS GASIFIER QUENCH WATER, COAL DUST SUPRESSION WATER, ETC. MAY BE SUPPLIED FROM THE CIRCULATING WATER LOOP, THEREBY ELIMINATING THE NEED FOR A DIRECT COOLING TOWER BLOWDOWN DISCHARGE.
3. ASSUMPTIONS- EVAPORATION 2.5%, DRIFT 0.05%, CYCLES OF CONCENTRATION 6.
REV
MADE
CHKD
APP
DATE
REVISIONS
CONSTRUCTION
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PROCESS FLOW DIAGRAM
COOLING WATER SYSTEM-PROCESS PLANT (UNIT 81)
GILBERT ASSOCIATES, INC.
UPDATED
A
NONE
08
8276
C-671-014
A
DRAWING NUMBER
REV
FIGURE 1-13

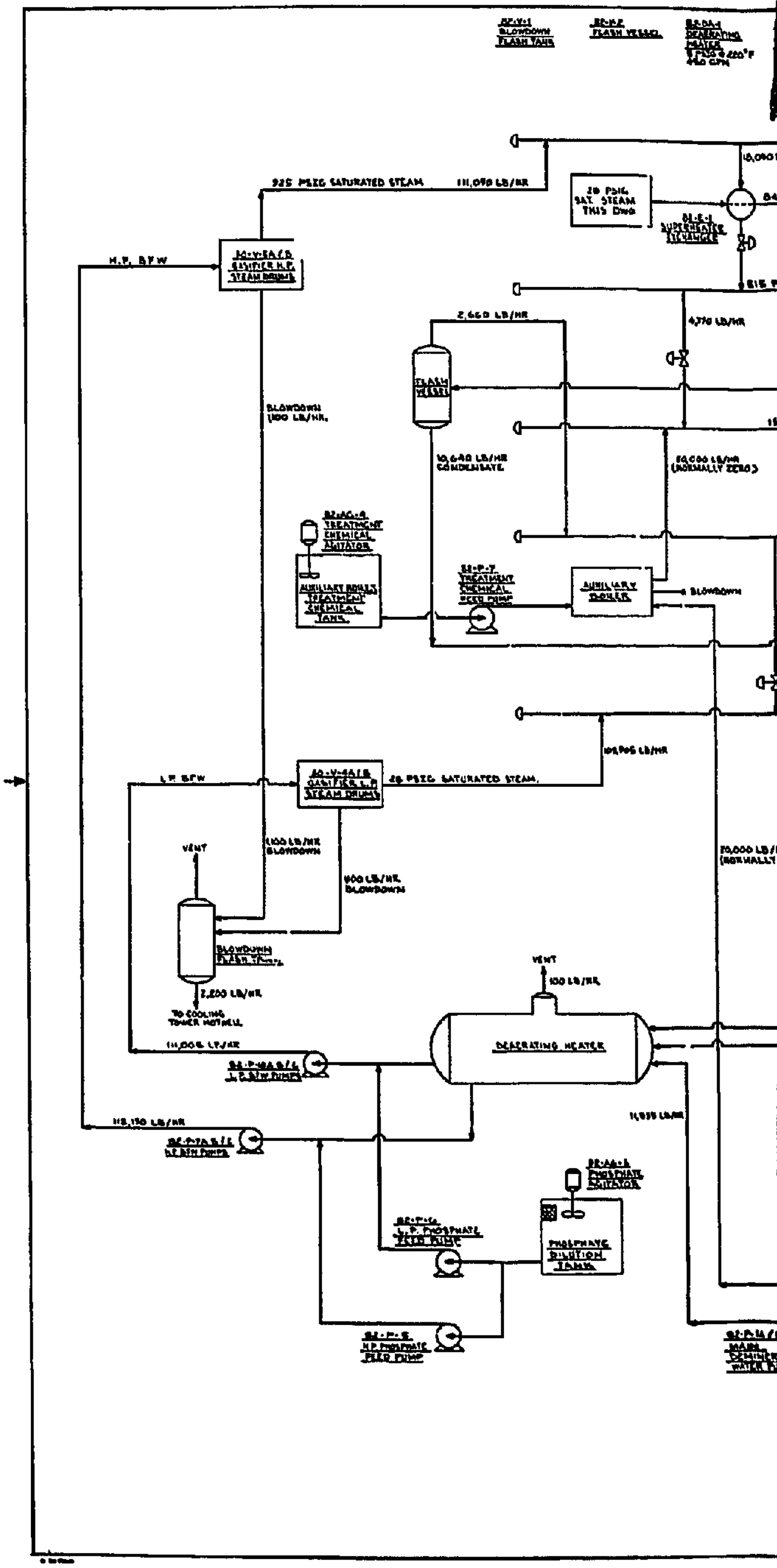
such that the normal operating cycles of concentration is 6.0. At 6.0 concentrations, the circulating water is generally balanced (i.e., does not exhibit corrosiveness or scale-forming tendencies), or has a slight scale-forming tendency. A scale inhibitor feed system is provided for maintaining a slight residual inhibitor concentration to prevent scale deposition on heat transfer surfaces.

For microbiological contamination control, shock treatment using chlorine gas is provided. Chlorine gas is supplied from one-ton containers via a manifold to the process cooling tower chlorinator. A chlorine residual analyzer provides a signal to control chlorine gas flow to the chlorine ejector. Motive and dilution water is supplied to the ejector by a booster pump. A total chlorine residual of 0.14 mg/l for a contact period of two hours is to be practiced, repeated as necessary, one to several times per day. Manual, intermittent feed of biodispersant to loosen up slime deposits is practiced several times per year.

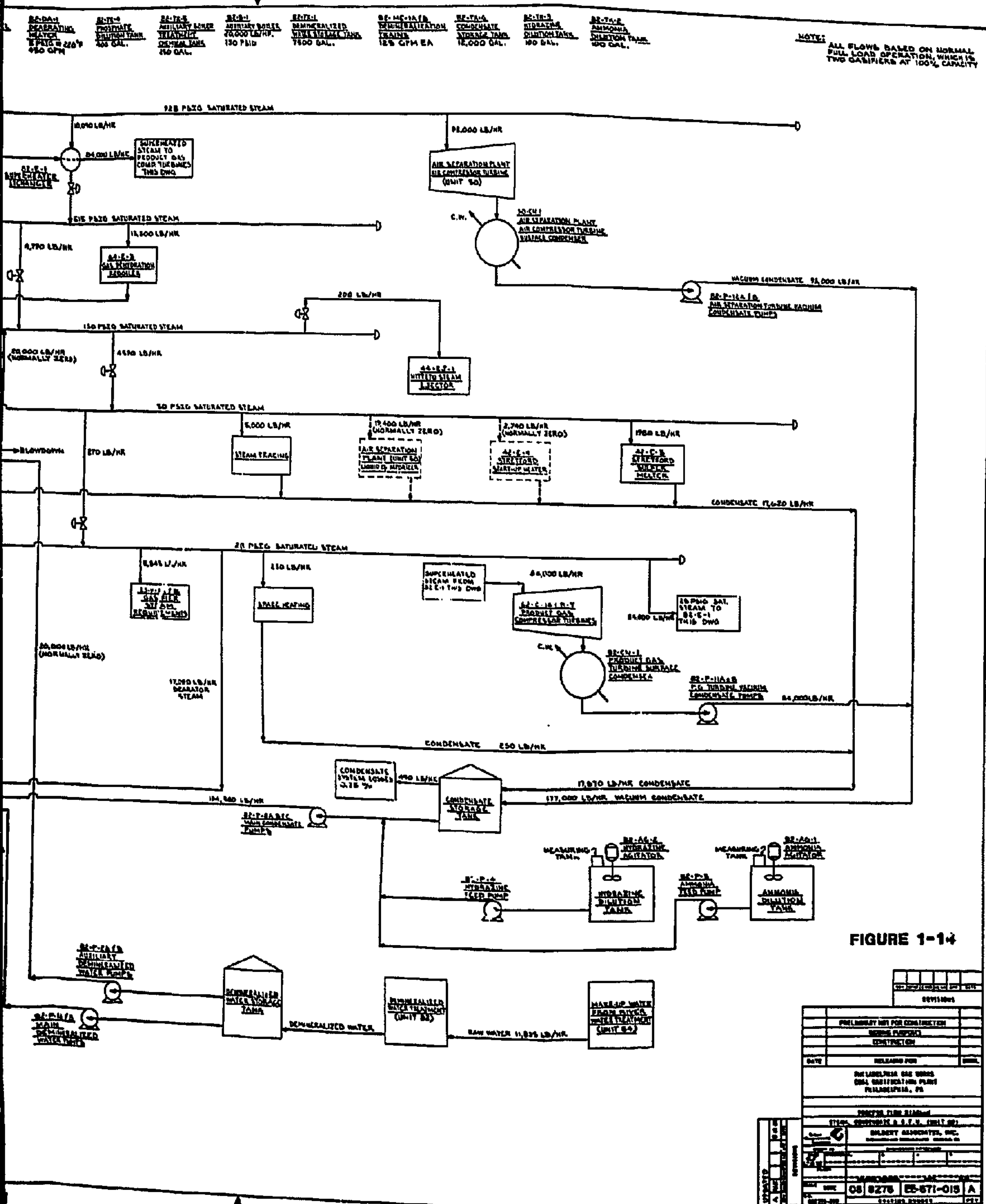
Cooling tower blowdown is discharged through a monitoring station in Unit 74 - wastewater treatment system and then directly to the Delaware River. In the final design phase, water consumers such as gasifier quench water, coal dust suppression water, etc. may be supplied from the circulating water loop, thereby eliminating the need for a direct cooling tower blowdown discharge.

1.11.3 Steam, Condensate, and Boiler Feedwater System

The process flow diagram shown in Figure 1-14 schematically represents the steam, condensate and boiler feedwater system (Unit 82). Under normal, full load, two-gasifier operation, sufficient steam is generated by the two gasifiers to support all process and plant users, approximately 65 percent of the power required for air separation plant air compression and 100 percent of the power required for product gas compression. An auxiliary boiler provides steam to supplement the normal gasifier steam supply as



BLOWDOWN FLASH TANK
FLASH VESSEL
DEAERATING HEATER
925 PSIG SATURATED STEAM
111,090 LB/HR
20 PSIG SAT. STEAM THIS DWG
SUPERHEATER
H.P. BFW
GASIFIER H.P. STEAM DRUMS
2,660 LB/HR
4,770 LB/HR
FLASH VESSEL
BLOWDOWN 1100 LB/HR.
10,640 LB/HR CONDENSATE
(NORMALLY ZERO)
TREATMENT CHEMICAL AGITATOR
AUXILIARY BOILER TREATMENT CHEMICAL TANK
TREATMENT CHEMICAL FEED PUMP
AUXILIARY BOILER
BLOWDOWN
L.P. BFW
GASIFIER L.P. STEAM DRUMS
20 PSIG SATURATED STEAM
VENT
1100 LB/HR BLOWDOWN
900 LB/HR BLOWDOWN
BLOWDOWN FLASH TANK
2,200 LB/HR
TO COOLING TOWER HOTWELL
VENT
100 LB/HR
DEAERATING HEATER
L.P. BFW PUMPS
H.P. BFW PUMPS
PHOSPHATE AGITATOR
L.P. PHOSPHATE FEED PUMP
PHOSPHATE DILUTION TANK
H.P. PHOSPHATE FEED PUMP
MAIN DEMINERALIZED WATER



NOTE: ALL FLOWS BASED ON NORMAL FULL LOAD OPERATION, WHICH IS TWO GASIFIERS AT 100% CAPACITY
128 PSIG SATURATED STEAM
92,000 LB/HR
AIR SEPARATION PLANT AIR COMPRESSOR TURBINE (UNIT 50)
SUPERHEATED STEAM TO PRODUCT GAS COMP TURBINES THIS DWG
515 PSIG SATURATED STEAM
C.W.
VACUUM CONDENSATE
150 PSIG SATURATED STEAM
200 LB/HR
50 PSIG SATURATED STEAM
5,000 LB/HR
STEAM TRACING
BLOWDOWN
CONDENSATE
25 PSIG SATURATED STEAM
SPACE HEATING
CONDENSATE 250 LB/HR
CONDENSATE STORAGE TANK
17,870 LB/HR CONDENSATE
177,000 LB/HR VACUUM CONDENSATE
MEASURING TANK
DEMINERALIZED WATER
RAW WATER

FIGURE 1-14

required for system startups, heating during gasifier shutdowns, and for equipment tracing.

The gasifier units generate two pressure levels of steam - 28 psig, saturated, low pressure (L.P.) steam from the gasifier jacket and 925 psig, saturated, high pressure (H.P.) steam from the gasifier waste heat boiler. H.P. steam is used for air separation plant air compression and let down to supply intermediate pressure steam at 515 psig, 100 psig and 50 psig levels for process users. The auxiliary boiler, generating 150 psig steam, supplements lower steam levels as required.

H.P. saturated steam at 925 psig and 537°F is generated in the gasifier waste heat boiler. Over 80 percent of the H.P. steam is fed to the air separation plant air compressor turbine. The remaining H.P. steam is let down to intermediate pressure levels. The 515 psig steam is used in the product gas dehydration reboiler and the 100 psig steam is used in the Nittetu steam ejector. The 50 psig steam is used in the Stretford sulfur melter, for steam tracing, and intermittently for the Stretford start-up heater. Gas dehydration reboiler condensate is de-pressurized in a flash drum to recover approximately 20 percent of the condensate flow as steam, at the 50 psig level. Intermediate steam pressure levels of 100 psig and less are supplemented as necessary by steam generated in the auxiliary boiler.

L.P. saturated steam at 28 psig and 272°F is generated in the gasifier jacket. About 8 percent of the L.P. steam is utilized as reactant steam in the gasification process and about 16 percent is utilized in the deaerating heater. A small portion of the L.P. steam is used for space heating; however, the majority of the L.P. steam, approximately 75 percent, is used to power the product gas compressor turbines. The 28 psig steam is superheated in a heat exchanger before being delivered to the gas compressor turbines (net of 25 psig to compressor turbines).

Under normal operating conditions, 85 percent or more of the total steam generated is returned as condensate for boiler feedwater. Condensate pumps are provided at the condensers for both the product gas compressor turbines and the air separation plant compressor turbines to convey condensate to the condensate storage tank. Three 50 percent capacity main condensate pumps convey condensate to the deaerating heater. Cycle losses are made up by demineralized water fed from the demineralized water storage tank.

Makeup water for boiler feedwater is treated Delaware River water which has been screened, clarified, filtered and demineralized. Two 50 percent demineralizer trains each consisting of a carbon filter, cation exchanger and anion exchanger are provided. One train normally operates, while the second is being regenerated and placed in the standby mode. With 85 percent of the total generated steam returned as condensate, one demineralizer train operates at approximately 25 percent capacity. The demineralizer trains are sized such that in emergencies, when contaminated condensate is dumped, all boiler feedwater for one gasifier unit can be supplied by demineralized makeup water utilizing both trains. Near zero solids water quality is specified for gasifier steam generation and dictates the BFW treatment philosophy for pH control and oxygen scavenging. Chemical feed systems are provided to feed ammonia solution for pH control and hydrazine solution for oxygen scavenging. An emergency phosphate solution feed system is provided in the event of BFW contamination.

For maximum flexibility, especially during weekend operation, three 50 percent capacity L.P. boiler feedwater pumps and three 50 percent capacity H.P. boiler feedwater pumps are provided to convey boiler feedwater to the respective L.P. and H.P. steam drums in the gasifier units.

1.11.4 Other Plant Utility Support Systems

- **Firewater System (Unit 83)**

A separate fire water protection system is provided for the gasification facility. The fire protection system consists of two fire water pumps (One electric driven and one diesel driven), a fire water jockey pump, a fire water storage tank, and an underground piping loop serving fire hydrants around each major plant facilities.

During normal operation, river water is the primary source of supply to the system. A diesel driven booster pump, taking suction from a 35,000 gallon storage tank, represents an auxiliary source of fire protection. The storage tank is fed from the city main. The fire water system pressure is maintained at a minimum of 125 psig by the fire water jockey pump.

- **Plant and Instrument Air (Unit 85)**

The gasification plant requires instrument air, plant air and a supply of nitrogen for purging equipment.

During normal operation, utility air compressors supply air at 125 psig for plant and instrument air services. The air dried to a dew point of -40°F in a fully automatic desiccant type dryer.

- **Sewer and Sanitary Drains (Unit 86)**

Sanitary sewer wastes from the gasification facility will be directed to the City of Philadelphia sanitary sewer system. Tie-in into the Philadelphia sanitary sewer system for the Riverside site shall be at Beach Street in accordance with the City regulations. A flow monitor and sampling chamber shall be constructed for the excess wash water stream in accordance to City regulations.

Storm water from the gasification facility will normally be discharged directly into the Delaware River. Storm drainage shall be diverted around coal and ash pile storage areas to prevent it from being contaminated.

Storm drainage from the process area, where the potential exists for chemical leaks or spills, shall be routed to a runoff monitoring pond before discharge. A valve shall be provided in the pond discharge line to be closed if an accidental leak or spill is detected.

- Auxillary Steam Generation (Unit 87)

A 20,000 lb/hr water-tube package boiler is provided for back-up steam generating capacity for the gasification facility. The boiler will not normally operate but will provide 150 psig saturated steam for steam tracing, space heating, and other critical services during plant shutdowns, start-ups, or turndowns. The boiler is designed to accommodate the firing of either medium-Btu producer gas, if available, or fuel oil. Fuel oil will be used during start-up or shutdown when medium-Btu gas is not available.

1.11.5 Plant Offsite Support Systems

- Main Process Flare & Relief (Unit 91)

A main process flare and relief system is required for the gasification plant to vent medium-Btu gas during emergency shutdowns. The process flare is also required to vent producer gas during reduced consumer demand periods. The amount of producer gas vented can be minimized, however, by maintaining good communication between the gasification plant and the consumers. Normally, the gasification plant is turned down prior to an anticipated consumer producer gas cut-back.

The main process will be sized to accommodate a total plant emergency shutdown at the 20 billion Btu/day rate. The main process flare system includes the following items:

a. Flare stack

b. Guyed supports

c. Flare burner tip and flare stack alloy section

d. Burner ancilliaries such as pilot and ignitor tubes

e. Flame front generator panel for pilot ignition

f. Molecular seal to prevent air diffusion back into the flare system

g. Flare knock-out drum and pump for condensate collection

A minimum diameter flare stack of 30 in. is required to accommodate a total gasification plant blowdown. The flare stack for the GKT plant is elevated 50 feet above grade to minimize the danger of high heat radiation from the flare flame to personnel in the area. The high flare elevation also aids the dispersion of combustion gases into the atmosphere. The diameter of the safety circle (440 Btu/hr/ft^2 radiation intensity) for a 20 billion Btu/day flame would be approximately 280 feet. Outside the safety circle gasification plant personnel could remain for an indefinite period during a major plant blowdown without any heat radiation discomfort.

Relief headers to the flare system are provided at several points within the gasification plant. The following relief headers are recommended for the gasification facility:

- o Upstream of GKT gas holders
- o Downstream of GKT gas holders
- o Downstream of Stretford Desulfurization Unit
- o Producer gas line exiting battery limits

For the flare stack a molecular seal installed immediately below the flare tip is recommended to prevent atmospheric air from entering the flare stack. The use of a molecular seal also reduces the amount of nitrogen required for stack purging.

o <u>Fly Ash Removal and Storage (Unit 92)</u>

The main purpose of the fly ash removal system is to remove fly ash sludge generated in the Wash Water Treatment Unit, on a continuous basis. The 50 percent moisture fly ash cake discharged from the rotary vacuum filters is conveyed to the coal feed pulverizer for recycle or to a temporary storage enclosure for disposal. The conveying system is designed to recycle a maximum of 50 percent of the fly ash cake to the coal pulverizers. If the cake is not recycled, the total fly ash produced is conveyed to storage.

The amount and composition of fly ash discharged from the gasification plant via Unit 92 is shown below for the non-recycle and the 50 percent recycle cases:

	Non-Recycle Case	50% Recycle Case
Flowrate, TPD	345	202
Composition, Wt%		
Carbon	30.93	26.46
Ash	19.07	23.54
Water	50.00	50.00

One fly ash conveying system is required to serve both gasifiers. Both rotary vacuum filters discharge fly ash cake onto a belt conveyor which elevates the material to a material divider. One stream is directed to a covered enclosure for storage and the other stream is directed for recycle to the coal pulverizer. The recycle system comprises five belt conveyors. The storage system comprises four belt conveyors and a tripper, they are integrated together to allow material to be deposited on a selective basis, over the entire plant area of the enclosure.

In the storage system, the fly ash material will be removed by a front end loader. The front end loader transfers the material onto a belt conveyor which conveys the material to a truck/railcar loader station outside the building. The belt conveyor elevates the fly ash and discharges into a surge hopper outside the building above the rail tracks, for rail or truck removal. The hopper discharges by means of rotary feed valve.

- Slag Removal and Storage (Unit 94)

The main purpose of the slag conveying and storage system is to remove, on a continuous basis, slag produced by the GKT gasification unit. The slag is transported from the GKT unit to a slag storage enclosure. Subsequently, the slag is removed from this enclosure on a batch basis and deposited in either a truck or railcar. The amount of slag generated varies with the fly ash recycle rate - it is 33 tpd at 0 percent recycle and 48 tpd at 50 percent recycle respectively. The gasification slag has the following characteristics:

Bulk Density, $lb/ft.^3$	75
Moisture Content, Wt%	15
Maximum Particle Size, in.	1/4

One slag conveying system is required to serve both gasifiers.

Each gasifier will discharge slag onto a belt conveyor. The material, carried by these two conveyors, operating in parallel, is deposited onto a common conveying system which eventually discharges into a covered storage enclosure. The common conveying system comprises four belt conveyors and a tripper. They are integrated together to allow material to be deposited, on a selective basis, over the entire plan area of the enclosure.

The slag material will be removed from storage by a front end loader. The front end loader discharges the slag onto a belt conveyor. The belt conveyor then feeds a screw conveyor by means of a transfer chute. The screw conveyor transfers slag into a surge hopper above the rail tracks for rail or truck removal.

1.12 LABOR, RAW MATERIALS, AND UTILITY REQUIREMENTS

Summarized in Table 1-5 is the labor, raw materials, and utility requirements for the operation of the PGW coal gasification plant. The operating labor requirement is based on the estimates shown in Table 1-6 for each individual unit or area.

TABLE 1-5

ANNUAL RAW MATERIALS, UTILITY, LABOR, AND BY-PRODUCT SUMMARY[1]

(PGW Coal Gasification Plant, 20.58×10^9 Btu/day)

On-Stream Factor	0.8
Raw Materials	
As Received Coal	329,376 ton/year
Stretford Chemicals[2]	104,420 lb/year
Electricity	136,761 MWhr/year
Water[3]	
City Water	3.212 MM gal/year
River Water Consumed	308.732 MM gal/year
Sanitary Sewer Discharge	34.106 MM gal/year
River Water Used and Returned	101.120 MM gal/year
Steam	None
Operating Labor	14 men/shift 3 shifts/day plus 3 men/shift 1 shift/day
By-Products[4]	
Slag	14,016 ton/year
Fly Ash	58,984 ton/year
Molten Sulfur	7,972 ton/year

Notes:

(1) 50% fly ash recycle case

(2) Stretford chemicals at \$6.45/lb. Approximately ten additional utility chemicals are required for treatment of makeup water, cooling water, boiler feedwater and wastewater at an annual cost of \$482,000.

(3)

City Water	\$1.05/1000 gallons
River Water consumed	\$0.06/1000 gallons
Sanitary Sewer Discharge	\$0.60/1000 gallons
River Water Used and Returned	\$0.0006/1000 gallons

(4)

Slag and fly ash disposal cost at	\$4-6/ton
Saleable molten sulfur credit at	\$110-125/ton

TABLE 1-6

OPERATING LABOR REQUIREMENTS

(PGW Coal Gasification Plant, 20.58 x 10^9 Btu/day)

	Men/Shift	Shifts/Day
Coal Handling	3	1
Coal Preparation	1	3
GKT Gasification	5	3
Oxygen Plant	2	3
Stretford & Nittetu Incineration	1	3
Gas Compression & Dehydration	1	3
Water Treatment	1	3
Utilities	1	3
Auxiliary Boiler	1	3
Offsites - ash & slag handling	1	3

2.0 DESCRIPTION OF THE ENVIRONMENT

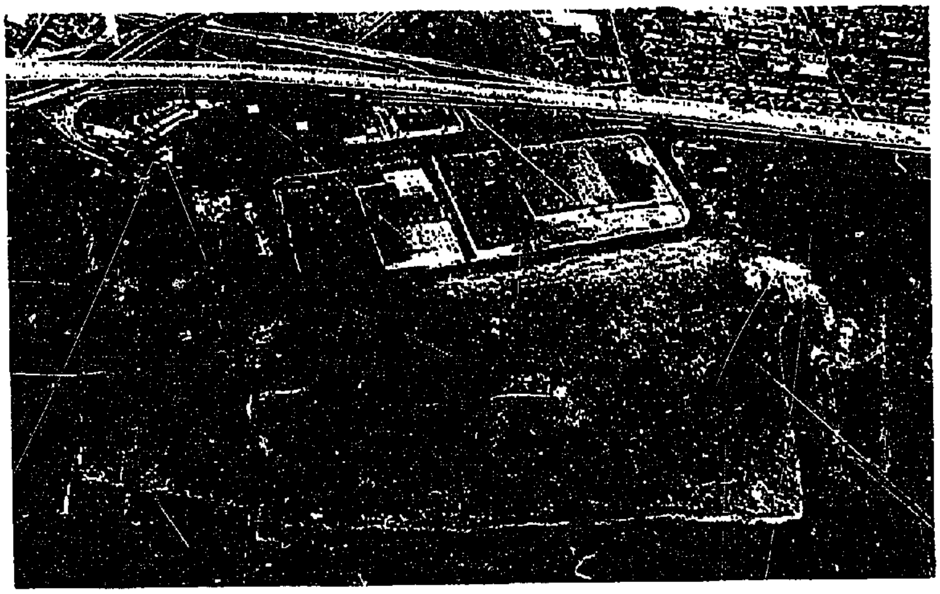
The site is the 43-acre Riverside Site, shown on Figure 2-1, now cleared and vacant, adjacent to Conrail's Port Richmond Terminal. Areas which were studied for the purpose of establishing environmental baseline conditions and contributing to the project conceptual design included the project site, the primary study area (Figure 2-2) and other selected areas. The primary study area includes the site, the pipeline corridor and its users, and the Pennsylvania area within a one-mile radius of the site. The other selected areas are those for which there were data relevant to the assessment, but the boundaries of which did not coincide exactly with the primary study area. Examples of the latter are statistics for the City of Philadelphia and selected census tracts which were used in the demographic, socioeconomic, and air quality analyses.

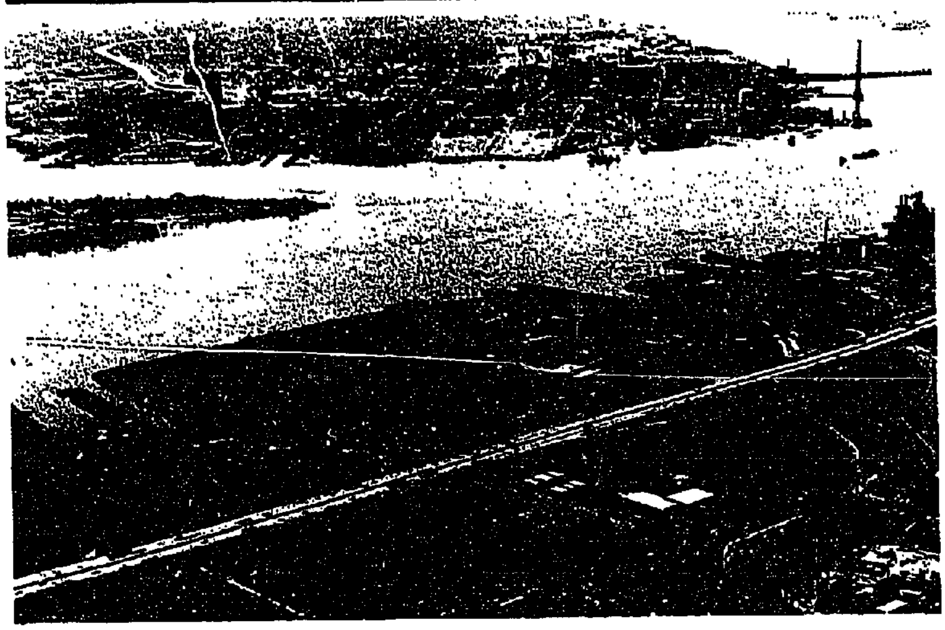
The general methods and approach employed to characterize the existing environment paralleled those outlined in the U.S. EPA's Environmental Impact Assessment Guidelines(1) and Department of Energy Guidelines.(2) Particular methods employed to characterize the existing environment are identified in the appropriate portions of the text.

Most baseline information for this assessment was developed from existing available information. Field work was limited to brief ground reconnaissance designed to measure noise levels, observe existing ecological and surface conditions firsthand, and verify the type and condition of structures in the vicinity of site and the pipeline.

2.1 PHYSICAL ENVIRONMENT

This section describes the general physical conditions that exist at the site and in the vicinity of the primary study area prior to the





Top: Overhead view of the "L" shaped site, for the PGW coal gasification plant. (I95 is visible in the upper portion)

Middle: Southeast view of site. (The Benjamin Franklin Bridge is visible in the upper right)

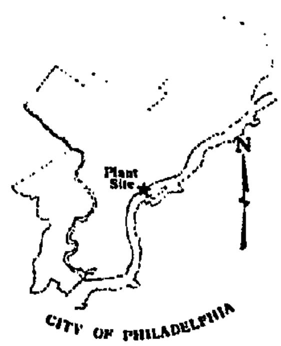


Figure 2-1
AERIAL PHOTOGRAPHS

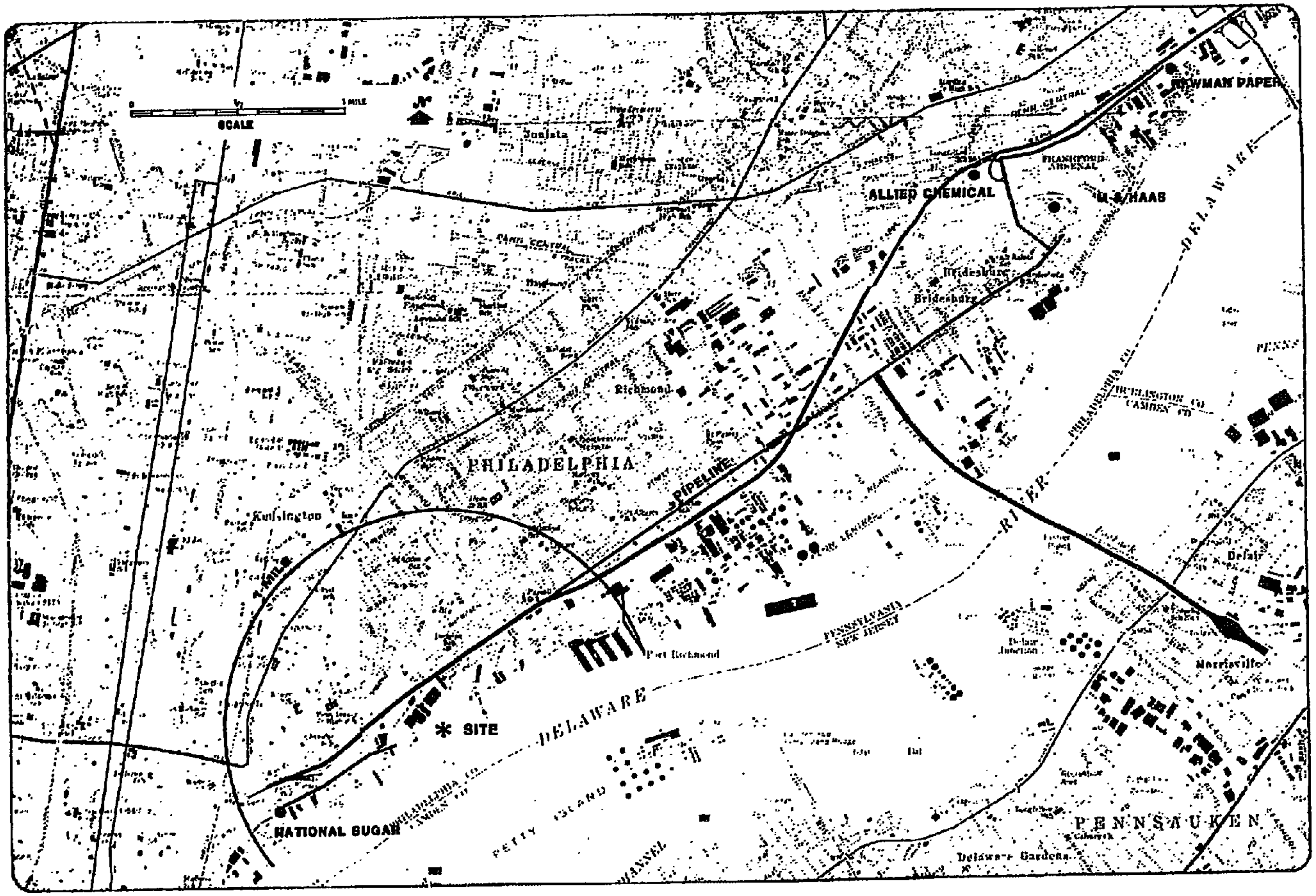


Figure 2-2

PRIMARY STUDY AREA

initiation of construction of the proposed project. Included herein are characterizations of site geology, hydrology, climate and meteorologic conditions, and air quality. Existing noise levels are addressed in Section 2.3.3.

2.1.1 Environmental Setting

The Riverside site shown in the aerial photographs on Figure 2-1 is located on the right bank of the Delaware River in northeast Philadelphia at approximately 39°58'18"N and 75°07'00"W. The site is an abandoned and filled pier area that is part of an industrial corridor between the river and Interstate Route I-95. Camden, New Jersey and an industrialized island (Petty Island) located in the New Jersey portion of the river are visible from the site. The site was selected from a number of alternatives described in the project feasibility study[3] on the basis of location in relation to the product gas users, size and availability, and environmental impacts. At present, Philadelphia Gas Works is negotiating to purchase the site from the present owner, a private trust.

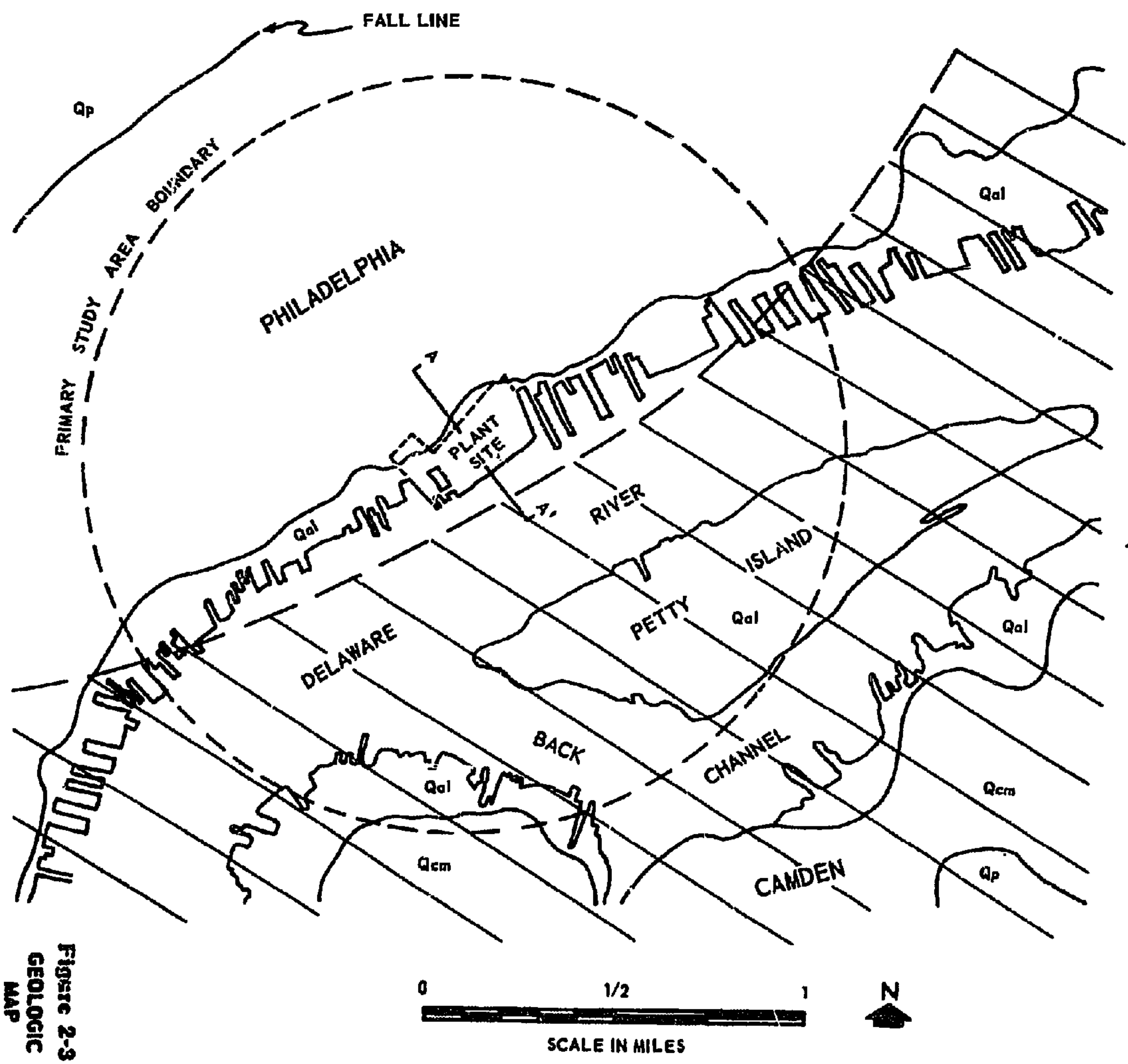
Conspicuous features of the site are rough grading, rubble, litter, and rather uniform weedy vegetation. Conspicuous features of nearby areas are tall industrial structures, abandoned structures and ruins, noise from Route I-95, coal handling facilities, and an extensive rail terminal which includes Port Richmond. Residential areas are effectively isolated from the site by elevated Route I-95.

2.1.2 Geology

The plant site is located in the Coastal Plain Physiographic Province.[4] In southeastern Pennsylvania, this province is characterized by a gently sloping surface between the Fall Line, which bounds the Piedmont Province to the northwest, and the Delaware River. Land surface rises from sea level at the river to an elevation of about 40 feet (12.2 meters) at the Fall Line and is locally incised by various drainageways. Maximum elevation at the project site is about 10 feet.

During periods of glaciation, the ancestral Delaware River cut deep channels into the underlying crystalline basement rocks. When the glacial epoch ended, floodwaters filled these older channels with glacial outwash consisting mainly of sand and gravel. These older glaciofluvial deposits have been, in turn, eroded by the river and mantled by more recent floodplain deposits of silt and clay. At the site, these floodplain deposits have been covered by a layer of fill material. A geological map is presented as Figure 2-3. A generalized geologic cross-section through the site is presented in Figure 2-4.

Stratigraphy: As shown on Figure 2-4, the site is underlain by a layer of fill material ranging from a few feet at its northwest boundary to as much as 20 feet (6.1 meters) in thickness where pier inlets have been filled. This fill layer is underlain by Quaternary floodplain deposits (mainly organic silts) which range up to 40 feet (12.2 meters) in thickness.[5] At the edge of the river channel, a wedge of fluvially deposited sands and clays belonging to the Raritan Formation of the Cretaceous Period underlies the Quaternary deposits and thickens to the southeast. On the northwestern half of the site, the Quaternary floodplain deposits may be underlain by as much as 20 feet (6.1 meters) of Pleistocene sand and gravel belonging to the Cape May Formation. The bedrock consists of a medium to coarsely crystalline mica schist to mica gneiss belonging to the pre-Cretaceous Wissahickon Formation. The bedrock surface ranges from 20 (12.2) to 50 feet (15.2 meters) in depth and dips to the southeast at a gradient of approximately 60 feet per mile (11.4 meters/kilometer).[5]



LEGEND

QUATERNARY

- Qal – ALLUVIUM: ORGANIC SILTS AND CLAYS
- Qcm – CAPE MAY FORMATION: LOWLAND TERRACE DEPOSITS OF SAND AND GRAVEL
- Qp – PENSAUKEN FORMATION: INTERMEDIATE TERRACE DEPOSITS OF SAND AND GRAVEL

CRETACEOUS

- APPROXIMATE BOUNDARY AND AREA UNDERLAIN BY RARITAN AND MAGOTHY FORMATIONS (SANDS AND CLAYS)

NOTES:

1. GEOLOGY FROM GREENMAN, ET AL., 1961 AND U.S.G.S., 1967.
2. SECTION A–A' IS PRESENTED IN FIGURE 2–2.
3. BEDROCK BENEATH THE MAPPED AREA CONSISTS OF MICA SCHIST AND MICA GNEISS BELONGING TO THE PRE–CRETACEOUS AGED WISSAHICKON FORMATION.

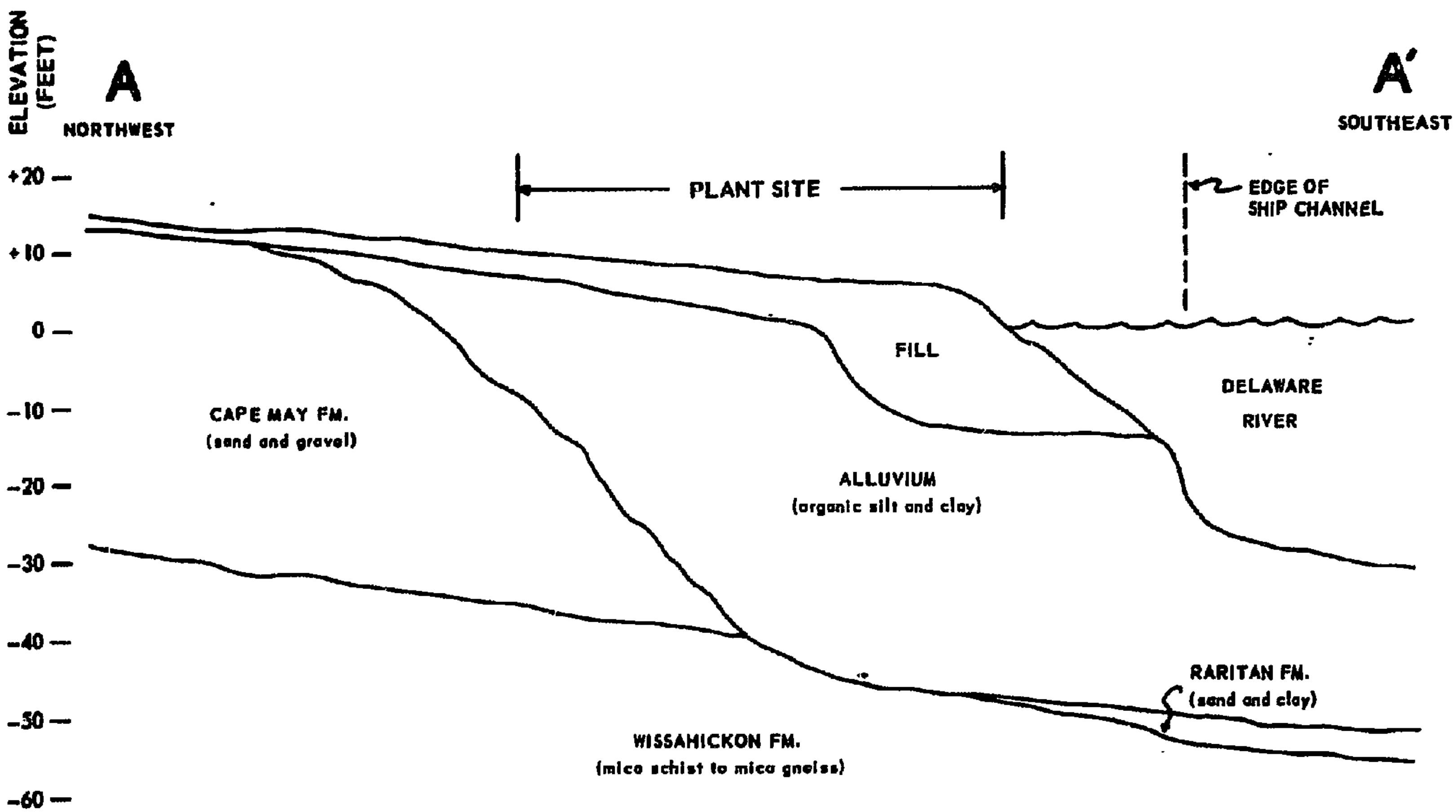
Figure 2-3
GEOLOGIC MAP

Structure: The site region lies on the southeast flank of the Appalachian Basin. The large scale structural features of this basin run from Alabama to New England. Through Pennsylvania the axis of the basin strikes approximately northeast. Bedding in the region of the site generally follows the strike of the basin (northeast) and dips southeast.(5)

The crystalline bedrock in the Philadelphia area is both folded and jointed. Both large- and small-scale folding are common with axes generally parallel to the regional trend (northeast-southwest). Jointing is irregular with intersecting joint sets resulting in breakage into polygonal blocks.(6)

Faulting and Seismicity: Minor faulting is common in the bedrock underlying the site area. These faults are generally parallel to the folding in the area (i.e., northeast-southwest). Many of these faults are filled and healed.(6) Major fault traces, also trending northeast-southwest, are located north and west of the Philadelphia area. The closest major fault is the Huntingdon Valley Fault which is about nine miles (14.5 kilometers) north of the site at its closest approach.(6) Recently it has been suggested that this fault be classified as an active fault based on the earthquake activity in the northern Philadelphia Area in March 1980.(7) However, this hypothesis is currently unsupported by direct evidence or data from seismic instrumentation and should be regarded as highly speculative.

Seismically, the site area lies within Zone 1 of the U.S. Coast and Geodetic Survey Earthquake Probability Map.(8) Zone 1 is described as a zone in which earthquake damage would be minor. Corresponding intensities are V and VI on the Modified Mercalli (MM) scale. Over 200 years of historical data show that 18 earthquakes of intensity V or greater have occurred within 50 miles (80.5 kilometers) of the site.(7,9) Of these, 17 earthquakes measured intensity V to VI and



HORIZONTAL SCALE:
ONE INCH EQUALS
APPROXIMATELY 310 FEET

VERTICAL EXAGGERATION = 15X

NOTES: THIS CROSS-SECTION IS BASED ON UNVERIFIED INFORMATION FROM THE REGIONAL LITERATURE.

Figure 2-4
GENERALIZED CROSS-SECTION THROUGH PLANT SITE

one measured intensity VII to VIII. The closest epicenter was for an intensity V to VI earthquake approximately seven miles (11.3 kilometers) to the northeast in Burlington County, New Jersey. The major historical earthquake affecting the site was the Wilmington, Delaware earthquake (12 miles or 19.3 kilometers from the site) on October 9, 1871 which was estimated to have an MM intensity of VII.[10] Because of the relatively close distance to the site, it is estimated that this earthquake would have been felt as an MM intensity of VI to VII. The recent earthquake activity of March 1980 that has been associated with the Huntingdon Valley Fault was measured as MM intensity V at the epicenter.[6]

Mineral Resources: With the possible exception of sand and gravel deposits, there are no known natural resources that could be economically produced in the site area. Sand and gravel has been produced in the past by dredging from the Delaware River.

Resources that are economically produced in the Philadelphia area include dolomite, limestone, and gneiss (building stone). The locations of these quarry operations are several miles or more from the site.

Surface Conditions: The present site surface rises gently from sea level at the river bank to an elevation of about 10 feet (3.0 meters) at the northwest edge. The surface is generally flat with scattered small mounds of fill and construction debris. A few low ridges of fill and construction debris trend north-south across the middle of the site. Both the scattered mounds and the ridges range up to about six feet (1.8 meters) in height. The material at the surface is predominantly a silty clay to a clayey silt with varying amounts of sand and gravel. This material is mixed with bricks, cinders, metal fragments, glass, wood, and concrete fragments.

Subsurface Conditions: Existing boring data taken in 1941 in the riverfront area at the site indicate that the site is underlain by 40 (12.2 meters) to 50 feet (15.2 meters) of unconsolidated sediments. This consists of 6 (1.8 meters) to 20 feet (6.1 meters) of fill underlain by 0 to 30 feet (9.1 meters) of soft, organic silt. On the northeastern half of the site, the silt is underlain by 0 to 30 feet (9.1 meters) of sand and gravel. On the southeastern half of the site, the silt is underlain by 0 to 5 feet (1.5 meters) of sand and clay.

Based on data from these borings, bedrock is estimated to be at a depth ranging from 40 (12.2) to 50 feet (15.2 meters), elevation -40 feet (-12.2 meters) to -30 feet (-9.1 meters). Rock is a mica schist or mica gneiss and is highly weathered in the top 10 (3.0) to 20 feet (6.1 meters).

At the riverfront, ship inlets for several piers have been backfilled. The fill has been end dumped and is probably very loose and susceptible to settlement. Buried concrete, sheet piling, wood piles, and wood cribbing may be encountered in the area where the piers have been buried.

At the southwest end of the site, a dry dock has been backfilled. Buried steel, reinforced concrete, and sheet piling may be encountered in this area.

Soils: The soils in the site area are mapped as undifferentiated urban soils by the USDA SCS.(11) The engineering properties of these urban soils are unlisted because of their variability.

Groundwater: The site lies over three aquifers: The Raritan Formation, the Cape May Formation, and the Wissahickon Formation. At the site, these aquifers are overlain by 15 to 40 feet of relatively impermeable alluvial silts and clays (see Figure 2-3).

The Raritan Formation begins under the southeast edge of the site at a depth of about 40 feet and thickens to the south and southeast. At the site, it ranges in thickness from 0 to 5 feet. In south Philadelphia and New Jersey, it provides significant well yields which range from 30 gpm to 1,350 gpm and average about 400 gpm.(6)

The Cape May Formation begins under the central portion of the site and thickens to the northwest. At the site, it lies at a depth of about 20 to 50 feet and ranges in thickness from 0 to 5 feet. Along the Delaware River in Philadelphia and Bucks Counties, it provides variable well yields of 8 gpm to 7,000 gpm, with the higher yields being located in southeastern Bucks County.(6)

The Wissahickon Formation underlies the whole plant site at a depth of about 40 to 60 feet. At the site, its thickness is over 2,000 feet. In the Philadelphia area it provides small to moderate well yields which range from 1 gpm to 300 gpm and average 65 gpm.(6)

In the vicinity of the site, ground water movement is to the south and southwest. Because of the constant slow recharge from the river, a ground water mound is most likely present on the southeast side of the site.

The closest well to the site is approximately 0.5 miles to the northwest (upgradient) and draws its water from the Cape May Formation. The closest downgradient wells are approximately 0.7 miles to the southwest. These downgradient wells draw their water from the Wissahickon Formation. All of these wells are used for industrial purposes. The closest well used for drinking water is one mile to the west (upgradient) in the Raritan Formation. The closest downgradient wells which are used for drinking water supply are over one mile to the south (across the river in Camden) in the Raritan Formation. Because of the ground water mound beneath the river, groundwater flow from the site vicinity probably never reaches these wells.

In summary, there will be negligible impact on the water quality of the area's wells from normal operation of the coal gasification plant. The effects on the production of any of the closest industrial wells will be negligible since any site dewatering would be for shallow excavations during construction.

2.1.3 Hydrology

The site lies along the west bank of the Delaware River at a point approximately 102 miles from the Atlantic Ocean. This portion of the river is part of the Delaware Estuary in which tidal effects largely govern the characteristics of the river.

Inflow to the estuary is gaged at Trenton, New Jersey, at U.S.G.S. gage No. 01463500. The Trenton gage is at the head end of the estuary at river mile 132 and is free from the tidal fluctuations occurring downstream. The drainage area at the gage is 6,780 square miles, while at the site, 30 miles downstream, it is 7,935 square miles.

Flows: The average monthly freshwater inflows to the estuary at Trenton range from a high of 22,500 cfs to a low of 6,000 cfs. The annual average inflow is 11,772 cfs. The tidal fluctuations in the estuary not only affect the elevation of the water surface, but also cause a daily reversal of the current.

A 1962 study[12] of the flow in the river between the Burlington-Bristol Bridge and the Delaware Memorial Bridge determined the extent of this variation in flow. This information is summarized in Table 2-1.

TABLE 2-1

VARIATION OF FLOW IN THE ESTUARY IN AUGUST 1955-1957

	Burlington-Bristol Bridge (117.4 mile)	Delaware Memorial Bridge (68.7 mile)
Maximum upstream velocity	2.31 fps	3.44 fps
Maximum upstream flow rate	66,200 cfs	594,000 cfs
Distance traveled upstream	28,700 feet	62,600 feet
Maximum downstream velocity	2.15 fps	2.61 fps
Maximum downstream flow rate	64,300 cfs	394,000 cfs
Distance traveled downstream	41,000 feet	49,200 feet

The data from Table 2-1 show that the daily exchange of water moving up and downstream in the estuary greatly exceeds the fresh water inflow. This constant movement of water thoroughly mixes the waters and results in a gradual transition in water quality from fresh water at Trenton to that of sea water at the mouth.

Water Levels: Water levels at the site can be estimated, based upon the readings of tide gages along the estuary. The nearest gages are at Palmyra, New Jersey, at river mile 107.45 and at Chester, Pennsylvania, at river mile 82.3. The maximum water level of record is estimated to be 8.8 feet above mean sea level, and the minimum at 8.7 feet below mean sea level. Normally, the level fluctuations are much less than this; for instance, the maximum tide in 1974 was about 6.8 feet above mean sea level and the minimum was about 3.1 feet below mean sea level.

High water levels, which could cause flooding of the site, where the maximum elevation is 10.1 feet,[13] are usually a combination of the effects of large fresh water inflows from the upstream drainage and high tides. Some record high water levels in the past, though, have been solely the result of high tides.

The Federal Emergency Management Agency[13] has determined the frequency of flood levels along the estuary as part of the Federal

Flood Insurance Program. The flood levels and their estimated periods are presented in Table 2-2.

TABLE 2-2

FLOOD LEVELS AND RECURRENCE INTERVALS AT THE PROPOSED SITE

Recurrence Interval (years)	Elevation (USGS Datum)	Elevation (Philadelphia Datum)
10	7.7 feet	2.0
50	9.3 feet	3.6
100	10.1 feet	4.4
500	14.8 feet	9.1

The flood plain zoning laws which have been adopted by the City of Philadelphia(14) require that all new construction in the flood plain must be constructed one foot above the level of the 100-year flood. Thus, a finished grade elevation of 11.1 feet (5.4 feet Philadelphia datum) will be required at the site.

2.1.4 Climate and Meteorologic Conditions

The site lies in the area of Pennsylvania climatologically classified as coastal plain. A humid continental type of climate prevails. The Appalachian Mountains to the west moderate the climate in the winter by protecting the area from many outbreaks of cold arctic air that frequently sweep south-eastward across the Central United States and Canada. Most weather disturbances that affect the area originate in the continental interior and are carried eastward by the prevailing westerly upper-level winds. The proximity of the Atlantic Ocean has only limited influence on the site. An exception is the occasional coastal storms of generally tropical origin that can cause above-normal precipitation.(13)

The annual average monthly temperature for the closest representative meteorological station, the Philadelphia

International Airport, is 54.6 F based upon the base years of 1941 through 1970. January exhibits the coldest monthly average, 32.3 F, while July has the highest, with a value of 76.8 F. Record extreme temperatures for the region are 104 F and -5 F. There are 19 days per year when the maximum temperature can be expected to equal or exceed 90 F. The winters are comparatively mild since there are, on the average, only 24 days of each year when the maximum temperature for a day is less than or equal to 32 F. On 100 days of each year the minimum temperature is expected to be 32 F or below. The average number of heating degree days for Philadelphia is calculated to be 4,865 for the period of record.(14)

Philadelphia shows an annual average of 39.93 inches of precipitation, with greatest amounts in the months of July and August as the result of summertime showers. The minimum amount of precipitation normally occurs in the month of February, with a 30-year average of 2.62 inches.(14) The extreme monthly amount of 9.70 inches occurred in August of 1955 largely as the result of Hurricane "Diane."(13) Mean total snowfall for the season averages 21.9 inches, the minimum amount for the Commonwealth. The record snowfall for a 24-hour period in Philadelphia is 14.6 inches.

The relative humidity, based on available records for the Philadelphia Airport, averages 67 percent, with a maximum average value of 76 percent observed at 7 A.M. and a minimum of 55 percent observed at 1 P.M.

The design Wet-Bulb value for Philadelphia, which is only exceeded one percent of the time in the months of June to September, is 77 F.

The annual prevailing wind direction for the Philadelphia International Airport is from the west-southwest, with a mean wind speed of 9.6 miles per hour. The prevailing wind direction for the summer months is from the southwest while northwesterly prevail in the winter season. Destructive wind speeds are comparatively rare and occur mostly in association with summer thunderstorms. The extreme recorded wind speed at Philadelphia is from the west-northwest at 73 miles per hour.(14) The occurrance of strong winds in the winter months usually accompanies advancing cold air following the passage of a deep low pressure system through the area. The damage from hurricanes in the area is from flooding rather than persistent high winds.(13)

Thunderstorms occur on the average 27 days per year with the heaviest distribution in the summer months. Heavy fog (visibility less than one-quarter mile) is observed on the average of 24 days per year. Heavy fog conditions are less prevalent in the city than at the airport because of urban heat effects.(14)

Hail occurrences are rare in the Philadelphia vicinity and are associated with summertime thunderstorms. For the 40-year observation period considered, there have only been 27 days upon which hail has been observed at the Philadelphia Airport. This value is minimal when compared with Cheyenne, Wyoming where hail was observed on 380 days.(15) Glaze ice storms are relatively rare in the Philadelphia area. This type of storm occurs when freezing rain or drizzle impacts upon exposed surfaces. Probability estimates of ice storms of this type have been developed. In a period of 50 years ice with a thickness equal to or greater than 2.5 cm (1 inch) was observed four times in the Commonwealth. In another study there were 18 to 26 glaze storms at various points in the Commonwealth over a period of nine years without regard to ice thickness. In nine years there were ten occurrences of ice storms where the thickness was equal to or greater than one-quarter inch and six storms where the ice was equal to or greater than one-half inch. The probability of at least one occurrence of an ice storm in any year at a representative point in the region is given as 0.0020 for thickness $\leq$ 2.5 cm (1 inch) and 0.00050 for ice thickness $\leq$ 5.0 cm

(2 inches). The region of the country (Illinois, Indiana, and Ohio) where the most storms are observed show probabilities of 0.0060 and 0.00018 for the same ice thickness noted above.(19)

The occurrence of severe weather in the site region is minimal. The probability for a tornado affecting a point in the Philadelphia area has been computed with a recurrence interval of one tornado in 2,653 years. As a point of comparison, the risk to any point in Oklahoma City (the highest tornado frequency in the United States) is five times greater than in Philadelphia.(16)

Hurricanes have only rarely caused widespread damage in the site region. Damage, when it occurs, has usually been through flooding and not wind. Two notable hurricanes caused excessive damage in the Philadelphia area through flooding. Hurricane "Connie" (lifetime of August 3 through 14, 1955) caused rains in excess of nine inches in many eastern Pennsylvania localities. These rains did not cause excessive flooding, but served to saturate the ground, fill the streams, and set the stage for Hurricane "Diane" which passed through the area a few days later. "Diane" (lifetime of August 7 through 21, 1955) passed through Philadelphia on the 18th of August. Damage from winds associated with this storm were minimal, but record-breaking rainfall occurred in Pennsylvania and several New England states. These rains produced devastating floods on the Schuylkill and Delaware Rivers.[13] In June 1972, Tropical Storm "Agnes" caused extensive damage in other areas of Pennsylvania, but did not produce excessive rains in the immediate Philadelphia area.

The dispersion of atmospheric pollutants is dependent primarily on the stability of the atmosphere and the wind speed. Atmospheric stability characterizes the general turbulent structure of the atmosphere with Class 1 (Extremely Unstable) favoring the best conditions for the period 1960 to 1964 for the Philadelphia Airport are given as follows:

Class 1	(Extremely Unstable)	00.4954 percent
Class 1	(Extremely Unstable)	00.4954 percent
Class 2	(Unstable)	04.9773 percent
Class 3	(Slightly Unstable)	10.9729 percent
Class 4	(Neutral)	51.1815 percent
Class 5	(Slightly Stable)	14.1579 percent
Class 6	(Stable)	18.2150 percent

It is noted that atmospheric conditions did not favor good dispersion 32 percent of the time during this period of record.(17)

The dilution of pollutants is proportional to the wind speed; the ground level concentration of pollutants is inversely proportional to the wind speed. It has been found that a dilution factor based upon the product of the mixing height (meters) and the wind speed (meters per second) is a good predictor of pollutant dispersion. The smaller the value of this product (H X U), the slower is the rate of dilution of pollutants within an urban mixing layer. Data were analyzed for 62 locations in the United States for the slowest dilution episodes for time periods of one to five days. The values given in Table 2-3 for Philadelphia were extracted from an isopleth analysis for the contiguous United States. The mean values are given for comparison purposes in order to relate to dilution at other locations in the country.(18)

TABLE 2-3

DILUTION OF POLLUTANTS - PHILADELPHIA, PA(14,20)

Slowest Dilution Period Lasting	Dilution Factor	Mean Dilution Factor
1 day	200 m^2/sec	263.03 m^2/sec
2 days	450 m^2/sec	472.67 m^2/sec
3 days	410 m^2/sec	664.85 m^2/sec
4 days	1400 m^2/sec	945.60 m^2/sec
5 days	1600 m^2/sec	1133.30 m^2/sec

2.1.5 Existing Air Quality

The City of Philadelphia is a part of the Metropolitan Philadelphia Interstate Air Quality Control Region (Pennsylvania - New Jersey - Delaware). In Pennsylvania the counties of Bucks, Chester, Delaware, Montgomery, and Philadelphia are included in the Control Region. In New Jersey, the counties include Burlington, Camden, Gloucester, Mercer, and Salem Counties. In Delaware, New Castle County is considered as part of the AQCR.

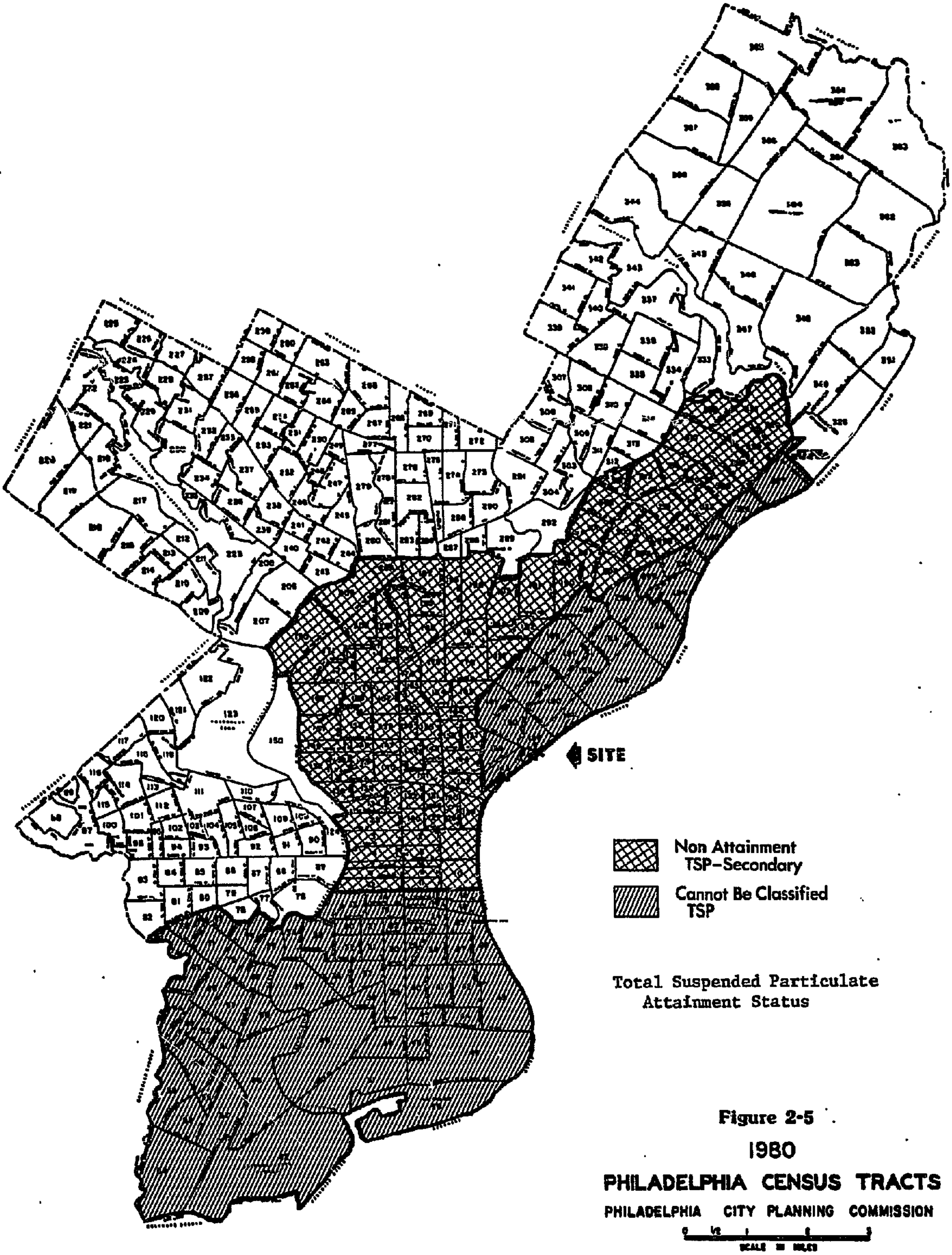
The Clean Air Act Amendments of 1977 required the states and the Environmental Protection Agency to classify all areas under their jurisdiction as to attainment of the National Ambient Air Quality Standards. These classifications refer to the pollutants of sulfur dioxide, total suspended particulates, nitrogen dioxide, carbon monoxide, and photochemical oxidants (O_3). In the City of Philadelphia the classification of attainment and non-attainment of air quality standards has been based upon census tract boundaries. These classes of the criteria pollutants are discussed in the following sections.[21]

Suspended Particulate Matter: The National Ambient Air Quality Standards for total suspended particulates (TSP) are as follows:

Annual - Primary 75 μg/m3; Secondary - 60 μg/m3; and 24-hour - Primary 260 μg/m3, Secondary 150 μg/m3.[22] Currently there are a large number of census tracts that have been classified as "non-attainment TSP - Secondary standards." The specific tract numbers are: Numbers 1-12, 125-142, 144-157, 162-177, 190-205, 293, 294, 298-302, 315-321, 323, 325, 326, and 329-332. This classification is based upon monitoring stations within the area. In cases where insufficient data are available for developing a classification, but where it is presumed that the standards may not be attained, the term "unclassified" is used. Tract Numbers 13-75, 143, 158-161, 178-189, 295-297, 322, 324, and 327 are classified in this way. The areas are depicted on Figure 2-5. It is noted that the proposed site is at the edge of an area termed "unclassified" which extends northeastward along the Delaware River. The remainder of the City of Philadelphia is classified as "attainment" for total suspended particulates.

In neighboring New Jersey, the City of Camden is classified as "non-attainment" TSP - Secondary standards." The remainder of the Metropolitan Philadelphia Interstate AQCR in New Jersey is considered to be attainment for TSP.

<u>Sulfur Dioxide</u>: The National Ambient Air Quality Standards for sulfur dioxide are as follows: Annual - Primary 0.03 ppm (80 μg/m3); 24-hour - Primary 0.14 ppm (365 μg/m3); and 3-hour - Secondary 0.50 (1,300 μg/m3).[22] The sulfur dioxide "non-attainment - Primary" area in Philadelphia is confined to Census tracts 2-9, 11, and 12. As can be seen on Figure 2-6 this area includes center city west of 7th Street to the Schuylkill River and bounded by Vine Street on the north and South Street on the south. This area is defined by monitor readings from an observation point on South Broad Street. The balance of the city is considered to be "Better than National Standards." The proposed site of the coal gasification plant is located outside of this "non-attainment" area.



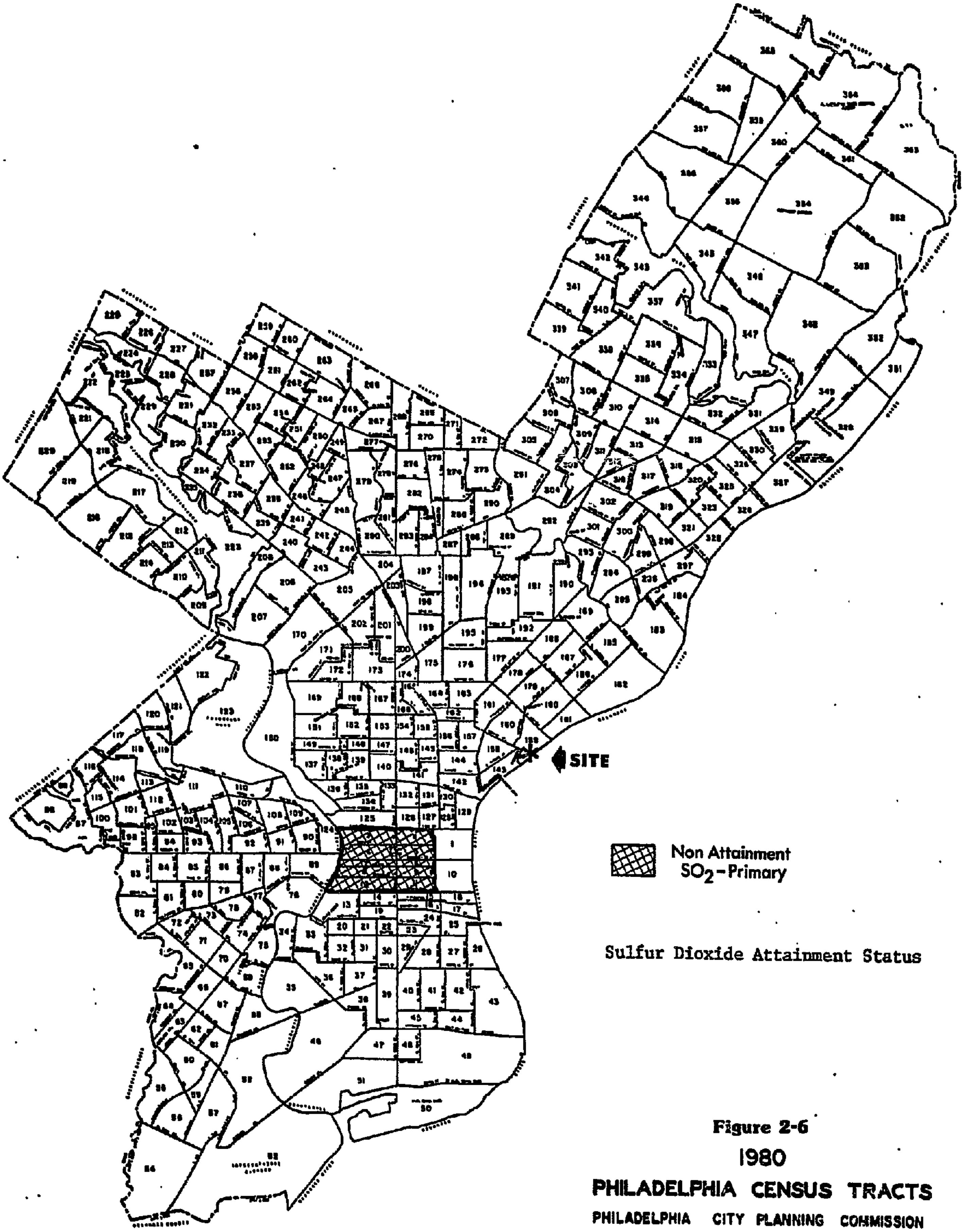
Total Suspended Particulate Attainment Status

Figure 2-5

1980

PHILADELPHIA CENSUS TRACTS

PHILADELPHIA CITY PLANNING COMMISSION



Sulfur Dioxide Attainment Status

Figure 2-6

1980

PHILADELPHIA CENSUS TRACTS

PHILADELPHIA CITY PLANNING COMMISSION

Delaware County in the Metropolitan Philadelphia Interstate AQCR is categorized as "Cannot be Classified." The remainder of the AQCR is classified as "Better than National Standards."

Nitrogen Dioxide: The National Ambient Air Quality Standard for nitrogen dioxide is based upon an annual average. The primary and secondary standards are the same with a value of 0.05 ppm (100 $\mu g/m^3$).(22) There are three stations monitoring this criteria pollutant in the City of Philadelphia. The city is classified as "Cannot be Classified or Better than National Standards." This classification also applies to the remainder of the Metropolitan Philadelphia Interstate Air Quality Control Region.

Carbon Monoxide: The National Ambient Air Quality Standards for carbon monoxide are based upon 1- and 8-hour standards. The 1-hour standard is 35 ppm (primary and secondary) and the 8-hour standard is 9 ppm.(22) The city business districts with high traffic density are classified as "Does Not Meet Primary Standards." The remainder of the city is listed as "Cannot be Classified or Better than National Standards." This category also applied to the remainder of the Pennsylvania portion of the Metropolitan Philadelphia Interstate AQCR. In the New Jersey part of the Metropolitan Philadelphia Interstate AQCR, the Cities of Trenton, Burlington, and Camden, and the Borough of Penns Grove are classified as "Does Not Meet the Primary Standards." The remainder of the AQCR is "Cannot be Classified or Better than National Standards." This classification also applies to the New Jersey parts of the Metropolitan Philadelphia Interstate AQCR.

Photochemical Oxidants (Ozone): The National Ambient Air Quality Standard for ozone is 0.12 ppm for the time period of 1-hour (primary and secondary).(22) The City of Philadelphia and the remainder of the state are classified as "Does Not Meet Primary Standards."

2.2 BIOTIC ENVIRONMENT

The phrase "biotic environment" is used here to refer collectively to all living organisms and systems (exclusive of humans) which inhabit or utilize the site, the primary study area, or the Delaware River in the vicinity of the site.

Information presented in the following sections was obtained from site visits, pertinent literature, and state and federal regulations. Existing water quality is presented and compared with applicable regulations. Existing habitats are described and the most important or abundant species are discussed below.

2.2.1 Terrestrial Ecology

Because the site has recently been created by filling and regrading an abandoned pier area, terrestrial ecological systems are extremely simplified and in an early stage of ecological succession. The overwhelming dominant plant appears to be a fleabane daisy, probably (*Erigeron* sp.). Woody plants are sparsely scattered over the site but the dominant woody plant is tree-of-heaven (*Ailanthus altissima*) Ground cover is thin in many parts of the site. Vegetation on the site and surrounding areas is unsightly because it has trapped large quantities of refuse and wind-blown litter.

The only animal observed on the site was a rat. It is expected that birds may visit the area to obtain weed seeds or nesting materials.

Areas adjacent to the site are industrial sites with little or no vegetation.

There are no known terrestrial ecological items of special interest or economic value in the vicinity of the site, although endangered birds noted in Section 2.2.3 occur in the region and could pass by the site.

2.2.2 Aquatic Ecology

Water Quality: The proposed site is located near the upstream end of a highly industrialized section of the Delaware River that has generally poor water quality. This section, extending from river mile (RM) 74 to RM 106 (the site is at RM 102), receives effluent from 20 municipal waste treatment plants, six power stations, and 44 other point-source dischargers.(23) A major water quality problem in this stretch is a low dissolved oxygen (DO) concentration combined with high oxygen demand, high coliform bacteria concentrations, and low pH. Water temperatures here also tend to be slightly higher than in other stretches of the river during all seasons.

Monthly dissolved oxygen, temperature and pH data measured almost four miles upstream and four miles downstream of the proposed site in 1978-79 are listed on Tables 2-4 and 2-5. The minimum monthly pH and minimum monthly DO were frequently below values specified by both EPA's water quality criteria,(24) and Pennsylvania's Water Quality Standards.(25) The conductivity was within the normal range for potable waters.(26)

Water quality parameters, including metals, measured in the vicinity of the proposed site are listed on Table 2-6. Of the parameters listed, iron, lead, and possibly coliform bacteria exceed the water quality criteria and standards. The applicable Pennsylvania standards are listed on Tables 2-7 and 2-8, and the EPA criteria on Table 2-9. Tyrawski states that between RM's 74 and 106 "concentrations on phenols, cadmium, nickel, iron, zinc, lead, aluminum and mercury often have been found to be above recommended safe levels ... ."(23) The toxicities of metals to aquatic life

TABLE 2-4

WATER QUALITY PARAMETERS FOR THE DELAWARE RIVER AT BENJAMIN FRANKLIN BRIDGE, PHILADELPHIA, 1978-79*

	Mo.	Flow (cfs) at Trenton	Spec. Cond. (umhos/cm) Max.	Min.	Ave.	pH Max.	Min.	Ave.	Temp. (°C) Max.	Min.	Ave.	Dissolved Oxygen (mg/l) Max.	Min.	Ave.
1978	Oct.	4,045	381	303	344	6.9	6.4	6.6	22.6	16.5	19.5	6.1	0.0	1.6
	Nov.	4,127	375	285	326	7.0	6.5	6.7	16.5	10.5	14.5	7.4	0.6	3.3
	Dec.	8,821	338	187	240	7.0	4.7	6.6	11.0	4.0	7.0	11.6	4.5	8.7
1979	Jan.	34,950	238	74	153	7.5	6.0	6.7	6.0	1.5	3.0	12.4	9.1	11.1
	Feb.	15,170	116	74	89	7.1	6.4	6.7	4.0	2.0	3.0	11.8	10.5	11.1
	Mar.	30,240	143	83	120	7.4	5.8	6.8	11.5	3.0	8.0	11.6	7.7	9.4
	Apr.	18,340	177	104	133	7.4	6.5	6.9	18.0	9.5	12.0	10.0	4.9	8.0
	May	19,920	214	82	163	7.1	6.1	6.6	22.5	17.0	19.5	8.9	0.5	4.6
	Jun.	10,538	263	97	187	7.0	6.1	6.3	25.5	18.0	23.0	8.2	0.1	2.6
	Jul.	5,330	317	238	280	6.8	6.3	6.5	28.0	24.0	26.0	3.8	0.1	0.9
	Aug.	4,366	300	171	229	6.7	6.0	6.4	28.0	23.5	25.5	6.5	0.0	1.2
	Sept.	9,062	257	65	134	6.8	6.2	6.4	26.5	19.5	23.0	4.6	0.2	2.1

* 3.75 miles downstream of the PGW site.

Source: Reference 27

TABLE 2-5

WATER QUALITY PARAMETERS FOR THE DELAWARE RIVER AT TORRESDALE INTAKE, PHILADELPHIA, 1978-79*

		Spec. Cond. (umhos/cm)			pH			Temp. (°C)			Dissolved Oxygen (mg/l)		
	Mo.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.
1978	Oct.	337	218	259	7.5	6.7	7.0	21.5	14.5	18.0	9.8	4.6	7.8
	Nov.	379	200	237	7.3	6.8	7.0	15.5	7.5	13.0	10.7	7.4	9.1
	Dec.	457	133	207	7.0	6.5	6.8	12.5	2.0	5.0	12.3	8.6	11.3
1979	Jan.	836	110	177	7.0	6.3	6.7	11.5	1.0	2.0	13.5	10.0	12.7
	Feb.	619	87	194	7.1	6.2	6.8	6.0	0.5	1.0	14.1	11.2	12.6
	Mar.	304	74	132	7.3	6.3	6.8	12.0	2.0	6.5	12.8	9.5	11.5
	Apr.	302	89	138	7.2	6.7	6.9	18.5	7.5	11.0	11.3	6.9	10.2
	May	279	84	145	7.3	6.2	6.7	23.0	15.5	18.5	11.0	5.0	7.9
	Jun.	418	103	170	7.1	6.3	6.5	26.5	17.5	22.5	8.8	3.1	6.1
	Jul.	285	170	231	7.0	6.2	6.6	30.0	22.5	26.5	7.9	1.2	5.1
	Aug.	330	191	227	7.1	6.3	6.6	30.5	23.0	27.0	8.7	1.8	5.7
	Sept.	336	110	180	6.9	6.2	6.5	28.5	19.0	24.0	9.0	2.4	6.3

* 3.6 miles upstream of the PGW site.

Source: Reference 27

are generally increased with low pH, low DO and high water temperatures.

Because of the mixing produced by the tidal fluctuations, the water quality varies with the distance from the ocean. The actual concentrations of seawater at any point in the estuary depends upon the amount of freshwater inflow during the previous months. High inflows tend to flush the seawater downstream lowering the seawater concentrations. Lower inflows allow the seawater to work its way further upstream. This effect is demonstrated by the specific conductance of the water at the Ben Franklin Bridge. When the inflow at the Trenton gage is greater than average, the conductance downstream is about the same as at Trenton. When the inflows fall below average, the conductance downstream rises significantly.

Physical Characteristics: The river is tidal at the proposed site. Salt water normally does not intrude upstream as far as the site; salt water intrusion to about RM 102 did occur during the drought of 1964-1966.[23]

A description of the percent composition of the river bottom substrate is available for RM 132 (above tidewater) and points upstream.[28] The river bottom there is composed primarily of boulders and rubble with lesser amounts of gravel and sand. Average river width at RM 132 and upstream is 500 to 600 feet, and average riffle depth ranges from 1.25 to 1.75 feet.

TABLE 2-6

WATER QUALITY PARAMETERS MEASURED IN THE VICINITY OF RIVER MILES 100-102, DELAWARE RIVER

Parameter	Dates	Concentration	
BOD	1967-72	ranging around 3 mg/1	
Fecal Coliform Bacteria	Mar. 1969	about 4,000/100 ml	
	July 1969	more than 20,000/100 ml	
Heavy metals	1971	mean (mg/1)	maximum (mg/1)
Zinc		0.10	0.19
Magnesium		5	7
Iron		0.83	2.72
Manganese		0.14	0.27
Lead		0.021	0.101
Aluminum		0.67	2.90
Cadmium		-	0.003
Copper		-	0.02
Chromium		-	0.02
Mercury		-	0

Source: Reference 23

TABLE 2-7

PENNSYLVANIA WATER QUALITY CRITERIA THAT APPLY TO THE DELAWARE RIVER IN THE VICINITY OF THE PGW SITE

Water Uses Protected: Warm water fishes (maintenance only)
Migratory fishes (passage only)

Criteria for Specific Parameters:

Parameter	Criteria
Aluminum	Not to exceed 0.1 of the 96-hour LC50 for representative important species.
Alkalinity	Between 20 & 120 mg/l.
Arsenic	Not to exceed 0.05 mg/l.
Bacteria	Fecal coliforms - maximum geometric mean of 770/100 ml.
Chromium	Not to exceed 0.05 mg/l as hexavalent chromium.
Copper	Not to exceed 0.1 of the 96-hour LC50 for representative important species.
Cyanide	Not to exceed 0.005 mg/l as free cyanide.
Dissolved Oxygen	Minimum daily ave. not to be less than 3.5 mg/l during periods 4/1-6/15 and 9/16-12/31; not less than 6.5 mg/l as a seasonal average.
Fluoride	Not to exceed 2.0 mg/l.
Hardness	Maximum monthly mean = 150 mg/l.
Iron	Not to exceed 1.5 mg/l as total iron; not to exceed 0.3 mg/l as dissolved iron.
Lead	Not to exceed the lesser of 0.05 mg/l or 0.01 of the 96-hour LC50 for representative important species.
Manganese	Not to exceed 1.0 mg/l.
MBAS	Not to exceed 1.0 mg/l.
Nickel	Not to exceed 0.01 of the 96-hour LC50 for representative important species.
Nitrate & Nitrate	Not to exceed 10 mg/l as N.
pH	Not less than 6.5, not greater than 8.5.
Phenolics	Not to exceed 0.005 mg/l.
Temperature	(See following table).
Threshold Odor Number	Not to exceed 24 at 60°C.
Total Dissolved Solids	Not more than 500 mg/l as a monthly average value; not more than 750 mg/l at any time.
Turbidity	Maximum monthly mean 40 NTU, maximum value not more than 150 NTU.
Zinc	Not to exceed 0.01 of the 96-hour LC50 for representative important species.
Radioactivity	Alpha emitters, max. 3 pc/l; beta emitters, max. 1,000 pc/l.

Source: Reference 25

TABLE 2-8

TEMPERATURE CRITERIA THAT APPLY TO THE DELAWARE RIVER IN THE VICINITY OF THE PGW SITE

Criterion: Not more than 5°F above the average daily temperature during the the 1961-66 period, shown below, or a maximum of 86°F, whichever is less.

Date	Average Daily Temperature (°F)
January 1	37
February 1	35
March 1	38
April 1	46
May 1	58
June 1	71
July 1	79
August 1	81
September 1	78
September 15	76
October 1	70
November 1	59
December 1	46
December 15	40

Criterion for size of heat dissipation area: area shall be no longer than 3,500 feet measured from discharge point. Width shall not exceed 2/3 of surface width measured from shore to shore, or width encompassing one-fourth the cross-sectional area of the stream, whichever is less. The rate of temperature change in the heat dissipation area shall not cause mortality of the fish.

Source: Reference 25

TABLE 2-9

EPA'S QUALITY CRITERIA FOR WATER FOR PARAMETERS THAT HAVE BEEN MEASURED NEAR THE PGW SITE

Parameter	Criteria
pH	6.5 to 9.0 for aquatic life.
Dissolved Oxygen	5.0 mg/l to maintain good fish population.
Zinc	0.01 of the 96-hour LC50 as determined through bioassay using a sensitive resident species.
Magnesium	None given.
Iron	1.0 mg/l for aquatic life.
Manganese	50 μg/l for domestic water supplies, 100 μg/l for protection of consumers of marine mollusks.
Lead	0.01 times the 96-hour LC50 value ... for sensitive freshwater resident species.
Aluminum	None given.
Cadmium	Soft water - 0.4 μg/l for cladocerans and salmonid fishes; 4.0 μg/l for less sensitive species. Hard water - 1.2 μg/l and 12/0 μg/l respectively.
Copper	0.1 times the 96-hour LC50 for a sensitive resident species.
Chromium	100 μg/l for aquatic life.
Mercury	0.05 μg/l for aquatic life.

Source: Reference 25

The river in its tidal region has slightly different physical characteristics. In the vicinity of the Chester Generating Station near Chester, Pa., the river is 1,500 to 2,000 yards wide, and has a midriver shipping channel.(29) Here the river bottom is composed mainly of clay and mud with lesser amounts of silt, sand and rubble.

The river immediately offshore of the proposed site appears to have a rubble bottom that may have been affected by razing and fill operations at the site. The shoreline, which drops steeply from the site to the water, consists of building rubble.

"Small but important wetlands exist" on the east shoreline at River Miles 102 and 103.[23]

Aquatic Biota: Some information on zooplankton, ichthyoplankton and adult fish is available for the site vicinity. During a study reported in 1977, rotifers were the dominant zooplankton group in winter, summer and fall (Tyrawski, 1979). Rotatoria comprised over 50 percent of the zooplankton, with a mean annual density of 99,264 per cubic meter. Cladocera were second in abundance (mean annual density of 61,401 per cubic meter), and copepods were third (mean annual density of 23,117 per cubic meter). Cladocera numbers peaked in June, and copepods in May.

The most abundant ichthyoplankton collected at RM 101.2 were river herring, temperate basses, minnows, and American eel. Ichthyoplankton was taken from the river from late April through late July.

The most abundant adult fish taken from industrial screens in the proposed site vicinity, in order of most to least numerous, were blueback herring, alewife, river herring, white perch, silvery minnow, American eel, gizzard shad, and mummichog.

In river sampling collections, the numbers of fish taken in winter was low compared to the other seasons. Gizzard shad, white perch and silvery minnow dominated the winter catch. In spring, alewife, blueback herring, silvery minnow, and white perch were most common. Alewife and blueback herring were also most common in summer, followed by other herrings, American eel, aud white perch.

In fall, blueback herring were most numerous, followed by alewife, river herring and white perch. A few American shad and striped bass were also taken. Most blueback herring, alewife and white perch taken in summer and fall were less than one year old.

A number of anadromous species of the clupeid family, including American shad, pass through the lower river on their way to and from upriver spawning grounds. Most shad spawning occurs between Easton, Pa. and East Branch, N.Y.[30] It was believed that, at least until 1976, the Delaware River had few American shad that returned to spawn in successive years because down-migrating adults died due to starvation plus the low dissolved oxygen concentrations in the lower river.

2.2.3 Special Considerations

Endangered and Threatened Species: The only federally-listed endangered or threatened species whose ranges include the site vicinity are the bald eagle (*Haliaeetus leucocephalus*), the peregrine falcon (*Falcon peregrinus anatum*), and the shortnose sturgeon (*Acipencer brevirostrum*).[31] The bald eagle and the peregrine falcon, both endangered species, are likely to be casual occasion visitors to the site area. They would not be expected to stay in the site vicinity because of lack of suitable habitat. The shortnose sturgeon, also endangered, was said to occur in the lower reaches of the river downstream of Wilmington, Delaware (personal communication, Endangered Species Coordinator, Delaware). Lee, et al., does not include the Delaware River in locations where the species has been recorded since 1949.[32] However, Tyrawski reports that two specimens were taken from the river between Bordentown and Trenton in 1971. The species' distribution within the river is unknown, except that it has not been found upstream of Trenton.[23]

No other additional species listed for the state by the Pennsylvania Fish Commission[33] would be expected to occur in the site vicinity.

Economically Important Species: Delaware River fishes that are listed by Tyrawski as having some commercial value and that occur in the project area are American eel, blueback herring, alewife, American shad, white perch, striped bass, and carp.[23] Most of these species are found in the project vicinity during some part of their life cycles. Species contributing to a recreational fishery include Atlantic sturgeon, American shad, white perch, striped bass, carp, white catfish, brown bullhead, channel catfish, and white sucker. The Pennsylvania Fish Commission[34] lists the Delaware River near Torresdale (upstream of the project) as a fishery for bass, panfish, pickeral, American shad, trout, and walleye.

The Delaware River Basin serves as the Atlantic Flyway, one of the four major North American flyways, for migrating waterfowl. One of the most important species using the flyway is the Canada goose.

Uniqueness Within the Region: The lower Delaware River itself is ecologically unique and important in that it serves as a migratory route for valuable aquatic species and waterfowl, and it supports a wide variety of estuarine and freshwater species. The river's wetlands may be considered unique because of their value to wildlife, and because development has reduced their extent.

The site itself cannot be considered unique because of the highly industrialized nature of the western shoreline, and because it has already been disturbed and filled.

Ecological Stress: The a· ·urrounding areas have already been significantly disturbed. ·wer Delaware River has had a history of water quality problems which have affected natural communities. Water quality has been a factor in the decline in abundance of many commercially and recreationally valuable species.(23) Although water quality is improving, fluctuations in or levels of certain parameters, such as dissolved oxygen, may still affect aquatic organisms. The disappearance of marshlands has also affected ecological communities by removing breeding, nursery, and feeding habitat.

2.3 HUMAN ENVIRONMENT

This section describes the existing human environment within the primary study area and selected other areas in the vicinity of the project. The human environment is here defined to include demographic, social, and economic characteristics; cultural amenities, community services, and transportation facilities; and land use patterns and trends.

Information presented in the following sections was obtained from site and study area reconnaissance, discussions with City of Philadelphia and Delaware Valley planners, 1970 census data, available reports and updates, and open files.

2.3.1 Demography

Despite being in a densely populated metropolitan area, the site is relatively isolated from the residential fabric of the area. The Delaware River separates the site from Camden while the elevated Delaware Expressway (Route I-95) separates it from residential areas of Philadelphia. The site is within an essentially non-residential, industrial-pier corridor lying between Route I-95 and the Delaware River. The corridor extends from south of the Benjamin Franklin

Bridge northward to the Bridesburg residential area, just north of the Betsy Ross Bridge. The industrial facilities of this corridor include: off-loading/on-loading warehouses, glass and chemical plants, rail yards, gas storage facilities, electrical generating stations and a municipal incinerator.

Population Distribution Near Site: For analyses purposes, three census tracts in Kensington and two in Fishtown were examined. They were CT143, 158, 159, 160 and 161 (see Figure 2-7). As 1980 data was not yet available at this writing, 1970 data were used for informative and comparative purposes only.

According to the 1970 data, there were some 31,700 persons residing in the area which is generally bounded by Lehigh, Frankford, and Delaware Avenues. Of this total, 68 percent were considered to have lived in the same area for five years or more as compared to 61.2 percent citywide.

Population Trends: Although, in general, housing conditions are sound, residents in the area have experienced difficulty in obtaining private mortgage money. This is due to the presence of many long-term vacant units in the area. The Neighborhood Strategies Program is designed to overcome these obstacles through expediting mortgage funding as well as in providing grants. According to the 1970 census of population, there was a slight decline in population between 1960 and 1970. The 31st Ward, which encompases part of the study area experienced an eight percent decline from 1960 to 1970. The evidence of still significant numbers of long-term vacant units indicates that the decline has probably continued but at a comparatively moderate rate.

Characteristics of Population and Age: In 1970, 36.3 percent of the population were under 20 years of age and 12.4 percent were over age 65. This compared with the city-wide total of 34.4 percent and 11.7

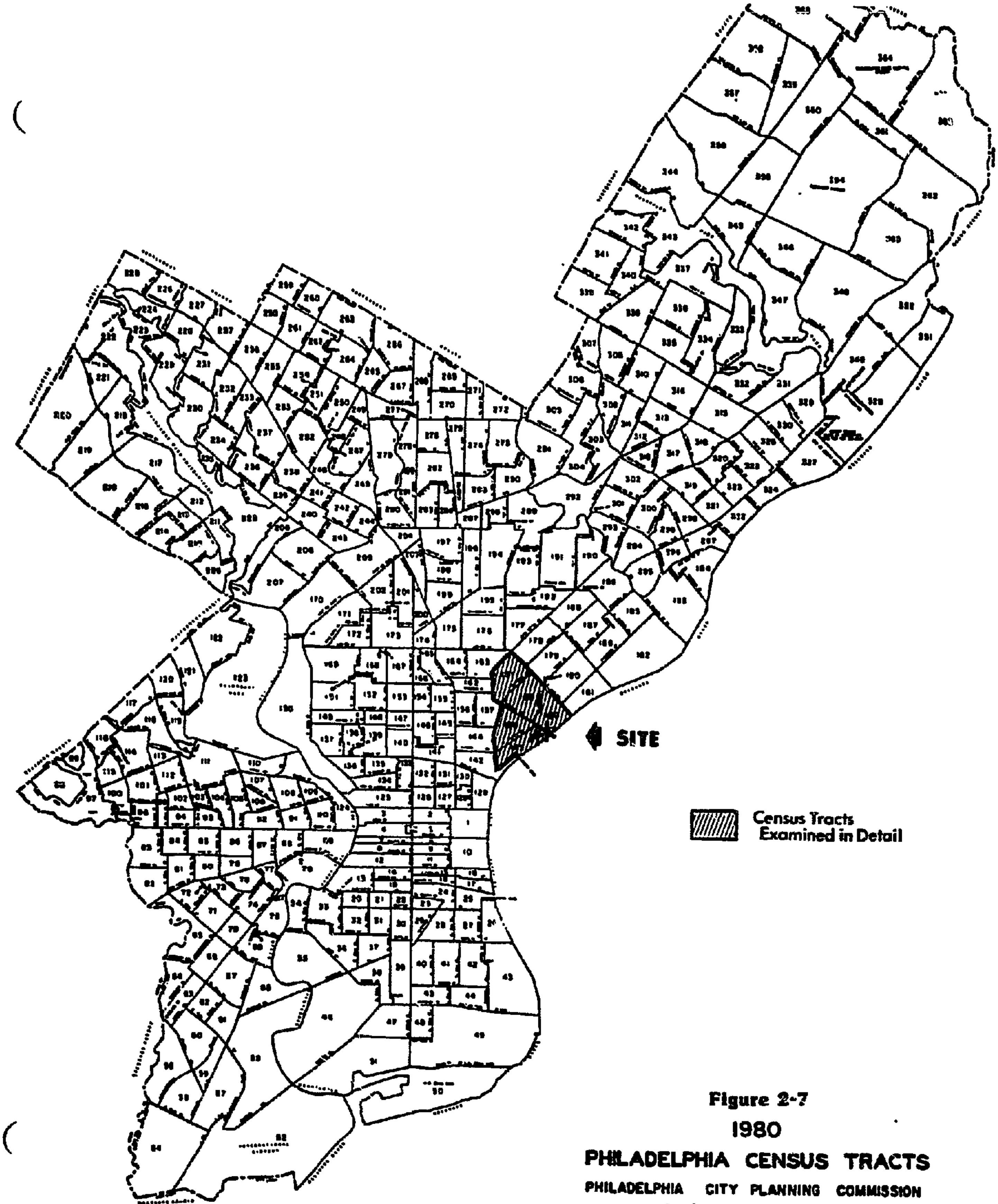


Figure 2-7

1980

PHILADELPHIA CENSUS TRACTS

PHILADELPHIA CITY PLANNING COMMISSION

percent, respectively. The higher percentages in these categories again reflects the generally stable character of the area.

The percentage of foreign born was placed at 20 percent as compared with 23 percent citywide. Less than one percent was non-white as compared with a city-wide 23 percent in 1970. See Table 2-10.

Population Projections: It is difficult to make population projections for the census tracts in questions. These are countervailing factors operating. On the one hand, there are some 800 long-term vacant units in the area. On the other, there are a sizable majority of units that are occupied and well maintained. There are homes also being sold to willing buyers. In addition, there is the city actively involved in a conservation program. The best estimate is that the population will remain stable.

2.3.2 Land Use

The site is currently zoned as "port industrial." Development of this site for industrial purposes is consistent with the current plan and zoning map of the City of Philadelphia.

It should be noted that in the preliminary study of the river front, the site was in the DO-11 area (see Figure 2-8),[35] which was given a high priority for industrial development in accordance with Coastal Zone Management (CZM) Priorities. The CZM Program states...."Energy production is a problem of national as well as state and regional significance, Pennsylvania Coastal Zones are no exception. The increasing demand for energy coupled with the inherent location the coastal zones offers to the siting of many energy facilities, makes it inevitable that additional facilities will be located in the Commonwealth's coastal area in the future..."[35]

TABLE 2-10

SOCIO-ECONOMIC CHARACTERISTICS BY CENSUS TRACT

	1970 POPULATION	% SAME PLACE OF RESIDENT 1965-1970	% FOREIGN BORN 1970	% NON-WHITE 1970	% UNDER 20-1970	% OVER 65 - 1970	MEDIAN FAM. INCOME 1970 ($)	1976 # UNITS	1970 UNITS---	PRE 1946 (1970)	OWNER OCCUPIED 1970	% FAMILIES BELOW POVERTY ----LEVELS 1970
CT 143	2,127	71	28	0.7	31.9	15.8	8,394	764	836	821	469	18.6
CT 158	7,876	67	19	1.0	35.2	12.6	8,970	2,592	2,618	2,553	1,748	10.3
CT 159	2,486	69	36	0.4	33.3	11.2	9,506	879	894	889	649	7.4
CT 160	9,766	69	21	0.7	37.5	11.2	8,740	3,221	3,265	3,213	2,305	8.2
CT 161	8,431	73	15	0.9	36.3	12.4	7,922	3,185	3,265	3,212	1,641	17.2

Sources: References 36 and 37

HUNTING PARK
0
1/2
1 MILE
SCALE
N
NEW CATHEDRAL CEMETERY
Golf Course
Juniata
PENN CENTRAL
ERIE
Belvue Cem
McKinley Playground
Temple Univ Hospital
Kensington
PHILADELPHIA
SITE
DELAWARE
Cramps
PHILADELPHIA CO
CAMDEN CO
PETTY ISLAND
Penn

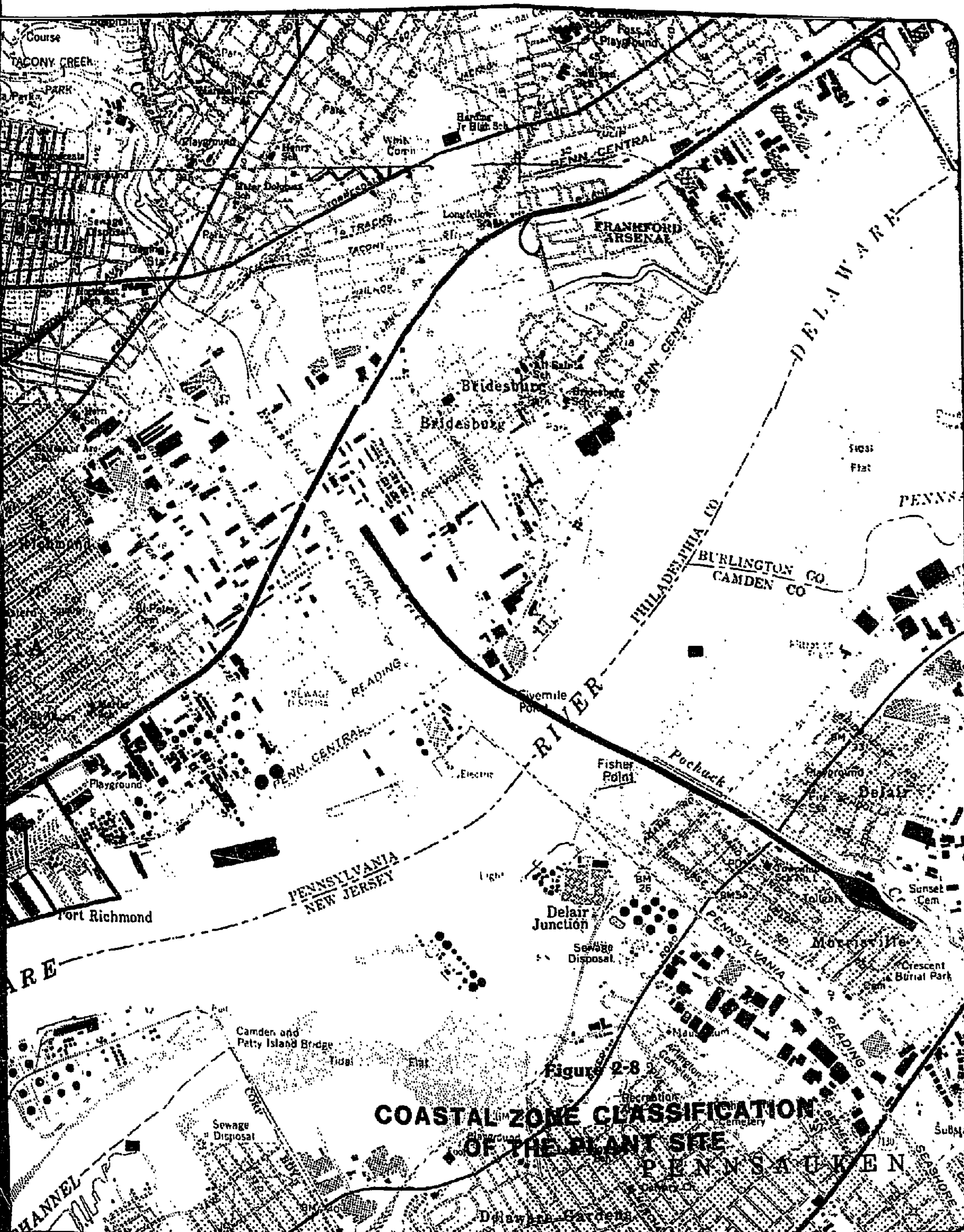


Figure 2-8

COASTAL ZONE CLASSIFICATION OF THE PLANT SITE

The two cities, Philadelphia and Camden, New Jersey, plus the urban areas surrounding them, constitute the Philadelphia Camden Standard Metropolitan Area.

The areas of Fishtown and Kensington, immediately adjacent to the proposed site, are primarily low-density residential in nature with some significant light industrial uses located within their interior. Essentially, however, these communities are separated from the major industrial - water front uses by the Delaware Expressway, see Figure 2-9.

<u>Ownership</u>: The type and condition of the housing units extends over a wide range of alternatives, see Figure 2-8. It is estimated that some 65 percent of these units are single family, owner occupied.

There are also long term vacant units in the area. It is estimated that there are over 800 such vacant units in the area.(38)

<u>Existing Land Use Pattern</u>: The land uses in and adjacent to the proposed PGW site are, to a large extent, defined by their position with regard to the Delaware Expressway. All of the land east of the expressway is industrial in character. Most of that land to the west is residential, but not uniformly so.

The residential aspect is primarily row-house, interspersed with commercial uses, such as bars, small groceries, etc. There are two sizable segments of industrial development within this residential area, which are located along Aramingo and the Front-Frankford Street area.

There are also small parks, cemeteries, schools, churches, and related institutions integral to older established neighborhoods.


0
1/2
1 MILE
SCALE
LEGEND
VACANT LAND
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
PENN CENTRAL
ERIE
Juniata
Kensington
PHILADELPHIA
SITE
Cramps
Coal
Penn
Port
DELAWARE
PHILADELPHIA CO
CAMDEN CO
PETTY ISLAND
TEMPLE UNIVERSITY
McKinley Playground
Belvue Cem
Greenmount Cemetery

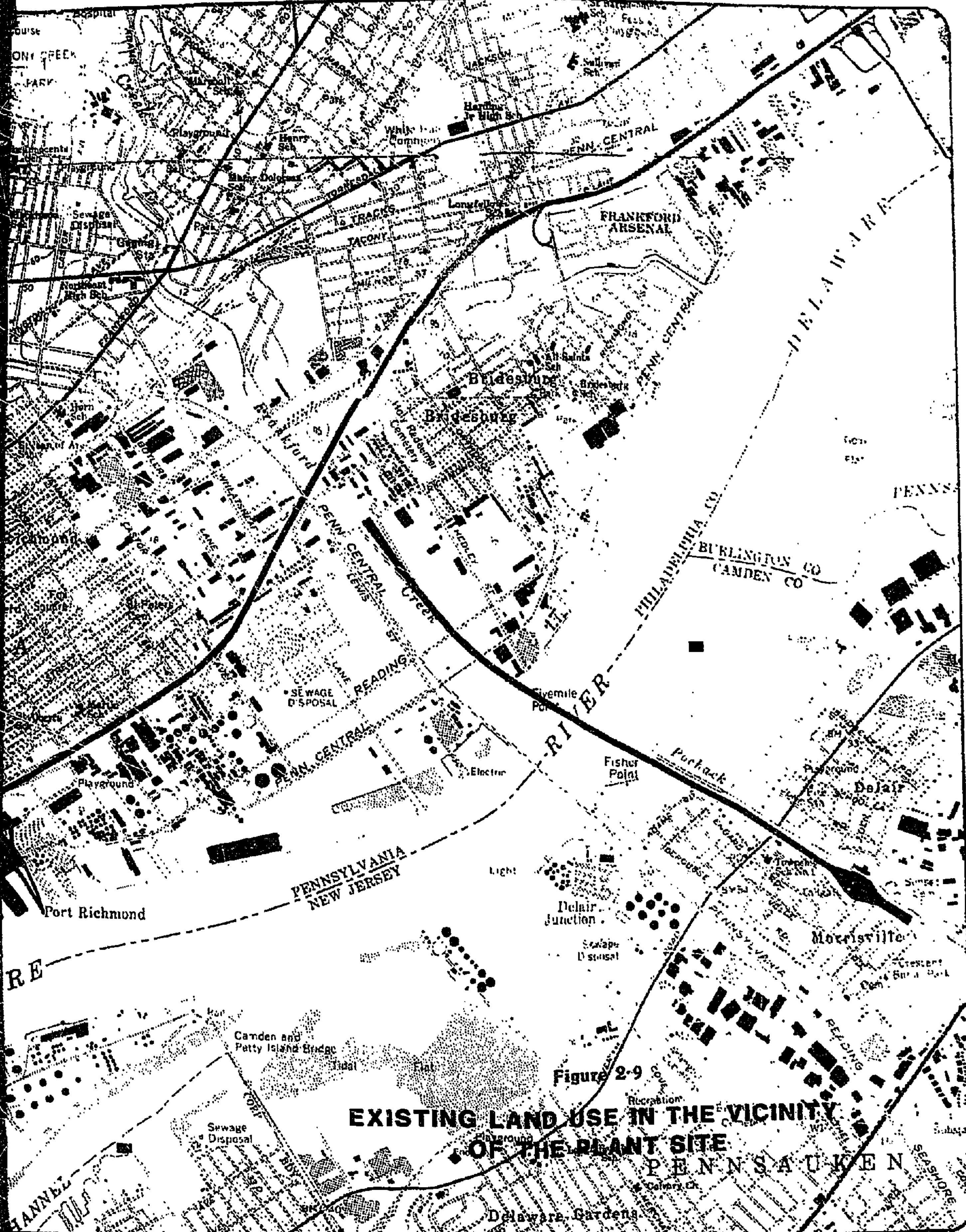


Figure 2-9

EXISTING LAND USE IN THE VICINITY OF THE PLANT SITE

The proposed site is in a "G2" industrially zoned district. This is one of the less restrictive of the industrial zones, in that it provides for a wide variety of manufacturing uses and storage such as lumber or coal yards.

It is in the "LR" district that the zoning code mentions gas manufacturing and related activities, including storage. No industrial district specifically mentions coal gasification as such. However, because of this it is to be expected that a routine permit will not be issued, and an appeal to the zoning board of the adjustment will be required for an LR zoning.

Land Values: Despite the sizable number of resources, residential values have increased. From an estimated median value of $5,000, in accordance with the 1970 census, the estimated current range of housing is valued at from $8,500 to upwards of $25,000.[38]

In median value of owner-occupied homes, the range was from $5,000 to $6,200. This was lower than the city-wide medium average of owner-occupied homes which was set at $10,600. A recent estimate of homes for sale has indicated that values have risen but no price estimate was available.

Landfills: Landfill space of sufficient capacity to accommodate 347 cubic yards per day of slag and ash in the vicinity of the proposed project is scarce. One potential hauler, Danella Bros., Inc. of Plymouth Meeting, Pa., presently hauls approximately 200 tpd of flyash from two of Philadelphia Electric's (P.E.) fossil fuel generating stations (Crombie and Eddystone) to the Montgomery County landfill where the flyash is used to form the brim around the landfill. Danella Bros. has confirmed their interest and capability for hauling solid waste from the gasification plant to a landfill available after 1984. The costs for hauling and disposing of slag and ash by Danella Bros. is projected to be $6.00 per ton in 1984.

(See Appendix A for a letter from Danella Bros. confirming their interest.)

Landfills which may be available in 1984 and beyond include the Ivy Rock, Sabia, and Glasco Quarries in Montgomery County. Other potential waste disposal sites may be available in Delaware, Chester, and Bucks Counties when they are needed for the project.

The Lanchester Corporation, which operates a landfill in Honey Brook, Pa., approximately forty miles from the proposed gasification plant, has 20 million cubic yards of capacity, of which 10 percent has been depleted to date. The proposed 250 tpd from the gasification plant would increase the filling rate by 25 percent. The projected 1985 per ton cost for disposal is $25.00, plus $3.00 per ton for hauling. (See Appendix A for a letter from The Lanchester Corporation confirming the capacity for receiving the solid waste from the gasification facility.)

In the unlikely event that existing landfills are not available or the economics of solid waste disposal are such that they justify this option, a dedicated landfill could be developed for use by the facility. In a preliminary exploratory study to identify quarries and devastated lands in a corridor running northwest of Philadelphia along the existing rail line, 11 potential disposal sites were identified. These would be examined in greater detail in the unlikely event that a dedicated landfill would need to be developed.

2.3.3 Transportation

The site is relatively accessible via the Delaware Expressway and its interconnections with other expressways and major roads in the metropolitan area. In addition, the Conrail marshalling yard, lying to the north of the site, offers convenient coal delivery movements with a minimum extension and disturbance of existing trackage.