

APPENDIX C

BORING AND WELL LOGS

**PART 2
WATER USE**

10/16/44

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W103378

UNIQUE WELL I D # AGF563

Water Right Permit No n/a

(1) OWNER: Name KOMO Television (Fisher Broadcasts) Address 100-Fourth Ave N., Seattle, WA

(2) LOCATION OF WELL: County KING SE 1/4 SW 1/4 Sec 30 T 25N NR 4E WM

(2a) STREET ADDRESS OF WELL (or nearest address) 100-Fourth Ave N, Seattle, WA
TAX PARCEL NO. n/a 25-4E-30P

(3) PROPOSED USE: Domestic Industrial Municipal
 Irrigation Test Well Other
 DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one) _____
 New Well Method Dug Bored
 Deepened Cable Driven
 Reconditioned Rotary Jetted
 Decommission

(5) DIMENSIONS: Diameter of well 7 inches
Drilled 155 feet Depth of completed well 155 ft

(6) CONSTRUCTION DETAILS
Casing Installed: Welded 6 5/8" Diam from 0 ft to 144 ft
 Liner installed NO" Diam from _____ ft to _____ ft
 Threaded _____" Diam from _____ ft to _____ ft

Perforations: Yes No
Type of perforator used _____
SIZE of perforations _____ in by _____ in
perforations from _____ ft to _____ ft

Screens: Yes No K-Pac Location 140'
Manufacturer's Name JOHNSON SCREEN
Type STAINLESS STEEL WIRE WRAP Model No _____
Diam 5 Slot Size .020 from 145 ft to 155' ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

Gravel/Filter packed: Yes No Size of gravel/sand _____
Material placed from _____ ft to _____ ft

Surface seal: Yes No To what depth? 18 ft
Material used in seal BENT. CHIPS
Did any strata contain unusable water? Yes No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____
Type _____ H P _____

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft
Static level 77.3 ft below top of well Date 8-29-01
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____
(Cap, valve, etc)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes No If yes, by whom? CASCADE
Yield 45 gal/min with 0 ft drawdown after 1 hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level
Date of test 8-30-01
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Airtest _____ gal/min with _____ ft drawdown after _____ hrs
Artesian flow _____ g p m Date _____
Temperature of water COLD Was a chemical analysis made? Yes No

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered

MATERIAL	FROM	TO
BRN SILT SAND, GRAVEL	0	18
BRN TILL SAND, GRAVEL	18	38
GRAY FINE SILT w SAND	38	48
BROWN SAND (FINE-MED)	48	76
BRN SAND /w GRAVEL	76	80
H ₂ O		
GRAY SAND (RTZ) FINE	80	88
MED SAND		
HARDER-GRAY SAND	88	97
w GRAVEL		
BRN SAND w CLAY	97	103
BRN SILT, CLAY, GRAVEL	103	118
MORE H ₂ O		
ALT. BRN SAND, GRAVEL	118	150
SOME FINE SILT		
SAME.	150	155

RECEIVED
OCT 11 2001
DEPT OF ECOLOGY

Work Started 8-27-01 Completed 8-30-01

WELL CONSTRUCTION CERTIFICATION:
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief
Type or Print Name Ed Kostecky License No 2490
(Licensed Driller/Engineer)
Trainee Name _____ License No _____
Drilling Company CASCADE DRILLING, INC.
(Signed) Ed Kostecky License No 2490
(Licensed Driller/Engineer)
Address P.O. Box 1184, Woodinville, WA
Contractor's Registration No CASCADI-088KK Date 9/16-01
(USE ADDITIONAL SHEETS IF NECESSARY)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Table 7.--Drillers' logs of wells in northwest King County, Wash.--Continued

Material	Thickness (feet)	Depth (feet)
Well 25/4-27K1		
Washington Toll Bridge Authority, test hole 1. On Harrison St. extended, 670 ft E. of Shore Line. Altitude -76 ft. Drilled, 1953.		
Sand and gravel -----	19	19
Clay -----	1	20
Sand and gravel -----	6	26
Sand, fine, and clay -----	1	27
Clay, blue -----	----	----
Well 25/4-30Q1		
Seattle Engineering Dept., test hole 1. On Highway U.S. 99 about 150 ft N. of Denny Way. Altitude about 104 ft. Drilled, 1948.		
Clay and gravel, hard, sandy -----	28	28
Wood -----	4	32
Sand, medium, light brown -----	7	39
Well 25/4-30R1		
Troy Laundry. About 200 ft N. and 100 ft W. of intersection of Thomas St. and Fairview Ave. N. Altitude about 90 ft. Drilled by N. C. Janssen Drilling Co.		
Sand and gravel -----	27	27
Gravel and blue clay -----	63	90
Gravel and sand -----	60	150
Clay, sandy -----	25	175
Gravel, medium -----	10	185
Gravel -----	30	215
Clay, brown -----	35	250
Gravel, cemented -----	41	291
Gravel -----	17	308
Gravel and clay -----	15	323
Gravel, cemented -----	5	328
Sand and gravel -----	24	352
Sand -----	5	357
Gravel and clay -----	13	370
Sand -----	3	373
Clay and sand -----	23	396
Gravel -----	29	425
Gravel and sand -----	10	435
Gravel -----	18	453
Sand -----	22	475
Clay -----	12	487
Sand -----	10	497
Clay -----	13	510
Sand and gravel -----	11	521
Gravel, cemented -----	14	535
Clay -----	20	555

Casing: 8-inch; perforated from 297 to 308 ft, and from 357 to 521 ft.



STATE OF WASHINGTON
DEPARTMENT OF WATER RESOURCES
DIVISION OF WATER MANAGEMENT

REC'D DEPT ECOLOGY
1-26-71
003162

WATER RIGHT CLAIM

RECEIVED
DEPARTMENT OF ECOLOGY

FEB-271003302

CASH _____ OTHER NONE

1. NAME TROY LAUNDRY
ADDRESS 311 FAIRVIEW N.
SEATTLE, WN. ZIP CODE 98109

2 SOURCE FROM WHICH THE RIGHT TO TAKE AND MAKE USE OF WATER IS CLAIMED: GROUND
(SURFACE OR GROUND WATER)

W.R.I.A. 08
(LEAVE BLANK)

A. IF GROUND WATER, THE SOURCE IS WELL

B. IF SURFACE WATER, THE SOURCE IS _____

3. THE QUANTITIES OF WATER AND TIMES OF USE CLAIMED:

A. QUANTITY OF WATER CLAIMED 1000 G.P.M. PRESENTLY USED 250 GPM
(CUBIC FEET PER SECOND OR GALLONS PER MINUTE)

B. ANNUAL QUANTITY CLAIMED 3830 PRESENTLY USED 108
(ACRE FEET PER YEAR)

C. IF FOR IRRIGATION, ACRES CLAIMED _____ PRESENTLY IRRIGATED 1

D. TIME(S) DURING EACH YEAR WHEN WATER IS USED: DAILY - EXCEPT SATURDAYS SUNDAYS + HOLIDAYS

4 DATE OF FIRST PUTTING WATER TO USE: AUGUST MONTH AUGUST YEAR 1946

5 LOCATION OF THE POINT(S) OF DIVERSION WITHDRAWAL _____ FEET _____ AND
_____ FEET _____ FROM THE _____ CORNER OF SECTION _____

BEING WITHIN _____ OF SECTION KING 30 T. 25N N _____ R 4E (E. OR W.) W.M.

IF THIS IS WITHIN THE LIMITS OF A RECORDED PLATTED PROPERTY, LOT 4 BLOCK 109 OF

DT DENNY 5TH ADDITION

(GIVE NAME OF PLAT OR ADDITION)

6. LEGAL DESCRIPTION OF LANDS ON WHICH THE WATER IS USED _____

SEATTLE COUNTY KING

7. PURPOSE(S) FOR WHICH WATER IS USED: LAUNDRY

8 THE LEGAL DOCTRINE(S) UPON WHICH THE RIGHT OF CLAIM IS BASED: APPROPRIATION WELL DRILLED
1936

DO NOT USE THIS SPACE

THE FILING OF A STATEMENT OF CLAIM DOES NOT CONSTITUTE AN ADJUDICATION OF ANY CLAIM TO THE RIGHT TO USE OF WATERS AS BETWEEN THE WATER USE CLAIMANT AND THE STATE OR AS BETWEEN ONE OR MORE WATER USE CLAIMANTS AND ANOTHER OR OTHERS. THIS ACKNOWLEDGEMENT CONSTITUTES RECEIPT FOR THE FILING FEE.

DATE RETURNED _____ REGISTRY NUMBER _____

FEB-271002435

THIS HAS BEEN ASSIGNED
WATER RIGHT CLAIM REGISTRY NO.

John H. Lickler

ASSISTANT DIRECTOR DIVISION OF WATER MANAGEMENT-DEPARTMENT OF WATER RESOURCES

I HEREBY SWEAR THAT THE ABOVE INFORMATION IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF

X *David J. [Signature]*
DATE 1-25-71

IF CLAIM FILED BY DESIGNATED REPRESENTATIVE PRINT OR TYPE FULL NAME AND MAILING ADDRESS OF AGENT BELOW

ADDITIONAL INFORMATION RELATING TO WATER QUALITY AND OR WELL CONSTRUCTION IS AVAILABLE

A FEE OF \$7.00 MUST ACCOMPANY THIS WATER-RIGHT CLAIM

RETURN A CHECK OR MONEY ORDER WITH CASH ON HAND TO THE DEPARTMENT OF WATER RESOURCES, DIVISION OF WATER MANAGEMENT, NON-RESIDENTS SERVICE CENTER, WA-10000

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

PRIORITY	
Date	2-10-71
Time	11 AM
Accepted	[Signature]

APPLICATION FOR A PERMIT

To Appropriate Public Ground Waters
OF THE STATE OF WASHINGTON

Application No. G. W. 11589

I, TROY LAUNDRY COMPANY
(Name of applicant)

RECEIVED
FEB 2 1971
A. M. P. M.
11 12 13 14 15 16 17 18 19

(a Washington Corporation see deep)

of 311 FAIRVIEW N. SEATTLE, WN. 98109
(Complete post office address)

do hereby make application for a permit to appropriate the following described public ground waters of the State of Washington, subject to existing rights. This application is made under the provisions of Chap. 263 of the Session Laws of 1945, and amendments thereto of the State of Washington and subject to the rules and regulations of the Department of Ecology.

1. The proposed appropriation will be from WELL
(Well, tunnel, infiltration trench)

located D T DENNY'S 5TH ADDITION SEATTLE, WN 98109
(Give approximate distance and direction from nearest city or town)

Area Sub-area
(Leave blank) (Leave blank)

Zone
(Leave blank)

Applicant's name or number of well or other works, if any

2. The quantity of water which applicant intends to withdraw for beneficial use is 1000
gallons per minute; 3829.9 acre feet per year.

3. The use or uses to which water is to be applied INDUSTRIAL (LAUNDRY)
(Domestic supply, irrigation, municipal, manufacturing, industrial use, etc.)

4. The time during which water will be required each year continuously 7 AM to 4:30 PM 260 WORKING DAY

5. Location of well or other works for withdrawal of water: In county of KING - CITY OF SEATTLE
150' W and 1250' N from SE corner Sec. 30
(a) 120' WEST OF N.E. CORNER LOT 4 D.T. DENNY 5TH ADDITION BLOCK 109
(Give distance and bearing from nearest corner of section or legal subdivision)

being within the LOT 4 - D T DENNY 5TH ADDITION of Sec. 30, Twp. T25N N., Rge. R4E
(Give smallest legal subdivision) (E. or W.)

or (b) If within limits of recorded platted property, town or city: Lot 4, Block 109
of the plat of D.T. DENNY'S 5TH ADDITION to North Seattle SEATTLE, WN
(Give name of plat or addition) (If within town or city, give name)

(c) Show this location on accompanying section plat. Other adequate maps or drawings will be acceptable.

Application Returned
2-3-71-EEJ

6. DESCRIPTION OF WORKS:

(a) Well ^{IS} ~~will be~~ DRILLED and ^{HAS} ~~have~~ a diameter of 10 inches and an estimated depth of 540 feet.
(Dug or drilled)

(b) Tunnels or trenches to be described: (Attach additional sheets if needed for full description.)

(c) Distribution system to be described: PIPES

(d) If pumps are to be used, give size and type:

* HAS 140' OF 5" X 1" COLUMN AND SHAFT TO TOP OF BOWLS
* 9' 11" BOWL ASSEMBLY (6" BOWLS)
* 10' SUCTION PIPE

(e) Give capacity and type of motor or engine to be used:

ELECTRIC 20 HP MOTOR

(f) If the location of the well, tunnel, or other works is less than one-fourth mile from a natural stream or stream channel, give the distance to the nearest point on each of such channels and the difference in elevation between the stream bed and the ground surface at the source of development:

1/2 MILE FROM SOUTH END LAKE UNION

(g) Ownership of each existing well or other works from which ground water is withdrawn within a radius of one-quarter mile and the distance and direction from well or other works being reported herein:

WE KNOW OF NO OTHER WELLS IN THIS AREA

(Name)	(Direction)	(Distance)

SUPPLY THE FOLLOWING INFORMATION ACCORDING TO USE PROPOSED:

7. For Municipal Supply: To supply the city, town, or community of _____, in the county of _____, having a present population of _____, and an estimated population of _____, in 19_____.

8. For Irrigation: Number of acres to be irrigated _____ acres.

RECEIVED FEB 3 1931

9. Legal Description of Property on which water is to be used for all purposes other than municipal supply:

(Copy legal description from deed)
(If more space is required, attach separate sheet)

~~PORTIONS 3 & 4) 109 & 0010 DENNY'S DT 5TH ADD LOTS 7 THRU 12
COUNTY KING SECTION 30 T 25 N R 4 E~~

To be verified/
by field
examiner

Block 109 of the plat of D.T. Denny's 5th Addition to North Seattle,
and a strip of land 21.92 in width abutting Lot 4 of said
Block 109 thereto to the south, within Sec. 30, T. 25 N., R. 4 E. W.M.

(On accompanying plat show location of the existing wells or works)

10. What interest do you have in the above described property?.....

OWNER

(Owner, lessee, contract buyer, etc.)

11. Do you have any other water rights appurtenant to the above described property?..... NO

If so, from what source?.....

12. Construction work will begin on or before..... ORIGINAL DRILLED 1936

13. Construction work will be completed on or before.....

14. Water will be put to complete beneficial use on or before.....

(Signature of applicant)

15. Name and address of owner of land on which well or works are located:

W. P. HAGEN

(Name)

7777 OVERLAKE DRIVE - MEDINA

(Address)

(Signature of legal landowner)

Signed in the presence of us as witnesses:

(Name)

(Address of witness)

(Name)

(Address of witness)

STATE OF WASHINGTON, }
COUNTY OF THURSTON. } SS.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and return the same for correction or completion as follows:

In order to retain its priority, this application must be returned to the Department of Ecology,
with corrections, on or before....., 19.....

WITNESS my hand this..... day of....., 19.....

STATE OF WASHINGTON, COUNTY OF King

CERTIFICATE OF GROUND WATER RIGHT

(Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology thereunder.)

THIS IS TO CERTIFY That TROY LAUNDRY COMPANY

of Seattle, Washington, has made proof to the satisfaction of the Department of Ecology of a right to the use of the public ground waters of the State of Washington from a well

located within Lot 4, Block 109 of the plat of D. T. Denny's 5th Addition to North Seattle
Sec. 30, Twp. 25 N., R. 4 E W.M.,

for the purpose(s) of industrial use (laundry)
under and specifically subject to provisions contained in Ground Water Permit No. 10486

issued by the Department of Ecology and that said right to the use of said ground waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the Department of Ecology and entered of record in Volume _____ at page G1-00389C; that the priority of the right hereby confirmed dates from February 10, 1971; that the quantity of ground water under the right hereby confirmed for the aforesaid purposes, is limited to an amount actually beneficially used for said purposes, and shall not exceed 250 gallons per minute; 400 acre-feet per year, continuously, for industrial use (laundry)

A description of the lands to which such ground water right is appurtenant is as follows:

Block 109 of the plat of D. T. Denny's 5th Addition to North Seattle; and a strip of land 21.92 feet in width abutting Lot 4 of said Block 109 thereto to the south, within Sec. 30, T. 25 N., R. 4 E.W.M.

The right to use of water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in RCW 90.03.380, 90.03.390 and 90.44.020.

This certificate of ground water right is specifically subject to relinquishment for nonuse of water as provided in RCW 90.14.180.

Given under my hand and seal of this office at Olympia, Washington, this 2nd day of May, 1973.

JOHN A. BIGGS, Director
Department of Ecology

by R. Jerry Bollen
R. JERRY BOLLEN
Assistant Director

Engineering Data

OK Heck

Ground Water Permit No.....

Certificate of Ground Water Right

Recorded in the Department of Ecology,
Olympia, Washington, in Book No.....
..... of Ground Water Right
Certificates, on page....., on the
..... day of.....
19.....

STATE OF WASHINGTON, } *ss.*
County of }

I certify that the within was received
and duly recorded by me in Volume
of Book of Water Right Certificates, at
page..... on the day of
....., 19.....

Progress Sheet—Ground Water Application

11-1-72
pa

Roland Hoefer, Mgr.
Troy Laundry
311 Fairview North

NAME Seattle, Washington 98109 Assigned to _____

G. W. APPLI. NO. 11589 PERMIT NO. 10486 CERT. NO. G100389C A

AMENDED _____ CANCELLED _____

Application received 2-10-71 Initial \$10.00 fee received 2-10-71
Statement of additional examination fee \$ _____ Sent _____ Received _____
Application returned for completion or correction _____ Received _____

TEMPORARY PERMIT: Approved by _____ Issued _____

PUBLICATION:
O.K.'d by [Signature] Date 3-12-71 Notice sent 3-17-71
Protests _____
Filed _____
Affidavit received and checked OK HWH 4/12/71 Time expired 4-30-71
Amended notice sent _____ Affidavit received _____
Time expires _____

DEPT. OF GAME REPORT _____

EXAMINATION Made 8-3-71 by BC
[Signature] O.K.'d for permit 10-13-71 by [Signature]
Statement of permit fee sent 10-8-71 Amount \$ 20.00 Received 10-12-71

PERMIT NO. 10486 ISSUED 10-29-71

BEGINNING OF CONSTRUCTION: Notice sent Started Filed -
Extension fee \$ _____ Extended to _____
Extended to _____

WELL DRILLER'S REPORT: Sent 11-8-71 Filed _____

COMPLETION OF CONSTRUCTION: Notice sent Completed Filed _____
\$2.00 extension fee _____ Extended to _____
To _____

PROOF OF APPROPRIATION: Sent 11-8-71 Filed 4/19/73
\$2.00 extension fee _____ Extended to _____

Statement of certificate fee sent _____ \$ _____ Received 4/19/73

CERTIFICATE OF GROUND WATER RIGHT NO. G100389C A ISSUED 5-2-73

check Q on PA.

[Signature]

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

DANIEL J. EVANS
GOVERNOR

JOHN A. BIGGS
DIRECTOR

Northwest Washington Regional Office
15345 NE 36th
Redmond, WA 98052

Telephone: 885-1900

May 2, 1973

County Auditor
Courthouse
King County
Seattle, Washington 98104

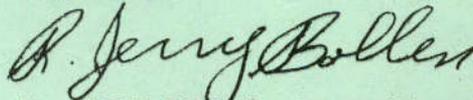
Dear Sir:

Enclosed is Certificate of Water Right No. ~~61-003898~~ and
a check or money order in the amount of ~~\$2.00~~ to cover
the cost of recording in your office.

When this has been done, please forward the certificate to:

Mr. Roland Hoefer, Mgr.
Troy Laundry
311 Fairview North
Seattle, Washington 98109

Sincerely,



R. JERRY BOLLEN, Asst. Director
Office of Operations

RJB:sf

Enclosures

Proof of Appropriation of Water

Application No.

Permit No. 10486

1. Name of Permittee TROY LAUNDRY COMPANY
2. Postoffice address (include zip code) 311 FAIRVIEW N. SEATTLE, WA - 98109
3. Actual source of appropriation WELL
4. For what purpose or purposes is water used? INDUSTRIAL LAUNDRY
5. Give date of beginning of construction of hydraulic system:
6. Give date of completion of construction of this work, including water distribution system.....
THIS WELL IS MANY YEARS OLD
7. Give date when water was completely applied to permitted use MAY 1ST 1972
8. If used for irrigation:
Give number of acres described in permit.....
Give number of acres actually irrigated.....
9. If used for power: HP actually developed.....

10. LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS USED:

LOT 4 BLOCK 109 OF PLAT OF D.T. DENNY'S 5TH ADDITION TO NORTH SEATTLE
SEC. 30 TWP 25 N. RGE 4 E WM KING COUNTY

BLOCK 109 OF THE PLAT OF D.T. DENNY'S 5TH ADDITION TO NORTH SEATTLE; AND A STRIP OF LAND 21.92 FEET IN WIDTH ABUTTING LOT 4 OF THE SAID BLOCK 109 THERE TO THE SOUTH WITHIN SEC. 30 T 25 N R 4 E WM

11. If source is a well, is an access port or airline now installed? YES
12. During what months is water used? 12 MONTHS PER YEAR
13. Does map filed with your application show correctly the location of well(s) or point(s) of diversion for withdrawal of water, and area of land where water is used? YES
14. If the dimensions, location, or type of hydraulic system and structure do not correspond to those described in your permit, state what changes have been made, giving dimensions, etc.....
15. Actual measured discharge or diversion of permanent system: 250 (gpm or cfs).

OK FOR CERT,
REDUCE "Q" TO 250 GPM
400 A/F PER YEAR HW# 4/20/73
(Sign certification on reverse side)

STATE OF WASHINGTON, }
County of KING } ss.

I, SELMER CHOSE, being first duly sworn, depose and say that I have read the above and foregoing proof of appropriation; that I know the contents thereof; and that the facts therein stated are true.

IN WITNESS WHEREOF, I have hereunto set my hand this 19th day of APRIL, 1973.

Selmer Chose
CHIEF ENGINEER

Subscribed and sworn to before me this 18th day of APRIL, 1973.

Richard H. Meyer
Notary Public.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Permit to Appropriate Public Waters of the State of Washington

Book No. 21 of Ground Water Permits, on page 10486 under Application No. 11589

TROY LAUNDRY COMPANY

of Seattle, Washington
is, pursuant to the Report of Examination which has been accepted by the applicant, hereby granted a permit to appropriate the following described public ground waters of the State of Washington, subject to existing rights and to the limitations and provisions set out herein.

Priority date of this permit is February 10, 1971

Source(s) of the proposed ground water appropriation is/are a well

The quantity of water appropriated shall be limited to the amount which can be beneficially applied and not to exceed 1000 gallons per minute; 476 acre-feet per year, to be used for the following purposes: industrial use (laundry), as more definitely set out below.

Approximate location(s) of the point(s) of withdrawal is/are: 150 feet west and 1250 feet north from southeast corner Sec. 30

being within Lot 4, block 109 of the plat of D.T. Denny's 5th Addition to North Seattle of Sec. 30, Twp. 25 N., Rge. 4 E. W.M., King County,

The use, or uses, to which water is to be applied:

Domestic/municipal supply: _____ gallons per minute; _____ acre-feet per year, during entire year.

Irrigation: _____ gallons per minute; _____ acre-feet per year from _____ to _____, each year, for the irrigation of _____ acres.

Other use(s): 1000 gallons per minute; 476 acre-feet per year, ~~from~~ continuously ~~for~~ each year, for industrial use (laundry)

LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS TO BE USED

Block 109 of the plat of D.T. Denny's 5th Addition to North Seattle; and a strip of land 21.92 feet in width abutting Lot 4 of said Block 109 thereto to the south, within Sec. 30, T. 25 N., R. 4 E.W.M.

ADDITIONAL LIMITATIONS AND PROVISIONS: The installation and maintenance of an access port as described in Ground Water Bulletin No. 1 shall be required prior to issuance of final Certificate of Water Right.

Nothing in this permit shall be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations including those administered by local agencies under the Shoreline Management Act of 1971.

DESCRIPTION OF PROPOSED WORKS:

The well ~~will be~~ ^{is} drilled and ~~have~~ ^{has} a diameter of 10 inches, and depth of 540 feet.
(Dug or drilled)

Description of tunnel or infiltration trench:

DEVELOPMENT SCHEDULE:

Construction work shall begin on or before Started

and shall thereafter be prosecuted with reasonable diligence and completed on or before

Completed

and complete application of water to proposed use shall be made on or before

November 1, 1972

This permit shall be subject to cancellation should the permittee fail to comply with the above development schedule and/or fail to give notice to the Department of Ecology on forms provided by that Department documenting such compliance.

Given under my hand and the seal of this office at Olympia, Washington, this 29th

day of October, 1971

JOHN A. BIGGS, Director
Department of Ecology

by R. Jerry Bollen

ENGINEERING DATA
OK *S.F.*

Report of Examination on Ground Water

Received date February 10, 1971 Date of exam. August 3, 1971 Appli. No. 11589

Name Troy Laundry Company Address 311 Fairview N., Seattle WA 98109

Type of works A well Dimensions 10" x 540'

Progress of works Complete

Quantity applied for 1000 g.p.m. Block 109, of the plat of D. T. Denny's 5th Addition to North Seattle acre-feet per year

Legal sub. Lot 4 / Sec. 30 Twp. 25 N. Rge. 4 E. County King

Use Industrial use (laundry)

Irrigation-acreage: Present _____ Planned - Feasible _____

Municipal: Population _____ as of _____

Industrial Laundry operation

Time pump will be operated Continuously

Other water rights appurtenant to this land None

Proximity to existing works, springs, wells, or streams None within 1/4 mile

Area _____ Sub-area _____ Zone _____

RECOMMENDATIONS

Approved for 1000 g.p.m. 476 acre-feet per year, subject to existing water rights. (1 acre-foot 325,850 gallons.)

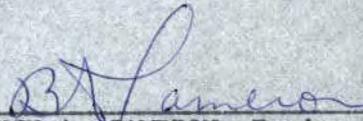
The annual quantity used is based on continuous pumping for 10 hours per day, 5 days per week at a rate of 1000 gallons per minute or 476 acre-feet per year.

The withdrawal rate using the present pumps will be less than the rate approved in this permit. However, the applicant may wish to install a new pump.

Thus it is requested that the applicant check the manufacturing specification for the well pump and any pumping test of the well that may have been conducted so that the final certificate will reflect the correct withdrawal rate. The correct pumping rate should be entered in the proof of appropriation form which will be forwarded after the permit issues.

Additionally, the permit when issued shall carry the following provision: "Nothing in this permit shall be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations including those administered by local agencies under the Shoreline Management Act of 1971."

Signed at Olympia, Washington,
this 24 day of SEPT, 1971.



BRUCE A. CAMERON, Engineer
Department of Ecology

Esbeck

Fidelity Onion Skin
100% COTTON

MAP TOO LARGE TO FILM - RETAINED IN NUMBERED

FILE IN DEPARTMENT OF ECOLOGY

61-00389C



Gas Tanks

Yacht Club

Flanagan Cem

Rogers Park

24

Queen Anne

25

Childrens Hospital

Pawley St

LAKES
UNION

20

Cap Cem

Lake View Cem

Volunteer Park

Water Tank
Power Plant

NAVAL RESERVE
TRAINING CENTER

Capitol Hill

ELLIOTT
BAY

Capitol Hill

Seattle Center

REPUBLICAN ST

HARRISON ST

THOMAS ST

BOLENE ST
FAIRVIEW ST

Capitol Hill

Edison High Sch

Seattle College

SEATTLE-PORT ANGELES-VICTORIA FERRY
SEATTLE-WINSLOW FERRY
SEATTLE-BREMERTON FERRY

R.A.E.W.M.

GW 1589
OFFICE 1

ELLIOTT BAY

PLZ VERIFY WELL LOC,
DETERMINE P.O.U. IF NOT ALL OF
Block 109

5276

5275

7130"

4000m N

5273

525 N

524 N

5272

HARRISON ST.

6.2%

120.0'

165.53'

60.0'

12

60.0'

60.0'

11

60.0'

7.7%

60.0'

10

60.0'

BOREN AVE

60.0'

9

60.0'

ALLEY 6.33%

140.0'

3

4.3%

FAIRVIEW AVE

60.0'

8

60.0'

28.0'

4

100.0'

5

60.0'

60.0'

7

60.0'

120.0'

140.115'

6

157.13'

16%

2.5%

THOMAS ST.



LOT PLAN

SCALE 1" = 50'

11589

GW 11589

D. T. DENNY'S SW ADDN. BLOCK 109

OFFICE 2

S10 30, T25N, R9E



See enlarged-scale map above for area within this band

GW 11589
OFFICE



OFFICE 5

AFFIDAVIT OF PUBLICATION

STATE OF WASHINGTON }
COUNTY OF KING } ss.

.....Louis Magrini....., being first duly sworn

on oath deposes and states: that he is the Publisher of the CAPITOL HILL TIMES, a weekly newspaper which is now and at all times mentioned herein has been published and printed in an office maintained at the place of publication at Seattle, King County, Washington; that by order of the Superior Court of the State of Washington in and for King County said newspaper is now and at all times mentioned herein has been approved as a legal newspaper for the publication of any advertisement, notice, summons, report, proceeding, or other official document required by law to be published; that said newspaper was published regularly, at least once a week, in the English language, as a newspaper of general circulation in Seattle, King County, Washington, at the time of application to the aforementioned Superior Court for approval as a legal newspaper, and was so published for at least six months prior to the date of said application, and is now and at all times mentioned herein has been so published.

That the annexed is a true copy of a legal notice

.....
as it was published in regular issues (and not in supplement form) of said newspaper once each week for a period of two consecutive weeks, commencing on the 24th day of March 1971, and ending on the 31st day of March, 1971, both dates inclusive, and that said newspaper was regularly distributed to its subscribers and as a newspaper of general circulation during all of said period. That the full amount of the fee charged for

the foregoing publication is the sum of \$ 29.26 which amount has been paid in full, at the rate of \$2.40 per hundred words for the first insertion and \$1.80 per hundred words for each subsequent insertion.

Louis Magrini

Subscribed and sworn to before me this 7 day of

April, 1971.

M. D. [Signature]
Notary Public in and for the State of Washington,
residing at Seattle.

State of Washington
DEPARTMENT OF ECOLOGY
Olympia
NOTICE OF
GROUND WATER RIGHT
Application No. 11589

TAKE NOTICE:

That Troy Laundry Company of Seattle, Washington on February 10, 1971 filed application for permit to withdraw public ground waters through a well situated within Lot 4, Block 109, of the plat of D.T. Denny's 5th Addition to North Seattle of Section 30, Township 25 N., Range 4E.W.M., in King County, in the amount of 1,000 gallons per minute, subject to existing rights continuously, each year for the purpose of industrial use (laundry).

Any objections must be accompanied by a two dollars (\$2.00) recording fee and filed with the Department of Ecology within thirty (30) days from March 31, 1971.

Witness my hand and official seal this 17th day of March, 1971.

GLEN H. FIEDLER
Department of Ecology

OK
1/24/71
4/12/71

RECEIVED
DEPARTMENT OF ECOLOGY

APR 9 1971

AM 7 8 9 10 11 12 1 2 3 4 5 6 PM





RECEIVED

MAR 14 2005

DEPT OF ECOLOGY

State of Washington

Application for a Water Right

Please follow the attached instructions to avoid unnecessary delays.

FEE PAID

for Ecology Use

Fee Paid 10

Date 14 Mar 05

Section 1. APPLICANT - PERSON, ORGANIZATION, OR WATER SYSTEM

Name LAKE VIEW CEMETERY, ASSN, INC Home Tel: (206) 322-1582
Mailing Address 1554 - 15TH AVE. EAST Work Tel: () -
City SEATTLE, State WA. Zip+4 98112+2805 FAX: (206) 322-0523

Section 2. CONTACT - PERSON TO CALL ABOUT THE APPLICATION

Same as above

Name GEORGE NEMETH, JR. Home Tel: () -
Mailing Address 1554 - 15TH AVE. EAST Work Tel: (206) 322-1502
City SEATTLE State WA. Zip+4 98112+2805 FAX: (206) 322-0523
Relationship to applicant BOARD SECRETARY / CEMETERY MANAGER

Section 3. STATEMENT OF INTENT

The applicant requests a permit to use not more than 30 - 50 (gallons per minute or cubic feet per second) from a surface water source or ground water source (check only one) for the purpose(s) of AN IRRIGATION WELL FOR WATERING CEMETERY PLANTS AND LAWN. ATTACH A "LEGAL"

DESCRIPTION OF THE PLACE OF USE. (See instructions.) NOTE: A tax parcel number or a plat number is not sufficient.

Estimate a maximum annual quantity to be used in acre-feet per year: NOV. 9, 2003 TO NOV. 10, 2004 METER READINGS = 59,716.00 - 63,691.00 = 3,975 CCF USED PER YEAR. (BASED ON 1 YR'S INV.)

Check if the water use is proposed for a short-term project. Indicate the period of time that the water will be needed:

From / / to / /

Section 4. WATER SOURCE

Form with sections: If SURFACE WATER, If GROUNDWATER, LOCATION, and a table for source location details. Includes fields for Name, Number of diversions, Source flows into, Size & depth of well(s), and a table with columns for 1/4 of, Section, Township, Range(E/W), County, Lot, Block, Subdivision.

Appl. No.: 61-28238

Section 5. GENERAL WATER SYSTEM INFORMATION

- A. Name of system, if named: _____
- B. Briefly describe your proposed water system. (See instructions.)

N/A

- C. Do you already have any water rights or claims associated with this property or system? YES NO
PROVIDE DOCUMENTATION.

Section 6. DOMESTIC / PUBLIC WATER SUPPLY SYSTEM INFORMATION
(Completed for all domestic/public supply uses.)

- A. Number of "connections" requested: _____ Type of connection _____
(Homes, Apartment, Recreational, etc.)
- B. Are you within the area of an approved water system? YES NO
If yes, explain why you are unable to connect to the system. *Note: Regional water systems are identified by your County Health Department.*

N/A

Complete C. and D. only if the proposed water system will have fifteen or more connections.

- C. Do you have a current water system plan approved by the Washington State Department of Health? YES NO
If yes, when was it approved? _____ Please attach the current approved version of your plan.
- D. Do you have an approved conservation plan? YES NO
If yes, when was it approved? _____ Please attach the current approved version of your plan.

Section 7. IRRIGATION/AGRICULTURAL/FARM INFORMATION
(Complete for all irrigation and agriculture uses.)

- A. Total number of acres to be irrigated: APPROXIMATELY 30 TO 35 ACRES
- B. List total number of acres for other specified agricultural uses:

Use <u>N/A</u>	Acres <u>0</u>
Use <u>N/A</u>	Acres <u>0</u>
Use <u>N/A</u>	Acres <u>0</u>
- C. Total number of acres to be covered by this application: APPROXIMATELY 30 TO 35 ACRES
- D. Family Farm Act (Initiative Measure Number 59, November 3, 1977, as amended by Chapter 237, Laws of 2001)
Add up the acreage in which you have a controlling interest, including only:
 - ‡ Acreage irrigated under water rights acquired after December 8, 1977;
 - ‡ Acreage proposed to be irrigated under this application;
 - ‡ Acreage proposed to be irrigated under other pending application(s).
 1. Is the combined acreage greater than 6000 acres? YES NO
 2. Do you have a controlling interest in a Family Farm Development Permit? YES NO
If yes, enter permit no: _____
- E. Farm uses: N/A
Stockwater - Total # of animals _____ Animal type _____ (If dairy cattle, see below)
Dairy - # Milking _____ # Non-milking _____

Section 8. WATER STORAGE

Will you be using a dam, dike, or other structure to retain or store water?

YES NO

NOTE: If you will be storing 10 acre-feet or more of water and/or if the water depth will be 10 feet or more at the deepest point, and some portion of the storage will be above grade, you must also apply for a reservoir permit. You can get a reservoir permit application from the Department of Ecology.

Section 9. DRIVING DIRECTIONS

Provide detailed driving instructions to the project site.

(SEE SEPARATE ATTACHED PAGE & MAP)

Section 10. REQUIRED MAP

A. Attach a map of the project. (See instructions.)

(SEE SEPARATE ATTACHED PAGE)

Section 11. PROPERTY OWNERSHIP

A. Does the applicant own the land on which the water will be used?

YES NO

If no, explain the applicant's interest in the place of use and provide the name(s) and address(es) of the owner(s):

B. Does the applicant own the land on which the water source is located?

YES NO

If no, submit a copy of agreement:

I certify that the information above is true and accurate to the best of my knowledge. I understand that in order to process my application, I grant staff from the Department of Ecology access to the site for inspection and monitoring purposes. Even though I may have been assisted in the preparation of the above application by the employees of the Department of Ecology, all responsibility for the accuracy of the information rests with me.

George Nemeth Jr.
Applicant (or authorized representative)

LAKE VIEW CEMETERY, ASSN., INC.
BOARD SECRETARY
CEMETERY MANAGER

3-10-2005
Date

SAME

Landowner for place of use (if same as applicant, write "same")

_____ Date

Use this page to continue your answers to any questions on the application. Please indicate section number before answer.

We are returning your application for the following reason(s):	
_____ Examination fee was not enclosed	APPLICANT PLEASE RETURN TO CASHIER, PO BOX 5128, LACEY, WA 98509-5128
_____ Section number(s) _____ is/are incomplete	APPLICANT PLEASE RETURN TO THE APPROPRIATE REGIONAL OFFICE
Explanation:	
Please provide the additional information requested above and return your application by _____ (date).	

Ecology staff _____ Date _____

Ecology is an Equal Opportunity and Affirmative Action employer.

To receive this document in alternative format, contact the Water Resources Program at (360) 407-6604 (Voice) or (360) 407-6006 (TDD).

SEC #3. LEGAL DESCRIPTION

COPY

PLAT OF LAKE-VIEW CEMETERY

JONES & HOFF
CIVIL

EXPLANATION

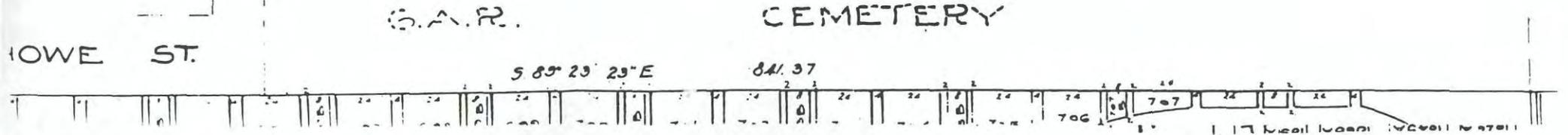
This Replot of Lake-View Cemetery embraces the Southeast quarter of the Southeast quarter (SE 1/4 of SE 1/4) of Section Twenty, (Sec. 20) Township Twenty-five North of Range Four East (Tp 25 N. R. 4 E. W.M.) King County, Washington.

The Initial Point is the second stone monument at the southeast corner of Section Twenty aforesaid. All Lots, Streets, Drives and Walks are therefrom as shown on the face of the plat.

Dimensions are as shown on the face of the plat.

Bearings refer to the established Meridian of the City of Seattle.

Sheet No.



SEC.#3 LEGAL DESCRIPTION

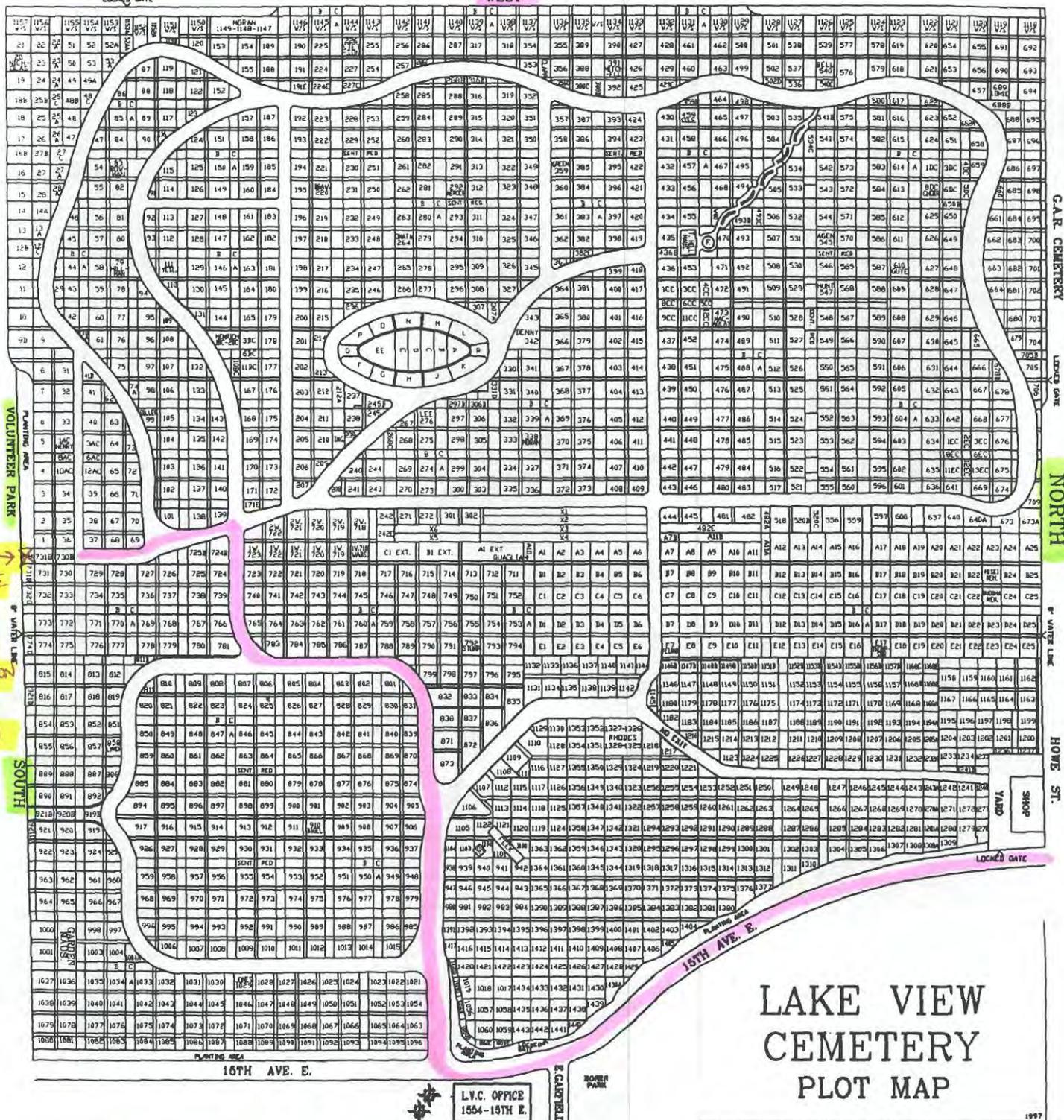
grant, convey, transfer, assign and set over unto the Buyer, its successors and assigns, forever, all and singular the property, assets, rights and interests of Lake View Cemetery Association, other than cash, as follows:

1. All interest of the Lake View Cemetery Association in and to the following described real estate situate in the County of King, State of Washington, together with the appurtenances, to-wit:

The southeast quarter ($SE\frac{1}{4}$) of the southeast quarter ($SE\frac{1}{4}$) of Section Twenty (20), Township Twenty-five (25), Range 4 East Willamette Meridian, lying west of 15th Avenue North, in the City of Seattle.

2. All contracts, agreements, leases, accounts receivable, bills receivable, credits, and choses in action of every

COPY



GREEN →
CONCRETE
BLOCK
BLDG.
(IRRIGATION
PUMP
HOUSE)

LAKE VIEW CEMETERY PLOT MAP

Driving directions from downtown Seattle: Going North on I-5 take Exit #168-A the Lakeview Bldv. off-ramp. Turn Left onto Lakeview Blvd. at the Stop sign and continue to Roanoke Street. Turn Right onto Roanoke Street at traffic light and continue 2 blocks to 10th Avenue East. Turn Right onto 10th Ave. East and continue to Boston Street, which is two traffic lights up the hill. Take a Left onto Boston Street and continue for approx 1/4 mile to the Cemetery entrance. Note: Boston street will become 15th Ave. East. The Cemetery entrance is on the right. Follow cemetery roads highlighted in pink on above map to proposed site. Note: site is proposed to be located just West of green concrete block pump house bldg., or possibly within pump house bldg. if possible and feasible. See more detailed sketch of proposed site area attached on separate sheet.

L.V.C. OFFICE
1554-15TH E.

TEER PARK

AREA	HENRY	6AC	65	72	103	136	141	170	173	206	209	240						
4	10AC	12AC	65	72	102	137	140	171	172	207	208	241						
3	34	39	66	71	101	138	139	171E										
2	35	38	67	70														
1	36	37	68	69														
	731B	730B			725B	724B				2W. 722	2W. 721	2W. 720	2W. 719	2W. 718				
	731D	731D	731	730	729	728	727	726	725	724	1W. 723	1W. 722	1W. 721	1W. 720	1W. 719	1W. 718		
	732D	732D	732	733	734	735	736	737	738	739	723	722	721	720	719	718		
					B	C										B		
			773	772	771	770	A	769	768	767	766	765	764	763	762	761	760	
	774D	774D	774	775	776	777	778	779	780	781	783	784	785	786	787			
							811B											
			815	814	813	812		810	809	808	807	806	805	804	803	802		
	921D	921D	816	817	818	819	811	820	821	822	823	824	825	826	827	828	829	
			854	853	852	851				B	C							
			855	856	857	858	LYNCH	850	849	848	847	A	846	845	844	843	842	841
			889	888	887	886		859	860	861	862	863	864	865	866	867	868	
												SENT.	RED					
			890	891	892			885	884	883	882	881	880	879	878	877	876	
			921B	920B	919B			894	895	896	897	898	899	900	901	902	903	
	921D	921D	921	920	919			917	916	915	914	913	912	911	910	BIGEL	909	908
			922	923	924	925		926	927	928	929	930	931	932	933	934	935	
			963	962	961	960						SENT.	RED				B	
			964	965	966	967		959	958	957	956	955	954	953	952	951	950	
			1000	GARDEN MAUS.	998	997		968	969	970	971	972	973	974	975	976	977	
			1001		1003	1004	1004A	996	995	994	993	992	991	990	989	988	987	
						B	C	1006	1007	1008	1009	1010	1011	1012	1013	1014		
			1037	1036	1035	1034	A	1033	1032	1031	1030	JONES 1029	1028	1027	1026	1025	1024	1023
			1038	1039	1040	1041		1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052
			1079	1078	1077	1076		1075	1074	1073	1072	1071	1070	1069	1068	1067	1066	1065
			1080	1081	1082	1083		1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094

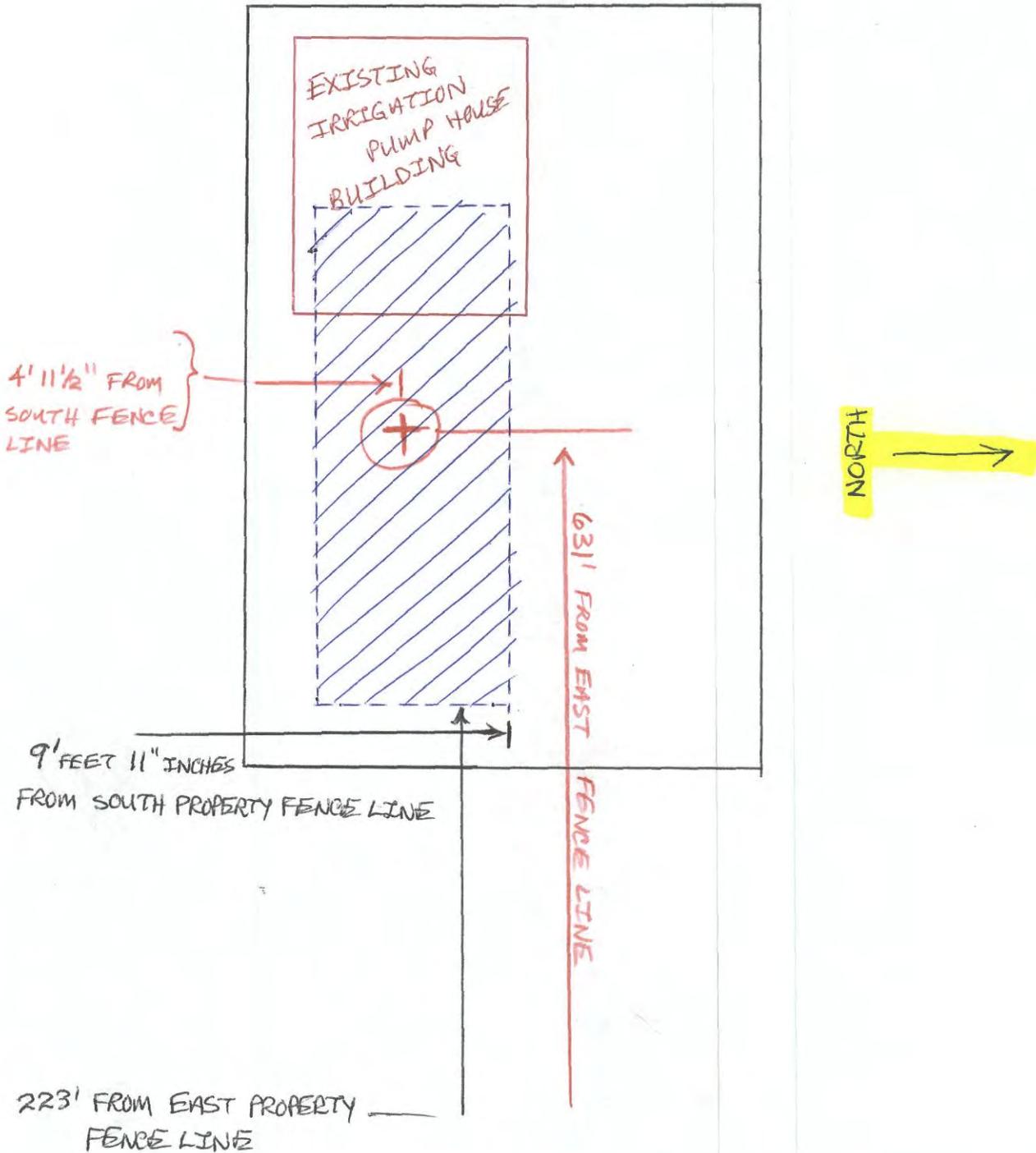
8' WATER LINE

SOUTH



SEC 10.

MAP OF PROJECT





STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION

WATER RIGHT CLAIM

1. NAME JOSEPH L. LORENTZ
ADDRESS 2536 MAYFAIR AVE. N.
SEATTLE, WASHINGTON ZIP CODE 98109

2. SOURCE FROM WHICH THE RIGHT TO TAKE AND MAKE USE OF WATER IS CLAIMED: GROUND WATER
(SURFACE OR GROUND WATER)
W.R.I.A. 03
(LEAVE BLANK)

A. IF GROUND WATER, THE SOURCE IS A SPRING
B. IF SURFACE WATER, THE SOURCE IS _____

3. THE QUANTITIES OF WATER AND TIMES OF USE CLAIMED:
A. QUANTITY OF WATER CLAIMED 10 GPM PRESENTLY USED 10 GPM
(CUBIC FEET PER SECOND OR GALLONS PER MINUTE)
B. ANNUAL QUANTITY CLAIMED _____ PRESENTLY USED _____
(ACRE FEET PER YEAR)
C. IF FOR IRRIGATION, ACRES CLAIMED _____ PRESENTLY IRRIGATED _____
D. TIME(S) DURING EACH YEAR WHEN WATER IS USED: CONTINUOUSLY

4. DATE OF FIRST PUTTING WATER TO USE: MONTH _____ YEAR _____

5. LOCATION OF THE POINT(S) OF DIVERSION/WITHDRAWAL: _____ FEET _____ AND _____ FEET _____ FROM THE _____ CORNER OF SECTION _____ BEING WITHIN _____ OF SECTION 19 T. 25 N., R. 4E (E.OR.W.) W.M.
IF THIS IS WITHIN THE LIMITS OF A RECORDED PLATTED PROPERTY, LOT _____ BLOCK _____ OF _____

(GIVE NAME OF PLAT OR ADDITION)
6. LEGAL DESCRIPTION OF LANDS ON WHICH THE WATER IS USED: LOT 19-25-04 BLOCK 9010

CODE: 0010, SEC. 19, TWP: 25, RG: 04, POR OF SW 1/4 OF NW 1/4 LY NLY OF N QUEEN ANNE DR WLY OF E LN OF 3RD AVE N PROD S ADD ELY OF 2ND AVE N PROD VAC POR SO 2ND AVE N LESS S 126 FT OF N 156 FT OF W 80 FT OF E 80 FT OF POR LY W OF C/L OF MAYFAIR AVE PROD S LESS E 60 FT OF N 70 FT OF W 98.55 FT OF E 158.55 FT OF S 53.5 FT OF E 80 FT OF W 104 OF PER LY E C/L MAYFAIR AVE PROD S LESS REG AT INTER OF C/L 2ND COUNTY KING AVE N AND C/L RAY ST TH E ALL PROTECTION OF C/L RAY ST 30.4 FT TO TPOB TH E 200 FT PLOT N MGN RAY ST TO MGN MAYFAIR AVE PROD S

7. PURPOSE(S) FOR WHICH WATER IS USED: WATER LAWN
8. THE LEGAL DOCTRINE(S) UPON WHICH THE RIGHT OF CLAIM IS BASED: APPROPRIATION

DO NOT USE THIS SPACE
THE FILING OF A STATEMENT OF CLAIM DOES NOT CONSTITUTE AN ADJUDICATION OF ANY CLAIM TO THE RIGHT TO USE OF WATERS AS BETWEEN THE WATER USE CLAIMANT AND THE STATE OR AS BETWEEN ONE OR MORE WATER USE CLAIMANTS AND ANOTHER OR OTHERS. THIS ACKNOWLEDGEMENT CONSTITUTES RECEIPT FOR THE FILING FEE.
DATE RETURNED _____ THIS HAS BEEN ASSIGNED WATER RIGHT CLAIM REGISTRY NO. PAR 105139055
John Biggs
DIRECTOR - DEPARTMENT OF ECOLOGY

I HEREBY SWEAR THAT THE ABOVE INFORMATION IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF.
X John Lorentz
DATE JUNE 28, 1974
IF CLAIM FILED BY DESIGNATED REPRESENTATIVE, PRINT OR TYPE FULL NAME AND MAILING ADDRESS OF AGENT BELOW.
JOSEPH L. LORENTZ
2536 MAYFAIR AVE. N.
 ADDITIONAL INFORMATION RELATING TO WATER QUALITY AND/OR WELL CONSTRUCTION IS AVAILABLE.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG

No Declar. #48
Cert. #25-D

Date 1921, 19__

Record by Puget Sound Light & Power

Source Decla. of G. W. Claim

Location State of WASHINGTON

County King

Area _____

Map Lot 11, Blk. 177, Seattle Tidelands
in SE 1/4 1/4 sec 31 1/4 25 N, R 4 E W

DIAGRAM OF SECTION

Drilling Co _____

Address _____

Method of Drilling Drilled Date _____ 19__

Owner Puget Sound Light & Power Company

Address 860 Stuart Bldg., Seattle, Wash.

Land surface, datum _____ ft above
below _____

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
-------------	----------	------------------	--------------

(Transcribe driller's terminology literally but paraphrase as necessary in parentheses if material water bearing so state and record static level if reported. Give depths in feet below land surface datum unless otherwise indicated. Correlate with stratigraphic column if feasible. Following log of materials list all casings perforations screens etc.)

Well log:

No data available

Pump Test:

Dim.: 145' deep; 6" and 10"

SWL: No data

DD: No data

Yield: 250 g.p.m.

Casing: 10" diam. well casing from 0 to 125'
6" diam. standard pipe from 0 to
145'

Perfs.: Perforations in 6" pipe from 125'
to 147'

Type & Size of Pump: Air lift

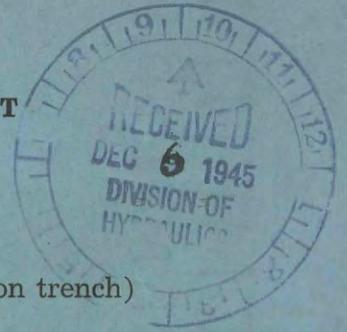
" " " " Motor: No data

Turn up _____

Sheet _____ of _____ sheets

25N/4E-31R
File number

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
Division of Hydraulics



Declaration of Ground Water Claim

(Separate claims should be filed for each well, tunnel or infiltration trench)

No. 47

I, Puget Sound Power & Light Co.
(Name of claimant)

of 860 Stuart Bldg., Seattle 1, Washington
(Complete postoffice address)

do hereby make declaration of claim of vested right to ground water by use prior to June 7, 1945, and file the same with the State Supervisor of Hydraulics, in accordance with Section 9, Chapter 263, Laws of 1945 of the State of Washington, and request a Certificate of Ground Water Right thereunder.

1. SOURCE from which water is withdrawn is Pump well
(Flowing well, pump well, infiltration trench, or tunnel)

2. LOCATION is: Within corporate limits of Seattle, Washington
(Approximate distance and direction from nearest city or town)
and is more particularly described as follows:

(a) _____
(Give distance and bearing to corner of section or other legal subdivision)

being within SE 1 2814 of Sec. 31, Twp. 24 N., Rge. 4 E
(Smallest legal subdivision) (E. or W.)

or (b) Within limits of incorporated city or town of Seattle, Washington,

in Lot 4, Block 195 of Seattle Tide Lands
(Name of addition or plat)

County of King within _____ area
(Leave blank)

_____ sub-area _____ zone
(Leave blank) (Leave blank)

(c) The location of the well or other works is shown on the accompanying plat, or other adequate maps or drawings.

(d) The owner of property on which the works are constructed is:

Puget Sound Power & Light Co. 860 Stuart Bldg., Seattle 1, Wash.
(Name) (Post office address)

3. CONSTRUCTION WORK was begun on 1901; was completed on 1901
(Date) (Date)

and the ground water claimed was first used for the purposes set out below on 1901,
(Date)

since which time the water has been used continuously
(Continuously or intermittently)

from 1901 to 1945
(Date) (Date)

4. QUANTITY of water claimed and used is 120 gallons per minute; 180 acre feet per year.

5. PURPOSE OR PURPOSES for which water is used Boiler feed water and cooling electric power transformers
(Domestic, irrigation, municipal, manufacturing, industrial, etc.)

5. (Continued)

(a) FOR MUNICIPAL SUPPLY: To supply the city, town or community of.....
in the county of....., having a present population of....., and an estimated
population of..... in 19.....

(b) FOR IRRIGATION: The land irrigated has a total area of..... acres, and water is
used each year for this purpose from..... to.....
(Date) (Date)

(c) Legal description of property on which water is used for all purposes other than municipal
supply:

South 15 feet of Lot 2, all of Lots 3 and 4, and Lot 5 (except
the southerly 100 feet) all in Block 195 of the Seattle Tide
Lands, Seattle, King County, Washington.

6. DESCRIPTION OF WORKS:

(a) WELL: Depth 180 feet. Diameter 8" & 10" see below inches or feet. Dug or drilled drilled
Flowing or pump well pump

IF PUMP WELL: Type and size of pump is S.S. centrif. - 200 gpm, 1,730 rpm.

Type and size of motor or engine is 7 1/2 HP, 220 V., 3 phase, 1,740 rpm.

Depth from ground surface to water level before pumping No data feet.

After continuous operation for at least four hours, the measured discharge of pump is No data
g.p.m., and the drawdown of water level is No data feet.

Date of test ----

IF FLOWING WELL: Measured discharge g.p.m. on..... (Date)

Shut-in pressure at ground surface..... lbs. per sq. in. on..... (Date)

Water is controlled by..... (Cap, valve, etc.)

CASING: (Give diameter, commercial specifications and depth below ground surface of each
casing size.)

10 inch diameter Casing from 0 to 180 feet

8 inch diameter Black pipe from 0 to 180 feet

inch diameter from to feet

inch diameter from to feet

Describe and show depth of shoe, plug, adapter, liner or other details:

7. Ownership of each existing well or other works for withdrawal of ground water within a radius of one-quarter mile and the distance and direction from well or other works being reported herein:

None that are known of (Name of owner)	(Direction)	(Distance)

(On accompanying plat or map show location of these existing wells or works.)

8. Remarks:

Puget Sound Power & Light Co.
C. F. Terrell
 (Signature of claimant)
 C. F. Terrell, Vice President

STATE OF WASHINGTON, }
 COUNTY OF King } ss.

I, the claimant named in the foregoing claim, being first duly sworn, depose and say that I have read the above and foregoing claim to ground water right; that I know the contents thereof; and that to the best of my knowledge, information and belief, the facts therein stated are true and correct.

Puget Sound Power & Light Co.
C. F. Terrell
 C. F. Terrell, Vice President

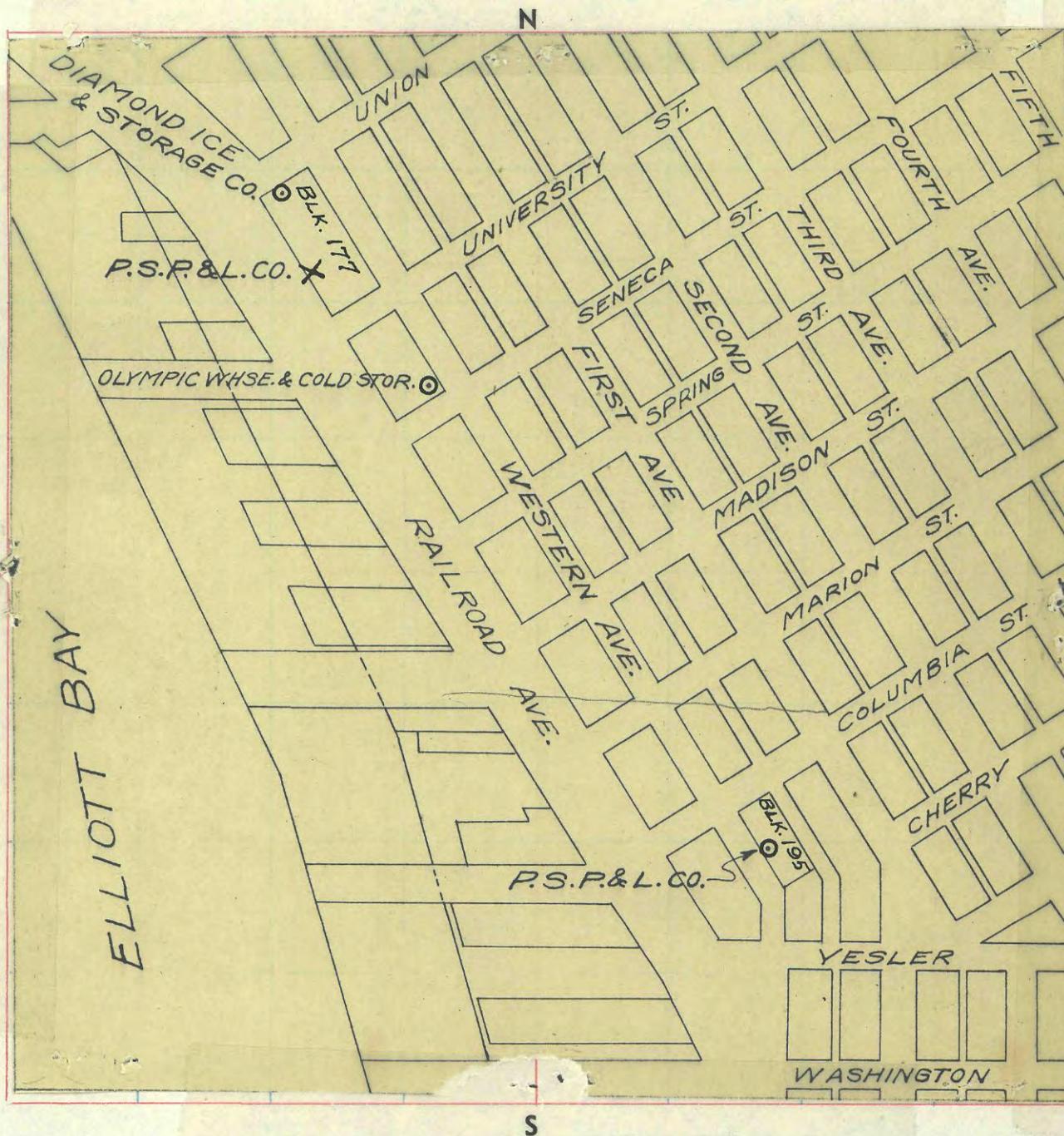
Subscribed and sworn to before me this 5th day of December, 1945



N. E. Klein
 Notary Public in and for the State of Washington,
 Residing at Seattle

A Portion of

Sec. 31 Twp. 24 25' N. R. 4 E



Show by a cross (X) the location of the well or other works covered by the application or declaration. Show by circle (O) the locations of other wells or works within a quarter of a mile. Also traveling directions from nearest town on main highway.

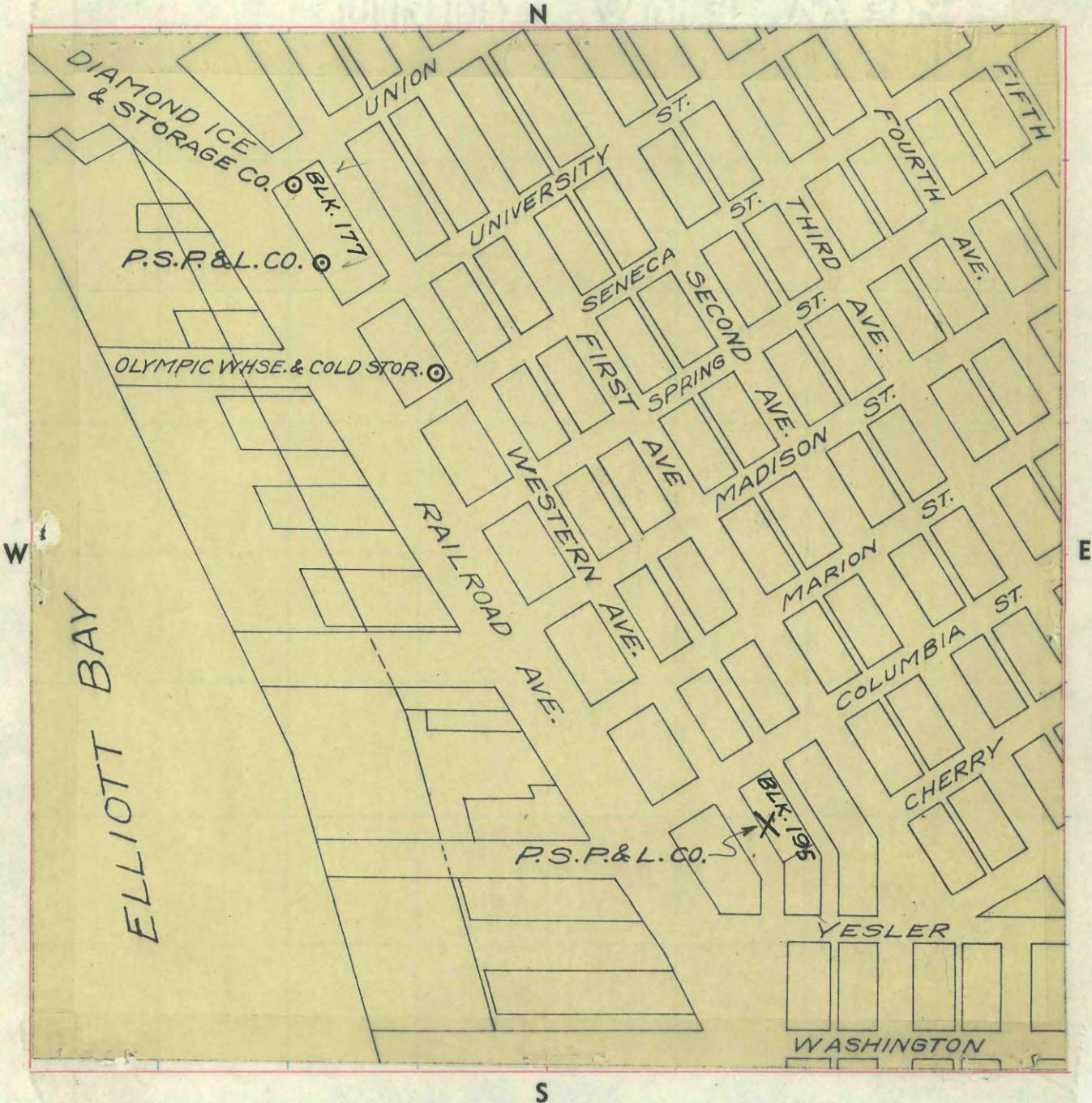
Scale: 1 inch = ⁴⁰⁰~~300~~ feet.

Well is located at Puget Sound Power & Light Co's Western Ave.
Station on Lot 4, Block 177, Seattle Tide Lands. The Station is
on Western Ave. between Union and University, Seattle.

IXE 4

A Portion of

Sec. 316 Twp. 24 N. R. 4 E



Show by a cross (X) the location of the well or other works covered by the application or declaration. Show by circle (O) the locations of other wells or works within a quarter of a mile. Also traveling directions from nearest town on main highway.

Scale: 1 inch = ⁴⁰⁰~~300~~ feet.

Well is located at Puget Sound Power & Light Co's. Post St. Station on Lot 4, Black 195 Seattle Tide Lands, Seattle, Washington. The Station is on Western Ave. between Yesler Way and Columbia St., Seattle.

D-47

D-47-48

STATE OF WASHINGTON
OFFICE OF SUPERVISOR OF HYDRAULICS
Olympia

NOTICE OF DECLARATIONS OF CLAIMS OF RIGHTS TO WITHDRAW GROUND WATERS
NOS. 47 and 48.

To Whom It May Concern: Notice is hereby given that Puget Sound Power & Light Company of Seattle, Washington, on December 6, 1945 filed with the State Supervisor of Hydraulics, Olympia, Washington, two declarations of claim of vested rights existing prior to June 7, 1945, to withdraw ground waters in King County, and has requested Certificates of Water Rights under such claims, as follows: Declaration No. 47 of claim to withdraw 120 gallons per minute, continuously for boiler feed water and cooling electric power transformers by means of a pump well located within Lot 4, Block 195 of Seattle Tide Lands (SE $\frac{1}{4}$ of Sec. 31, Twp. 24 N., Rge. 4 E.W.M.), with priority (date of first beneficial use of water) in the year 1901; and Declaration No. 48 of claim to withdraw 250 gallons per minute, continuously for boiler feed water and supplying condenser cooling water by means of a pump well located within Lot 4, Block 177 of Seattle tide lands (SE $\frac{1}{4}$ of Sec. 31, Twp. 24 N., Rge. 4 E.W.M.), with priority as of the year 1921.

Any person, firm or corporation disputing such claims or protesting the rights claimed are not vested rights to be recognized under Chap. 263, of the 1945 Session Laws of the State of Washington, may file with the State Supervisor of Hydraulics, at Olympia, Washington, such objections or representations, in writing, as he may desire to make, within thirty (30) days after date of last publication, which date is _____

Witness my hand and official seal this 7th day of December, 1945.

RODNEY RYKER,
State Supervisor of Hydraulics
By: CHAS. J. BARTHOLET, Deputy

STATE OF WASHINGTON
Office of Supervisor of Hydraulics
Olympia

Notice of Declarations of Claims of Rights to Withdraw Ground Waters Nos. 47 and 48.

To Whom It May Concern: Notice is hereby given that Puget Sound Power & Light Company of Seattle, Washington, on December 6, 1945, filed with the State Supervisor of Hydraulics, Olympia, Washington, two declarations of claim of vested rights existing prior to June 7, 1945, to withdraw ground waters in King County, and has requested Certificates of Water Rights under such claims, as follows: Declaration No. 47 of claim to withdraw 120 gallons per minute, continuously for boiler feed water and cooling electric power transformers by means of a pump well located within Lot 4, Block 195, of Seattle Tide Lands (SE 1/4 of Sec. 31, Twp. 24 N., Rge. 4 E., W. M.), with priority (date of first beneficial use of water) in the year 1901; and Declaration No. 48 of claim to withdraw 250 gallons per minute, continuously for boiler feed and supplying condenser cooling water by means of a pump well located within Lot 4, Block 177, of Seattle Tide Lands (SE 1/4 of Sec. 31, Twp. 24 N., Rge. 4 E., W. M.), with priority as of the year 1921.

Any person, firm or corporation disputing such claims or protesting the rights claimed are not vested rights to be recognized under Chap. 263, of the 1945 Session Laws of the State of Washington, may file with the State Supervisor of Hydraulics, at Olympia, Washington, such objections or representations, in writing, as he may desire to make, within thirty (30) days after date of last publication, which date is Dec. 18, 1945.

Witness my hand and official seal this 7th day of December, 1945.
(Seal) RODNEY RYKER,
State Supervisor of Hydraulics.
By: CHAS. J. BARTHOLET,
(2348) Deputy.



Affidavit of Publication

STATE OF WASHINGTON, } ss.
COUNTY OF KING

M. E. Brown, being first duly sworn, on oath deposes and says that he is one of the publishers of The Daily Journal of Commerce, a daily newspaper. That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of the publication hereinafter referred to, published in the English language continuously as a daily newspaper in Seattle, King County, Washington, and it is now and during all of said time was printed in an office maintained at the aforesaid place of publication of said newspaper. That the said Daily Journal of Commerce was on the 12th day of June, 1941, approved as a legal newspaper by the Superior Court of said King County.

That the annexed is a true copy of a
Notice of Rights to Ground Water Nos. 47 & 48
as it was published in regular issues (and not in supplement form) of said newspaper once each week for a period of two (2) consecutive weeks, commencing on the 11th day of December, 1945, and ending on the 18th day of December, 1945, both dates inclusive, and that said newspaper was regularly distributed to its subscribers during all of said period.

M. E. Brown

Subscribed and sworn to before me this
18th day of December, 1945.

J. C. Jones

Notary Public in and for the State of Washington, residing at Seattle.
(This form officially sanctioned by Washington State Press Association.)
Form C.

January 25, 1946.

Mr. C. F. Terrell, Vice Pres.
Puget Sound Power & Light Company
860 Stuart Building
Seattle 1, Washington

Dear Mr. Terrell:

Re: Ground Water Declarations
of Claim Nos. 47 and 48

This is to advise you that the above numbered claims have been approved and certificates of water right will be issued upon payment of the fees set out in the attached statement.

However, it will be necessary for us to know the percentage of time each year that water is withdrawn from each well so that we may figure the acre-feet of water used each year.

It also appears from our maps that the township in which your wells are located should be 25 instead of 24 as shown in the declarations. Will you please check this and confirm it.

Yours very truly

CJB:GH

CHAS. J. BARTHOLET
Consulting Engineer

PUGET SOUND POWER & LIGHT COMPANY

860 Stuart Building
Seattle 1, Washington
February 14, 1946



Mr. Charles J. Bartholet
Consulting Engineer
Department of Conservation and Development
Transportation Building
Olympia, Washington

Dear Mr. Bartholet:

Enclosed herewith are checks for \$3 and \$1.50 covering fees due on Declarations of Ground Water Claims No. 47 and 48 as set forth in your letter of January 25, 1946.

Water from both of these wells is used continuously throughout the year.

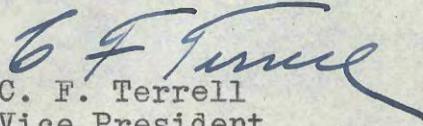
We appreciate your calling to our attention the correct township in which these two properties are located. Description of location of these two wells was based primarily on lot and block number in Seattle, and such locations are correct as shown on the original applications. However, legal subdivision descriptions for the two locations should read as follows:

Claim No. 47 - Northeast quarter section 6,
Township 24 N., Range 4 E.W.M.

Claim No. 48 - Southeast quarter section 31,
Township 25 N., Range 4 E.W.M.

We trust that with the foregoing information you will be able to furnish Certificates for these two Ground Water Claims.

Yours very truly,


C. F. Terrell
Vice President



GROUND WATER
DECLARATION OF CLAIM
PROGRESS SHEET

*Check trip
when send for
fees
1-10-46*

NAME: Puget Sound Power & Light Co.
860 Stuart Bldg., Seattle, Wash.

DECLARATION NO. 47

CERTIFICATE NO. 24-D

Declaration received 12-6-45 Initial fee received 12-6-45

Returned for completion or correction _____ Received _____

Statement of add. fee sent _____ Amount \$ _____ Received _____

Amended _____

Cancelled _____

Approved - Same - 12-2-45
O.K'd for publication Dec 7 by leg B

Notice of declaration sent 12-7-45

Protests filed _____

Affidavit of Publication received and checked 12-21-45 (Jan. 18, 1946)

Time for making protests expires _____

Examination made _____ by _____

O.K'd for Certificate Jan 14 by leg B

Statement of filing and recording fee sent 1-25-46 Amount \$ 1.50

Fee received 2-15-46

Ground Water Certificate issued 2-18-46 No. D. 24

miss

CERTIFICATE RECORD No. 1 PAGE No. 24-D UNDER DECLARATION OF CLAIM No. 47

STATE OF WASHINGTON, COUNTY OF King

Certificate of Ground Water Right

Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and the rules and regulations of the State Supervisor of Hydraulics thereunder.

THIS IS TO CERTIFY That PUGET SOUND POWER & LIGHT COMPANY
of Seattle, Washington has filed
in the office of the State Supervisor of Hydraulics of Washington Declaration of Claim No. 47
to withdraw ground waters of the State from a pump well,
located within Lot 4, Block 195 of Seattle Tide Lands, in the NE 1/4 of Sec. 6,
Twp. 24 N., Rge. 4 E.W.M.

for the purpose of Boiler feed water and cooling electric power transformers.

The right to the use of said ground waters has been sustained and approved by the Supervisor of Hydraulics in accordance with Chapter 263, Laws of Washington for 1945, and is hereby entered of record in Volume 1 of Ground Water Certificates at page 24-D; the right approved has a priority of the year 1901; the amount of water which the Declarant is entitled to withdraw for the aforesaid purpose is limited to the amount actually beneficially used and shall not exceed 120 gallons per minute; 180 acre-feet per year; and is appurtenant to the following described lands or place of use:

South 15 feet of Lot 2, all of Lots 3 and 4, and Lot 5 (except the southerly 100 feet) all in Block 195 of the Seattle Tide Lands, Seattle, King County, Washington.

The right to the use of the ground water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Sections 6 and 7, Chapter 122, Laws of 1929.

WITNESS the seal and signature of the State Supervisor of Hydraulics affixed this 18th day of February, 19 46

By: Chas. J. Bartholet
RODNEY RYKER
State Supervisor of Hydraulics.
CHAS. J. BARTHOLET, Deputy

Declaration of Claim No. 47-

**CERTIFICATE OF GROUND
WATER RIGHT**

Recorded in the office of State Super-
visor of Hydraulics, Olympia, Washington,
in Book No. 1 of Ground Water
Right Certificates, on page 24-D on the
18th day of February, 1946.

STATE OF WASHINGTON, }
County of King } ss.

I certify that the within was received and
duly recorded by me in Volume
of Book of Water Right Certificates, page
on the day of
, 19.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG

No. Decla. #49
Cert. #23

Date 1901

Record by L. E. Karrer

Source Decla. of G. W. Claim

Location State of WASHINGTON

County King

Area

Map

~~XXXX~~ SE $\frac{1}{4}$ sec 31 T 25 N, R 4 E ~~W~~

DIAGRAM OF SECTION

Drilling Co

Address

Method of Drilling drilled Date unknown 19

Owner Diamond Ice & Storage Co.

Address 860 Stuart Bldg., Seattle 1, Wn.

Land surface, datum _____ ft above
below _____

CORRE LATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
-----------------	----------	---------------------	-----------------

(Transcribe driller's terminology literally but paraphrase as necessary in parentheses. If material water bearing, so state and record static level if reported. Give depths in feet below land surface datum unless otherwise indicated. Correlate with stratigraphic column if feasible. Follow log of materials list all casings, perforations, screens, etc.)

No data available

Pump test:

Dim: 467' x 8" & 6"

SWL: no data

D.D. "

Yield " 120 g.p.m. for Cert.

Casing: 8" dia. casing from 6'-3"
to 268'-3"; 6" dia. standard pipe
from 6'-3" to 467'; 5" dia. standard
pipe from 467 to 479'.

Perforations: 5" pipe with 1,200- $\frac{1}{2}$ "
holes from 467 to 479'.

Type and size of pump: air lift

Turn up

Sheet _____ of _____ sheets

25N/4E-31R
File number

of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
Division of Hydraulics



Declaration of Ground Water Claim

(Separate claims should be filed for each well, tunnel or infiltration trench)

No. 49

I, Diamond Ice & Storage Co.
(Name of claimant)

of 860 Stuart Bldg., Seattle 1, Washington
(Complete postoffice address)

do hereby make declaration of claim of vested right to ground water by use prior to June 7, 1945, and file the same with the State Supervisor of Hydraulics, in accordance with Section 9, Chapter 263, Laws of 1945 of the State of Washington, and request a Certificate of Ground Water Right thereunder.

1. SOURCE from which water is withdrawn is Pump well
(Flowing well, pump well, infiltration trench, or tunnel)

2. LOCATION is: Within corporate limits of Seattle, Washington;
(Approximate distance and direction from nearest city or town)

and is more particularly described as follows:

(a) _____
(Give distance and bearing to corner of section or other legal subdivision)

being within SE 1/4 of Sec. 31, Twp. 25 N., Rge. 4 E
(Smallest legal subdivision) (E. or W.)

or (b) Within limits of incorporated city or town of Seattle, Washington,

in Lot 1, Block 177 of Seattle Tide Lands Plat
(Name of addition or plat)

County of King within _____ area
(Leave blank)

_____ sub-area _____ zone
(Leave blank) (Leave blank)

(c) The location of the well or other works is shown on the accompanying plat, or other adequate maps or drawings.

(d) The owner of property on which the works are constructed is:

Diamond Ice & Storage Co. 860 Stuart Bldg., Seattle 1
(Name) (Post office address)

3. CONSTRUCTION WORK was begun on 1901; was completed on 1901
(Date) (Date)

and the ground water claimed was first used for the purposes set out below on 1901,
(Date)

since which time the water has been used continuously
(Continuously or intermittently)

from 1901 to 1945
(Date) (Date)

4. QUANTITY of water claimed and used is 120 gallons per minute; 180 acre feet per year.

5. PURPOSE OR PURPOSES for which water is used Cooling ammonia condensers in refrigeration plant
(Domestic, irrigation, municipal, manufacturing, industrial, etc.)

5. (Continued)

(a) FOR MUNICIPAL SUPPLY: To supply the city, town or community of _____ in the county of _____, having a present population of _____, and an estimated population of _____ in 19_____

(b) FOR IRRIGATION: The land irrigated has a total area of _____ acres, and water is used each year for this purpose from _____ to _____
(Date) (Date)

(c) Legal description of property on which water is used for all purposes other than municipal supply:

Lots 1 and 2, less Northern Pacific Railway Co. right of way in Block 177, Seattle Tide Lands Plat in Seattle, King County, Washington.

6. DESCRIPTION OF WORKS:

(a) WELL: Depth 467 feet. Diameter 8" & 6" (see below) inches or feet. Dug or drilled drilled
Flowing or pump well Pump

IF PUMP WELL: Type and size of pump is Air lift

Type and size of motor or engine is _____

Depth from ground surface to water level before pumping No data feet.

After continuous operation for at least four hours, the measured discharge of pump is No data available
g.p.m., and the drawdown of water level is _____ feet.

Date of test ----

IF FLOWING WELL: Measured discharge _____ g.p.m. on _____ (Date)

Shut-in pressure at ground surface _____ lbs. per sq. in. on _____ (Date)

Water is controlled by _____ (Cap, valve, etc.)

CASING: (Give diameter, commercial specifications and depth below ground surface of each casing size.)

<u>8</u>	<u>inch diameter</u>	<u>Casing</u>	<u>from 6'-3" to 268'-3"</u>	<u>feet</u>
<u>6</u>	<u>inch diameter</u>	<u>Standard pipe</u>	<u>from 6'-3" to 467</u>	<u>feet</u>
<u>5</u>	<u>inch diameter</u>	<u>Standard pipe</u>	<u>from 467 to 479</u>	<u>feet</u>
_____	<u>inch diameter</u>	_____	<u>from _____ to _____</u>	<u>feet</u>

Describe and show depth of shoe, plug, adapter, liner or other details:

6 inch pipe is within the 8 inch down to the 268'-3" level.

7. Ownership of each existing well or other works for withdrawal of ground water within a radius of one-quarter mile and the distance and direction from well or other works being reported herein:

Puget Sound Power & Light Co. South Approx. 200 feet
(Name of owner) (Direction) (Distance)

Olympic Warehouse & Cold Storage Co. South Approx. 500 feet

(On accompanying plat or map show location of these existing wells or works.)

8. Remarks:

Diamond Ice & Storage Co.
L. E. Karrer
(Signature of claimant)
L. E. Karrer, Vice President

STATE OF WASHINGTON, }
COUNTY OF King } ss.

I, the claimant named in the foregoing claim, being first duly sworn, depose and say that I have read the above and foregoing claim to ground water right; that I know the contents thereof; and that to the best of my knowledge, information and belief, the facts therein stated are true and correct.

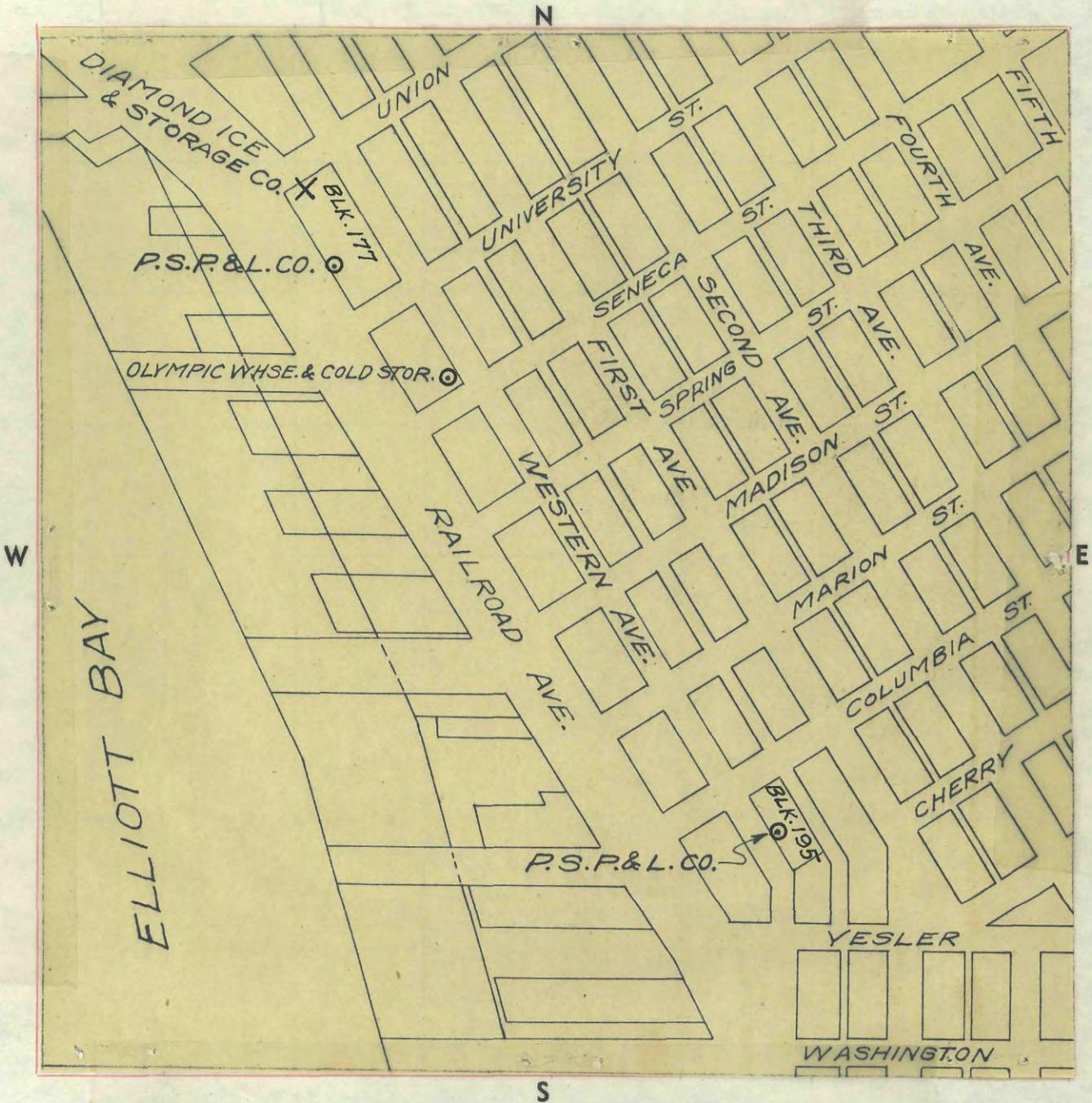
Diamond Ice & Storage Co.
L. E. Karrer
L. E. Karrer, Vice President

Subscribed and sworn to before me this 2nd day of December, 1945

A. E. Klein
Notary Public in and for the State of Washington,
Residing at Seattle



A Portion of
Sec. 31 Twp. 24 N. R. 4 E



Be sure to show distance and bearing of point of diversion from nearest 40-acre corner. Also traveling directions from nearest town on main highway.

Scale: 1 inch = ⁴⁰⁰~~800~~ feet.

Well is located at the Diamond Ice & Storage Co's Plant on Lot 1, Block 177, Seattle Tide Lands. The Plant is on Western Ave. at Union St., Seattle.



STATE OF WASHINGTON
Office of Supervisor of Hydraulics
Olympia

NOTICE OF DECLARATION OF
CLAIM OF RIGHT TO WITH-
DRAW GROUND WATER NO. 49.
To Whom It May Concern:

Notice is hereby given that Diamond Ice & Storage Co., of Seattle, State of Washington, under date of December 7, 1945, filed with the State Supervisor of Hydraulics, Olympia, Washington, a declaration of claim of vested right existing prior to June 7, 1945, to withdraw public ground waters from a pump well in the Seattle locality in the amount of 120 gallons per minute; 195 acre-feet per year, with priority (date of first beneficial use of water) of 1901, which water is used continuously each year for the purpose of cooling ammonia condensers in refrigeration plant; that the location of the well from which water is withdrawn is within Lot 1, Block 177 of Seattle Tide Lands Plat, County of King, and has requested a Certificate of Water Right under such claim.

Any person, firm or corporation disputing such claim or protesting that the right claimed is not a vested right to be recognized under Chap. 263 of the 1945 Session Laws of the State of Washington, may file with the State Supervisor of Hydraulics, at Olympia, Washington, such objections or representations, in writing, as he may desire to make, within thirty (30) days after date of last publication, which date is 26th December.

Witness my hand and official seal this 11th day of December, 1945.

(Seal) RODNEY RYKER,
State Supervisor of Hydraulics.
By CHAS. J. BARTHOLET,
(2430) Deputy.

Affidavit of Publication

STATE OF WASHINGTON, } ss.
COUNTY OF KING

M. E. Brown, being first duly sworn, on oath deposes and says that he is one of the publishers of The Daily Journal of Commerce, a daily newspaper. That said newspaper is a legal newspaper and it is now and has been for more than six months prior to the date of the publication hereinafter referred to, published in the English language continuously as a daily newspaper in Seattle, King County, Washington, and it is now and during all of said time was printed in an office maintained at the aforesaid place of publication of said newspaper. That the said Daily Journal of Commerce was on the 12th day of June, 1941, approved as a legal newspaper by the Superior Court of said King County.

That the annexed is a true copy of a

Notice to Withdraw Ground Water No. 49

as it was published in regular issues (and not in supplement form) of said newspaper once each week for a period of

two (2) consecutive weeks, com-

mencing on the 19th day of December, 1945,

and ending on the 26th day of December, 1945

both dates inclusive, and that said newspaper was regularly distributed to its subscribers during all of said period.

M. E. Brown

Subscribed and sworn to before me this

26th day of December, 1945

Estace S. Devet

Notary Public in and for the State of Washington, residing at Seattle.
(This form officially sanctioned by Washington State Press Association.)
Form C.



Diamond Ice & Storage Co.

Seattle

Washington

December 7, 1945

pump well

120

the Seattle

195

xxxxxxx 1901

xxx continuously

xx

cooling amonia condensers in refrigeration

plant;

well

Lot 1, Block 177

of Seattle Tide Lands Plat

King

xxxxxxx

xxxxxxx

xxxxxx

11th

December

45

RODNEY RYKER

By: CHAS. J. BARTHOLET, Deputy

GROUND WATER
DECLARATION OF CLAIM
PROGRESS SHEET



NAME: DIAMOND ICE & STORAGE CO.
') STUART BUILDING, SEATTLE L, WASH.

DECLARATION NO. 49 CERTIFICATE NO. 23

Declaration received 12-7-45 Initial fee received 12-7-45

Returned for completion or correction _____ Received _____

Statement of add. fee sent _____ Amount \$ _____ Received _____

Approved - Same 12-21-45

Amended _____

Cancelled _____

O.K'd for publication BW7 by B G B ○ 11565

Notice of declaration sent 12-11-45

Protests filed _____

Affidavit of Publication received and checked 12-29-45 (Jan. 26, 1946)

Time for making protests expires _____

Examination made _____ by _____

O.K'd for Certificate Jan 21 1946 by B G B

Statement of filing and recording fee sent 1-25-46 Amount \$1.50

Fee received 2-8-46

Ground Water Certificate issued 2-8-46 No. D. 23

CERTIFICATE RECORD No. 1 PAGE No. 23-D UNDER DECLARATION OF CLAIM No. 49

STATE OF WASHINGTON, COUNTY OF King

Certificate of Ground Water Right

Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and the rules and regulations of the State Supervisor of Hydraulics thereunder.

THIS IS TO CERTIFY That DIAMOND ICE & STORAGE COMPANY
of Seattle, Washington has filed
in the office of the State Supervisor of Hydraulics of Washington Declaration of Claim No. 49
to withdraw ground waters of the State from a Pump Well,
located within Lot 1, Block 177 of Seattle Tide Lands Plat, King County
(SE $\frac{1}{4}$ of Sec. 51, Twp. 25 N., Rge. 4 E.W.M.)

for the purpose of Cooling ammonia condensers in refrigeration plant

The right to the use of said ground waters has been sustained and approved by the Supervisor of Hydraulics in accordance with Chapter 263, Laws of Washington for 1945, and is hereby entered of record in Volume 1 of Ground Water Certificates at page 23-D; the right approved has a priority of the year 1901; the amount of water which the Declarant is entitled to withdraw for the aforesaid purpose is limited to the amount actually beneficially used and shall not exceed 120 gallons per minute; 180 acre-feet per year; and is appurtenant to the following described lands or place of use:

Lots 1 and 2, less Northern Pacific Railway Company's right-of-way in Block 177, Seattle Tide Lands Plat in Seattle, King County, Washington.

The right to the use of the ground water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Sections 6 and 7, Chapter 122, Laws of 1929.

WITNESS the seal and signature of the State Supervisor of Hydraulics affixed this 8th day of February, 19 46.

By: Rodney Ryker
RODNEY RYKER
State Supervisor of Hydraulics.
CHAS. J. BARTHOLET, Deputy

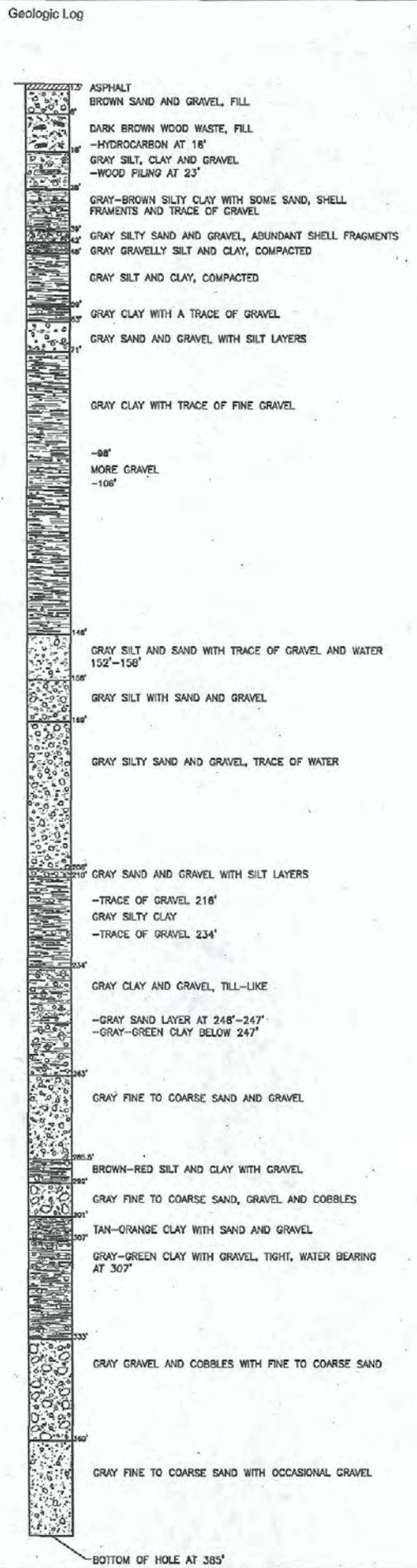
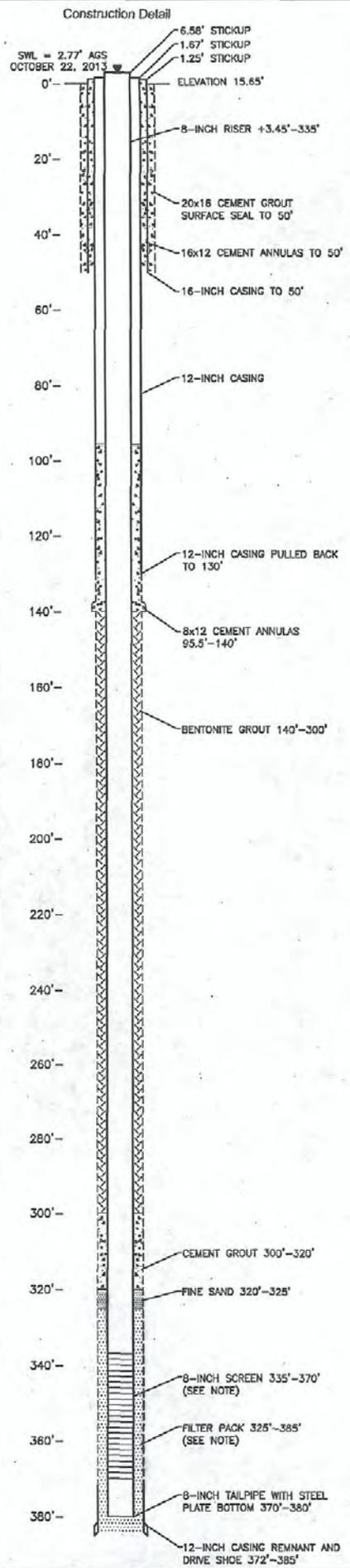
Declaration of Claim No. 49

**CERTIFICATE OF GROUND
WATER RIGHT**

Recorded in the office of State Super-
visor of Hydraulics, Olympia, Washington,
in Book No. 1 of Ground Water
Right Certificates, on page 23-D on the
8th day of February, 1946.

STATE OF WASHINGTON, } ss.
County of King }

I certify that the within was received and
duly recorded by me in Volume.....
of Book of Water Right Certificates, page
..... on the..... day of
....., 19.....





STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION

WATER RIGHT CLAIM

RECEIVED
DEPARTMENT OF ECOLOGY

FEB 21 1974 075454

CASH OTHER ZONE

1. NAME City of Seattle, Department of Lighting

ADDRESS 1015 Third Avenue

Seattle, Washington ZIP CODE 98104

2. SOURCE FROM WHICH THE RIGHT TO TAKE AND MAKE USE OF WATER IS CLAIMED: Surface
(SURFACE OR GROUND WATER)

W.R.I.A. 08
(LEAVE BLANK)

A. IF GROUND WATER, THE SOURCE IS _____

B. IF SURFACE WATER, THE SOURCE IS Lake Union

3. THE QUANTITIES OF WATER AND TIMES OF USE CLAIMED.

A. QUANTITY OF WATER CLAIMED 37051 gpm PRESENTLY USED 37051 gpm
(CUBIC FEET PER SECOND OR GALLONS PER MINUTE)

B. ANNUAL QUANTITY CLAIMED 59,764 acre feet PRESENTLY USED 59,764 acre feet (See attached sheet)

C. IF FOR IRRIGATION, ACRES CLAIMED _____ PRESENTLY IRRIGATED _____ (sheet)

D. TIME(S) DURING EACH YEAR WHEN WATER IS USED Continuously (See attached sheet)

4. DATE OF FIRST PUTTING WATER TO USE: MONTH Unknown YEAR 1914

5. LOCATION OF THE POINT(S) OF DIVERSION/WITHDRAWAL: 1,850 FEET East AND 900 FEET South FROM THE N.W. CORNER OF SECTION 29

BEING WITHIN N.E. 1/4 N.W. 1/4 OF SECTION 29 T. 25 N., R. 4 E (~~EXXXX~~) W.M.

IF THIS IS WITHIN THE LIMITS OF A RECORDED PLATTED PROPERTY, LOT _____ BLOCK _____ OF _____

(GIVE NAME OF PLAT OR ADDITION)

6. LEGAL DESCRIPTION OF LANDS ON WHICH THE WATER IS USED: See attached sheet

COUNTY _____

7. PURPOSE(S) FOR WHICH WATER IS USED: Cooling water for steam electric generating plant.

8. THE LEGAL DOCTRINE(S) UPON WHICH THE RIGHT OF CLAIM IS BASED: Appropriation

DO NOT USE THIS SPACE

THE FILING OF A STATEMENT OF CLAIM DOES NOT CONSTITUTE AN ADJUDICATION OF ANY CLAIM TO THE RIGHT TO USE OF WATERS AS BETWEEN THE WATER USE CLAIMANT AND THE STATE OR AS BETWEEN ONE OR MORE WATER USE CLAIMANTS AND ANOTHER OR OTHERS. THIS ACKNOWLEDGEMENT CONSTITUTES RECEIPT FOR THE FILING FEE.

DATE RETURNED: THIS HAS BEEN ASSIGNED TO WATER RIGHT CLAIM REGISTRY NO. _____

APR 10 1974 052167

John Pizzi

DIRECTOR - DEPARTMENT OF ECOLOGY

I HEREBY SWEAR THAT THE ABOVE INFORMATION IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF

X L. K. Ambrose

DATE 19 Feb 74

IF CLAIM FILED BY DESIGNATED REPRESENTATIVE, PRINT OR TYPE FULL NAME AND MAILING ADDRESS OF AGENT BELOW

L. K. Ambrose

1015 - 3rd Avenue

Seattle, Washington 98104

ADDITIONAL INFORMATION RELATING TO WATER QUALITY AND/OR WELL CONSTRUCTION IS AVAILABLE

A FEE OF \$2.00 MUST ACCOMPANY THIS WATER RIGHT CLAIM

ORIGINAL DWR

RETURN ALL THREE COPIES WITH CARBONS INTACT ALONG WITH YOUR FEE TO
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION
OLYMPIA WASHINGTON 98504

LAKE UNION STEAM PLANT

Legal Description

State of Washington,
County of King,
City of Seattle

Lots 1, 2 and 3 - Block 67 of Lake Union Shore Lands

Southerly 72.36 feet of Block 66 of Lake Union Shore Lands

Lots 5 and 6 (except streets), 7, 8, 9, 10, 11, 12, 13 and 14,
Block 68 of Lake Union Shore Lands

All of Lots 1, 2, 3, 4, 5, 6 and 7, Block 4 of R. C. Graves Add.

All of Lots 1, 2, 3, 6 (except street), 7, 8, 9 and 10 of
Block 4 of Frances Add.

Part of Government Lot 1, Section 29, Township 25 N. Range
4 E. W.M., Bounded on the north by Lot 6, Block 4, Frances Add.;
on the south by Lot 9, Block 11, East Park Add.; on the east by
Eastlake Avenue and on the west by the Government Meander Line.

Lots 8 and 9, Block 11 - East Park Add.

Answer to Questions No. 13 and 14

The cooling water is pumped directly from Lake Union and discharged entirely
back into the lake with no chemical change. The plant is on cold standby but is
subject to being run anytime at any time of the year, and could be run for long
periods if the power situation in the northwest required it. However, in a
normal or near normal year, the plant would not be run and therefore would not
be using cooling water.



STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION

WATER RIGHT CLAIM

27 74065540

CASH OTHER NONE

1. NAME LAKE UNION DRYDOCK COMPANY

ADDRESS 1515 Fairview Ave. E.

Seattle, Washington ZIP CODE 98102

2. SOURCE FROM WHICH THE RIGHT TO TAKE AND MAKE USE OF WATER IS CLAIMED: Surface
(SURFACE OR GROUND WATER)

W.R.I.A. 08
(LEAVE BLANK)

A. IF GROUND WATER, THE SOURCE IS _____

B. IF SURFACE WATER, THE SOURCE IS Lake Union

3. THE QUANTITIES OF WATER AND TIMES OF USE CLAIMED:

A. QUANTITY OF WATER CLAIMED up to 150 gallons/min PRESENTLY USED occasionally up to
(CUBIC FEET PER SECOND OR GALLONS PER MINUTE) 150 gpm

B. ANNUAL QUANTITY CLAIMED 5 acre ft. PRESENTLY USED about 5 acre ft/yr
(ACRE FEET PER YEAR)

C. IF FOR IRRIGATION, ACRES CLAIMED _____ PRESENTLY IRRIGATED _____

D. TIME(S) DURING EACH YEAR WHEN WATER IS USED: sporadic

4. DATE OF FIRST PUTTING WATER TO USE: MONTH January YEAR 1946

5. LOCATION OF THE POINT(S) OF DIVERSION/WITHDRAWAL: various points within property below.
FEET _____ AND _____
(mostly submerged shoreland)

FEET _____ FROM THE _____ CORNER OF SECTION _____

BEING WITHIN _____ OF SECTION 21 T. 25 N., R. 7 (E.D.R.W.) W.M.

IF THIS IS WITHIN THE LIMITS OF A RECORDED PLATTED PROPERTY, LOTS all BLOCK 65 & 66 OF

Lake Union Shorelands addition to City of Seattle

(GIVE NAME OF PLAT OR ADDITION)

6. LEGAL DESCRIPTION OF LANDS ON WHICH THE WATER IS USED: _____

all of blocks 65 and 66 Lake Union Shorelands

addition to City of Seattle

COUNTY King

7. PURPOSE(S) FOR WHICH WATER IS USED: Ballast for ships and drydocks

8. THE LEGAL DOCTRINE(S) UPON WHICH THE RIGHT OF CLAIM IS BASED: Riparian

DO NOT USE THIS SPACE

THE FILING OF A STATEMENT OF CLAIM DOES NOT CONSTITUTE AN ADJUDICATION OF ANY CLAIM TO THE RIGHT TO USE OF WATERS AS BETWEEN THE WATER USE CLAIMANT AND THE STATE OR AS BETWEEN ONE OR MORE WATER USE CLAIMANTS AND ANOTHER OR OTHERS. THIS ACKNOWLEDGEMENT CONSTITUTES RECEIPT FOR THE FILING FEE.

DATE RETURNED _____ THIS HAS BEEN ASSIGNED WATER RIGHT CLAIM REGISTRY NO. _____

SEP 10 74 76388

John P. Papp

DIRECTOR, DEPARTMENT OF ECOLOGY

I HEREBY SWEAR THAT THE ABOVE INFORMATION IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF

X J. Francis

DATE 3-25-74
IF CLAIM FILED BY DESIGNATED REPRESENTATIVE PRINT OR TYPE FULL NAME AND MAILING ADDRESS OF AGENT BELOW.

ADDITIONAL INFORMATION RELATING TO WATER QUALITY AND/OR WELL CONSTRUCTION IS AVAILABLE.

A FEE OF \$2.00 MUST ACCOMPANY THIS WATER RIGHT CLAIM

ORIGINAL DWR

RETURN ALL THREE COPIES WITH CARBONS INTACT, ALONG WITH YOUR FEE TO:
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION
P.O. BOX 829 OLYMPIA WASHINGTON 98501

Department of Ecology

Claim Separator Sheet

Claim Number

98-000950





STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

STATEMENT OF WATER RIGHT CLAIM

FOR OFFICE USE ONLY

8/33

98000950

WRIA

98 JUN 19 8:01

Phone No. (206) 524-3383

1. Dr. Daniel D. Eggers, Ph.D.
Name
6011 26 Ave NE
Mailing Address
Seattle, WA 98115-7107
City State Zip

2. Date water was first put to use on your property (see instructions) Month ? and Year 1906

3. COMPLETE ONLY ONE BOX BELOW (please read the instructions)

<p>3a. GROUND WATER</p> <p><input type="checkbox"/> Well</p> <p><input type="checkbox"/> Infiltration Trench</p> <p><input type="checkbox"/> Other _____ Give Name</p> <p>4a. INSTANTANEOUS QUANTITY _____ gpm (See instructions 10 gpm=0.02 cfs ; 1 cfs=450 gpm)</p> <p>5a. ANNUAL QUANTITY OF WATER _____ afly (One acre foot = 325,581 gallons)</p>	<p>3b. SURFACE WATER (Give name if known)</p> <p><input type="checkbox"/> _____ River <input checked="" type="checkbox"/> <u>Union</u> Lake</p> <p><input type="checkbox"/> _____ Creek <input type="checkbox"/> _____ Spring</p> <p><input type="checkbox"/> _____ Ditch <input type="checkbox"/> _____ Pond</p> <p><input type="checkbox"/> Other _____</p> <p>4b. INSTANTANEOUS QUANTITY <u>9.71</u> cfs (See instructions 10 gpm=0.02 cfs ; 1 cfs=450 gpm)</p> <p>5b. ANNUAL QUANTITY OF WATER <u>13334</u> afly (One acre foot = 325,581 gallons)</p>
--	--

6. PURPOSE OF USE:
 Irrigation (Number of acres irrigated) 20.5 Stockwater
 Domestic Use (Number of units) _____ Municipal
 Commercial (Description) Synthetic fuel production Other (List all) _____
See enclosed Coal Gasification and Liquefaction

7. PERIOD OF USE: Continuous Seasonal From April 15 To October 1
and

8. LOCATION OF THE POINT OF DIVERSION/WITHDRAWAL:
Approximately 550 Feet (~~north~~, south) and 150 Feet (east, ~~west~~) From The NW Corner of Section 30
Being Within The NW 1/4 NW 1/4 of Section 30 T. 25 N., R. 4 (E. ~~30~~) W.M.

9. IF THE POINT OF DIVERSION/WITHDRAWAL IS LOCATED ON PLATTED PROPERTY:
Lot 11 Block 43 of Lake Union Shore Lands (Plat or Addition)
Section 30 T. 25 N., R. 4 (E. ~~30~~) W.M.

10. LEGAL DESCRIPTION OF PROPERTY WHERE WATER IS USED:
Burkes 1 st Add and Lake Union Shore Lands blocks 42, 43, 44 and 45
Within Section s 29 and 30 T. 25 N., R. 4 (E. ~~30~~) W.M., County King

11. TAX PARCEL NUMBER: 1249700005 (1901 N. Northlake Way)

12. LEGAL DOCTRINE: Appropriation Riparian Other (Use prior to 1917)

REGISTRATION NUMBER
300558

THIS IS NOT A WATER RIGHT

If this form is not fully completed, it will be returned.
I hereby swear that the above information is true and accurate to the best of my knowledge.

Signature: Daniel D. Eggers
Date: June 16, 1998



STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 • Olympia, Washington 98504-7600
(360) 407-6000 • TDD Only (Hearing Impaired) (360) 407-6006

July 13, 1998

Daniel Eggers PhD
6011 26th Ave NE
Seattle WA 98115-7107

Dear Daniel Eggers PhD:

Your claim to the use of historic water has been accepted in the 1997 claims registration. The registration number is on the bottom left hand side of the form. The law requires that we include the following language after registration of your claim:

"The filing of a statement of claim does not constitute an adjudication of any claim to the right to use of waters as between the water use claimant and the state, or as between one or more water use claimants and another or others."

The acceptance of this statement of claim by the Department **does not** give you the right to use the water if you can't prove, in a superior court the historic use of the water.

Please be aware under Chapter 90.14.068 RCW

....This reopening of the period for filing statements of claim shall not affect or impair in any respect whatsoever any water right existing prior to July 27, 1997. A water right embodied in a statement of claim filed under this section is subordinate to any water right embodied in a permit or certificate issued under Chapter 90.03 or 90.44 RCW prior to the date the statement of claim is filed with the Department and is subordinate to any water right embodied in a statement of claim filed in the water rights claims registry before July 27, 1997.

Sincerely,

Candy Pittman
Water Resources Program

Enclosure
Claim No. 300,558



Is your RETURN ADDRESS completed on the reverse side?

SENDER:

- Complete items 1 and/or 2 for additional services. 300,558
- Complete items 3, 4a, & 4b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece below the article number.
- The Return Receipt will show to whom the article was delivered and the date delivered.

I also wish to receive the following services (for an extra charge)

- 1. Addressee's Address
- 2. Restricted Delivery

Consult postmaster for fee.

3. Article Addressed to:
 Daniel Eggers PhD
 6011 26th Ave NE
 Seattle 98115-7107

4a. Article Number
 P583903899

4b. Service Type

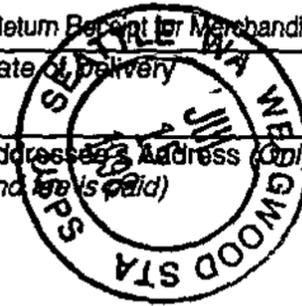
- Registered Certified
- Express Mail Insured
- Return Receipt for Merchandise COD

5. Received By: (Print Name)
 Daniel Eggers

7. Date of Delivery

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Addressee or Agent)
 X Daniel H. Eggers



Thank you for using Return Receipt Service.

PS Form 3811, December 1994

102585-97-B-0179

Domestic Return Receipt

P 583 903 899

US Postal Service
Receipt for Certified Mail
 No Insurance Coverage Provided.
 Do not use for International Mail (See reverse)

Sent to	
Street & Number	
Post Office, State, & ZIP Code	
Postage	\$
Certified Fee	
Special Delivery Fee	
Restricted Delivery Fee	
Return Receipt Showing to Whom & Date Delivered	
Return Receipt Showing to Whom, Date, & Addressee's Address	
TOTAL Postage & Fees	\$
Postmark or Date	

PS Form 3800, April 1995

Dr. Daniel D. Eggers, Ph.D.
6011 26 Ave NE
Seattle, WA 98115-7107
(206) 524-3383
June 16, 1998

Mr. Keith Phillips, Program Manager
Water Resources Program
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Dear Mr. Phillips:

I am submitting a water rights claim for the Lake Station of the Seattle (Gas) Lighting Company (1906), Seattle Gas Co. ("Gasco") (1930), Washington Natural Gas (1955), and at the current time Gas Works Park in Seattle, WA. I am submitting this claim as curator of the historical exhibit, such as there is at the present time.

The proof for the Appropriation part of the claim is the picture on the cover of my booklet Coal Gasification and Liquefaction that is enclosed showing the gas plant in operation about 1910. As noted inside the front cover the picture comes from the Museum of History and Industry, Seattle WA, and the negative number is 83.10.8930.1

The point of Diversion / Withdrawal is marked on Fig. S1 the outline of the park, Fig. S2 the Plat of the park area, Fig. S3 the map of the area and in Fig. 7 on page 5 in Gas Works Park - A photographic tour with a red dot.

The numbers used to compute the amount of water used has been based upon the material you supplied for irrigation, and upon calculations of how much water was used to make Synthetic Natural Gas (SNG) at the Lake Station at peak capacity. The information about the capacity was taken from the article "How Seattle Met Worst Winter Demands", Gas Age, March 15, 1943, page 31, taking into account that the number of generators had been triple by the end of 1947. According to my calculations about 564,681 gallons / day was consumed making gas. I am guessing that about 20 times that or 11,293,621 gal / day was also used for heat transfer, but it was not otherwise consumed in the process of making the gas. For instance cold lake water was pumped through pipes in the intercooler shown in Fig. 20 on p. 18 of my booklet Gas Works Park - A photographic tour while the hot gas passed over the outside of the tubes inside the intercooler, so there was no mixing of the water and the gas. In addition to the water used to make the gas 41 acre feet per year would have been used for irrigation.

There are a number of additional specific points I wish to make in my water right claim:

1. I claim the right to rebuild the lake heat exchanger (lake exchanger) by placing pipes in the water in Lake Union for the purpose of transferring heat to the water in the lake through the walls of the pipes, mostly as a historical exhibit. Fig. S4 shows a picture of the Lake exchanger in 1947. The size of the lake exchanger at that time was 18 ft by 50 ft. The current area where

the lake exchanger will be restored is shown in Fig. S5. Part of the old lake exchanger was filled in with concrete to make a sidewalk, and the current size is approximately 18 ft by 18 ft. The location of the lake exchanger is also shown on the cover of my booklet Gas Works Park – A photographic tour.

2. I claim the right to use the lake water for demonstration scale use in making synthetic fuel up to two acre feet per year, and 40 acre feet for cooling (heat transfer).
3. The water will probably be used primarily to make the grass green at Gas Works Park, but it will not be used as potable water.
4. The quality of the water in Lake Union according to the Lake Union Water Quality / Environmental Assessment, Vol. 1, Executive and Technical Summary, Brown and Caldwell and Associated Firms, Nov. 1994, has been found to have "good overall water quality".
5. In addition to using the area in the lake for a lake heat exchanger, the actual use of the water will probably be less than:

41 af/y for irrigation
2 af/y for fuel synthesis
40 af/y for heat transfer
83 af/y Total

However, in the event of a national emergency, such as, but not limited to a nuclear war, I reserve the right to use the full amount of the water claimed on the claim form to put the Lake Station back into operation doing fuel synthesis. The Lake Station was put on standby by the Washington Natural Gas Company in 1956, and if a national emergency does not occur, then you can consider the Lake Station to still being on standby.

Thank you.

Sincerely yours,



Dr. Daniel D. Eggers, Ph.D.
Ph.D. in Computer Science
M.S. in Mechanical Engineering
B.S. in Mathematics
B.A. in Economics

P.S. I originally started out to be a chemist like my father.

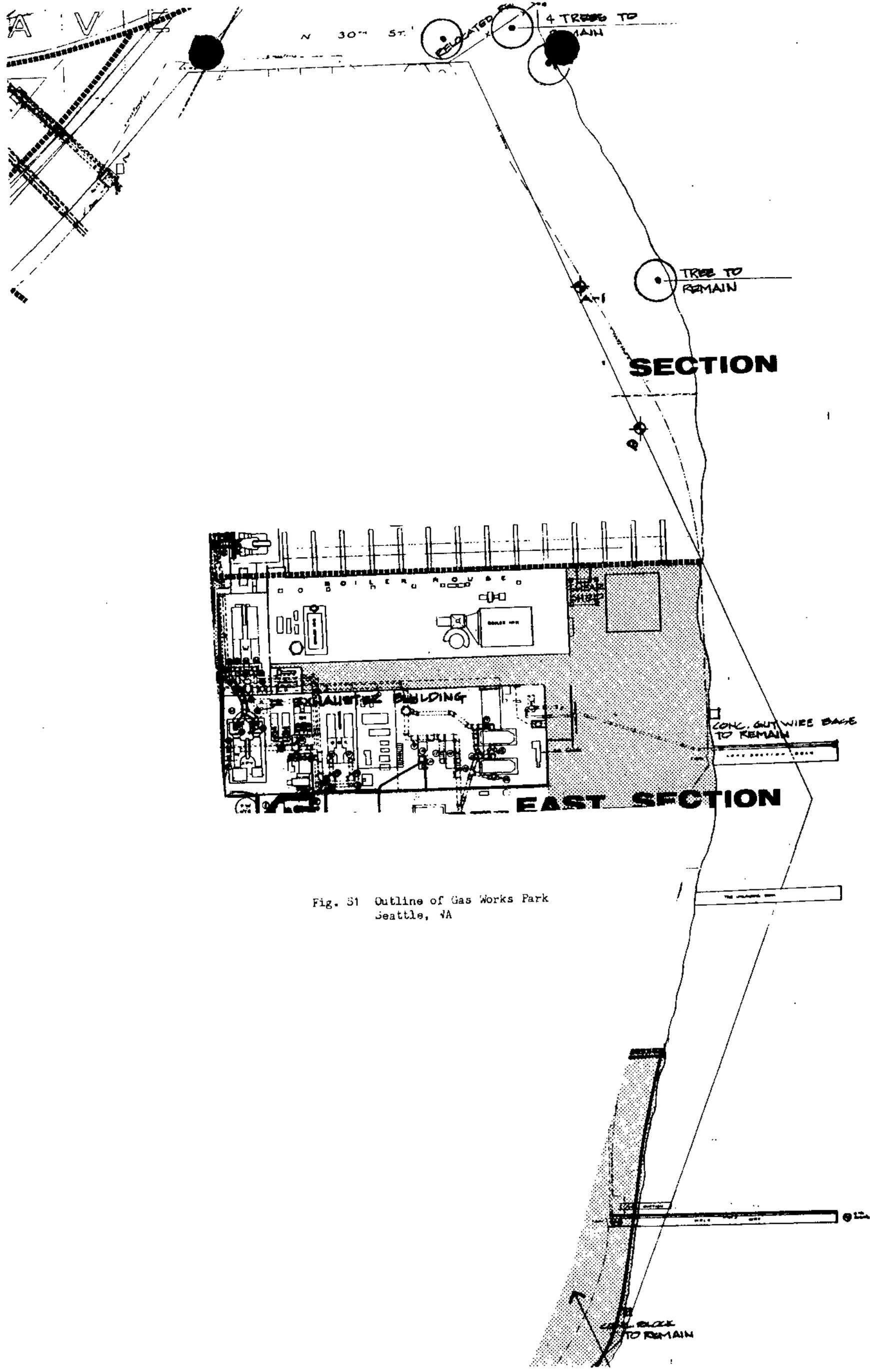


Fig. S1 Outline of Gas Works Park
Seattle, WA

DEPT. OF ASSESSMENTS

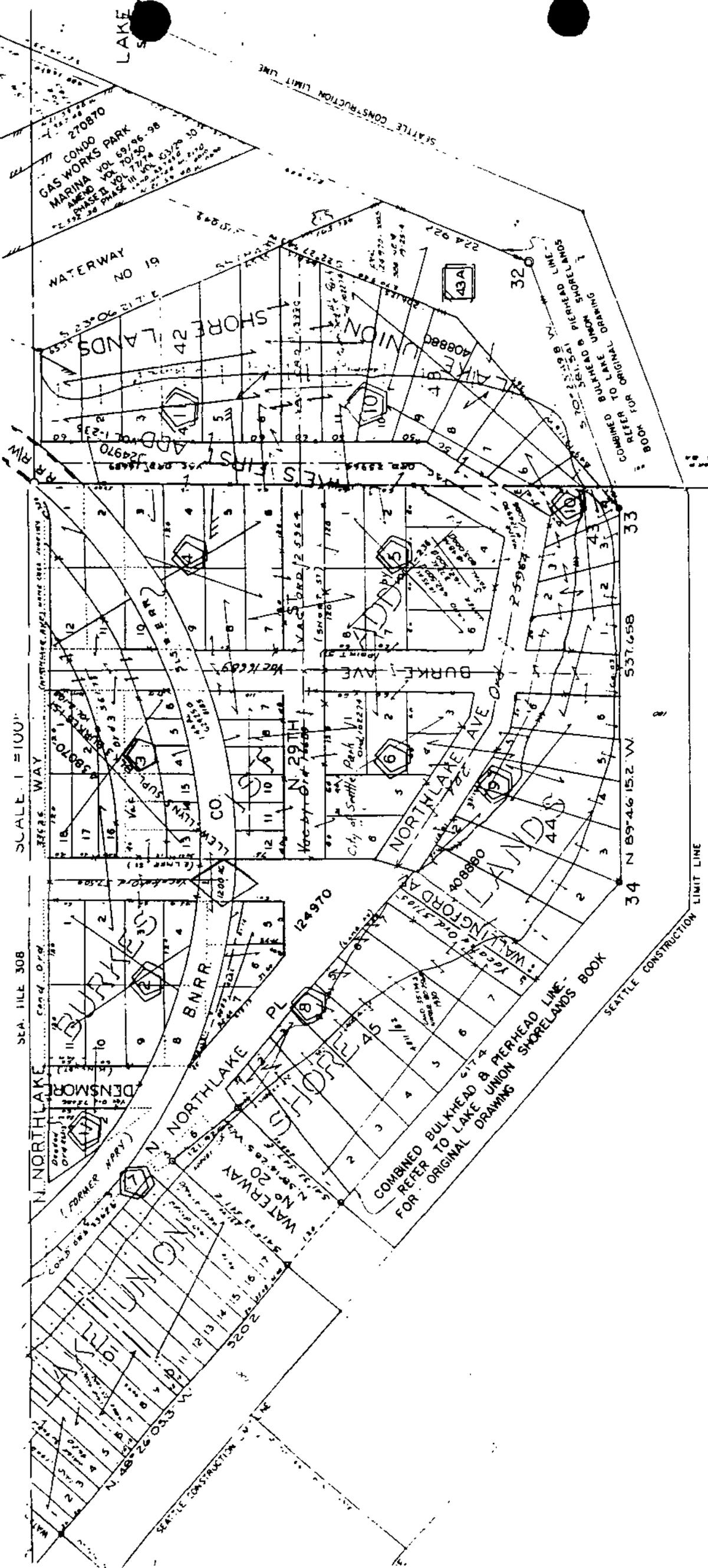


Fig. S2 Platt of the Gas Works Park area

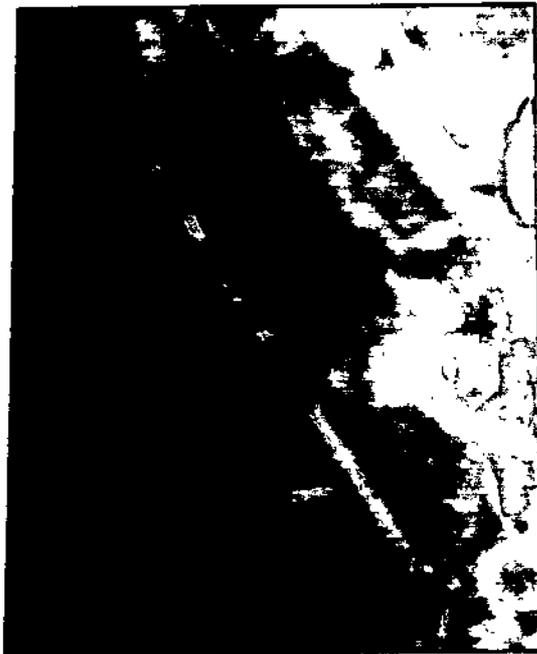


Fig. S4 Lake (heat) exchanger 1947

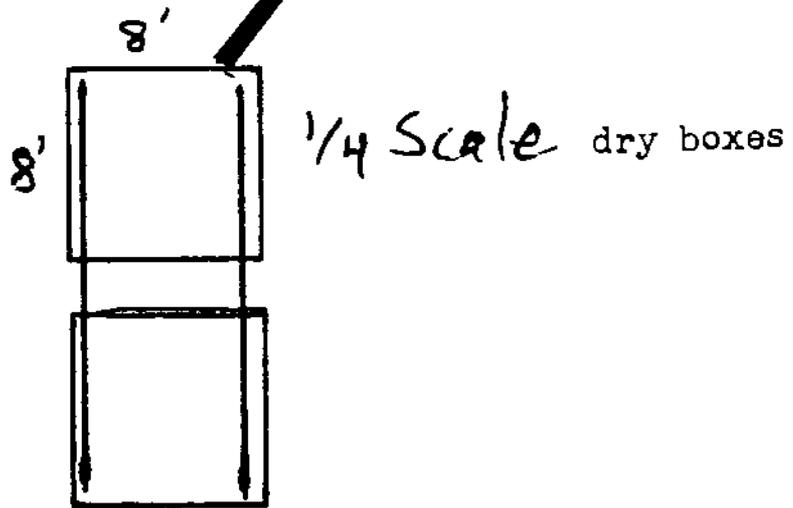
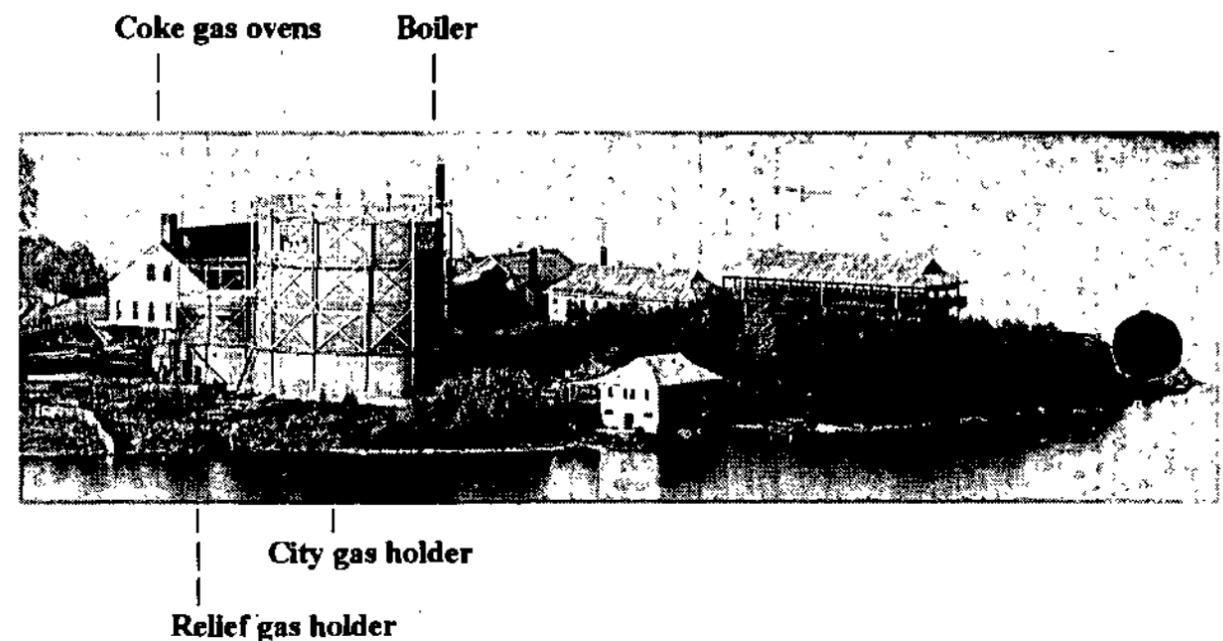


Fig. S5 Remaining portion of Lake (heat) exchanger.
"pipe" ends in the Lake exchanger area.

\$2.95

Coal Gasification and Liquefaction



Seattle (Gas) Lighting Co. circa 1910
The Gas Works 1906 – 38

© Copyright 1998

Dr. Daniel D. Eggers, Ph.D.
P.O. Box 85641
Seattle, WA 98145-1641

ABSTRACT

At one point in time there were a total of 1440 gasification plants in the United States. In 1932 there were 144,000 gas ovens in use that gasified 532 million tons of coal a year. Today the entire industry is all gone. Due to the decline in the world oil supply the oil industry as we know it today will also become extinct. However, our society will survive just as it survived the passing of the coal gasification industry. This paper presents an interesting look at the now extinct gasification industry both because it is interesting in itself and as a bridge to the future. We synthesized natural gas when it was necessary to do so, and we will also synthesize gasoline at reasonable cost when it is necessary to do that.

Cover: Fig. 1 The cover shows a picture of the Seattle (Gas) Lighting Co. Circa 1910 when coal was used to make Synthetic Natural Gas (SNG) that was used for lighting and cooking, etc. Museum of History and Industry, Seattle, WA Neg. # 83.10.8930.1

18. Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., New York, NY, 1924, Table 39, P 313.
19. Reedy, J.H., Industrial General Chemistry, University of Illinois, 1929, p. 341.
20. Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., 1924, Fig 112, p. 282.
21. Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., 1924, Fig 112, p. 322, Table 42 for coke oven tar.
22. Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., 1924, Fig 112, p. 330
23. Ullmann's Encyclopedia of Industrial Chemistry, 5th Edition, Vol. A2, Deerfield Beach, FL, 1985, p. 153.
24. Blauvelt, Warren S., By-Product Coke and National Defense, Gas Age, Feb 3, 1938, P. 16.
25. Lowry, H. H., Chemistry of Coal Utilization, Vol. II, John Wiley and Sons, Inc., New York, NY, 1945, p. 960.
26. Lowry, H. H., Chemistry of Coal Utilization, Vol. II, John Wiley and Sons, Inc., New York, NY, 1945, p. 963.
27. Lowry, H. H., Chemistry of Coal Utilization, Vol. II, John Wiley and Sons, Inc., New York, NY, 1945, p. 968.
28. The Holy Bible, King James Version 1611, American Bible Society, New York, NY, 1990, Deuteronomy 5:19..
29. "Energy: Our Future is Today", Fossil Fuel: Oil, U.S. Department of Energy, Fy 94.
30. The Holy Bible, King James Version 1611, American Bible Society, New York, NY, 1990, Matthew 6:25-33.
31. Private communication with DOE's Fossil Energy Division.

Introduction

In general the point of this paper is that when we did not have natural gas we made Synthetic Natural Gas (SNG), and when all of the oil is gone the world will not come to an end. We will simply make Synthetic Gasoline (SG). The author and the DOE are currently working on inexpensive processes for the synthesis of SG.

Coal Gasification

The coal gasification that will be discussed in this section is typical of the coal gasification that was used during the 1800s and the early 1900s. In the case of the Seattle Gas Co., the conversion from coal gasification to oil gasification took place between 1936 and 1938. Today the technology that was used here, and in other locations, in the early 1900s is now referred to as dirty coal technology. The new technology that has been developed more recently by the U.S. Department Of Energy (DOE) is referred to as clean coal technology. The reason why the coal technology that will be discussed in this first section is referred to as dirty coal technology is because it produced and emitted coal tars. Some of the coal tars are suspected of being carcinogens, but fortunately most of those compounds can be successfully treated by bioremediation techniques.

Coal Gas Ovens

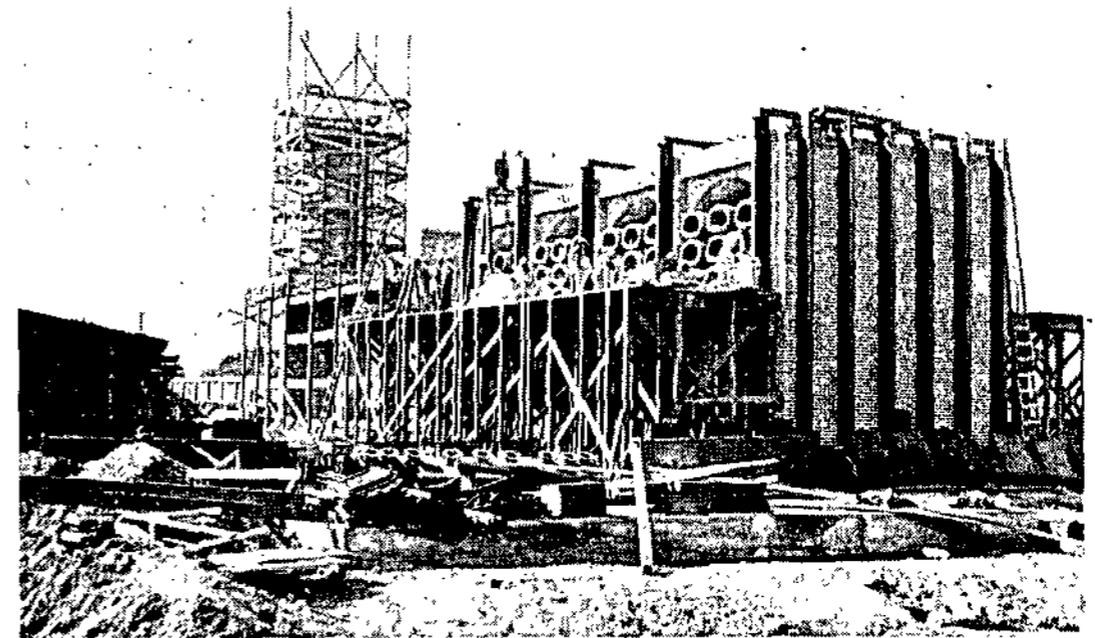


Fig. 2 Seattle Lighting Co. gas ovens that were located at the Lake Union gas plant. The D shape of the ovens, and also the fact that they are grouped in groups of nine ovens indicates that these are Gas Machinery Company ovens for the production of city gas[1]. Special Collections, Univ. of Washington Libraries, Neg. # 17746.

Before natural gas was available in Seattle Synthetic Natural Gas (SNG) was produced from coal. During the period when the gas that was being manufactured it was called "city gas". City gas is no longer manufactured in the United States, because it has now been replaced by natural gas. The last city gas manufactured in Seattle was made in 1956.

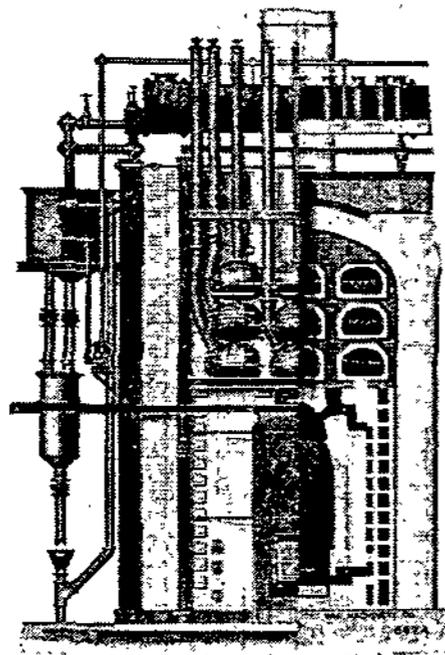


Fig. 3 Bench of Nine Horizontal Gas Retorts, Transverse Section [1].

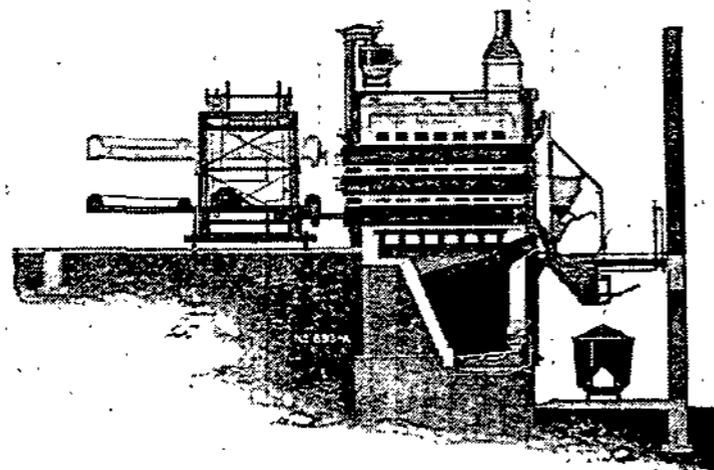


Fig. 4 Bench of Horizontal "Through" Retorts, Longitudinal Section (Showing discharging ram for coke, gas-producer, etc.) [2].

COAL

The coal that was used in the ovens was subbituminous coal that came from the Blue Lake mine of the Blue Canyon Coal Co. in Wacorn County near Bellingham. The analysis of the coal was:

Table 1 Analysis of Blue Canyon coal on Dry Basis (percent)

Moisture as Received	Vola- tile Matter	Fixed Carbon	Ash	Sul- fur	BTU- per pound	
8.01	43.44	37.23	19.33	0.35	10,760	[6]
1.790	31.479	62.744	3.679	0.308		[7]

References

- Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., New York, NY, 1924, Table 39, p. 341.
- Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., New York, NY, 1924, Table 39, p. 342.
- Budavari, Susan, Editor, The Merck Index, 11th Edition, Merck and Co., Inc., Rahway, NJ, 1989, #4719, p. 759.
- Mahagaokar, Uday, and Krewinghaus, A.B., Coal conversion Processes (Gasification), Encyclopedia of Chemical Technology, 4th Edition, Vol. 6, John Wiley and Sons, New York, NY, 1993, p. 541. The authors are with the Shell Development Company.
- Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., New York, NY, 1924, p. 165.
- Chemistry of Coal Utilization, Vol. II, John Wiley and Sons, Inc., New York, 1945. This two volume set was produced by the National Academy of Sciences as a part of the war effort during World War II.
- Reports of the Efficiency of Various Coals, 1896 to 1898 - Expenses of Equipment Abroad 1902 - 1903, and Recent Chemical Analyses of Coal at Navy - Yard, Washington, DC, Government Printing Office, Washington, DC, 1906.
- Budavari, Susan, Editor, The Merck Index, 11th Edition, Merck and Co., Inc., Rahway, NJ, 1989, #9952, p. 1583.
- Hiller, Heinz and Reimert, Rainer, Gas Production, Ullmann's Encyclopedia of Industrial Chemistry, 5th Edition, Vol A 12, VCH Publishers, New York, NY, 1989, p. 179. The authors were with the Lurgi Corp.
- Porter, Horace C., Coal Carbonization, Chemical Catalog Co., Inc., New York, NY, 1924, Table 39, P 312, data is for horizontal retort gas.
- Frey, A.C., "Report of sub-committee on use of oxygen in water gas machine", Proceedings of the American Gas Association, American Gas Association, New York, NY, 1925.
- Collins, Robert D., and Oakley, Michael J. U.S. Patent 5,458,857, col 1, 1995.
- Private communication with Rolls-Royce plc in which they indicated they have an autothermal reformer and shift reactor with an efficiency of over 90% based on Higher Heating Values for both methane and hydrogen
- McAuliffe, Charles A., Hydrogen and Energy, Macmillan Press Ltd., Hong Kong, 1980, p. 32.
- Douglas, John, Beyond Steam: Breaking Through Performance Limits, EPRI Journal, Vol 15, No. 6, Dec 1990, p. 4. The figure given was for a state of the art plant.
- Chang, Raymond, Chemistry, 4th Edition, McGraw-Hill, Inc, New York, NY, 1991, p. A10. Only the Lower Heating Value can be achieved in transportation applications.
- Chang, Raymond, Chemistry, 4th Edition, McGraw-Hill, Inc., New York, NY, 1991, p. A10. The Higher Heating Value can only be achieved in space and hot water heating applications.

Clean Coal Technology

The United States Department of Energy has financed the development of a large number of clean coal technologies that do not produce the pollution due to tar that the old dirty coal technology used to create. In my telephone conversation with DOE headquarters I was told that DOE has financed the development of 45 different clean coal technologies[31]. That ought to be enough to convince anyone that we do have the technology to do without any foreign oil.

A recent computer search of the patent literature since 1969 revealed that there have been 305 patents granted that are related to coal gasification. In addition there have also been 264 patents that were granted related to coal liquefaction.

All of the oil companies have processes for coal liquefaction so they will continue to be able to make gasoline when oil is no longer available. One of the most prolific publishers of coal technology patents is the Texaco Co.

In Seattle self service patent searches can be conducted at the Engineering Library at the University of Washington. Patent searches can also be done at other federal depository libraries nation wide.

Other sources of information about coal gasification and liquefaction include: The Encyclopedia of Chemical Technology, articles in Hydrocarbon Processing, Ullmann's Encyclopedia of Industrial Chemistry, etc.

The truth about our situation is that the problem is not that we have no alternative to going and dying for oil, but rather which of the hundreds of excellent alternatives to put into use first.

Additional information about DOE's clean coal technology program can be obtained by visiting DOE's internet page at WWW.FE.DOE.GOV

The Chemistry of City Gas Production

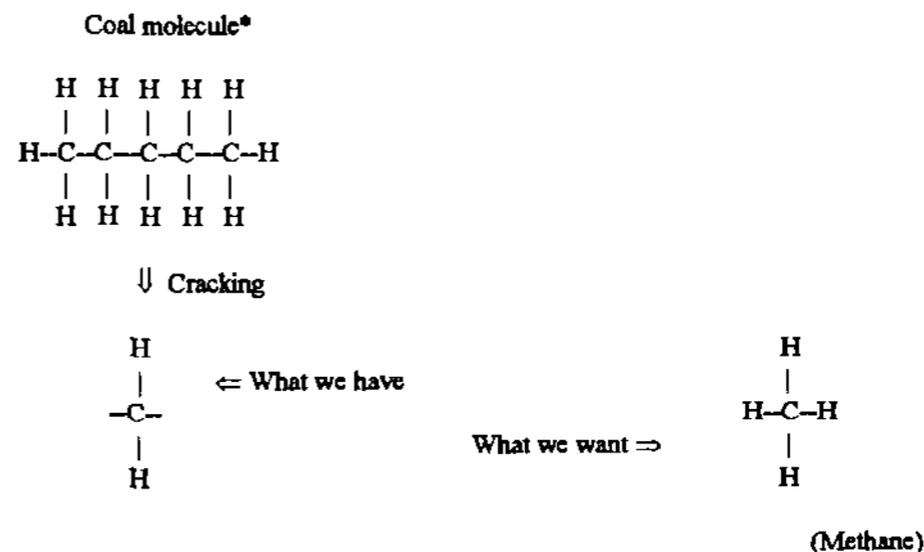
Hydrogen (Protium) was first recognized as an element by Cavendish in 1766, and it was named by Lavoisier[3]. City gas was first successfully produced in 1792. [4]. Attempts had been made a couple of decades earlier, but the bricks that were needed to hold the heat while the gas was being made were not available or used until 1792.

The reactions that are necessary to make city gas only occur at high temperatures. Consequently the first thing that must be done is to put the coal into the coal ovens and start the coal burning to heat up the refractory bricks that will hold the heat during the gas production portion of the cycle. The temperatures in the flues during the gas making portion of the cycle were frequently in the range of 2,550° - 2,600° F (1400° - 1425° C)[5]. The portion of the cycle when the coal and ovens were being heated up was referred to as the blowing portion of the cycle, because blowers blew air through the coal to make the fire burn very hot. Unfortunately during this portion of the cycle some coal tars were blown out of the chimney and into the environment. The other portion of the cycle was gas producing part of the cycle. During gas production the ovens would cool down and it would then be necessary to switch back to a blowing cycle to get the ovens warmed up again. Blowing periods and gas making periods would then alternate during the gas production. By having more than one group of ovens in a battery it was possible to generate gas more or less continuously by blowing in some ovens while generating gas in other ovens. The chemical reactions that were used to make city gas were thermal cracking of the coal combined with the water gas and shift reactions.

The Water Gas and Shift Reactions

The water gas reaction involves blowing steam (water) through the bed of coal and that caused fragmentation and it also reacted with the coal. At high temperatures the formation of carbon dioxide is favored over the formation of water, so the carbon steals the oxygen from the water producing hydrogen. Once hydrogen is formed it is then free to engage in chemical reactions to produce new products. Some of the new products that are formed are the components of the city gas that is produced.

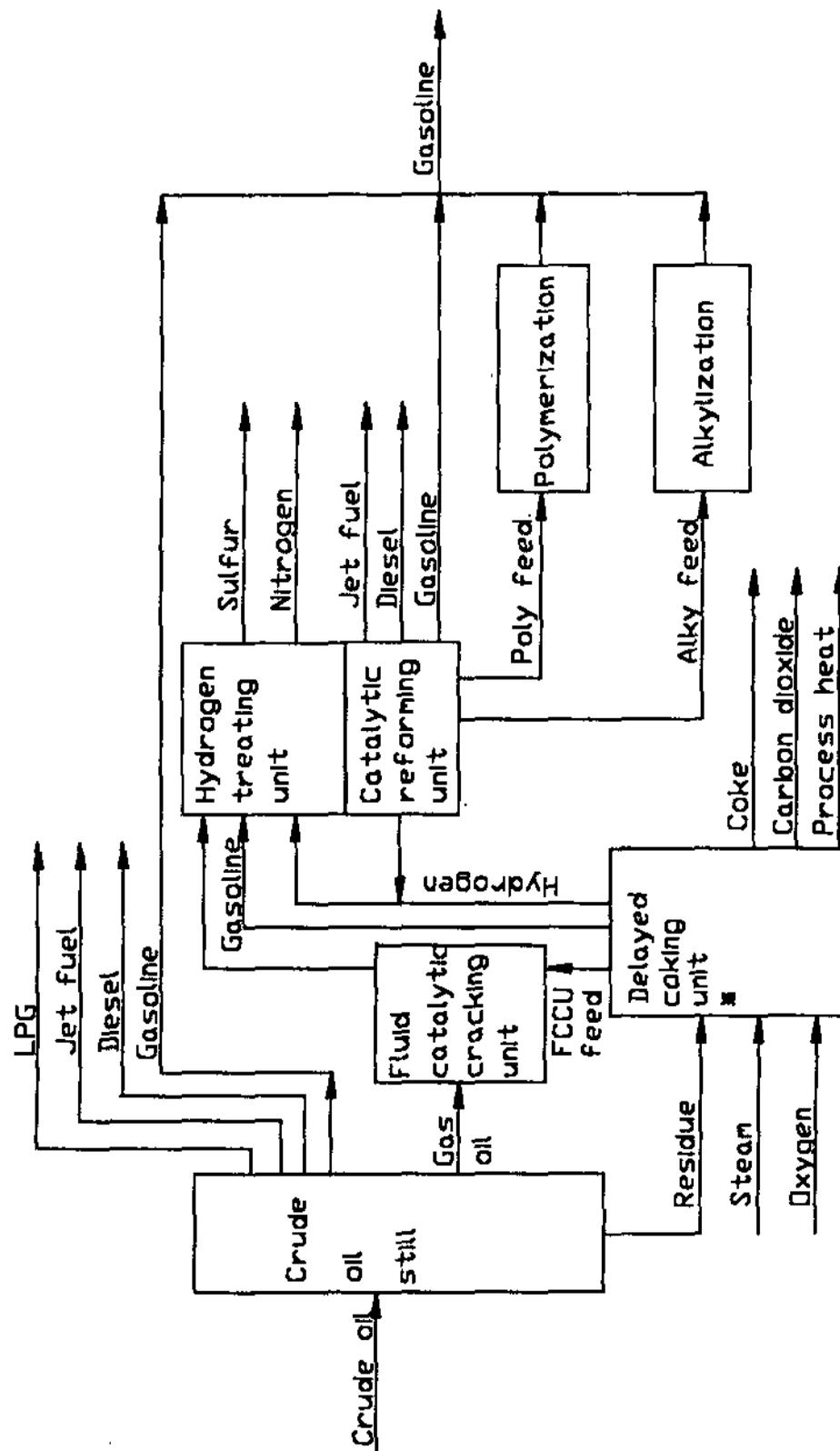
Desired reactions



* The molecule shown is actually pentane. The structure of coal (and bunker C) is more complicated, but the same process works for all of the feedstocks.

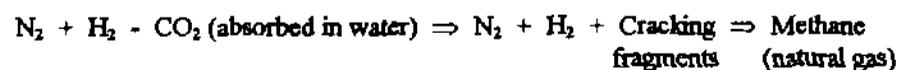
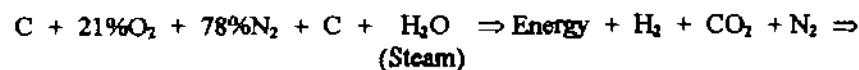
Oil Refinery

Fig. 7



■ This is essentially the process used by the Germans during World War II to make gasoline from coal. Copyright © 1998 by Dr. Daniel D. Eggers, Ph.D.

Air process



$$\text{Result: } 0.2\%O_2 + 52.5\%H_2 + 31\%CH_4 + 3.2\%N_2 \quad [10]$$

$$615 \text{ BTU/ft}^3$$

Air separation (distillation)

Table 2 Properties of air at ambient pressure

Gas	Percent	Boiling Point (°C)
N ₂	78.03	-196.0
O ₂	20.99	-183.1
Ar	0.94	-185.7
CO ₂	0.033	-78.5 (Sublimes)

Carbon dioxide can easily be separated from air due to the difference in the temperature at which it condenses or freezes. Because the amount is so small, and because it is inert it is not necessary to separate Argon from the other gasses. A description of how oxygen separation was done for use in manufacturing city gas can be found in "Report of sub-committee on use of oxygen in water gas machines" by Frey[11].

Steam reforming vs. Electrolysis

Steam reforming:

Efficiency of steam reforming = 60% [12], [13]

$$1 \text{ unit of } H_2 = 1 / .60 = 1.66 \text{ units of C}$$

Electrolysis:

Efficiency of electrolysis is 57% to 82% [14]

Efficiency of electrical transmission 97%

Efficiency of generating electricity from coal 37% [15]

$$1 \text{ unit of } H_2 = (((1 / .82) / .97) / .32) = 3.4 \text{ units of C}$$

Carbon dioxide ratio:

$\frac{\text{Electrolysis units of C}}{\text{Steam reforming units of C}} = 2.05 \equiv \text{Twice as much carbon dioxide!!!}$

The conclusion here is that if you are concerned about the amount of carbon dioxide produced, then electrolysis should not be used to produce hydrogen!

Energy per atom



$\frac{\text{Energy per H atom}}{\text{Energy per C atom}} = \frac{-120.9}{-393.5} = 0.307 \approx 1/3$

The conclusion here is that if the cost is the same for an atom of carbon as an atom of hydrogen it is better to take the carbon atom, because you get about three times as much energy as you would gotten if you had take the hydrogen atom. In addition having some carbon in the fuel increases the density of the fuel, and it makes it easier to store. City gas is lower in energy than natural gas, because pure hydrogen does not contain any carbon. If the Higher Heating Value of 142.9 kJ/mol had been used the ratio would have been 0.363, or still about 1/3 [36].

Composition of by-product coke oven gas

After removal of the ammonia, light oils, most of the carbon dioxide and the tar the composition of by-product coke oven gas in terms of percentage was:

Table 3 Average composition of by-product coke oven gas[18]

CO ₂	2.0
Illuminants	3.2 (such as C ₂ H ₄) [19]
Oxygen	0.3
CO	5.5
CH ₄	32.3
Hydrogen	51.9
Nitrogen	4.8
Specific gravity	0.394
BTU per cubic foot	569.0
H ₂ S pounds per 1,000 cubic feet	0.61
Naphthalene, gr. per 100 cubic feet	0.95

Because of the problems with storing hydrogen it is very unlikely that hydrogen will ever be used as a transportation fuel. However, if hydrogen was to be used as a transportation fuel, it is interesting to note that coke oven gas produces methane (CH₄) and hydrogen in approximately the right ratio to use the methane to heat homes and offices and hydrogen for use as a transportation fuel.

Oil Refinery vs. Coal Refinery

Crude oil does not contain enough hydrogen to permit it to be converted into gasoline. In order to make up the deficiency oil companies currently use the water gas and shift reactions, that were covered earlier, in a partial oxidation process that uses oxygen to produce the additional hydrogen. The partial oxidation process results in the loss of some carbon as carbon dioxide, but it also converts some of the heavy oil into lighter compounds that can be upgraded for use in gasoline. The partial oxidation process takes place in what is called a Delayed Coking Unit that is shown in Fig 7, that is the diagram of an oil refinery.

Because heavy oil is very deficient in hydrogen it is actually very similar to coal, and what works for heavy oil will also work for coal. Fig 8, is a diagram of a coal refinery, that shows diagrammatically how gasoline can be produced by using coal.

Counting our blessings

God has kept his promise to provide us with what we need by providing this nation with an enormous supply of coal that can be used to make all of the gasoline we need without a single drop of foreign oil. That is fortunate because one of the ten commandments is "Neither shalt thou steal." [28], and that commandment means is it would be wrong for the United States to take oil from the people in the Middle East by force.

As previously mentioned we can make all of the gasoline we need from coal. However, we can even reduce our dependence on oil further by using the nuclear power that the Lord has provided for stationary applications. Approximately 30% of the oil that is used in the United States is used for residential and commercial space heating [29] that could be replaced by electricity generated by nuclear reactors. In fact all of the electricity that this nation uses, except that that comes from hydroelectric sources, should be generated by nuclear reactors to save our supply of coal for making gasoline in the future.

The bottom line here is that we need to give thanks unto the Lord for providing for our needs as he has promised in Matthew 6:25-33 [30].

While it is true that no one needs to go and die for oil, because we can make all of the gasoline we need without it if our nation uses the gifts that God has given, that should not be interpreted to mean that it is OK to refuse military service, because it is not.

The circulating tank at least partially separated the tar and the liquid. Some of the solution in the circulation tank was pumped through the collecting main to flush out tar that had condensed in the collecting main, as already mentioned. The rest of the solution was pumped into decanters. The decanters were tanks with vertical metal plates in them. The tar that had a specific gravity of 1.18 at 15.5/15.5 degrees C [21] would sink to the bottom and then be sent to the tar storage tank. The liquid from the decanters would then be sent to the ammonia liquor storage tank.

Pipes and equipment occasionally started to become plugged up with tar. Because that was a constant problem steam injection points were provided in a large number of location so that the tar could be melted out of the pipes to keep the plant operating.

Ammonia

After the tar had been removed from the gas it was then sent through ammonia washers that would wash the ammonia out of the gas by contacting the gas with a fine spray of water. After the ammonia had been absorbed by the water it would be sent to the ammonia storage tank. The ammonia solution in the ammonia storage tank was a fairly weak solution. In order to increase the concentration of ammonia the solution in the ammonia storage tank was sent to a still that separated most of the water from the solution. Once the concentration of ammonia had been increased it was then possible to add sulfuric acid to the solution to precipitate out crystals of ammonia sulfate that were used as fertilizer.

The ammonia yield was about 0.2 to 0.4 percent of the coal[22], but its commercial value made it one of the most important products of the by-product process. At the time when coke oven gas was being made, before the Halber-Bosch process was in wide spread use, coke ovens were the primary source of ammonia in the United States, and a large factor in the supply for all countries.

The Halber-Bosch process[23] for manufacturing ammonia was discovered in 1905, but it was not used significantly in the United States until after 1924.

Ammonia is used in the manufacture of nitric acid, explosives and fertilizers. Ammonia is also used in refrigeration systems.

Light oils

Light oils were recovered from the gas mixture by contacting the gas in a counter current direction with a spray of heavy oil. The oil was called "straw oil" at that time. Today when there is an oil spill straw is used to absorb the oil so that it can be removed from the environment. Since the heavy oil absorbed the light oil it was probably logical to have called the oil "straw oil". In the early years the straw oil only absorbed about one percent light oil. The heavy oil and the light oils were then separated by fractional distillation into the various components and the heavy oil was then reused, but that was not very energy efficient. Other "straw oils" were found later that would absorb eight percent light oils, and the process has continued to become more and more efficient.

The light oils in the gas mixture were mainly benzene, toluene, xylene, solvent naphtha, etc. Each of the different components boils at a different temperature, so they can be separated from one another by fractional distillation.

One of the light oils that was recovered was toluene, and that was used to make explosives. As a result the coke ovens and later the oil gasification plants in the United States played an important role in winning World War I and World War II. In fact, the United States Government was so desperate for toluene that it paid to install additional city gas plants and expand existing ones in order to increase the production of toluene during those wars[24].

H₂S

Hydrogen sulfide was removed from the gas by passing it along with some steam through what were called "dry boxes". Dry box technology for the removal of sulfur had been developed in the 1860s[25].

The dry boxes contained wood chips that were coated with iron oxide. The iron oxide that came from rusted materials or some iron ores were catalysts that were used to reduce hydrogen sulfide to elemental sulfur in a multiple step oxidation reaction. The conditions that were reported to be optimal were 65 percent humidity at 100° F[26] along with the addition of some air to provide the oxygen necessary for oxidation. The reactions that took place were an absorption of the hydrogen sulfide by the iron oxide forming an iron oxysulfide as an intermediary with water being produced as a leaving group. Next oxygen would replace the sulfur on the iron thus regenerating the catalyst and resulting in the formation of elemental sulfur. The sulfur could then be extracted with one of the following solvents: 1) ammonium sulfide solution or 2) organic liquids such as carbon disulfide, hydrocarbon oils, or halogenated hydrocarbon solvents. Ammonium sulfide required prolonged extraction and more heat. The problem with using carbon disulfide and organic liquids was that they would ordinarily extract both tar and sulfur. Additional information about sulfur extraction can be found in reference [27].

A number of dry boxes were connected in series to remove sulfur. However, the first dry box would inevitably be the one that absorbed the majority of the sulfur, so pipes and valves were installed so that the order of the dry boxes could be changed to distribute the sulfur more or less evenly between the different dry boxes. Changing the order of the dry boxes was referred to as "rotation of the boxes".

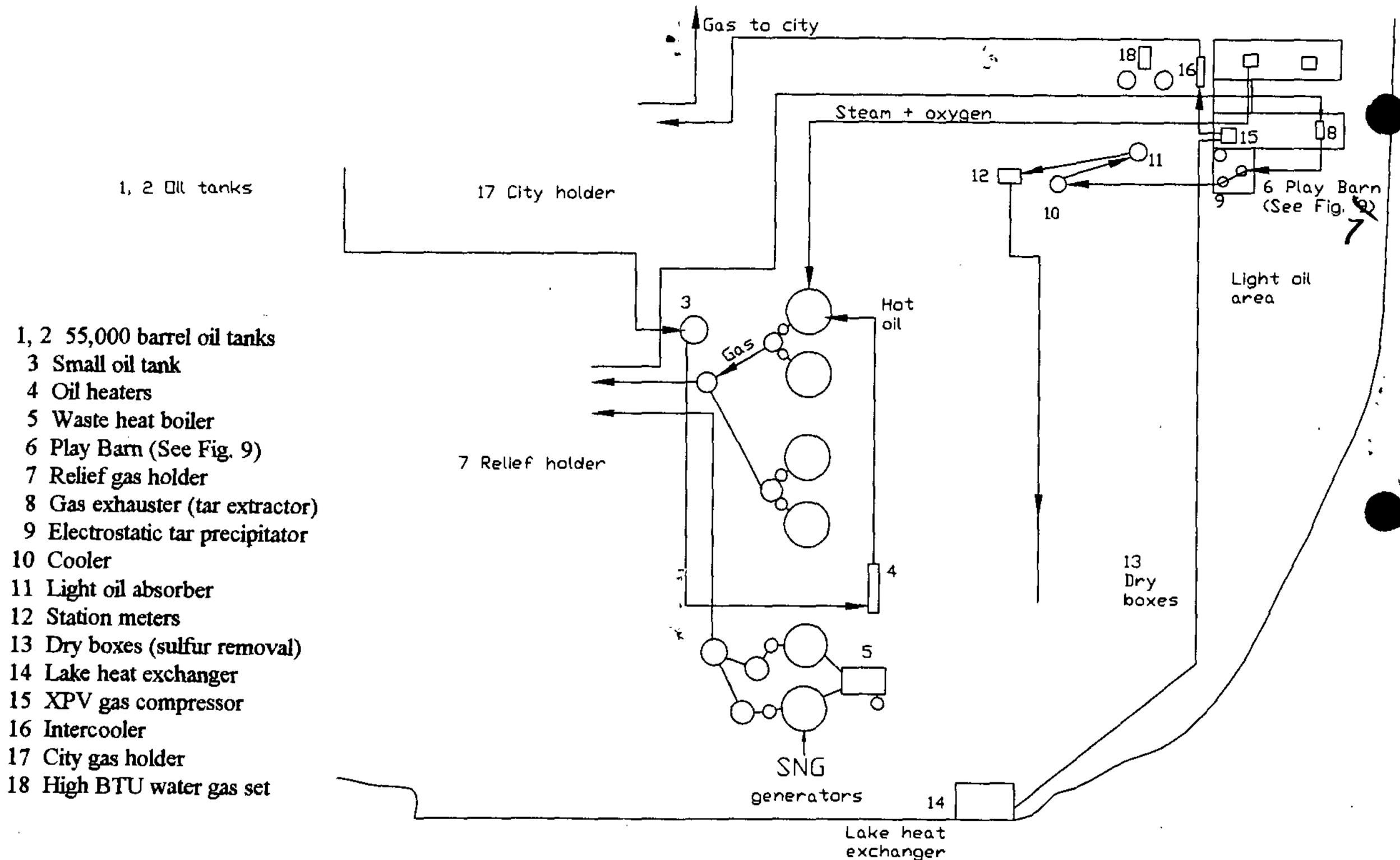
Sulfur was used as a pesticide, and it was also used for making sulfuric acid.

Carbon Dioxide

Most of the carbon dioxide in the gas was removed by contacting the gas with water under pressure. Anyone who drinks carbonated beverages knows that carbon dioxide dissolves in water when it is under pressure. Everyone also knows that when the pressure is relieved the carbon dioxide leaves the water. Once the carbon dioxide left the water it could then be reused to remove more carbon dioxide.

Do NOT Copy

Gas Works Park - A photographic tour



- 1, 2 55,000 barrel oil tanks
- 3 Small oil tank
- 4 Oil heaters
- 5 Waste heat boiler
- 6 Play Barn (See Fig. 9)
- 7 Relief gas holder
- 8 Gas exhauster (tar extractor)
- 9 Electrostatic tar precipitator
- 10 Cooler
- 11 Light oil absorber
- 12 Station meters
- 13 Dry boxes (sulfur removal)
- 14 Lake heat exchanger
- 15 XPV gas compressor
- 16 Intercooler
- 17 City gas holder
- 18 High BTU water gas set

Answers

1. The temperature increase as a result of compression in the turbocharger in a Volvo is 72°F
2. The expansion of the volume due to the increase in temperature without an intercooler would be about 13%

Jet engine design (Turbomachinery design) is a senior elective course in Mechanical Engineering. Not even Freshmen in college are prepared to do the necessary mathematics to actually design turbomachinery. So, if you are still in high school do your homework, but do not waste your time, at this point, trying to understand something that is way over your head at the moment. It is good to be curious and do scientific calculations based upon actual facts, but some things will have to wait until you are better prepared.

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Fig. 1 The cover shows the general layout of the equipment at Gas Works Park. The area now occupied by Gas Works Park was called the "Lake Station" when it was owned by the Seattle Gas Company.

Photo credits

- Fig. 1 Assembled by Eggers, Daniel, 1997, based upon 1938, 1947, and 1949 information.
Fig. 2 Gas Age, April 14, American Gas Association, 1938, p. 29.
Fig. 3 Eggers, Daniel, 1997.
Fig. 4 Eggers, Daniel, 1997.
Fig. 5 Proceedings of the American Gas Association, American Gas Association, Inc., 1925, p.1227.
Fig. 6 Eggers, Daniel, 1997.
Fig. 7 Assembled by Eggers, Daniel, 1997, based on 1949 information.
Fig. 8 Steam - Its Generation and Use, Babcock and Wilcox Co., 37th Edition, Babcock and Wilcox Co., 1955, p. 14-10.
Fig. 9 Steam - Its Generation and Use, Babcock and Wilcox Co., 37th Edition, Babcock and Wilcox Co., 1955, p. 23-11.
Fig. 10 Inherited, 1947.
Fig. 11 Inherited, 1947.
Fig. 12 Richard, Michael, Seattle's Gas Works Park, Tilikum Place Printers, 1983, p. 35. Used with permission of the author and copyright holder
Fig. 13 Eggers, Daniel, 1997.
Fig. 14 Eggers, Daniel, 1997.
Fig. 15a Eggers, Daniel, 1997.
Fig. 15b Porter, Horace C., Coal Carbonization, The Chemical Catalog company, Inc., New York, NY, 1924, p. 289.
Fig. 16 Eggers, Daniel, 1997.
Fig. 17 Eggers, Daniel, 1997.
Fig. 18 Eggers, Daniel, 1997.
Fig. 19 Gas Age, April 14, American Gas Association, 1938, p. 29.
Fig. 20 Eggers, Daniel, 1997.
Fig. 21 Morgan, Jerome J., Water Gas, Chapter 37 in Lowry, H.H., Chemistry of Coal Utilization, Vol II John Wiley and Sons, Inc., New York, NY, 1945, p. 960.
Fig. 22 Report of Seattle Gas Company to the Public Safety Committee of the City Council of the City of Seattle on steps taken to comply with requirements of the city ordinance no. 64604, 1935, p. 21. Located in the University of Washington Special Collections.
Fig. 23 Report of Seattle Gas Company to the Public Safety Committee of the City Council of the City of Seattle on steps taken to comply with requirements of the city ordinance no. 64604, 1935, p. 22. Located in the University of Washington Special Collections.
Fig. 24 Eggers, Daniel, 1997.
Fig. 25 Olsen, John C., Unit Processes and Principles of Chemical Engineering, D. van Nostrand Co., Inc., New York, NY, 1932, p.236.
Fig. 26 Gas Age, April 14, American Gas Association, 1938, p. 29.

Lake Station

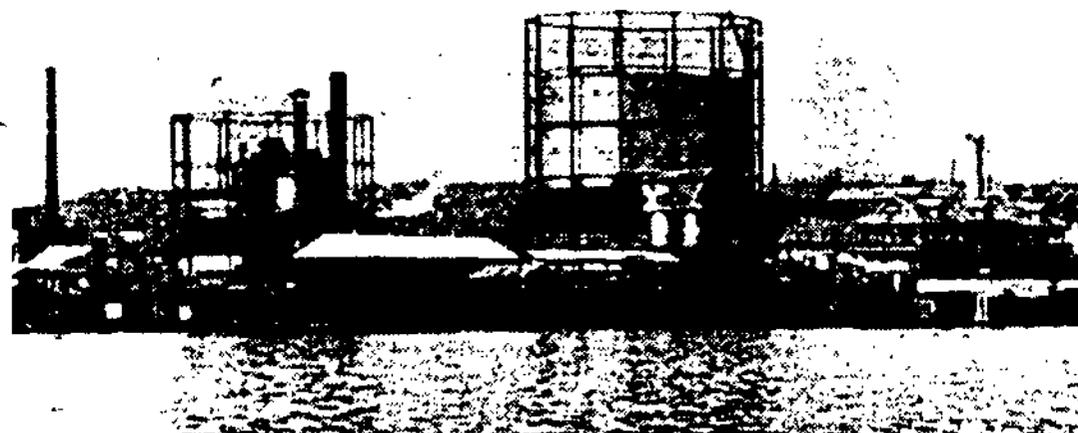


Fig. 2 Seattle Gas Company's redesigned Lake Union plant 1938 [1]

Introduction

The Lake Station, that is now Gas Works Park, was built to produce Synthetic Natural Gas (SNG) for use in Seattle and the surrounding area before the natural gas pipeline reached Seattle. This booklet has been written to explain how the equipment for making the SNG worked when it was in operation. Due to the rust on the equipment one may get the impression that this technology is no longer in use, however, that is totally incorrect. The chemistry that was used to manufacture SNG is still in use in every oil refinery in the world. In spite of the appearance of the equipment today, it is actually a bridge from the past to the future, because it demonstrates that when we needed natural gas we could synthesize it which should convince everyone that after the oil is gone we will be able to synthesize gasoline too.

Hydrogen (Protium) was first recognized as an element by Cavendish in 1766, and it was named by Lavoisier [2]. Synthetic Natural Gas, that was called "city gas" at the time, was first successfully produced in 1792 [3]. Attempts had been made a couple of decades earlier, but the bricks needed to hold the heat while the gas was being made were not available or used until 1792.

From 1906 until the installation of the first oil gas generators in 1937-38, the Lake Station gasified coal. The story of the coal gasification era is covered in a separate booklet entitled "Coal Gasification and Liquefaction"[4].

The SNG generators that are currently located in Gas Works Park are oil generators. They operated by cracking oil at high temperatures which were about 1650° F at the beginning of a gas generating run, and 900° F at the end. After the oil had been cracked, hydrogen was added to the molecules. The hydrogen was obtained by using the so called water gas and shift reactions.

Reactants (ingredients)

Oil storage and heating

Bulk oil storage was provided by two 55,000 barrel oil tanks (#1 and #2 in Fig. 1) contained in an impound wall to prevent a spill in the event of a leak in a tank. The impound area was located in the Northwest section of the station. A smaller oil tank was located west of generators 5 and 6, (#3 in Fig. 1). Oil was delivered by ship to the Lake Station and was pumped from the ship into the bulk storage tanks. From the bulk storage tanks it eventually flowed into the small tank near the generators. After leaving the small tank near the generators it was sent to the oil heater heat exchangers shown in Fig. 3 (#4 in Fig 1). The oil heaters used waste heat from the gas exiting the

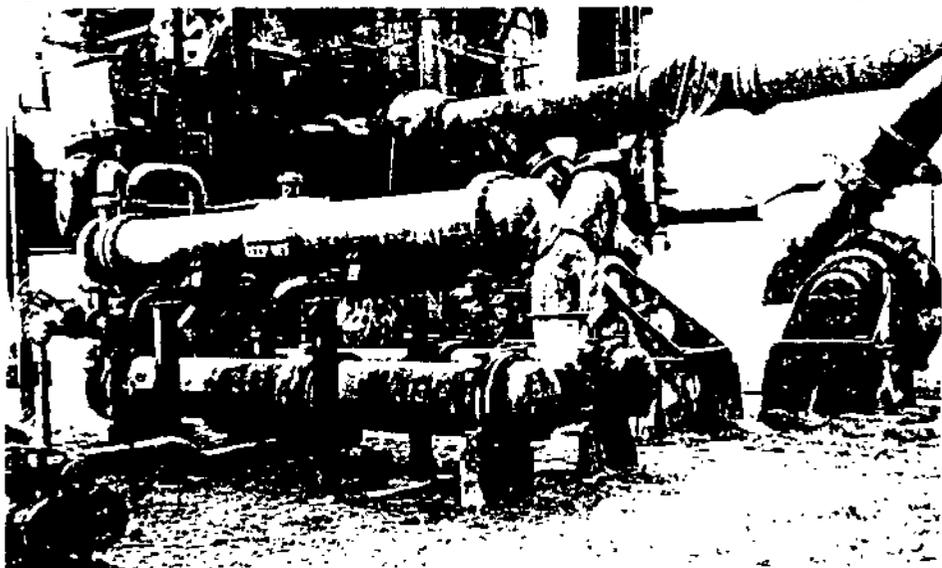


Fig. 3 Oil heater heat exchangers and 10,000 CFM air blowers generators to heat the incoming oil while cooling the exiting gas. Heating the oil going into the generators made it possible to make longer gas generating runs because the generators were not cooled down as quickly as they would have been by cold oil.

Heat Exchangers

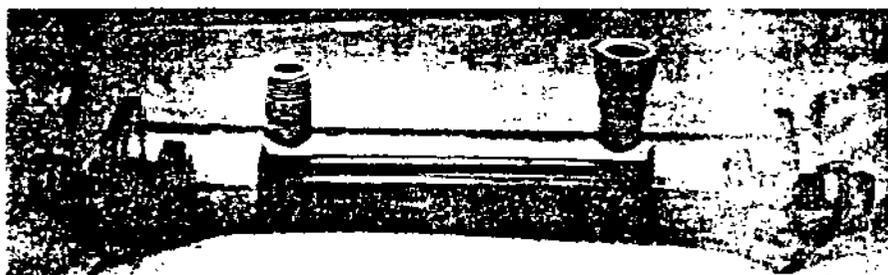


Fig. 4 Shell and tube heat exchanger

To be able to follow the explanation of how things worked, it will be necessary to understand how some of the equipment functioned, so let us first look at the heat exchangers. Heat exchangers are widely used pieces of equipment, and many of them were used at the Lake Station. They are also extensively used in oil refineries, and are even used to heat water in large buildings. Figure 4 shows a heat exchanger made for demonstration purposes. The shell side of the heat exchanger is

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35. Report of Seattle Gas Company to the Public Safety Committee of the City Council of the City of Seattle on steps taken to comply with requirements of the city ordinance no. 64604, 1935, p.22. Located in the University of Washington Special Collections.
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the area inside the outer shell and outside the inner tubes. The tube side of the heat exchanger is inside all of the tubes. This type is called a shell and tube heat exchanger. The two fluids usually flow in opposite, or counter current directions through the heat exchanger, but in this type of heat exchanger the two fluids never come into contact with each other. Heat is just simply transferred through the walls of the tubes. Although there are exceptions, the hotter fluid normally goes through the shell side and the cooler fluid goes through the tube side.

Steam + Oxygen

The building part of the Play Barn Fig. 7 (#6 in Fig. 1) can be divided into two primary areas. One part is the boiler house, that is essentially the North half, and the pump house that is essentially the South half.

The Pump House can be divided into three areas. The area on the West end is where the pumps are located for compressing the SNG. The equipment in the East end are "Exhausters" that both pumped the gas through the system, and also removed tar from the gas at the same time. The equipment in the center portion was used to separate air into oxygen that was used in the SNG generators and nitrogen that was returned to the air.

Air Separation

In 1920 E.E. Norton published a process for making oxygen that utilized compressors and heat exchangers with energy recovery to reduce that amount of energy that was required to cool the air and separate the components under pressure[5]. Low cost oxygen that could be used to make SNG was not available until after 1924 when the process had been successfully demonstrated.

The air separation plant is located in the center portion of the pump house. The air was initially compressed by the compressors in the center section of the pump house. After it was compressed it was run through an intercooler, and then heat exchangers that would cool the gas down until the oxygen would become a liquid, but the nitrogen would remain a gas. The oxygen could then be separated from the nitrogen. On the way out of the separation system both gasses went back through the same heat exchangers to cool down the incoming air while the exiting gasses were being reheated. The oxygen was then heated further and sent to the SNG generators along with some process steam from Boiler 9.

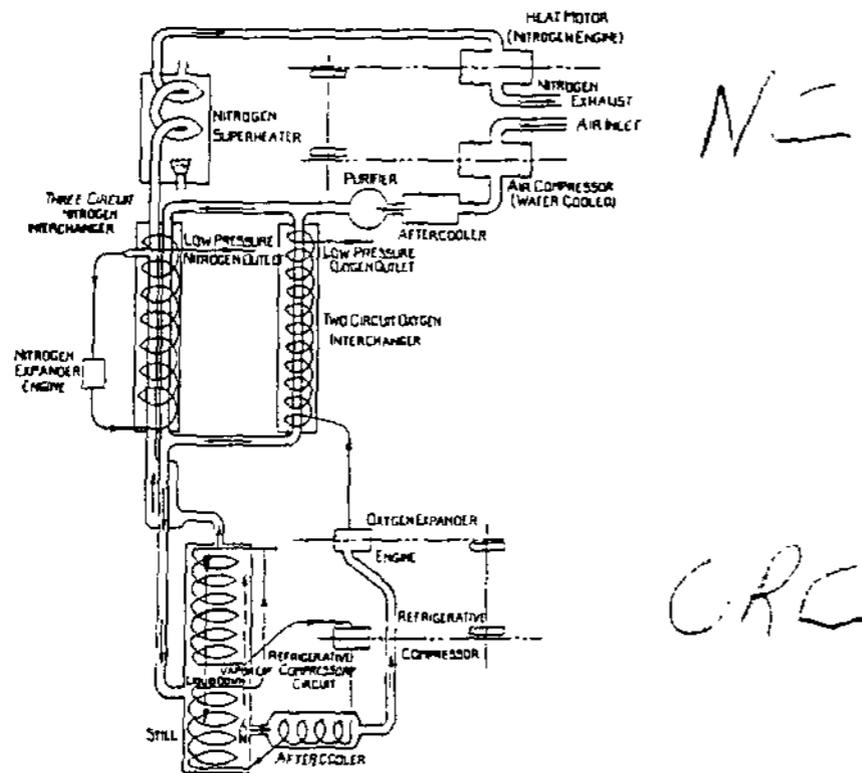
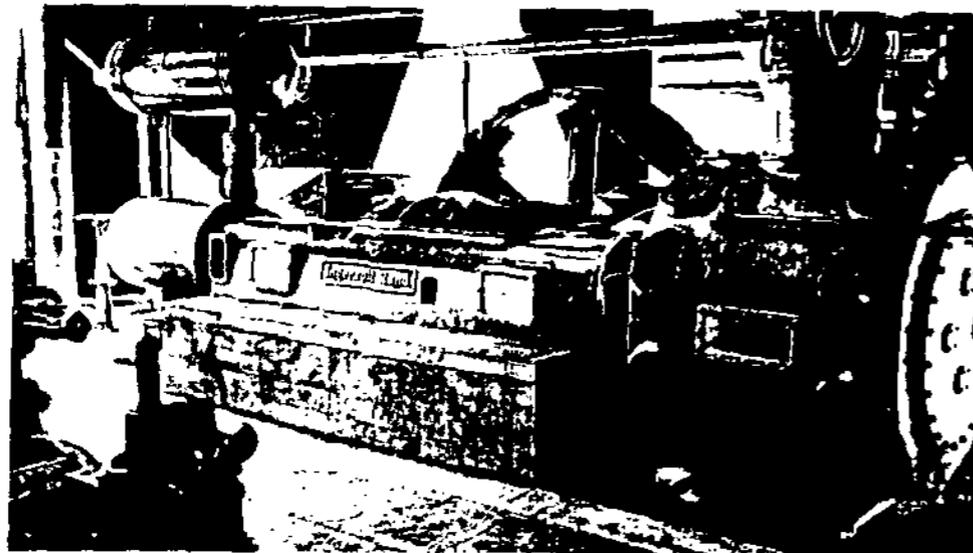


Fig. 5 Jeffries-Norton Corp. Gas Separation System [6]

After the nitrogen had been heated back up it was still under considerable pressure, so the nitrogen was expanded in an expander shown in Fig. 6 that is part of the gas compressor in the Southwest end of the pump house. As the nitrogen expanded in the expander it provided part of the power required to compress the finished gas and pump it into the city holding tank (#17 in Fig. 1). The fact that most of the energy required to compress the air was recovered in the process is what made oxygen affordable. The nitrogen was eventually super heated in boiler number 9 and used to drive the steam engine of the nitrogen compressor.



Steam engine Nitrogen expander engine Gas compressor

Fig. 6 XPV gas compressor with nitrogen gas expander

Exercises for the interested reader

1. Calculate how much the temperature of the air increases due to compression in the Volvo turbocharger mentioned on p. 19 by using formula 2 on p. 19. My friendly local Volvo dealer told me that after the air goes through the turbocharger the pressure is 8.1 Lb./in² greater than atmospheric pressure. Atmospheric pressure is 14.7 Lb./in². Make the standard assumption that $T_1 = 300$ K. The value of $R/C_p(\text{Air}) = 0.2857$
 $^{\circ}\text{C} = \text{K} - 273.15$ and $F = (9/5) * C + 32$
2. If it were not for the intercooler in a Volvo the volume of the air after compression would take up a greater volume. Compute the amount by which the volume would have been greater in terms of percent without the intercooler. The volume would have been greater by the ratio of absolute temperatures, so: $\text{Vol}(\text{increase}) = T_2/T_1 * 100\% - 100\%$

The answers are given inside the back cover.

The Kelley Pressure Filter

The Kelly Filter consists of a supporting frame, steel pressed shell, filter carriage, filter leaves and quick locking head mechanism. The cast iron head is mounted on wheels which run on the outer track on top of the supporting frame, while the rear end of the carriage runs on tracks inside the shell. The leaves are all of the same length but of different widths, and are made of rolled steel pipe and double crimped wire screen. The forward corners of the leaves are connected to openings through the head, through which openings the filtrate passes out of the press. The filter cloth is made in the form of bags and sewed on the leaves.

A cycle of operation consists in closing and locking the filter, building the cake, expelling the excess sludge, washing with water or other solution, expelling the excess wash water, and drying the cake by letting air flow through cake, and then opening the filter and discharging the cake.

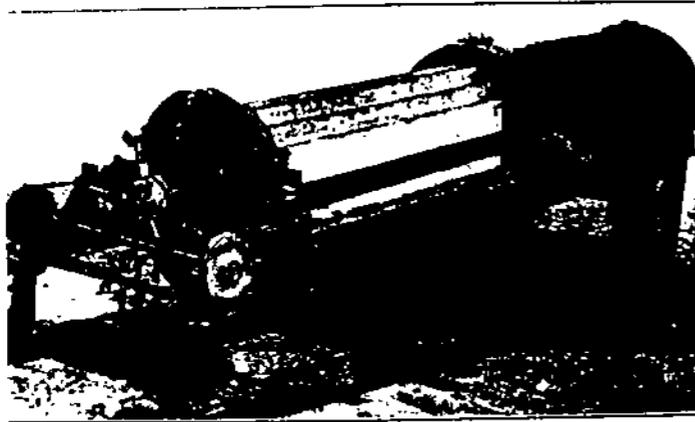


Fig. 25 Kelly Filter open, showing the leaves, etc. [36]



Fig. 26 Briquet machinery, carbon black drying kilns at rear [1]

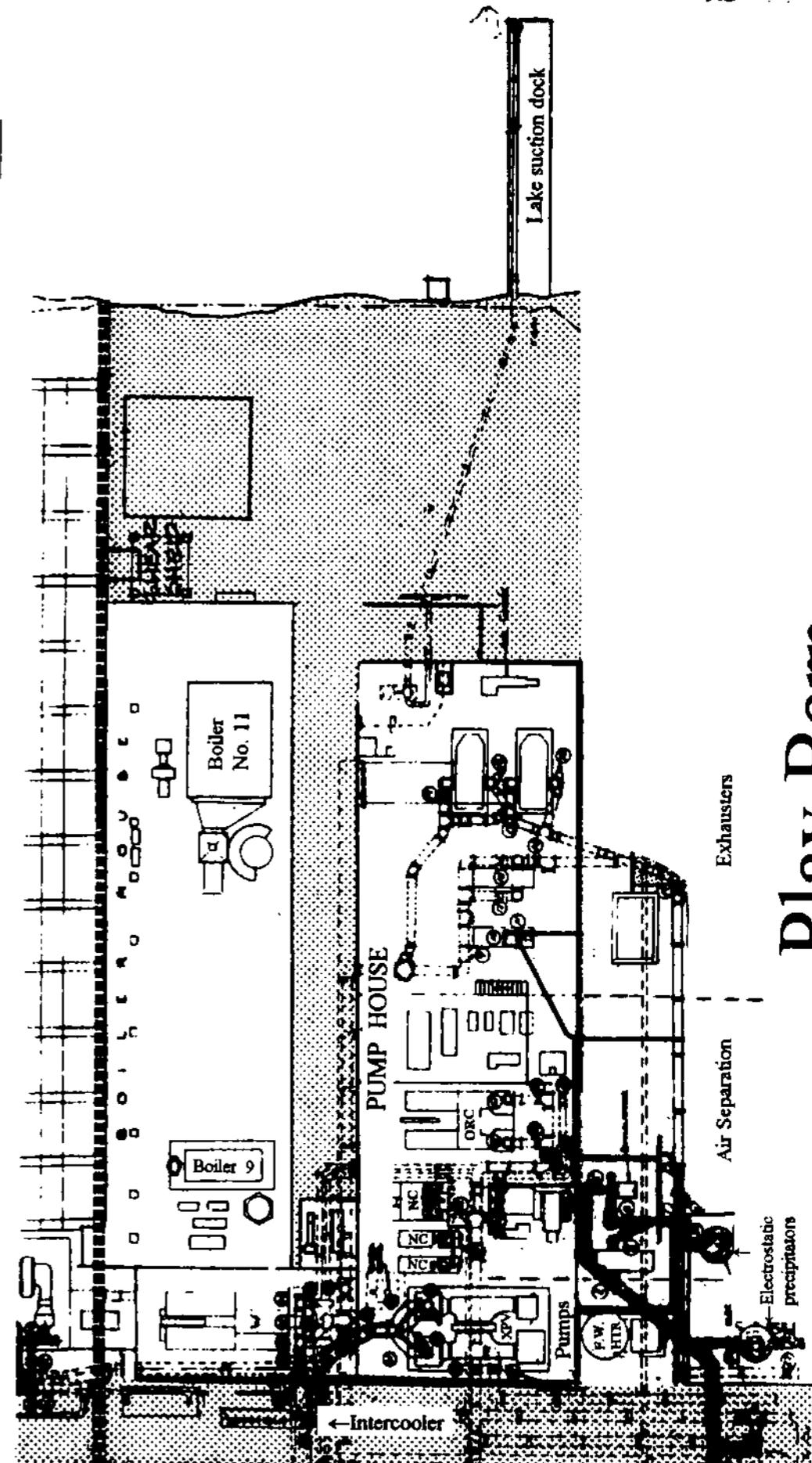


Fig. 7 Play Barn area with Boiler House and Pump House

Play Barn

Boilers

There were two boilers in the boiler house. Boiler number 9, which has been removed, provided process steam and boiler number 11 provided engine steam to drive the engines of the pumps in the pump house. Both of the boilers were designed to burn a combination of low melting point tar and oil.

The reaction used inside the SNG generators is called the "water gas" reaction, but steam was actually used to avoid cooling the generators down more rapidly than necessary. At least part of the process steam used in the SNG generators was generated by pumping lake water through boiler number 9. The lake water was pumped into the system by boiler feedwater pump number 1. After the water left the feedwater pump it went through the intercooler heat exchanger (see Fig. 7) that cooled the finished gas while heating up the water prior to entering boiler number 9. When the water actually entered boiler number 9 it was already partially heated, and the boiler then converted the warm water into steam. The steam was then combined with oxygen and the mixture was sent through insulated pipes to the SNG generators. Some of the steam was probably also generated in the waste heat boiler attached to the older Smet-Solvay SNG generators.

Corrosion causes hundreds of billions of dollars of loss every year in the United States. In order to slow down the rate of corrosion, rust inhibitors are added to the water in boilers. Rust inhibitors could not be added to the lake water that was converted into process steam in Boiler 9, because the water only went through that boiler once. However, rust inhibitors were added to the water in Boiler 11 that produced engine steam. Because the gas company did not want to lose the chemicals they had put into the water for Boiler 11, after the steam had been used it was condensed back into water and sent back to the boiler to be used again. If we start at the boiler where water is turned into steam at about 125 PSI we can follow it around the loop. The steam went from the boiler to a steam engine that provided the power to run the pumps in the pump house. After the steam left the pump it next went to a condenser where it was condensed back into water. The liquid water from the condenser went into boiler feedwater pump 2. From there the pump sent the water to the boiler feedwater heater that is the large cylinder just outside the Southwest corner of the pump house. The water was heated up a certain amount in the boiler feedwater heater using waste heat from another stream. The water then left the boiler feedwater heater and it was sent back to the boiler to be converted into steam for another round.

Boiler number 11 was shipped to Seattle on September 1, 1941.

Information below and on the next page has been taken from Steam -- It's generation and use [7] and information provided by Babcock and Wilcox.

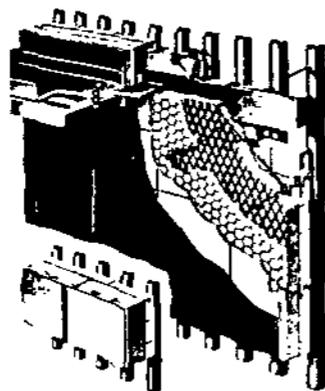


Fig. 8 Construction of tube and brick wall -- particularly suitable for oil and tar fired boilers. The water tubes in the wall of the boiler provide water-cooling to keep the refractory bricks within their operating temperature range.

10072



Fig. 23 Photograph of two of the Smoke Arrester Hoods in place (1935). Special Collections, Univ. of Washington Libraries, Neg. #17711 [35]

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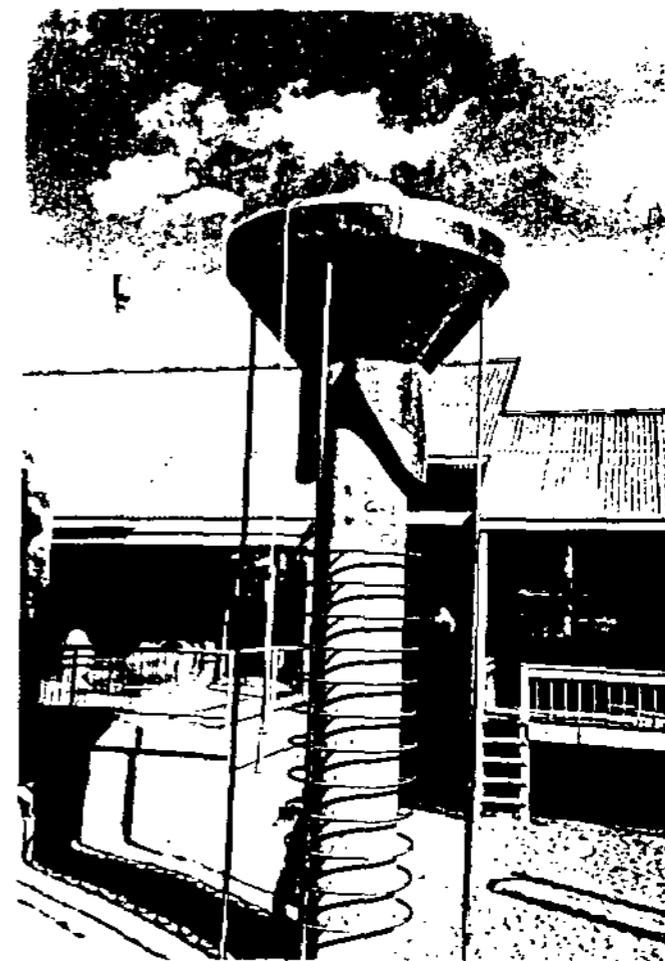


Fig. 24 Photograph of the Smoke Arrester Hood (1997)

6770

SMOKE ARRESTER HOODS ON WATER GAS MACHINES

In 1934 the Seattle City Council passed Ordinance 64604 that required the Seattle Gas Company to reduce the emission of smoke, noise and odor from its Lake Union plant. The following is an excerpt from the gas company's response to the Seattle City Council having to do with its reduction of smoke, and it also describes why the red hood in the play area is shaped the way it is.

The diagram shows the principle on which these hoods operate. The large funnel "A" is about ten feet in diameter. Inside of this is the stack "B" which flares at the top to make a funnel within a funnel. In the center and above the top of the stack is a double cone "C". The outer funnel is partially covered with a circular plate "D" which bends downward at the point "D". As the mixture of burned gasses, and the heavy particles of soot, ash, coke dust, etc. which are represented by the arrows, moving upward through the stack, strike the lower cone "C" they are diverted over against the inner funnel "B" reflected upward against the underside of "D" and then downward against the top of the cone "C" and out. In the course of these several changes in direction the heavy particles of solid matter represented by black dots drop out and are collected in the two skirts "E" on either side of the funnel "A" and are conducted downward through the pipes "F".

These arresters were designed by the Company's own engineers after building several models and two other different full sized heads, which were abandoned after trial because they were not fully satisfactory. The hoods above described have been installed on all three of the water gas sets which are used in regular operation. Because of the high temperatures to which these hoods are subjected, it appears to be impossible to keep them painted and this is the cause of the discoloration of the one on the left. The one on the right was the last one installed on the "stand by" generator set and has not been heated up.

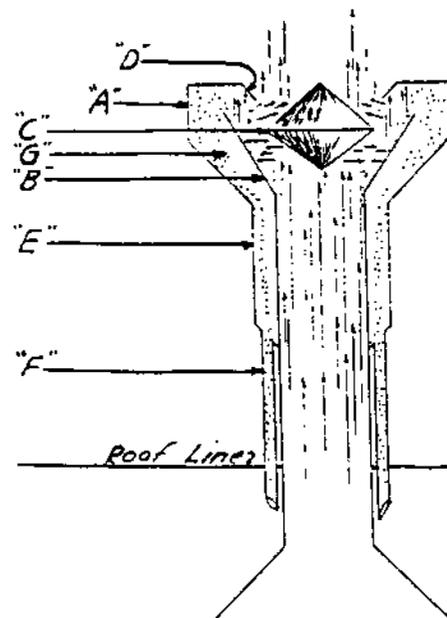


Fig. 22 Diagram that shows the principle on which the hoods operate

Information on this page and the next, from: Report of Seattle Gas Company to the Public Safety Committee of the City Council of the City of Seattle on steps taken to comply with requirements of the city ordinance no. 64604. (1935) [34]

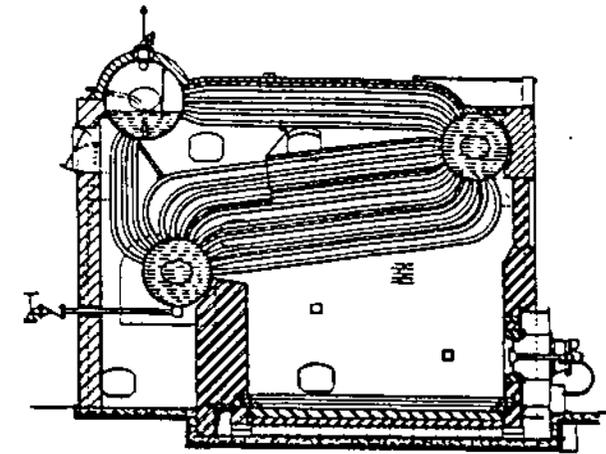


Fig. 9 Type H Stirling Boiler

General description

Bent tube boiler unit, generally field assembled. Some small sizes can be shop assembled and shipped. Usually without superheater, though super heater may be fitted.

Ratings		
General		Boiler 11
Range in Size, Steam output to	50,000 LB per hour	50,000
Design pressure	160 to 300 LB per sq. in.	200
Operating pressure	15 to safety valve setting	125
Steam temperature saturation to	175 F superheat	
Fuel oil and gas; coal with all types of stokers;		oil and tar
	bagasse (residue) and wood	
Operational control, usually manual		
Furnace refractory; frequently water-cooled for oil or coal firing		
Dimensions - Smallest	15 ft long x 6 ft wide x 15 ft	
	Largest 25 ft long x 18 ft wide x 23 ft	25 ft long x 18 ft wide x 20 ft

Indicated field of application

- In the production of steam for heating, process or power needs within the output and specifications noted above, using any of the fuels listed.
- Where utmost simplicity and minimum first cost are prime factors.
- Where use of low cost fuels does not justify an economizer or air heater. However, either or both may be installed if warranted by the evaluation of the saving in purchased fuel.
- Where simple field erection methods can be followed

General comments

The type H Stirling boiler is essentially simple and inexpensive. It is particularly well suited for moderate duty service and limited headroom. With good combustion efficiency that can be maintained even at very low rates of output -- often an important advantage when used for heating service.

The standard baffle for this unit is in checker form which in effect, permits a single-pass or straight-through gas flow. This arrangement gives good efficiency without the higher draft loss usually associated with sharp gas turns in multi-pass flow.

Products: Gas and byproducts

The product that the Lake Station was built to produce was synthetic natural gas, but in addition there were a number of valuable byproducts that were sold. Not all of the oil was successfully converted into natural gas as intended. Some of the oil was converted into tar. There was a ready market for the high melting point tar in Seattle, because it was needed for roofing. However there was not as much demand for the lower melting point tar, so it was mixed with oil and used as boiler fuel to make steam.

Other products included lamp black which is carbon of very small particle size, charcoal briquettes, sulfur, benzene that was called benzol at that time, and toluene that was called toluol at the time. The lamp black, essentially carbon dust, is used as pigment in rubber tires, inks and as a coloring agent for stoves, lamps, etc. Some people burned charcoal briquettes instead of burning coal for heat. The advantage of burning charcoal briquettes was they produced less smoke than coal and, so were cleaner. Sulfur was in demand for use as an insecticide. The benzene was used as an octane booster in gasoline. The Octane number for benzene is 106, so it is very desirable from an octane rating standpoint. However, we now know that benzene is also carcinogenic. Toluene has an octane number of 97, and it can also be used to boost the octane rating of gasoline, but it is also used to make explosives. In fact the United States Government was so desperate to get the toluene during the world wars that it actually paid to install gas plants similar to the Lake Station, and to expand others in order to get the toluene for the war efforts [8].

Making Synthetic Natural Gas (SNG)

The six large round cylinders on the west side of the park are the SNG generators. They have been referred to as "oxygen generators" in some of the documentation, because they used oxygen rather than air when making SNG. However, they actually consumed oxygen rather than producing it.

The six existing oil SNG generators were numbered from one to six starting at the lake and going North. Installation of generators 1 and 2 was started in 1937 and completed in 1938. Installation of generators 3 through 6 was started in 1946 and completed in 1947 to meet the demands of a growing city. The Seattle Gas Company originally planned to install only two additional generators, but later decided to install four. Generators 1 and 2 were Semet-Solvay type that included a waste heat boiler (#5 in Fig. 1) on the east side which has been removed. A waste heat boiler makes the operation more efficient and less costly when the price of oil is high. Apparently the cost of oil was low enough when the newer Semet-Solvay SNG generators 3 through 6 were installed that no waste heat boiler was installed.

The feed material used to make SNG was Bunker C fuel oil from California. Bunker oil is very low quality inexpensive oil, and tended to be mostly ring compounds. It had a specific gravity of 0.94 - 0.96, 84.4% carbon, 11.1% hydrogen, 0.59% - 3.3% sulfur, and 18,550 to 18,800 BTU per pound. The percentage of hydrogen appears to be rather low, but the standard for reporting percents of fuels is to quote weight percentage. Hydrogen is much lighter than carbon, so the number of hydrogen atoms are not as few as one might think. The oil was black and very viscous[9]

The oil was converted into SNG at high temperatures. The oil was first heated in the oil heater heat exchangers located on the East side of the generators between the older Semet-Solvay generators and the newer Semet-Solvay generators. Fig. 10 is a picture of SNG generator number 6 when it was first installed. The two rings around the top are pipes covered with asbestos insulation that were removed before the park was opened. One of the pipes distributed hot oil to nozzles that sprayed it into the generator. The other pipe distributed a combination of oxygen and steam. If the ports around the generator were numbered then one could say that hot oil was

High BTU water gas equipment

The high BTU water gas equipment (#18 in Fig. 1) probably used a higher grade of oil, and they also consisted of a generator, carburetor and a super heater. The six large SNG generators produced gas in a single shell. However, the disadvantage of the single shells was that the conversion of hydrogen and carbon to methane did not go as far as it would have if there had been a longer residence time. The gas company was required, by city ordinance, to maintain a minimum BTU value of 550 BTU per cubic foot. (Naturally occurring natural gas has a nominal BTU value of 1000 BTU per cubic foot.) In order to satisfy that requirement the high BTU water gas equipment was used to produce some additional higher BTU gas to maintain the required BTU value. Hydrogenation of the carbon to produced methane that boosted the BTU value of the gas primarily took place in the super heater portion of the high BTU water gas unit. Blue gas also contained an appreciable amount of carbon monoxide, and that also raised the BTU value of the gas. At one time there were a total of six units. The one located across from the concession stand is the only one that remains at the present time. The unit is nearly complete, except for the wash box and the control system that is shown in Fig. 21.

In 1934 the Seattle City Council required the gas company to reduce the emission of smoke from the Lake Station. To comply the plant engineers developed smoke arrester hoods for the high BTU water gas sets that are shown in Fig. 23 and Fig. 24.

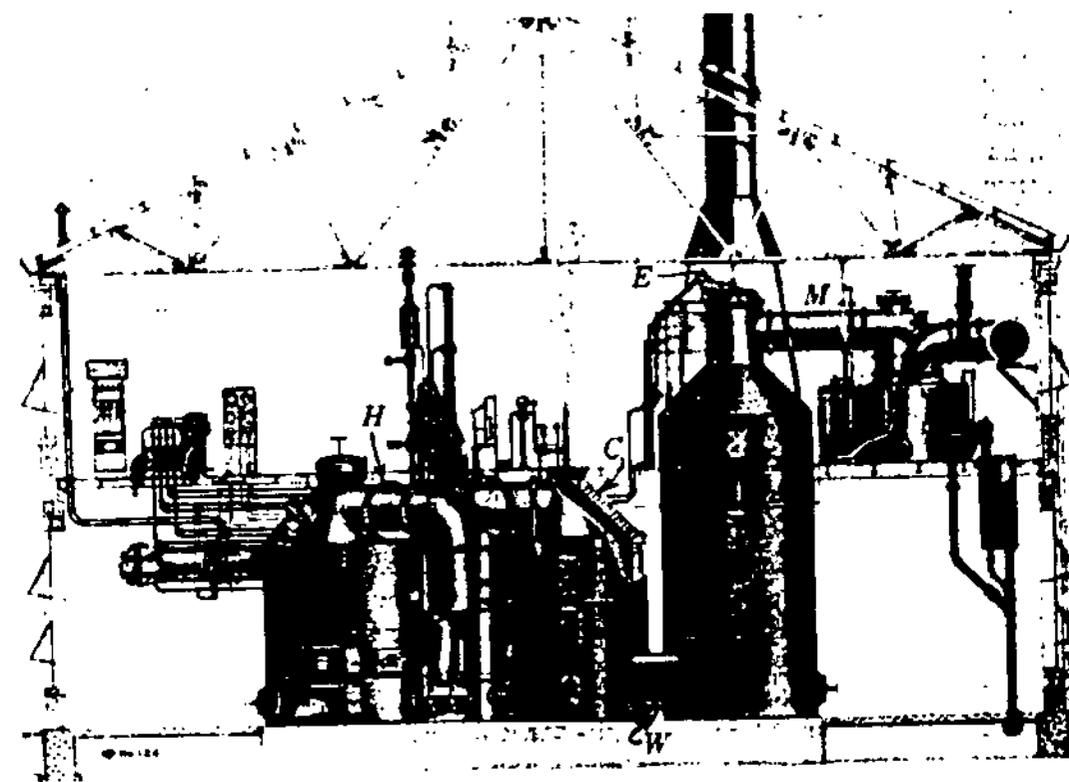


Fig. 21 Standard high BTU United Gas Improvements cone-top carburetted-blue-gas apparatus [33]

The future

What remains of the Lake Station at Gas Works Park is actually a bridge between the past and the future. It is a bridge because it is possible for us to see that we made our own fuel in the past, and we can see that we can make our own fuel in the future without oil. The Department Of Energy's "New" Clean Coal Technology uses a number of the same reactions that were used here at the Lake Station in the past. However, the tar that caused so much trouble for the people who were trying to make city gas is the very thing that DOE is trying to increase in the production from coal, because the tar that is obtained is later upgraded into gasoline.

Currently more than half of the gasoline produced by all of the oil companies uses the reactions that were used to make SNG here at the Lake Station. As a result, one can not actually say that the chemistry that was used in the old rusted shells here in the park is old and obsolete. For those who are interested there is another booklet entitled Coal Gasification and Liquefaction[4] that describes the coal era at the Lake Station and the chemistry in greater detail.

The element Carbon can probably be obtained from coal for the next couple of hundred years, but making gasoline requires hydrogen as well. One way to obtain hydrogen is to use the water gas and shift reactions that were used here at the Lake Station along with the production of some carbon dioxide. The other way to produce hydrogen without producing carbon dioxide is to do it by thermochemical separation of hydrogen and oxygen in water by using heat from a nuclear reactor. The details for such a process are given in the 1973 patent 3,761,352 entitled "Method and Device for the use of High Temperature Heat-Energy, in particular of Nuclear Origin (for the production of hydrogen)"[29].

Nuclear reactors are safe in spite of the fact that some people with no specialized education may try to tell you otherwise. When they are trying to tell you otherwise you should keep in mind that the Chernobyl accident occurred after they had defeated the automatic control system during an "experiment". Nuclear waste is not a problem, because if Uranium 238 and Plutonium were removed from the waste the one long term storage site we now have would last 100 years. Conversion of the Uranium 238 to Plutonium would increase our energy supply and it would eliminate the need to store Uranium 238 anywhere.

What we need to do is to stop listening to the Evil One's followers, who do not want us to use what the Lord has given, so that they can send us to die trying to steal someone else's oil even though the Lord has said, "Thou shalt not steal." [30]. In Philippians 4:19 it says that "God shall supply all your need" [31], and he has. All we need to do is to use what the Lord has given us, and then we will have all we need without a single drop of foreign oil. Ephesians 6:12 tells us that our real battle is against evil when it says, "For we wrestle not against flesh and blood, but against principalities, against powers, against the rulers of the darkness of this world, against spiritual wickedness in high places" [32].

injected in the even ports and a combination of steam and oxygen was injected in the odd numbered ports. In other words they alternated around the generator. It can also be seen that there was another set of pipes and injection ports around the generator at the level of the first cat walk.

When the steam and oxygen were injected into a hot generator along with hot oil they reacted in what is referred to as the water gas reaction. Basically a carbon atom from an oil molecule steals the oxygen from a water molecule, resulting in the production of hydrogen that is then combined with another carbon atom to produce methane. Methane is the major component of natural gas. The oxygen sprayed into the generators was simply to burn part of the oil to produce heat to keep the process going. The carbon dioxide formed in the process was eventually absorbed in the water used later in the process, and in that way was eliminated from the gas.

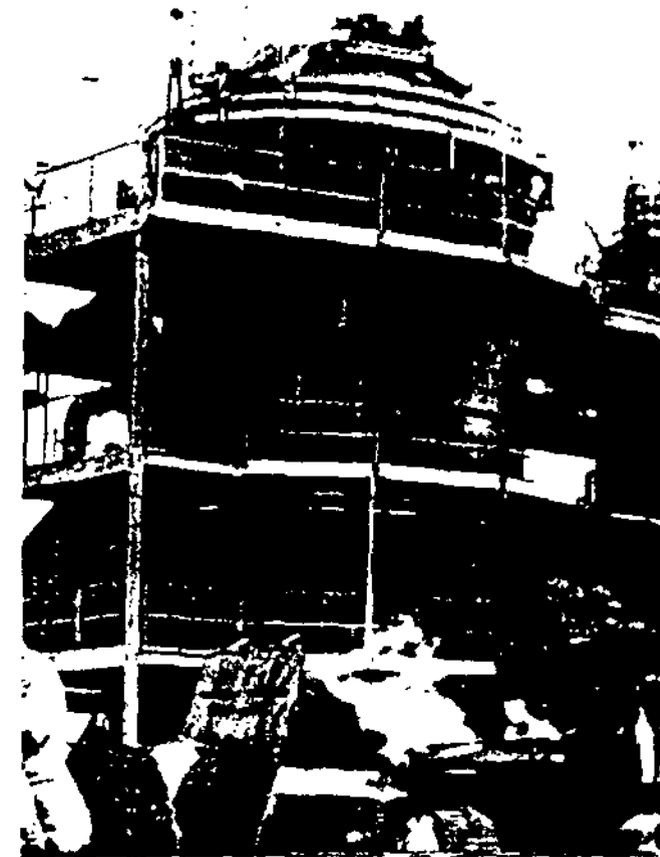


Fig. 10 SNG generator number 6 soon after installation in 1947.

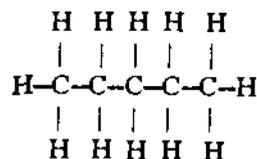
The water gas reaction is slightly endothermic, which means that it requires some additional heat, and consequently the generators would cool off during a gas producing run. Fig. 6 shows the refractory bricks that line the insides of the SNG generators. The purpose of the bricks was to insulate the generator and store the heat produced during a burning period so that it could be used during a gas generating period. When the generators were started up some oil was sprayed into the units and burned to heat them up. When they cooled off too much during the gas making phase the top of the units were opened, and the left over carbon was burned with air from the blowers to heat the units up. Once the units had been reheated they began another gas making run. The process was staggered so that some were generating gas while others were being reheated.



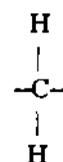
Fig. 11 Refractory brick in SNG generator No. 5

Desired reactions

Oil molecule*

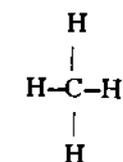


↓ Cracking



← What we have

What we want ⇒



(Methane)

* The molecule shown is actually pentane. The structure of bunker C is more complicated, but the same process works for all of the feedstocks.

because more pumping power is required, and the tank must be stronger. Thus it was more advantageous to cool the gas instead. If the gas had not been cooled the tank would have had to have been a little over twice as large.

Volvo automobiles have turbochargers that compress the air used by the engine using exhaust gas to turn the compressor. The temperature of the air is also increased in a Volvo when the air is compressed. As a result an intercooler is also used in a Volvo to decrease the volume of air in order to make the compression part of cycle more efficient. However, in a Volvo everything is on a much smaller scale.

The normal pressure in a gas line is about 300 PSI. Therefore, let us assume that the storage pressure in the tank needs to be 600 PSI to supply gas to the gas lines. If we assume that the gas pressure at the input to the compressors was 30 PSI and the pressure in the tank is 600 PSI we can then use the formula for isentropic compression, equation 2, to calculate how much the gas was heated up as a result of compression.

$$T_2(\text{at } 600 \text{ PSI}) = T_1(\text{before compressor}) * (P_2/P_1)^{(R/C_p(\text{SNG}))} = 641.75^\circ \text{F} \quad (2) [25]$$

C_p is the heat capacity at constant pressure of Synthetic Natural Gas. This requires some complicated averaging, because SNG is not a single gas, but rather a mixture of gasses. The result is that $C_p(\text{SNG}) = 2.894 \text{ kJ/kg}\cdot\text{K}$. The value of R given in references, such as Chang[26] must be converted to make the units compatible, and in this case the value of $R = 0.7567 \text{ kJ/kg}\cdot\text{K}$. Temperatures T_1 and T_2 must be in Kelvin, and ambient temperature, or T_1 , is always taken to be 300 K in combustion work, so we might as well use $T_1 = 300 \text{ K}$. Unless you are an aspiring jet engine designer it is probably best just to take my word for it.

One thing that should be mentioned here is that the air that was compressed in the air separation plant was also heated up beyond ambient temperature as a result of compression. In order not to have to pay to refrigerate the air later on, the compressed air in the air separation plant was also sent through an intercooler prior to being cooled down further. That helped to save energy in the air separation plant.

Composition of the finished gas

After removal of the tar, light oils, sulfur, and most of the carbon dioxide the composition of the gas in terms of volume percent was:

Table 1 Average composition of the gas[27]

CO ₂	2.0
Illuminants	3.2 (such as C ₂ H ₄) [28]
Oxygen	0.3
CO	5.5
CH ₄	32.3
Hydrogen	51.9
Nitrogen	4.8

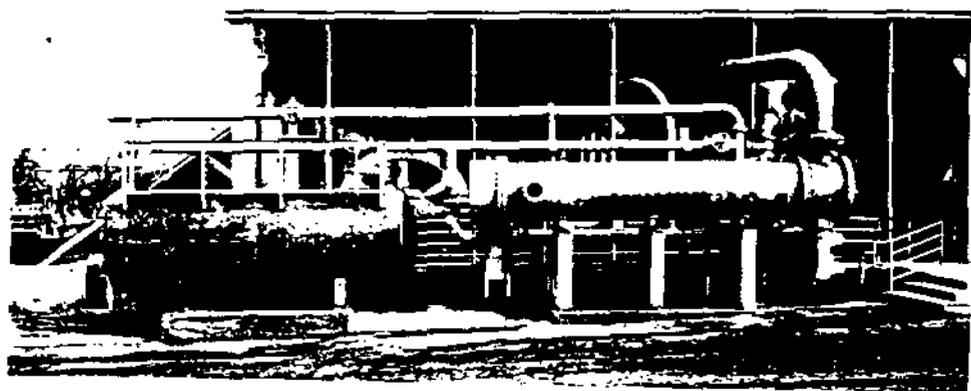
Because of the problems with storing hydrogen it is very unlikely that hydrogen will ever be used as a transportation fuel. However, if hydrogen was to be used as a transportation fuel, it is interesting to note that the gases produced methane (CH₄) and hydrogen are in approximately the right ratio to use the methane to heat homes and offices and hydrogen for use as a transportation fuel.

Compression and storage of the gas

After the tar, light oils and sulfur had been removed, the gas was ready to be compressed and sent to the city holding tank for storage. From the city holding tank the gas was then sent to the customers through the gas company's distribution system.

The gas was compressed by two very large compressors in the west end of the pump house. The gas compressors are labeled W and XPV in Fig. 7. Because electricity is generally more expensive than steam, the compressors were steam powered, and they had large fly wheels to make sure that they operated smoothly. The XPV compressor shown in Fig. 6 has about a 3,000 HP rating. The compressed gas was run through an intercooler shown in Fig. 20 (#16 in Fig. 1, also see Fig. 7) and then sent to the 2 million cubic feet collapsible city holder tank (#17 in Fig. 1).

When the gas was compressed in the pump house its temperature also increased by approximately 642° F. Hot gas takes up more room than cooler gas, so the gas was then cooled in the intercooler in order to save storage space. The gas went through the shell side of the intercooler heat exchanger, and lake water went through the tube side to provide the cooling.



Intercooler

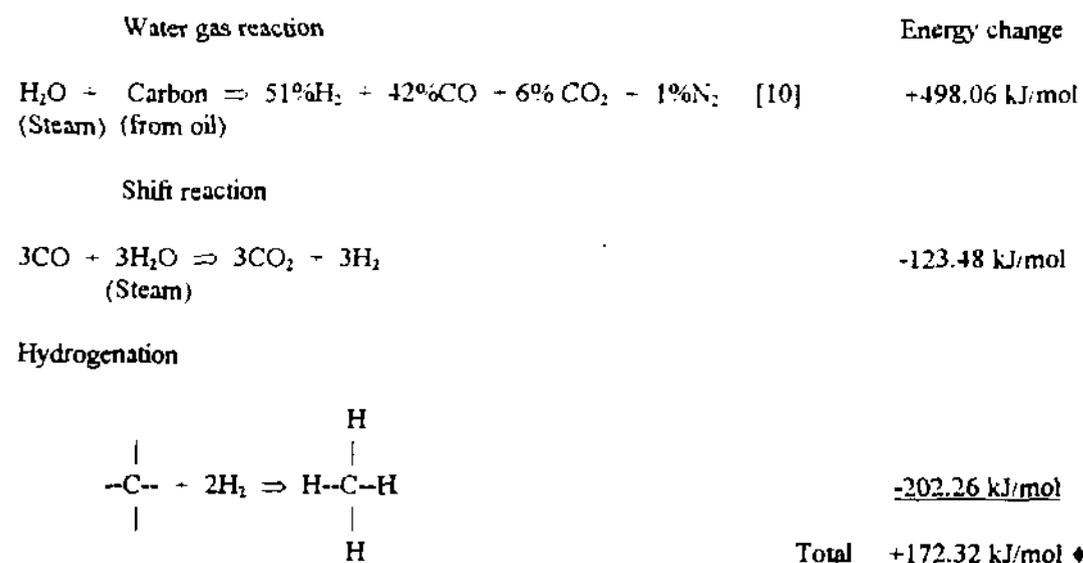
Fig. 20 Intercooler for finished gas

The volume of a gas depends upon temperature according to the ideal gas law that is:

$$V = \frac{nRT}{P} \quad (1) \quad [24]$$

Where V is volume, n is a given amount of gas, R is the universal gas constant, T is temperature and P is pressure. Because T is in the numerator, the higher the temperature is the greater the volume that will be required to store the gas. An increase in volume results in an increase in the cost of the storage tank, and that is very undesirable. Since P is in the denominator, the greater the pressure is the smaller the tank can be. However, it also costs money to increase the pressure.

Making hydrogen via the water gas and shift reactions



Water gas and shift reactions vs. electrolysis

Water gas and shift reactions:

Efficiency of water gas and shift reactions = 60% [13], [14]

1 unit of H_2 = $1 / .60 = 1.66$ units of CO_2

Electrolysis:

Efficiency of electrolysis is 57% to 82% [15]

Efficiency of electrical transmission 97%

Efficiency of generating electricity from coal 37% [16]

1 unit of H_2 = $((1 / .82) / .97) / .37 = 3.4$ units of CO_2

Carbon dioxide ratio:

$\frac{\text{Electrolysis units of } CO_2}{\text{Water gas + shift units of } CO_2} = 2.05 \cong \text{Twice as much carbon dioxide!!!}$

The conclusion here is that if you are concerned about the amount of carbon dioxide produced, then electrolysis should not be used to produce hydrogen.

♦ The actual starting molecule for these calculations was propane, and the products were assumed to be 52.5% H_2 and 31% CH_4 , as shown in [11]. See [12] for energy calculations.

Energy per atom



$$\frac{\text{Energy per H atom}}{\text{Energy per C atom}} = \frac{-120.9}{-393.5} = 0.307 \approx 1/3$$

$$\text{Energy per C atom} = -393.5$$

The conclusion here is that if the cost is the same for an atom of carbon as an atom of hydrogen it is better to take the carbon atom, because you get about three times as much energy. In addition having some carbon in the fuel increases the density of the fuel, and it makes it easier to store. City gas is lower in energy than natural gas, because it contains hydrogen, and hydrogen does not contain any carbon. If the higher heating value of 142.9 kJ/mol had been used the ratio would have been 0.363, or still about 1/3 [18]. It should be noted that the higher heating value can only be achieved in heating applications and not in transportation fuel applications.

Another interesting thing to note about hydrogen is that because it is the lightest atom it has the highest energy per unit weight. That is why NASA uses liquid hydrogen in its rockets. However, gaseous fuels are not purchased by weight. They are purchased by the cubic foot, and hydrogen has the lowest energy density of any of the fuels on a per cubic foot basis.

City gas (SNG)

Let us return to the SNG generators and follow the gas stream from the generators back to the pump house and on to the city storage tank.

Tar removal

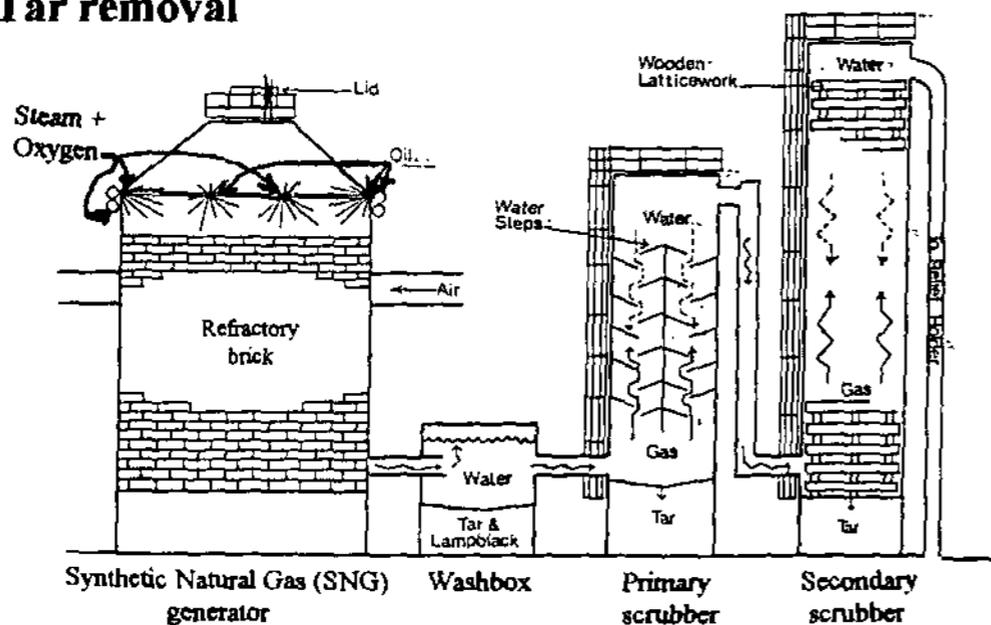


Fig. 12 Diagram of gas flow through primary tar removal equipment [19]

Once the SNG and byproducts had been formed inside the generators the mixture was first sent through a wash box shown in Fig. 13. The water in the wash box would cool the mixture coming out of the generator enough that the highest melting point tar would condense and sink to the bottom of the wash box. Lamp black was also removed from the top of the wash box. Fig. 12

100°F



Fig. 19 General view of newly erected benzol recovery plant with distillation towers[1]

Sulfur removal

Sulfur was removed by passing the gas through a series of "dry boxes" (#13 in Fig 1). The sulfur was in the gas in the form of hydrogen sulfide. It was removed from the gas phase by low temperature combustion that produced water vapor and elemental sulfur. Dry box technology had been developed by 1860[22]. The dry boxes were filled with wood chips coated with iron oxide that acted as a catalyst for the reaction. The conditions reported as ideal for the reaction were 65% humidity and 100° F[23]. Some steam was added to increase the humidity and a little air or oxygen was added to make the formation of water possible.

A number of dry boxes were connected in series, but the first dry box would always remove the greatest amount of sulfur. In order to distribute the sulfur more or less evenly between the dry boxes pipes and valves were provided so that the order of the dry boxes could be changed to distribute the sulfur more uniformly. Changing the order of the dry boxes was referred to as "rotation of the boxes".

As mentioned earlier, sulfur was used as a pesticide, but it was also used to make ammonium sulfate and sulfuric acid.

Once the gas had passed through the dry boxes, it next went to the lake exchanger (#14 in Fig 1) where the water vapor in the gas mixture was condensed out of the gas by heat exchange with the water in the lake. All of the gas passed through the inside of the tubes that made up the lake heat exchanger, and only heat passed through the walls of the tubes. As a result, using the lake water for cooling did not cause any pollution to the water in the lake.

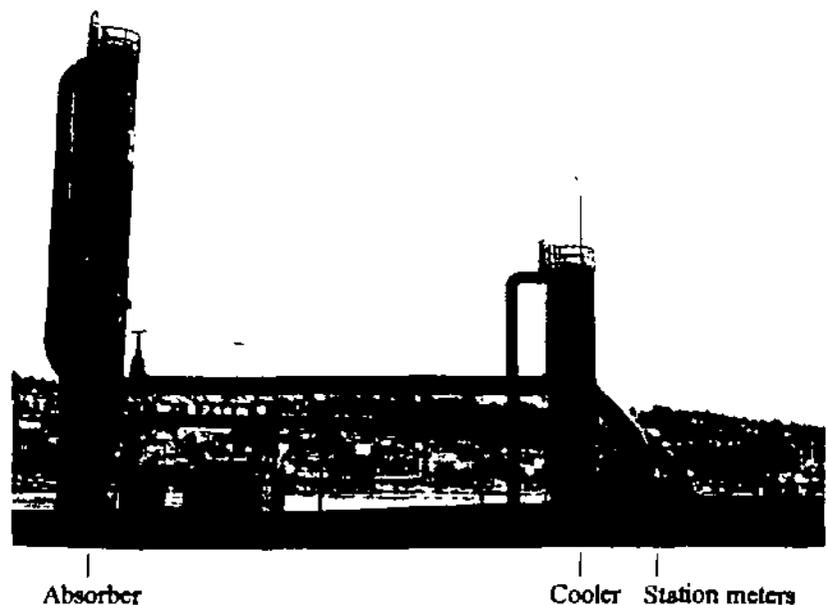


Fig. 17 Light oil absorption system and station meters

After all of the tar and light oils had been removed, the remaining mixture of gas and hydrogen sulfide was sent through the station meters shown in Fig. 17 (#12 in Fig. 1).

Distillation towers

A number of different components in a mixture, such as benzene, toluene, naphthalene and straw oil can all be separated from one another in a single pass through a distillation tower.

Distillation towers have a number of trays inside them, and the vapor rises through the different trays. The temperature is highest at the bottom of the tower and coolest at the top of the tower. As the vapor rises if it becomes a liquid when it enters a particular tray with a certain temperature the substance, such as naphthalene will stay in that tray. Other components with lower boiling points will simply go through the next tray up until they also become liquids.

One way in which vapors can get from tray to tray is to go through "bubble caps". Bubble caps prevent the unrestricted flow of vapors up the column by forcing the vapors to bubble through the liquid on the tray. If the component has the same boiling point as the liquid on the tray it joins the liquid on the tray. If it has a lower boiling point it simply bubbles through the liquid, and it goes up to the next tray level where the process is repeated for another temperature range.

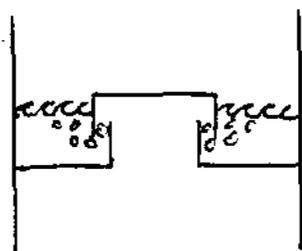


Fig. 18 Bubble cap in a tray in a distillation tower

shows lamp black coming out of a wash box and being sent to a lamp black thickener through a flume.



Fig. 13 SNG generator (left), wash box (center) and primary scrubber (right)

From the wash box the remaining mixture went to a tall primary scrubber shown in Fig. 13. The primary scrubber was essentially a direct contact heat exchanger where the gas flowed in a counter current direction through a spray produced by water cascading over a wooden lattice. The primary scrubber is shown diagrammatically in Fig. 12. The scrubber cooled the product mixture and it removed additional tar. At that point most of the tar had been removed from the mixture.

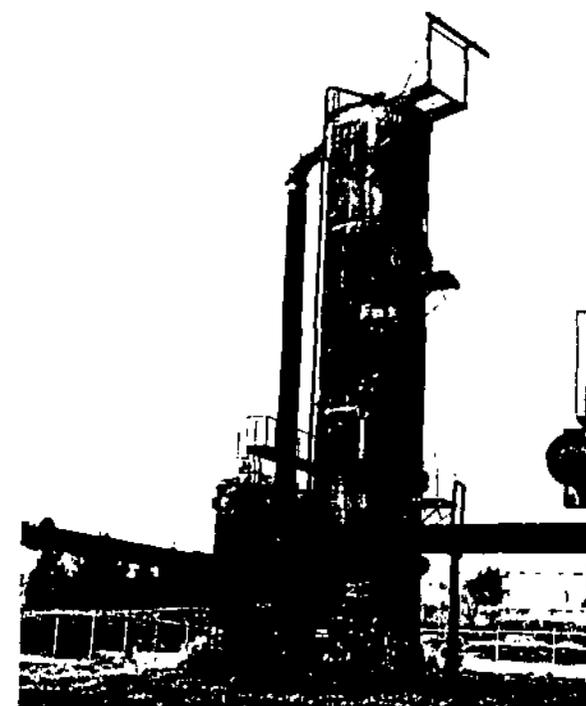


Fig. 14 Secondary scrubber

After going through the primary scrubber, the mixture next went through a secondary scrubber shown in Fig. 14. The mixture also flowed in a counter current direction through cascading water in the secondary scrubber, and then it went into a relief holder (#7 in Fig 1). The relief holder was

a collapsible tank of one half million cubic foot capacity. The relief holder during this period of time appears to be the tank that was used previously as the city holder. The amount of gas produced by the SNG generators varied depending upon how many were in operation and how many were going through a reheat phase. The relief holder helped to even out the flow of gas so that the rest of the equipment could process gas at a constant rate. The 2 million cubic foot city holder, (#17 in Fig 1), was also a collapsible tank that expanded when more gas was produced than was consumed, and it collapsed when more gas was consumed than was being produced. The city holder was necessary, because the gas plant made gas at a constant rate, but people consumed more gas during the daytime than they did at night.

The gas, from the relief holder, next went to the exhaustor end of the pump house where it went through Connersville type gas exhaustors (tar extractors) similar to those shown in Fig. 15a (#8 in Fig 1). Exhaustors both pumped the gas through the system and also caused the fine drops of tar to impinge upon the pump blades. When the fine drops of tar impinged upon the pump blades they formed larger globs of tar that were then removed from the gas stream. Once the tar had been removed from the gas stream it was mixed with oil, and sent to one of the two boilers in the boiler house side of the Play Barn.

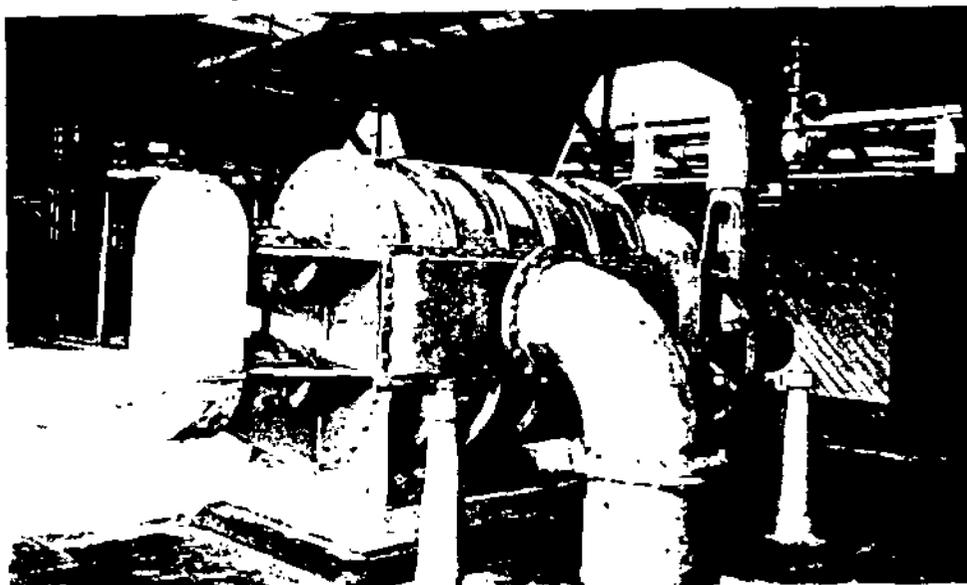


Fig. 15a Connersville type gas exhaustor (tar extractor) [20]

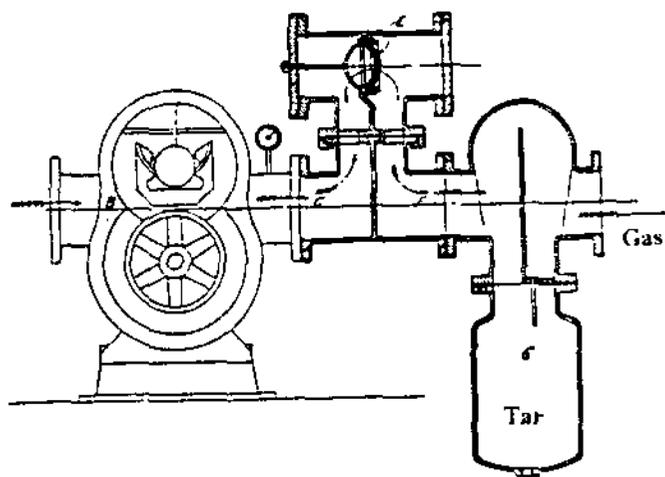


Fig 15b Diagram of Smith type gas exhaustor (tar extractor) [21]

After the gas went through the exhaustors it next went to the electrostatic precipitators. (#9 in Fig. 1). The electrostatic precipitators removed the finest drops of tar by attracting them to high voltage wires. After the tar hit the surface of the wires it would run down the wires and out the bottom of the precipitator. When all of the tar had been removed the gas was next sent to the light oil absorber.



Boiler
feedwater
heater

Electrostatic
tar
precipitators

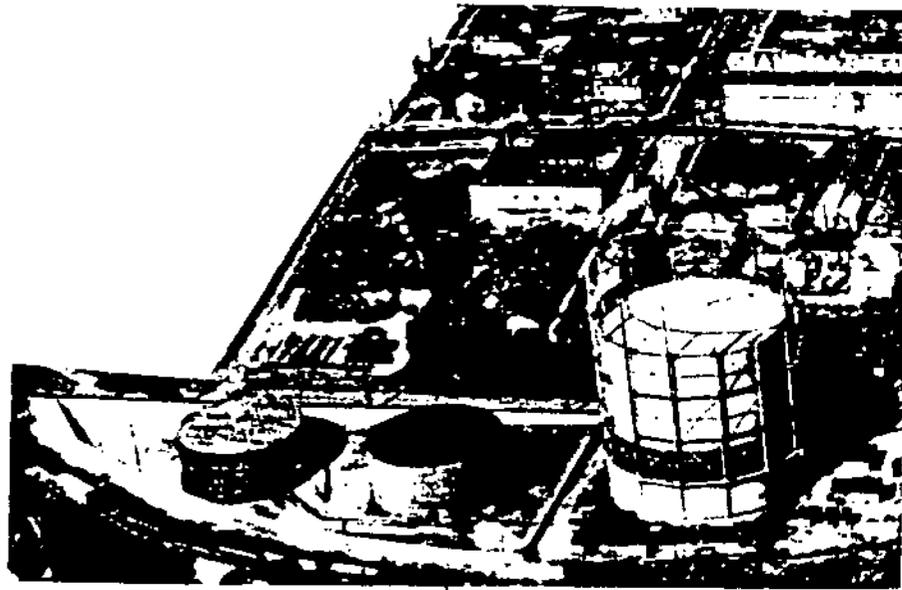
Fig. 16 Boiler feedwater heater and electrostatic tar precipitators

Light oil absorption

The mixture of gas and light oils was first sent to a cooler that cooled the mixture to the right temperature to make it possible for the maximum amount of the light oils to be absorbed. The cooler is shown in Fig. 17 (#10 in Fig. 1). After going through the cooler, the gas and the light oils were contacted with heavy oil called straw oil in a counter current direction in the light oil absorber. The absorber was filled with wood chips so that the straw oil would cascade over the chips and make better contact with the gas. The absorber is the tall tower in the middle of the park. The absorber is also shown in Fig. 17 (#11 in Fig. 1). When there is an oil spill, straw is normally used to absorb the oil that has been spilled. So, it is probably logical that they would have called the heavy oil that absorbed the light oils "straw oil". The light oils were benzene, toluene and naphthalene. Each of those oils, and the straw oil have different boiling points. Because the boiling points were different the components could be separated by fractional distillation in a distillation tower in the light oil area south of the pump house. The benzene, toluene, and naphthalene were stored in tanks and later sold. After separation the straw oil was then sent back to the light oil absorber to absorb more light oils.

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Old cover

Gas Works Park – A photographic tour



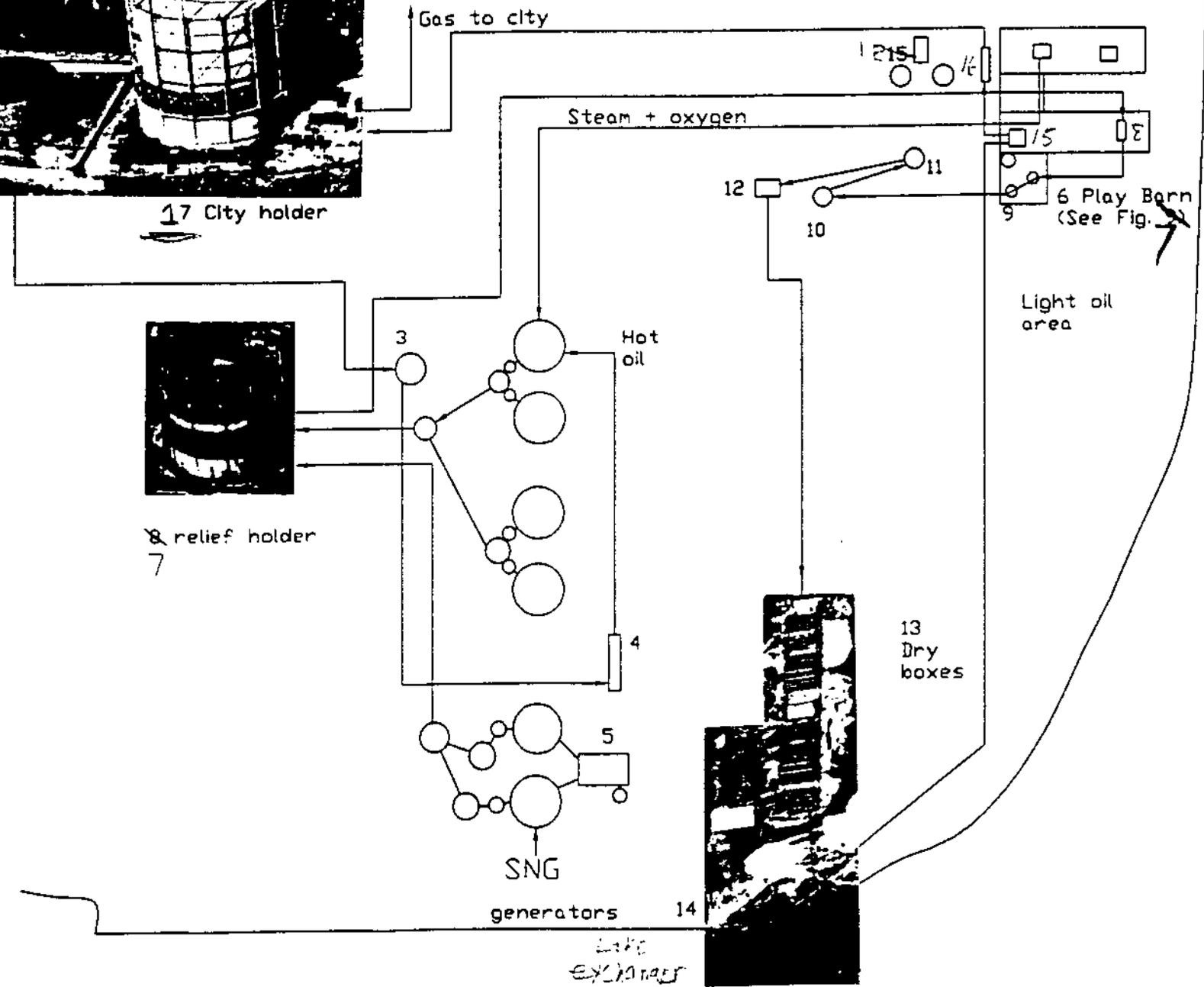
1, 2 Oil tanks

17 City holder



8 relief holder
7

- 1, 2 55,000 barrel oil tanks
- 3 Small oil tank
- 4 Oil heaters
- 5 Waste heat boiler
- 6 Play Barn (See Fig. 9)
- 7 City gas holder
- 8 Relief gas holder
- 9 Electrostatic tar precipitator
- 10 Cooler
- 11 Absorber
- 12 Station meters
- 13 Dry boxes
- 14 Lake heat exchanger
- 15 High BTU water gas set



13 Dry boxes

14 Lake heat exchanger

Light oil area

6 Play Barn (See Fig. 9)

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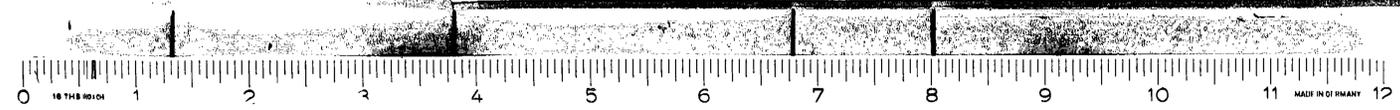
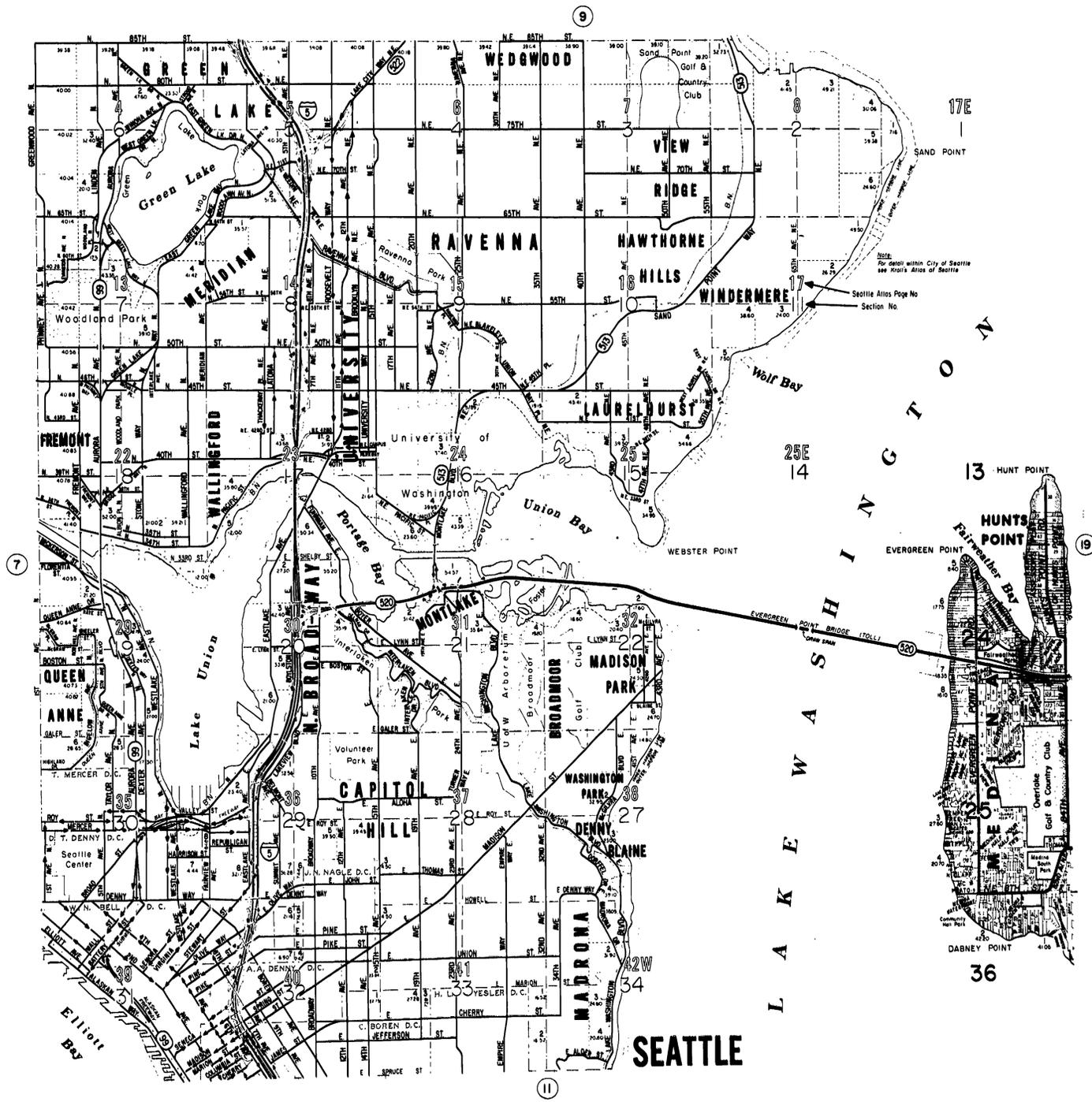
KROLL'S PLAT OF
TOWNSHIP 25 NORTH, RANGE 4 EAST, W. M.
RANGE 4 EAST, W.M. KING COUNTY, WASHINGTON
SCALE: 2 INCHES = 1 MILE

LEGEND

- State Route
- Interstate Route
- U. S. Route
- Other Main Traveled Routes
- King County Tax Lot No.

10

Fig. 83



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